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Cannabis production and markets in Europe

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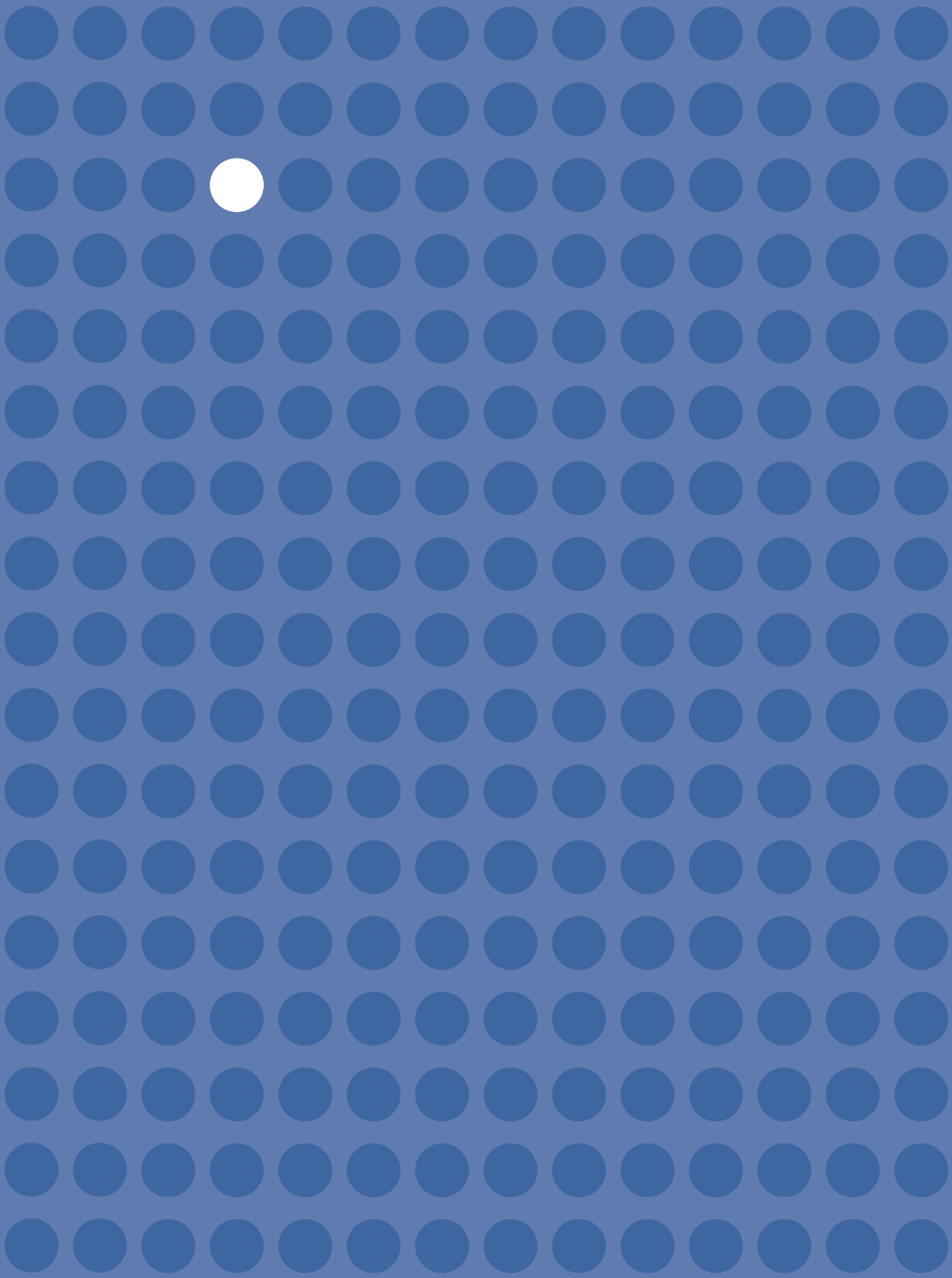


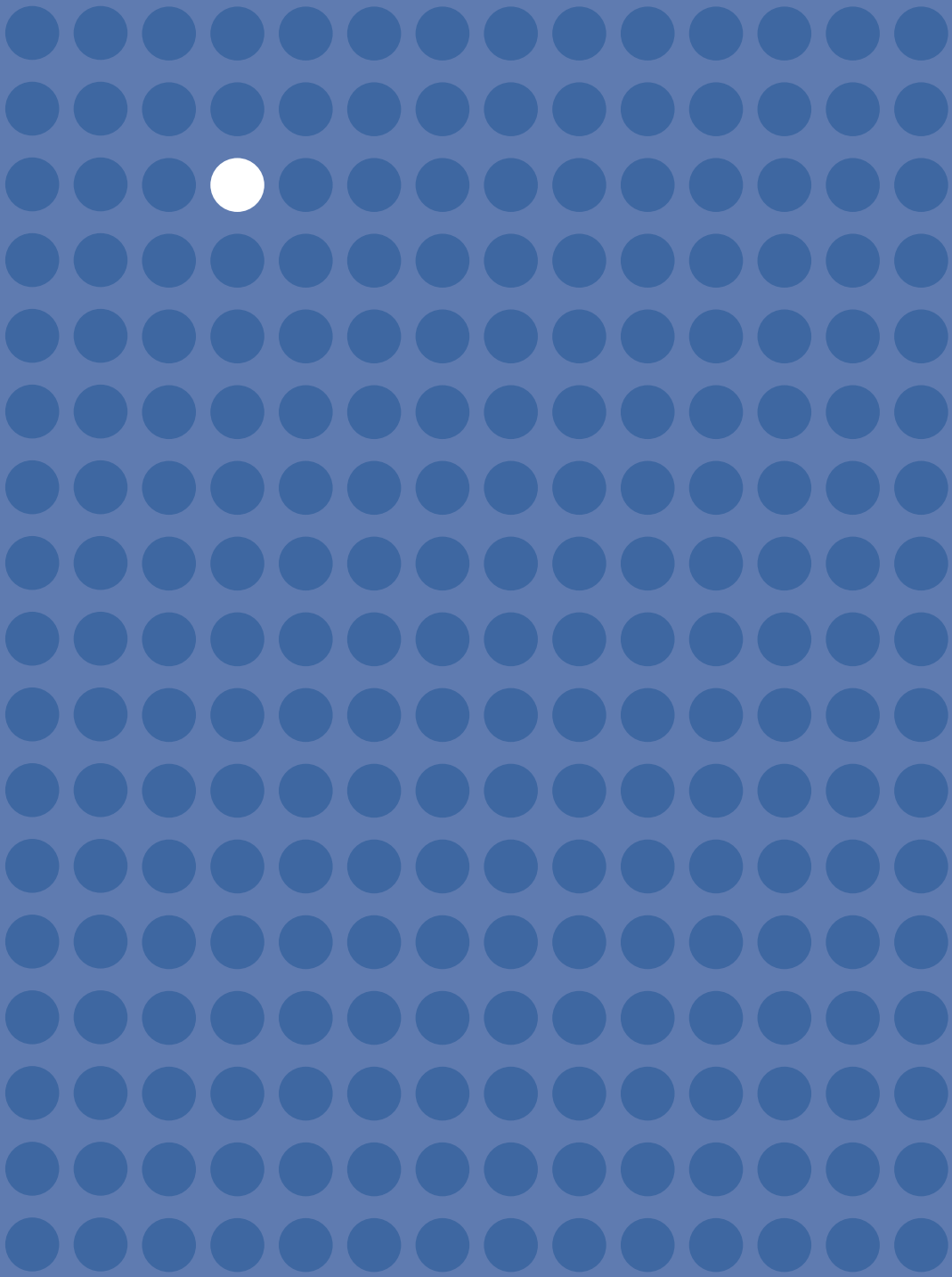
Foreword

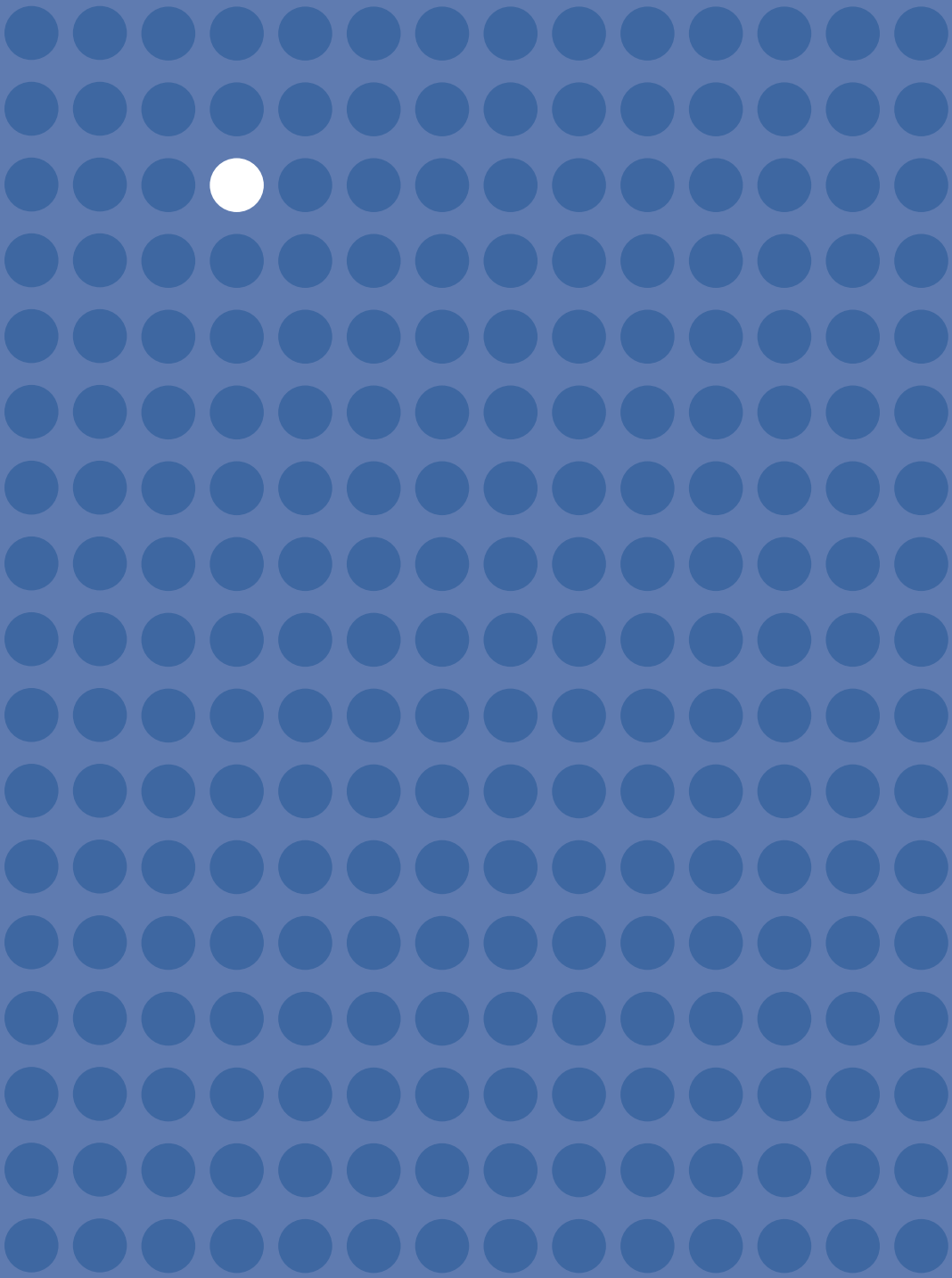
Of all the illicit drugs, cannabis is the one with which we are collectively most familiar. This is perhaps not surprising. It has a long history, with the earliest evidence of cannabis use by humans stemming from the Neolithic period. The cannabis leaf itself has at times been a symbol of youthful rebellion, and no other illicit drug has become so closely associated in the public imagination with some of the social changes that Europe has seen in the last half-century. References to cannabis use appear regularly across popular culture, and it is also the substance over which public and political sentiment is most conflicted. Today, cannabis is the most widely consumed illicit drug in Europe and the world. Estimates suggest that at some time during each year at least 22 million Europeans will use this drug. This use is not without cost, as illustrated by the fact that those with cannabis-related problems now represent a sizeable proportion of those receiving help from drug services in many countries. In parts of Europe, cannabis consumption is both visible and difficult to ignore. Yet despite all this familiarity, and the self-evident fact that a highly developed industry must exist to support current consumption levels, the cannabis market in Europe remains to a large extent an obscure and unexplored topic.

That we know so little about this market is surprising. The drug has been well studied, and we know in some detail about current patterns of use. It is a reality of modern life that wherever you live in Europe today, it is likely that not very far from where you are, cannabis is being bought and sold. You may or may not be aware of this fact, but in either case you are unlikely to be surprised by it. But what you are unlikely to be aware of is how the drug got there or what form it takes. In this detailed assessment, we, for the first time, bring together the available evidence in this area to provide the reader with a comprehensive analysis of what is known about the production of and market for cannabis across the European Union. This is a broad topic, and you will find it makes for some detailed, diverse and, I hope also, engrossing reading. To accomplish our task we must embark on a journey that spans not only the continents, as we look at how cannabis is grown, prepared and trafficked, but also topics as diverse as botany and plant genetics, the economics of cannabis distribution and the role of organised crime. This is the first time such a breadth of information has been brought together in one publication on this topic, and it provides an invaluable resource for understanding the dynamic market for this drug in Europe. The analysis is also timely, as some of the major developments that

we chart are worrying ones. Europe has become not only a major consumer of this drug, but also an important producing area. The consequences of this in terms of crime and public health are now becoming more visible, and in both areas they raise the concern that the future costs associated with the European cannabis market may be greater than the historical ones.

Wolfgang Götz
Director, EMCDDA





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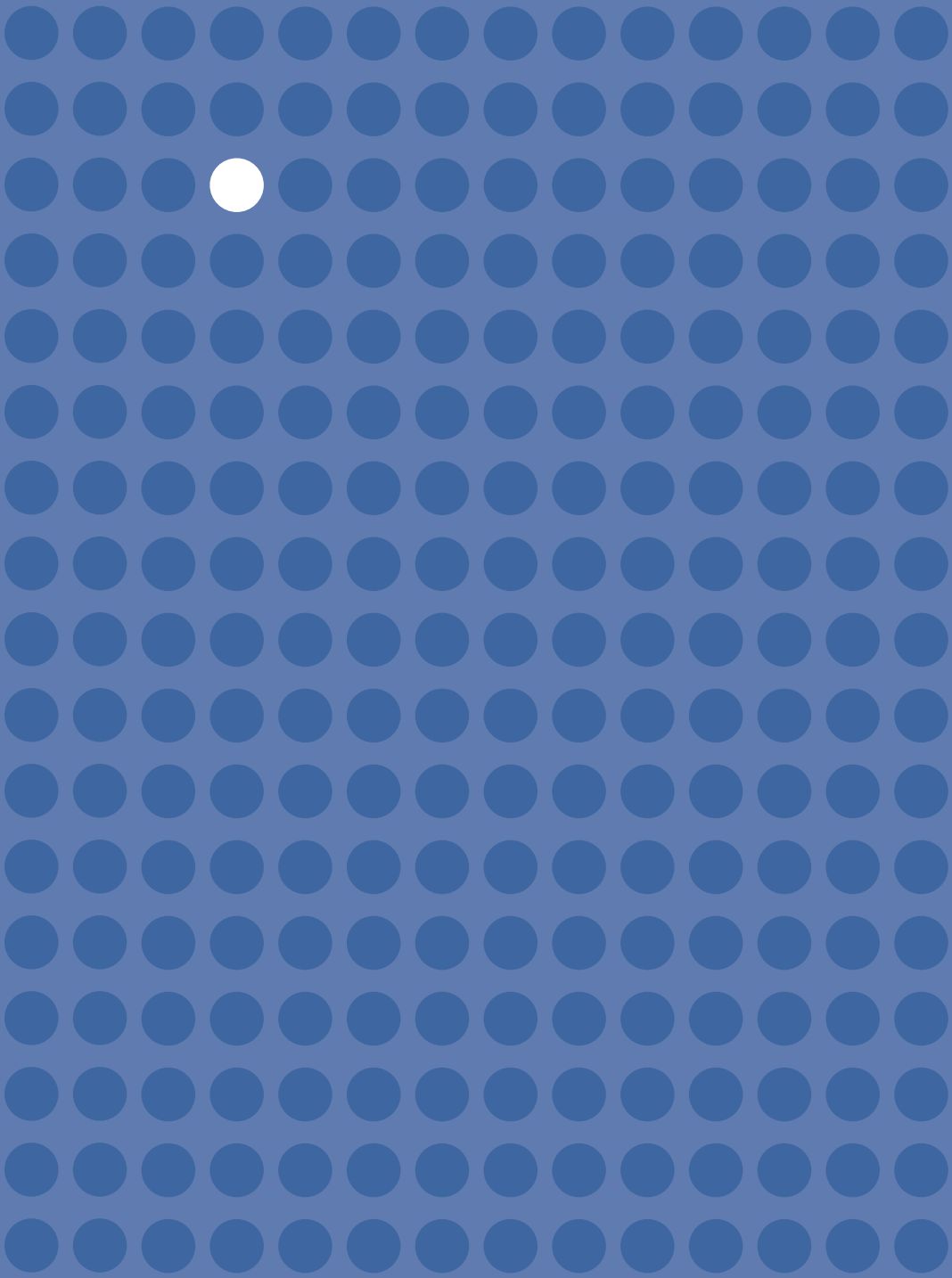


Introduction: The European cannabis market in context

Although countries still differ in terms of prevalence of use, the overall picture is a broadly similar one in respect to the drug's social development as the most commonly used illicit substance. A caveat here would be that modern patterns of drug use developed later in the countries of the former Eastern Bloc. However, it is probably fair to say that the roots of today's European 'cannabis culture' can be traced back to the 1960s, when the drug became associated with the emerging youth and counter-culture. From the 1960s up until the end of the 1980s, the European situation was somewhat bi-polar, with only a few countries reporting high rates of prevalence. But during the following decade and into the early 2000s, most European countries saw cannabis consumption rates increase. And, although inter-country differences still persisted, they became somewhat less pronounced. Recent data indicate an overall stable, or even slightly declining, situation, but levels of use still remain high by historical standards. Currently, around 9 million young Europeans (15–34 years of age) report using the drug in the previous month (EMCDDA, 2011a). This represents a sizeable market which, like the patterns of use it supports, has also evolved considerably over the last 30 years. In respect to both its size and sophistication, today's European cannabis market sits in considerable contrast with the early days of the 1960s, when cannabis importation was mostly a pursuit of what might be described by today's standards as amateurs and enthusiasts. Moreover, cannabis itself as a product has also undergone a profound change over this period; in this volume, we chart these changes to put the modern European cannabis market in its social and historical context.

A starting point for this discussion is to note that perhaps one of the most important developments that have impacted on the modern cannabis market is simply its increase in scale. The European market for cannabis is extremely large, and supplying cannabis, whether it is at the importation, production or distribution level, requires organisation and logistics, human and other resources, and the need to generate and distribute income and profits. This all has to be achieved in a clandestine manner with a bulky product that is not particularly difficult to identify or detect. It is a sobering thought that this is accomplished with such efficiency that users in many countries report that cannabis availability is a constant. As the scale of the European cannabis market has grown, so too have the profits it generates,

and this has made the area increasingly of interest to organised crime. This has, to some extent, resulted in the 'mainstreaming' of cannabis supply within the interests and activities of criminal organisations, as opposed to the more separated and specialist situation that tended to exist previously. This development has also seen more violent and other crime being associated with the cannabis market, and greater integration with other illicit commodities, including the trafficking in drugs such as cocaine, which now benefits from the infrastructure and methods developed for the clandestine importation of cannabis.

It is also important to remember that in a market of this size, for every major player there are many more bit parts. The cannabis supply chain in Europe involves thousands of other actors — among which are small independent entrepreneurs and low-level employees or 'contractors' of criminal gangs — who make a living from growing or distributing illicit cannabis products; while sharing the risks, few of these individuals are likely to share in the riches that involvement in drug supply can bring. Involvement may also be driven by economic factors, for example both in producer countries, like Morocco, and within parts of Europe, involvement in cannabis supply may be viewed by some as an attractive alternative to a legal job market that provides insufficient opportunities. More recently, coercion has been cited as a reason for involvement in the cannabis trade — with reports that the domestic production of cannabis within Europe may sometimes rely on labour from individuals trafficked into the European Union specifically, and unknowingly, for this purpose. The extent to which this happens in practice is unclear, but it does serve as a warning that it is unsafe to assume that all those working in the drug market have made a completely free choice to do so.

Turning to the product itself, a theme running through this report is the complexity resulting from the variety of cannabis products now found on the European market. In the early 1990s, most European cannabis users were to be found in western Europe, and most of them were using resin imported predominantly from Morocco, but also sometimes from Lebanon, Pakistan and Afghanistan. This picture is no longer true. Cannabis consumption is more widespread — and has been increasing in eastern and central Europe. This increase has often been associated with the use of herbal preparations, as opposed to resin. Overall, this serves as a backdrop for more general *partial substitution* to have taken place across some of the major western European markets, with imported resin being replaced by herbal material produced in Europe itself, or imported.

This picture grows more complicated as advances, occurring both outside and within the European Union, in plant genetics, mode of cultivation, processing and preparation, have resulted in a great increase in the diversity of cannabis products available. We describe these developments here, mindful that, to date, information available on the consumption levels of these different preparations has, and to a large extent remains, extremely limited. As different products may appeal differentially to users and the chemical composition may differ in non-trivial ways, understanding this detail is clearly helpful. Even a basic distinction between resin and herbal materials is a valuable first step in that direction, notwithstanding that both may be further broken down into a number of sub-types with different compounds and therefore varying effects and potential implications for health. A crude but useful analogy here is that currently when we consider cannabis consumption, it is as if we were looking at the use of alcohol, but without the ability to distinguish between beer, wine and whisky consumption.

A driver of change in respect to the diversity now seen in cannabis products in the European Union has been the dramatic increase in domestic production that has occurred in parts of Europe. Virtually all countries now report some local cultivation of cannabis; in some of them, substantial seizures of cannabis plants are reported. To increase the complexity further: cannabis grown in Europe comes from both indoor facilities and from outdoor plantations. Indoor cultivation can be intensive, using sophisticated techniques to increase both the quantity and 'quality' of the cannabis produced. The size of indoor and outdoor plantations varies considerably, depending on the motivation and resources of the grower. A cannabis 'plantation' may therefore vary from a few plants produced for personal use to many thousands growing in large sites and intended for commercial purposes.

Cannabis production seems to have experienced a sharp increase from the early to mid-1990s in some western European countries. It was made possible by advances in horticultural knowledge and technology, which increased yields and reduced the chances of detection. As with so many other areas of modern life, the Internet is likely to have played an important role in the diffusion of innovation in this area (Hough et al., 2003; Jansen, 2002; Szendrei, 1997). The production of cannabis also has a public face — in a number of European countries, specialist 'grow shops' selling the equipment and know-how needed to grow cannabis have become an increasingly common addition to the high street. It is not clear if these establishments support those producing the drug at home for their own use or more commercially

focused enterprises. However, the number of outlets found in some countries does suggest that interest in home production may be considerable.

Assessing the extent of cannabis cultivation in Europe is a considerable challenge, as the information available in this area is scarce. Yet, reports from a number of countries suggest that it may no longer be viewed as marginal. Domestic cannabis production has also become more visible. Some users promote self-production as a source of supply that avoids the need to become involved with the 'criminal market' and ensures quality. Large-scale production has also risen higher as a concern for drug interdiction efforts, in part because of its association with other criminal behaviours, and is now a priority for law enforcement activities in some countries. For example, in the Netherlands and the United Kingdom, large-scale police interventions against cannabis plantations have been implemented, reportedly resulting in the closure of thousands of growing sites. It has been suggested in some countries that growing sites may be significant fire hazards, while organised crime involvement in cannabis production has led to killings and the exploitation of young undocumented immigrants (ACPO, 2009; EMCDDA, 2010; Spapens, 2009, 2011).

In most European countries, cannabis has been the illicit drug most often involved in drug law offences, and cannabis seizures are both the most numerous and those that result in the largest total amounts of confiscated drugs. Although this situation is a reflection of the widespread availability and consumption of the substance in Europe, it also suggests that substantial law enforcement and criminal justice activity in the field of illicit drugs remains directed at cannabis and cannabis users.

The report

As we have seen, the European cannabis market spans a diverse set of topics and forces us to consider a complex set of interrelated issues. This publication is intended to provide a state-of-the-art analysis of the knowledge on cannabis production and markets in Europe from each of these divergent perspectives. We have brought together here, for the first time, a considerable amount of information, some of which is new to the public domain. However, the reader should be aware that with a topic such as this, considerable uncertainty will remain and some areas continue to be more a topic for speculation than analysis and review. Reflecting this, another objective of this report is to identify those areas in which important knowledge gaps remain.

The analysis presented in this volume covers, as far as possible, the 30 countries that participate in the EMCDDA's reporting system. That is the 27 EU Member States,

Croatia, Turkey and Norway. The information reviewed is based on a number of sources and methodologies. We list below the main sources and data used as a basis for the analysis, and more detailed methodological notes are provided throughout the text.

Some of the data used in this report are derived from the EMCDDA's routine monitoring, based on its Reitox network of national focal points. Data on prevalence and patterns of drug use, drug seizures, police reports of drug law offences, cannabis potency and retail prices are part of the quantitative data sets submitted by reporting countries on an annual basis. Quantitative data are routinely analysed and made available in the online Statistical bulletin (EMCDDA, 2011b), but more in-depth analyses were carried out for this publication. In addition, the EMCDDA's routine monitoring includes a national narrative report providing an overview of the drug phenomenon and, among other issues, information on drug supply and drug trafficking, drug laws and sentencing practices. Legal texts held in the European Legal Database on Drugs (ELDD) and an ad hoc consultation of the legal correspondents network that informs the database were also used as sources of information for this report.

In addition, two independent studies were carried out to obtain more detailed data and other information on specific aspects of cannabis production and markets in Europe. The issue of market shares of different cannabis products was a focus of both of these exercises. First, the national focal points, within the context of a Selected issue data collection exercise (Reitox national focal points, 2009), provided an overview of cannabis production (brief history, plantations seized, 'grow shops'), distribution of cannabis at national level (structure and actors, wholesale prices, retail outlets, transaction sizes) and cannabis supply reduction responses (law enforcement activities, cannabis seizures, cannabis offences). These national contributions result from an analysis of different sources, including quantitative data, targeted studies, research, expert opinions and information from operational actors such as law enforcement. Second, the EMCDDA commissioned a study (Costes et al., 2009) to provide an overview of cannabis production methods (covering topics such as materials and costs) and typologies of growers, and of cannabis flows and trafficking routes to and within Europe. The authors carried out a survey based on key informants drawn from across Europe as part of this exercise.

This report is also informed by an extensive review of the literature, which took in both scientific papers published in peer-reviewed journals and the 'grey literature'

(including reports from international organisations). For a number of the issues addressed in this report, the literature served as the only information source or as a complement. Analysis of the literature proved to be key in areas where standardised data collections are relatively rare, in particular on the botany of cannabis and on the production of cannabis both outside and within Europe.

Scope and content of this report

Chapter 1 reviews the origins of cannabis and its diffusion. Consideration is given to the morphology and anatomy of this interesting plant — which can be characterised by its extreme natural variation. This is accompanied by an analysis of production issues, including cultivation and processing for consumption.

Chapter 2 provides an overview of the source countries for the cannabis imported into Europe. It includes a critical review of the considerable, and arguably insurmountable, challenges associated with estimating global cannabis production. The chapter focuses mainly on cannabis production in, and exportation to Europe from, the five regions and countries (the 'big five') most often mentioned as a source: North Africa (Morocco), south-west Asia (Afghanistan), the Balkans (Albania), the Middle East (Lebanon) and sub-Saharan Africa (South Africa).

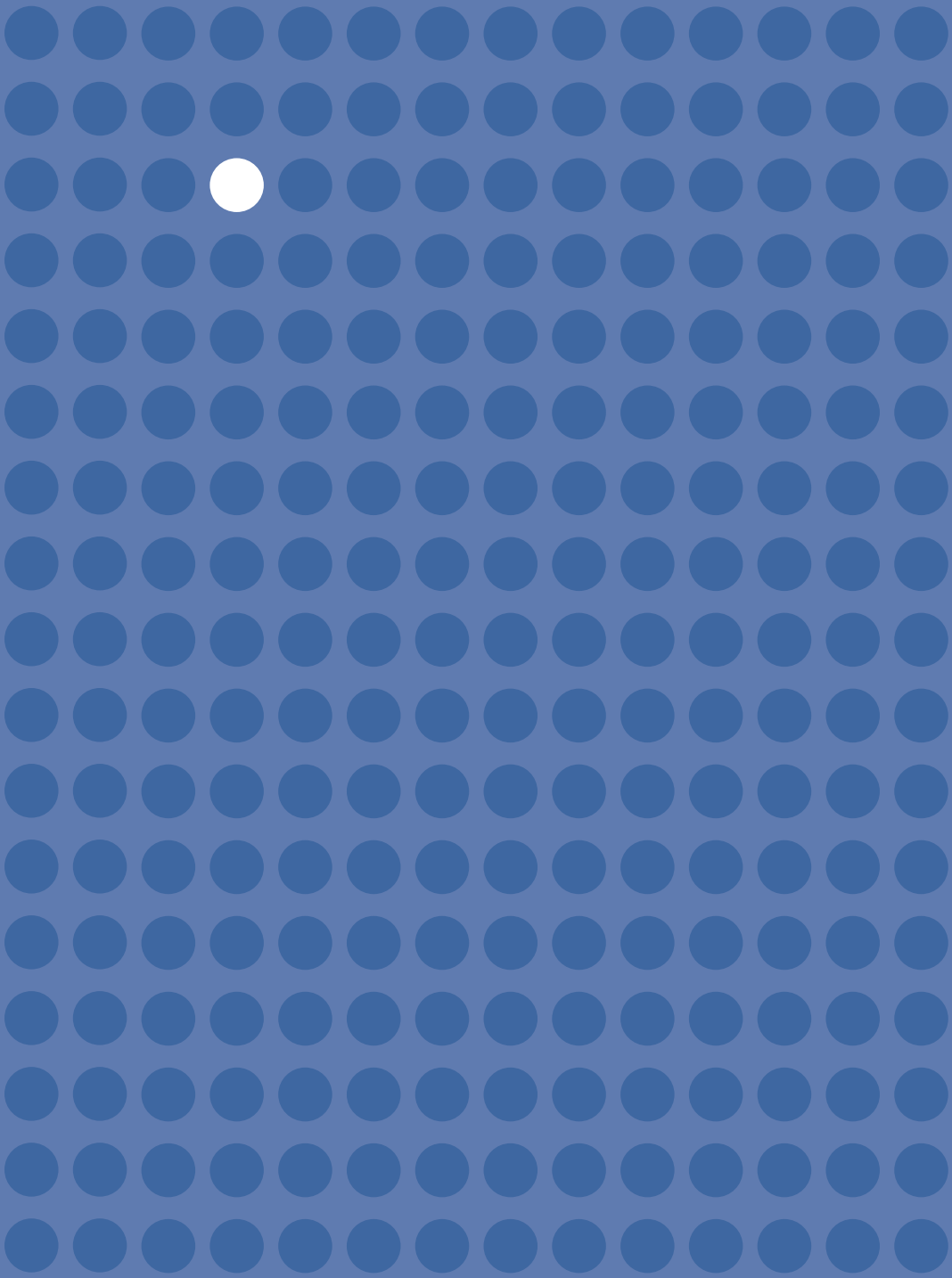
Chapter 3 is dedicated to cannabis production in Europe. Starting with the historical context, including the substitution of imported resin by domestically produced herb in some countries, it then reviews available evidence of the extent and type of cannabis cultivation across Europe. A typology of cannabis growers and their motivations is discussed. Distribution, either social or commercial, is addressed, and an analysis of issues related to transactions and prices is presented.

Cannabinoid contents, and in particular tetrahydrocannabinol (THC), are addressed in Chapter 4, as are issues affecting the sampling and quantitative analysis of THC in cannabis products. This is followed by a review of the data available on cannabis potency in Europe.

Chapter 5 focuses on cannabis consumption. Starting with an overview of the situation and trends in cannabis use in Europe, it then reviews the results of the few studies that have estimated the size of the market for cannabis in Europe. It ends with an analysis of the market shares at consumer level of cannabis herb and cannabis resin across Europe.

Differences in the legislations controlling cannabis cultivation and supply in Europe are discussed in Chapter 6, which also provides an analysis of data on cannabis offences

reported by law enforcement, and of cannabis seizures across Europe. The chapter ends with a brief overview of the strategies and tactics employed by law enforcement in their fight against cannabis cultivation and cannabis trafficking in Europe.



Chapter 1: Botany and cultivation of cannabis

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Botany of cannabis

Origins and spread

Cannabis sativa L. is a cosmopolitan species that has adapted to grow in almost all parts of the world, from the equator to latitude 66°N (in Russia) (Grigoryev, 1998), and is now found in all continents apart from Antarctica (McPartland et al., 2000). The origin of the species is not clear, but is commonly accepted to be central Asia (Wills, 1998), with an area just north of Afghanistan favoured by many experts (e.g. Schultes and Hoffman, 1980). One credible proposed origin is the Pamir Plain in modern-day Tajikistan (CamIn, 1936), just a few degrees to the west of China, where a close relative of *Cannabis sativa*, the hop, *Humulus lupulus* L., is believed to have originated (Neve, 1991). Archaeological finds indicate that the earliest human use of cannabis was possibly in China, as long as 6 000 years ago (Merlin, 2003), and it is believed that 4 800 years ago Emperor Shen-nung taught the Chinese to cultivate the plant for the versatile fibres in its stems (Schultes, 1970), which were used to produce ropes, textiles and paper (Raman, 1998). In addition, the plant's highly nutritious seeds could be crushed to produce oil for culinary purposes and lamp fuel. The flowers and upper leaves were a source of medicines and a mind-altering drug called tetrahydrocannabinol (THC), which is unique to cannabis, and this found sacramental and recreational uses. Having so much to offer, the plant would have been carried on many trade routes, and dispersed well away from its original home. Heavily influenced by man, the species adapted to survive in a range of habitats and growing regimes.

Referring to it as *kannabis*, the Scythian peoples migrating from modern-day Iran to the northern shores of the Black Sea brought the species to Europe. Finds from the eighth century BCE are evidence of this (Mignoni, 1997). The Etruscans spread hemp to Italy in the sixth century BCE, and a century later the Greek historian Herodotus described its use in modern-day Bulgaria. Cannabis seed and leaf remains from Germany appear to date from the same period (Schultes, 1970). European hemp fibre production escalated in the fifteenth century AD, first in Italy and subsequently in the Netherlands, primarily to provide sail cloth and rope for the naval industry. A century later, in England, landowners were legally obliged to plant hemp for this purpose, and in 1564 King Philip of Spain similarly ordered hemp to be grown throughout his Empire, which extended across the Atlantic to Chile (Conrad, 1994).

The genus *Cannabis*

The modern-day binomial *Cannabis sativa* L. carries the suffix L., denoting its adoption by the Swedish taxonomist Carl Linnaeus in his *Species Plantarum* of 1753. However, the binomial had been widely used before this, including by Leonardt Fuchs in his *Kreuterbuch* of 1543 (Fuchs, 2003 [1542]). Just as Linnaeus recognised only one species, most modern-day taxonomists also regard *Cannabis* as monotypic, considering the species as one isolated gene pool (Harlan and de Wet, 1971). This includes the hemp form of the plant, grown for its fibre and seeds, and the drug type, which is known simply as cannabis or one of many colloquial names. The biological (reproductive) definition of a species states that all specimens of a population are of a single species if they are naturally able to sexually reproduce, generating fertile offspring. This is the case throughout the genus *Cannabis*, and by this definition, therefore, there are no clear biological grounds to separate it into different species. However, within the species *Cannabis sativa* L., several subspecies are sometimes identified (Small and Cronquist, 1976).

Despite this, modern *Cannabis* taxonomy remains confused, as a scientific minority prefers to define species according to their typological or morphological characteristics. In 1974, Schultes et al. described three putative species, *Cannabis sativa* L. (a typically tall species used for fibre, seed or psychoactive use), *Cannabis indica* Lam. (a short, wide-leafed plant from Afghanistan, used to produce resin) and *Cannabis ruderalis* Jan. (a short unbranched roadside plant with minimal drug content). Chemotaxonomy has also been used to categorise cannabis plants into different species according to their essential oil content (Hillig and Mahlberg, 2004).

The argument for there being more than one *Cannabis* species gained legal significance from 1972 onwards, when, in an increasing number of court cases in the USA, defence lawyers challenged the taxonomy in convictions involving marijuana. United States law attributed the illegal recreational marijuana status solely to the species *Cannabis sativa*. Lawyers, claiming that the defendants were involved with *Cannabis indica* or other suggested species, argued that there was no case to answer (Small, 1976). Empathising with this challenge to the law, and acknowledging the important part that *Cannabis* has held within the anti-establishment movement, many within the recreational cannabis industry still commonly refer to the 'species' *Cannabis indica* and *Cannabis ruderalis* in addition to *Cannabis sativa* (Snoeijer, 2002). The recreational cannabis seed industry widely uses these species names (Rosenthal, 2001); they are very popular and regularly discussed in the grey literature on cannabis plant cultivation (UNODC, 2006a).

Cannabis morphology and anatomy

Depending on the provenance and genotype, cannabis is an extremely variable annual herb. It is naturally dioecious, by definition producing separate male and female plants, but fibre hemp varieties have been specifically bred to be monoecious (hermaphrodite) (Small and Cronquist, 1976). Stem height can vary between 20 cm and 6 m or more, although 1–3 m is more common, with male plants generally a little taller than the females (UNODC, 2009a). The leaves are mostly palmate, and in the iconic image of a cannabis leaf there are seven lobes, the lowest pair depicted as backwards-facing spurs. However, the number and shape of leaves are not fixed. On seedlings the leaves form symmetrical pairs on opposite sides of the stem. The first pair are typically monophylous (single lobed), the second pair usually have three lobes and the next usually have five. In many plants, especially those of central Asian origin, the number of leaves does not exceed five, whereas others can have up to 13 leaves.

When mature, the sepals on the male flowers open to expose the anthers, which hang freely on fine filaments (Figure 1.1). The exposed anthers soon split to shed pollen on to any passing air current. Shortly after the cessation of pollen production, the male dies, but females from the same population will continue to mature for up to several weeks. During this period, receptive white (or more rarely pink or orange) stigmas are formed in abundance. This period is extended if pollen is not received. Unpollinated female inflorescence material is often referred to as sinsemilla (a Spanish term meaning without seeds).

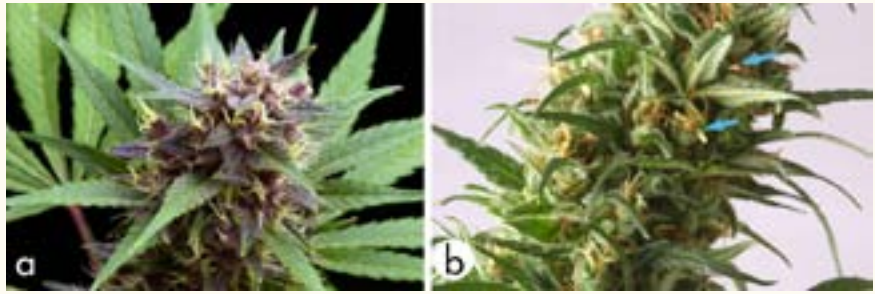
Figure 1.1: A cluster of male flowers with sepals split open and reflexed to expose the anthers

Note: The scale bar denotes 5 mm.

An example of a well-developed female inflorescence is shown in Figure 1.2a. As the plant ages, the older stigmas lose viability and senesce to a brown colour. When the majority of the stigmas have senesced, this is an indication that the plant is ready for harvest (UNODC, 2009a). After several weeks of enforced non-pollination, a female plant may exhibit hermaphrodite development, resulting in the production of its own anthers and viable pollen (Figure 1.2b). As this pollen carries only the female X-chromosome, any seeds consequently formed after pollination with this material will be guaranteed to be female. Commercial plant breeders now produce all-female cannabis seeds by chemically inducing female plants to produce pollen (UNODC, 2009a).

The psychoactive drug delta-9-tetrahydrocannabinol (THC) is not evenly distributed throughout the plant. It is absent from the roots and seeds, and dried stem material will typically contain around 0.3 % THC or less (Fritschi et al., 2006; Potter, 2004). The lower leaves contain less than 1 %, and mixed samples, which contain all the foliage including the uppermost leaves of female plants, will more typically contain 2–3 % THC (Potter and Duncombe, 2012; UNODC, 2009a). However, unpollinated all-female floral material is by far the main source of THC and other closely related chemicals unique to cannabis called cannabinoids. A THC content of well over 20 % can be found in some samples. However, the cannabinoid content of floral material can be extremely variable within a single plant, and high potency values in small samples are often not truly representative of the plants from which they came (EMCDDA, 2004).

Figure 1.2: Unpollinated female cannabis inflorescences in the later stage of flowering



Note: The many white stigmas are receptive to pollen. The specimen in (b) has started to produce anthers (indicated by arrows). Pollen released from the anthers will possibly result in self- or cross-pollination. The pollen contains only the female chromosome.

Cannabis secretory trichome: form and function

The extreme variation in the THC content of the different tissues is due to markedly different distributions of glandular trichomes on the surface of the plant. It is widely accepted that the cannabinoids are predominantly, if not entirely, synthesised and sequestered in these small structures (Mahlberg et al., 1984). Most of the monoterpenes and sesquiterpenes (essential oils) found in *Cannabis* are also produced there (Malingré et al., 1975; Turner et al., 1980). Three forms of glandular trichome are found in female cannabis. The most important, and by far the largest, of these is the capitate stalked form (Figure 1.3a). Trichomes of this form are found only on floral and immediately surrounding tissue, where they can form a dense pubescence (Potter, 2009a) (Figure 1.3b) that is thought to have a range of protective functions. By trapping a layer of air close to the surface, this provides some protection against desiccating cold winds (Mahlberg et al., 1984), by reflecting infrared light it has cooling properties and, being equally effective in reflecting ultraviolet (UV) light, it reduces sunburn (Roberecht and Caldwell, 1980). Phenolic resins like the cannabinoids have also been shown to offer protection from UV radiation (UV is absorbed) (Rhodes, 1977). The pubescence also acts as a physical barrier to insect pests.

Figure 1.3: Cannabis capitate stalked trichomes. (a) A single trichome. (b) A dense pubescence of trichomes on part of the female inflorescence

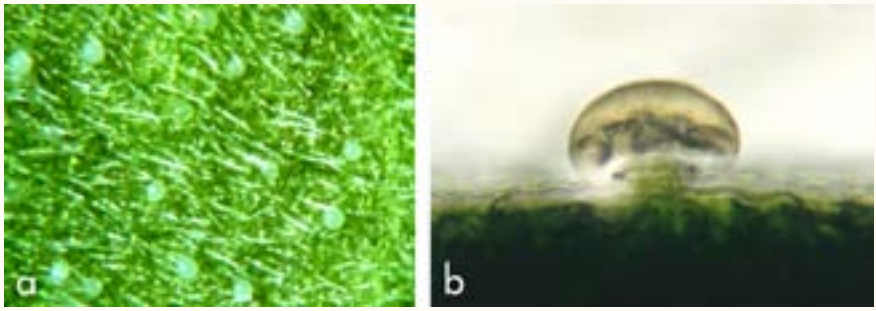
Note: Secretory cells at the base of the resin head on top of the stalk synthesise the THC and other cannabinoids, and the essential oils. The resultant sticky mixture is sequestered within the resin head.

In addition to cannabinoids, the secretory cells within the glandular trichomes produce a mixture of volatile monoterpenes and viscous bitter-tasting sesquiterpenes. This mixture is glutinous and sticky, and insects making contact are immobilised and prevented from further feeding and colonisation (Figure 1.4) (Potter, 2009b).

The stems, foliage and floral tissue exhibit two additional types of glandular trichome, the sessile and bulbous forms. The storage volume of a sessile trichome is estimated to be one-eighth of a capitate stalked form (Figure 1.5), and this is part of the reason for the large difference in cannabinoid concentration of foliar and floral material (Potter, 2009b). A sessile trichome has a much lower monoterpene content, and this type does not ensnare insects. However, the repellent bitter sesquiterpenes within these will deter many predators. The bulbous form is so small that its potential contribution to the plant's overall cannabinoid and terpene production is less than 1 %.

Figure 1.4: An aphid with its legs irreversibly adhered to the resin heads of capitate stalked trichomes

Figure 1.5: (a) The underside of a cannabis leaf. (b) A sessile trichome on the edge of a cannabis leaf



Note: The leaf undersides exhibit a large number of sessile trichomes and leaf hairs. The trichomes synthesise THC and other cannabinoids in a mixture with repellent bitter-tasting essential oils. This deters predation by herbivores.

Cultivation

Traditional hemp cultivation in Europe

In feudal times, fibre hemp production was widespread across Europe, reaching a peak in the seventeenth century due to the demands of the naval industry. Hemp was an easy crop to grow and, exhibiting extremely vigorous growth, rapidly smothered weeds. Having minimal susceptibility to pests and diseases, the crop was and still is regularly grown without the use of man-made pesticides. For this reason, hemp products are widely regarded as environmentally friendly.

Hemp is an annual plant and is sown in spring as soon as soil temperatures are suitable, this being between early March and late April in Europe. Harvesting the crop for fibre use is the most difficult part of hemp cultivation (Bócsa and Karus, 1998). The plants are typically in the early stages of flowering when cut down. This is much earlier than the harvest time of a drug cannabis crop, which takes place at the end of flowering. Traditionally, the valuable outer fibres of the stem would be separated from the rest of the plant, which involved a procedure called retting. This is a natural process in which bacteria and fungi break down the molecules that bond the outer fibres and inner stem together. Originally, the stems would be submerged in water for several days, in what was a pungent process, and the effluent would then be drained away in a potentially polluting operation. More modern methods involve a dew retting process, in which crops are mown and left to lie in the field for a period before baling.

Outdoor cultivation of illicit cannabis

According to the UNODC's 2009 *World drug report* (UNODC, 2009b, p. 90), approximately one-third of the earth's land mass is suitable for outdoor cannabis cultivation. This includes most of Europe from the Mediterranean coast up to the southern tip of Scandinavia, at latitude 55°N. The report acknowledged that it is difficult to estimate the quantity grown here, but a previous report (UNODC, 2006b) suggested that 4 % of the world's herbal cannabis is grown outdoors in Europe. However, little attention has been given to European cannabis outdoor cultivation (Costes et al., 2009). The few detailed reports available have concentrated on the Netherlands and the United Kingdom, although some limited information on Albania is also available.

In Albania, large quantities of outdoor low-potency herbal cannabis have been produced for export to neighbouring countries. The term herbal cannabis in this context refers to the harvested and compressed female flowering tops of plants grown in the presence of male plants, including seeds as a result of pollination (Costes et al., 2009). Similar mixed-sex plant populations are used to make cannabis resin in Morocco, but very little of this is reported to be made in Europe. In the Netherlands, a high proportion of the outdoor plants would be small plantings for personal use (Decorte, 2008; Wouters, 2008). However, larger plantings intended for commercial supply have been seized by police or thieves (Jansen, 2002). In some cases these cannabis crops have been grown in open fields, surrounded by maize to hide their location (Spapens et al., 2007). In the United Kingdom, research crops of mixed sex and all-female drug varieties of cannabis have been successfully grown outdoors for 10 consecutive years at latitude 51°N (Potter, 2009b). Relatively small numbers of illicit crops have been sporadically found across England and Wales (ACPO, 2009).

Several commercially available high-THC seed varieties are specifically bred and marketed for the outdoor production of sinsemilla in central and northern Europe. Planting typically occurs in late April or May, at the same time as a hemp fibre crop. However, as full floral development is required, the plants are not ready for harvest until the beginning of October. In the humid autumn conditions of northern Europe, the plant is especially prone to disease, just as it comes ready for harvest. Having successfully nurtured a crop for 5 months, the grower can see the plants ruined by *Botrytis* fungus within days, especially if the harvest is delayed by rain (Potter, 2009b; Spapens et al., 2007).

In the United Kingdom, outdoor-grown crops have achieved similar yields and THC levels to those grown indoors (Potter, 2009b). Once dried and processed, the two

can be indiscernible in appearance. The costs of growing the plant outside are minimal compared with those of an artificially illuminated, ventilated and heated indoor crop. However, whereas the indoor grower can produce at least six crops a year, and stagger these so that only a few plants are ready for harvest at any one time, only one outdoor crop is possible. This will all be ready for harvest at about the same time, on a date dictated by nature.

The cannabis plant is a so-called short-day plant, commencing flowering at a precise date in late summer. The species has evolved to recognise when the so-called *critical daylength* has arrived. Owing to the effect of latitude on daylength, if these plants are moved north, commencement of flowering is delayed. Because of this, at 55°N (the suggested northerly extreme for outdoor growing of drug-type cannabis) the flowering period is very short and weather conditions are increasingly unlikely to be favourable.

Processing of outdoor-grown cannabis for drug use

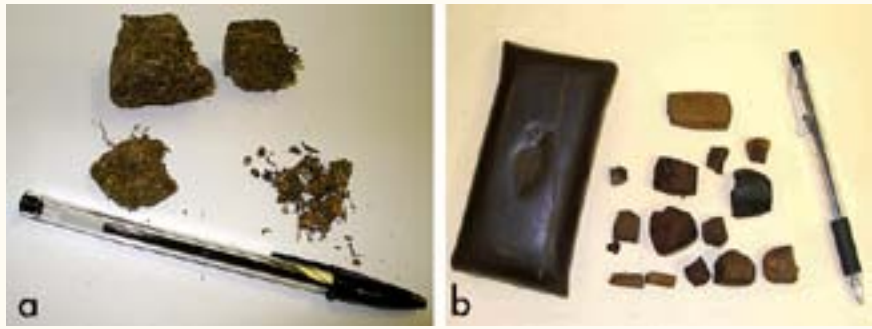
Herbal cannabis

Once ready for harvest, the flowers and upper leaves are cut from the plant and allowed to dry naturally. This floral-rich material would typically be referred to as herbal cannabis in English-speaking Europe. In the USA, where herbal cannabis dominates the illicit market, the product is known as marijuana. To minimise bulk during transportation, the drug is usually compressed into dense blocks (Figure 1.6a). As a result of excessive residual moisture, fungal contamination is regularly found on arrival (Hardwick and King, 2008; Potter et al., 2008).

Cannabis resin production

Cannabis resin or hashish is a compressed material, primarily containing the glandular trichomes from the female flowers. Contrasting cultural methods of resin manufacture exist around the world. These create products that are contaminated with differing amounts of dirt and plant fragments and vary greatly in appearance, odour and potency (Clarke, 1998). Cannabis resin consumed in Europe originates predominantly in Morocco (see Chapter 2). Material made there is formed by thrashing and sieving dried flowers and leaves of sun-dried cannabis plants. The powder of glandular trichomes and fine plant fragments is then compressed to make a dark-brown resin. The most common form is shown in Figure 1.6b.

Figure 1.6: (a) Compressed herbal cannabis material. (b) Examples of Moroccan cannabis resin samples (<1 g up to 230 g) seized by United Kingdom police



Note: Some of the herbal cannabis has been pulled apart to reveal a number of intact seeds.

Escaping the law: the move to indoor growing

There is some evidence to suggest that in recent decades the European cannabis market has changed, with an increasing proportion of users apparently preferring to consume unfertilised floral parts of the female cannabis plant (sinsemilla). Most of this is grown indoors (UNODC, 2006a). In the more easily controlled indoor environment, cannabis quality is increasingly guaranteed (UNODC, 2009b).

Evidence suggests that production of cannabis in the USA and Canada began to escalate in 2005, partly because of the increasing involvement of organised crime groups, and that an increasing proportion of cannabis is grown indoors (US Department of Justice, 2010). Similar observations have been reported from the United Kingdom (ACMD, 2008), where there has been a shift from cultivation of cannabis in domestic dwellings rented solely for this purpose (initially over 90 % of cases) (Silverstone, 2010) to the use of commercial or industrial premises (ACPO, 2009). Within these buildings crops are typically grown under powerful lamps, which are specifically developed to encourage plant growth. The high energy consumption of these lighting systems is usually of little financial concern to the grower, as the electrical energy is typically stolen (ACMD, 2008).

It has been suggested that the move to indoor growing may be part of the reason for the increase in cannabis potency in some European countries since the late 1990s (EMCDDA, 2004). Grown in optimised cultivation conditions under artificial lights,

cloned female cannabis can produce a drug product of consistently higher potency (UNODC, 2009b). This move would not have been possible without the breeding of cannabis varieties specifically for indoor growing.

Drug cannabis breeding

Cannabis consumption in western Europe, up until the 1980s, was dominated by the use of imported cannabis resin (hashish). However, herbal cannabis was also imported. As is still the case, this material would have been grown in a number of locations around the world. Although the imported material would primarily contain the flowers and upper leaves of female plants only, the original crop would have been grown in the presence of male plants and consequently the material would usually contain abundant seeds. Many amateur enthusiasts attempted to grow sinsemilla cannabis from these seeds. However, the seeds' parent plants had adapted to grow outdoors at more equatorial latitudes, in very different conditions. These plants did not perform well in Europe, either indoors or in a glasshouse. In the United Kingdom, those that did grow typically produced material containing between 1 % and 8 % THC (HLSCST, 1998). In the Netherlands, efforts were made to breed better plants locally, but anecdotal evidence suggests that the yield and taste of this material was poor (Rosenthal, 2001).

In 1984, cannabis breeding in Europe underwent a major change with the arrival in Amsterdam of new varieties from the United States (UNODC, 2006a). This was the result of a policy change by the Reagan administration, which instructed federal police to increase activity against cannabis producers. The Netherlands, with a fine horticultural heritage and a more tolerant attitude to cannabis production, was a natural escape route. Perhaps the most influential of the new varieties to arrive in the Netherlands was Skunk #1, allegedly named because of its pungent odour. This variety was created by crossing tall, slow-growing, but potent, Columbian and Mexican varieties with short, wild Afghan plants. The latter have a comparatively modest THC content but their diminutive stature and very short flowering period are desirable characteristics. Skunk #1 combined the high THC content of the Columbian and Mexican varieties with the short stature and flowering period of the Afghan parent. It also proved to be 'stable', so that the progeny of self-fertilised plants retained the desirable characteristics (Clarke, 2001). Skunk #1 seeds were produced in large numbers. In the United Kingdom, the name *skunk* is now a generic term for any intensively grown sinsemilla. In 1985, a year after Skunk#1 seeds arrived in the Netherlands, the first shop was established there to sell the lighting and other

equipment required for indoor cannabis growing, and a now common retail activity had begun (Bruining, 2003).

In northern Europe, Skunk #1 can only be grown indoors. Plant breeders have since produced many other varieties similarly suited to indoor growing, as well as a few for outdoor growing in Europe. One of many such influential indoor varieties is Northern Lights. This was allegedly the first variety to be specifically bred for growing indoors, at northern latitudes, using electrically powered lights.

The most commonly consumed drugs in the western world are caffeine, nicotine and alcohol (Gupta and Ray, 2004). These are legal drugs, and part of the typical enjoyment of consuming these comes from the taste of the plant materials with which they are produced. Cannabis is perhaps unique in being the only widely used illicit drug whose taste is important to consumers. Cannabis varieties can differ markedly in their terpene content, which in turn affects the fragrance and taste. Some consumers select their varieties accordingly (Rosenthal, 2001). These monoterpenes are also suggested to interact in varying ways with the cannabinoids to produce differing psychotic and/or pharmacological effects (McPartland and Russo, 2001; Russo, 2011).

Today several hundred so-called varieties of cannabis are commercially available. As the possession of cannabis seeds is not an offence in any European country, these are freely traded across international borders. The Netherlands would appear to be the world's largest seed producer, followed by Canada, from where many varieties are exported to Europe (UNODC, 2006a). Varieties purported to have originated in Australasia and African countries are also advertised. However, it should be emphasised that in all countries these are produced in an unregulated and at times unscrupulous market, and their provenance is not assured. Very few of these seeds come from varieties which have registered plant names and plant breeders' rights protection, without which quality and uniformity are not guaranteed (Snoeijer, 2002).

Indoor cultivation of cannabis

It seems that a large proportion of drug-type cannabis cultivated in at least some parts of Europe (e.g. Netherlands, United Kingdom) is now grown indoors. A glasshouse environment offers the grower the ability to use at least some free natural daylight. If timed correctly, the grower can achieve two consecutive crops over the spring and summer months. However, few do so for fear of detection. The majority of plants are grown in sealed rooms, these being fitted with bright lights specifically designed to emit wavelengths that maximise plant growth.

In most habitats, cannabis is conventionally grown as a *short-day* plant, by definition developing flowers only at the end of summer in response to a shortening in daylength. To maximise yields, the crop is initially grown in a long-daylength environment, to establish a good vegetative structure. This is most rapidly achieved by creating an artificial environment of 24 hours daylength, for approximately 3 weeks, but some growers opt for a shorter daylength of about 18 hours, despite the fact that this slows growth (UNODC, 2006b). It is then an almost universal practice that growers place their plants in a 12-hour-daylength environment, to induce and maintain flowering. As demonstrated by Potter (2009a), just altering this regime by 1 hour to 11 or 13 hours is deleterious to yields of most varieties. This same study showed that once placed in a short-daylength environment, plants typically take 7–9 weeks to reach harvest-ready stage.

Plants from extreme latitudes do not exhibit this response to changing daylength. Tropical plants do not encounter daylength variation, and commence flowering when sufficiently mature. FIN-314 is an example of a variety at the opposite extreme. This oil seed variety is derived from Russian accessions k-313 and k-315 from the Vavilov Institute. Adapted to growing in Finland during extremely short summers, these plants begin flowering within 3 weeks of germination, irrespective of daylength (Grigoryev, 1998). In around 2004, a recreational cannabis variety called Lowryder arrived in Europe, which demonstrated the same early-flowering trait (Rosenthal, 2004). This variety is very short, has a lower THC content than most recreational varieties and is not high yielding. In addition, it is also almost impossible to duplicate it through cuttings (clones). However, it can be grown in confined spaces without the need for artificial daylength control. Several crops can be grown outdoors each year. A large number of so-called auto-flowering varieties are now entering the market, with much improved yields and increased THC content. Their impact on the seed market, and on organised cannabis production, is yet to be seen.

Cannabis grown in the United Kingdom for pharmaceutical purposes is propagated in individual pots containing a peat-based growth medium (Potter, 2009b). The majority of seized illicit crops within the United Kingdom are also grown in a similar medium. The crop has in the past been commonly associated with hydroponic (soil-free) growing systems, it being commonly perceived that such systems produce more potent cannabis. Hydroponic systems are expensive and complicated to install, although they do have the advantage of preventing the accumulation of used soil and peat that is an indicator of illicit cannabis growing, thus helping to

avoid detection. However, some hydroponic systems still generate large quantities of fibreglass or other waste materials. Evidence suggests that yields and potency are not improved by hydroponic growing (UNODC, 2006b; Vanhove et al., 2012a).

Studies on light intensity on cannabis potency and yield

A universal feature of successful indoor cannabis growing is the use of extremely bright lighting systems. Cannabis growth is strongly correlated with light intensity (Chandra et al., 2008), and to maximise crop yields growers have to recreate the light availability that exists in a natural outdoor environment. This consumes vast amounts of electrical energy. To assist growers, numerous printed and online growing guides are available, and these repeatedly recommend a high-pressure sodium lighting system, consuming between 400 and 600 watts per square metre of crop (Potter and Duncombe, 2012; Vanhove et al., 2011).

Light is vital for photosynthesis, which enables plants to produce the sugars and proteins necessary for structural development. Biosynthesis of THC, and the accompanying essential oils, in cannabis demands especially large amounts of energy. This has been calculated to be approximately three times greater than required to synthesise an equivalent weight of sugars (Gershenzon, 1994). The amount of prevailing light energy therefore has a potential effect on cannabis potency as well as yield.

A recent study has shown that, when light intensity is increased, the overall THC content of the cannabis plant is boosted (Potter and Duncombe, 2012). However, this is because plants in brighter conditions produce proportionally more female flowers, which contain a greater concentration of THC than does foliage. The same study, and additional research by Vanhove et al. (2011), have shown that, within the range of light conditions typically used by indoor cannabis growers, light intensity does not affect the potency (THC concentration) of this floral material.

There is abundant evidence to link cannabis yields to light intensity. Some growers predict yield on the basis of the energy consumption of their lighting system, and records of the lighting conditions found at crime scenes are useful evidence when estimating potential yields. Anecdotal claims suggest that 1 g of dried flower head can easily be produced for each watt of electrical energy used by the lighting system (Hough et al., 2003). Indeed, many cannabis seed producers now quote their variety's potential yield in terms of grams per watt of light energy, and a yield of 1 g/W is regularly claimed (Rosenthal, 2007).

There is also an important relationship between cannabis yield and the total amount of electrical energy consumed for lighting. This too can facilitate useful estimates of illicit cannabis yields. This requires a consideration of the electrical lighting energy level and the length of time required to produce a crop. Typically, cannabis will be grown in a long-daylength environment of 18–24 hours for the first 2–4 weeks, which establishes vigorous vegetative growth. The daylength is then reduced to 12 hours for approximately 8 weeks to induce and maintain flowering.

The growing instructions of 200 cannabis varieties available in Europe in 2011 reveal that both the mean and the median recommended duration in a short-daylength environment is 57 days: 88 % of varieties have an optimum short-day requirement of between 7 and 9 weeks (Table 1.1). The majority of the remainder are slower-growing varieties that are likely to be of more interest to enthusiasts than to drug suppliers seeking maximum yield and profitability.

Table 1.2 summarises the yield and lighting energy consumption from four European studies. In the United Kingdom growth room study, Potter and Duncome (2012) provided light for 24 hours per day for an initial 3-week period, followed by an 8-week period of 12 hours daylength. During the initial phase, plants were small and tightly packed so that the area requiring illumination was half that required during the second phase, when plant density was also halved. In two studies in Belgium, Vanhove et al. (2011, 2012a) cultivated plants for an initial vegetative phase of 18 hours' light per day for 4 weeks and then a flowering phase of 7 weeks of 12-hour days. The plant density was kept uniform throughout the test. Toonen et al. (2006) studied yields of illicit crops discovered by police in the Netherlands

Table 1.1: The recommended flowering period of 200 indoor high-THC cannabis varieties (10 randomly selected from each of 20 producers) available in Europe, 2011

Weeks in12-hour days	Proportion of varieties (%)
6	4.5
7	26.5
8	32
9	29.5
10	3.5
11	3.5
12	0.5

Source: Online commercial suppliers, February 2011.

Table 1.2: A comparison of effects of lighting intensity ([1]) on the mean yields of dry sinsemilla cannabis recorded in four published European studies

Study (reference)	Mean yield of dry flowers (grams per square metre)			Mean yield of dry flowers (grams per watt)			Mean yield of dry flowers (grams per kilowatt hour)		
	400 W/m²	510 W/m²	600 W/m²	400 W/m²	510 W/m²	600 W/m²	400 W/m²	510 W/m²	600 W/m²
Potter and Duncombe, 2012 ([2])	497	–	544	1.24	–	0.91	1.34 ([2])	–	0.98 ([2])
Vanhove et al., 2011	210	–	362	0.53	–	0.60	0.48	–	0.55
Vanhove et al., 2012a	–	–	627	–	–	1.05	–	–	0.96
Toonen et al., 2006 ([3])	–	505	–	–	0.99	–	–	1.13	–

([1]) Lighting was provided by high-pressure sodium lamps at three different levels of electrical power (indicated in watts per square metre).
([2]) Energy calculations were adjusted, recognising that these plants were tightly packed at 20 per square metre for the vegetative phase and then spread to 10 per square metre during flowering.
([3]) The average number of hours that crops were illuminated was assumed to be the same as in the other three studies.

and the time taken to grow each crop to maturity is therefore not known. However, an average flowering period of 8 weeks was assumed based on Table 1.1. Only high-pressure sodium lamps, which currently dominate the European cannabis indoor growing scene, were used in the four studies.
In their first study, Vanhove et al (2011) had no previous cannabis-growing experience. As is typical in this situation (Jansen, 2002) yields were unrepresentatively low. One or two attempts at growing cannabis are often enough to enable a grower to achieve good yields (Decorte, 2008). Indeed, this team reported substantially improved yields in their later study. Overall, the results in Table 1.2 suggest that, in the lighting conditions typically found in illicit cannabis-growing operations, approximately 1 g of dry cannabis is produced for each watt of power being used by the lighting system. As an example, lighting systems consuming 500 W to illuminate 1 square metre would be predicted to produce average yields of 500 g per square metre.

The results of the studies also indicate that the total amount of electrical energy used to illuminate a cannabis crop, from the date of planting to harvest, equates to approximately 1 kilowatt hour per gram of dry floral material produced. Where energy consumption figures are available, these may be a useful indicator of likely illicit cannabis yield.

Harvesting, drying and processing of indoor-grown cannabis

Once ready for harvest, plants are typically cut at or near the base of the stem. Being an annual plant, new aerial growth cannot regenerate from below ground and the root ball has to be disposed of. The harvested material then needs to be dried promptly to avoid spoilage by bacteria and fungi. This process takes 1–2 weeks, with anecdotal reports suggesting that a slower drying process improves the final flavour. Whole plants are commonly hung to dry in low humidity, but in some cases smaller portions of material are laid horizontally on aerated shelves. At the start of this process, the plants typically contain about 78–80 % moisture, but this needs to be reduced to about 10–15 % moisture before the cannabis can be packaged and consumed.

Only the floral portion of the harvested crop is required, and this has to be separated from the leaf and stem. Some commercially available mechanical devices are available to assist this activity, but more generally the process is achieved by a labour-intensive manual process, known colloquially as manicuring. A dried female cannabis inflorescence, before and after this process, is shown in Figure 1.7.

The leaves and stems are typically disposed of as waste. However, commercially available sieving equipment is available to enable glandular trichomes to be dislodged, and separated from this material. This can be processed to form a potent cannabis resin (Jansen and Terris, 2002).

Sinsemilla cannabis enters the market either as a loosely ground material or as still intact portions of whole inflorescence. The latter generally commands higher prices (Vanhove et al., 2012a). Both forms are typically divided into small bagged portions, for sale into a retail market. Before use, the material has to be ground into a friable material, if it is to be smoked or vaporised. A variety of grinding devices are commercially available and widely used.

Cannabis grinders and production of trichome powders

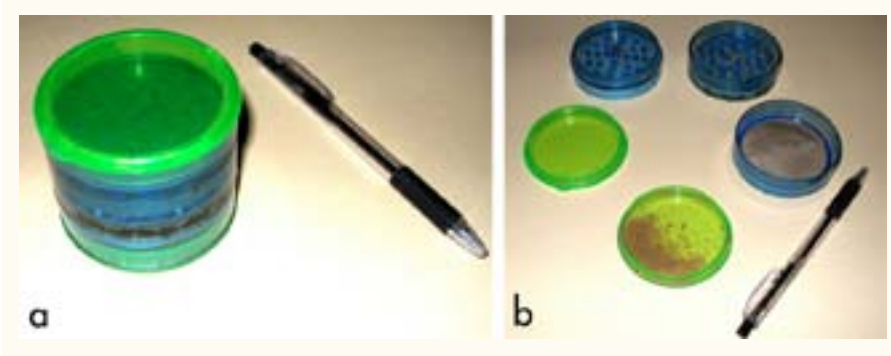
To prepare sinsemilla or traditional seeded herbal cannabis for smoking, the material is commonly prepared using a cannabis grinder such as that shown in Figure 1.8. In this example, the material is placed in the top right-hand chamber. The top left-hand component is then inverted and securely fitted inside its top right-hand counterpart. The surfaces of these two sections of the grinder are constructed with sharp teeth. When these are manually contra-rotated, one inside the other, the cannabis trapped between the two surfaces is broken into a friable material. This falls through holes within the

Figure 1.7: A dry cannabis inflorescence (a) before and (b) after manicuring

Note: The separated sinsemilla floral material is the preferred material that is ready for use. The leaf and stem material is discarded or can be processed to make a resin with very high THC content.

surface of the top right-hand component, and is collected in the next chamber (extreme right), which has a fine mesh as its base. The friable cannabis caught on this mesh is then collected for use. Prior to this, it can be stored in a chamber on the underside of the top left-hand component. The lid for this is shown extreme left. Glandular trichomes dislodged from the cannabis during the grinding process fall through the mesh and are trapped in the lowermost chamber. This powder has an extremely high THC content, and can be used to boost the potency of other cannabis products. Many users compress this powder into blocks, using commercially available presses.

Figure 1.8: A used cannabis grinder (a) in assembled mode and (b) separated into its individual components

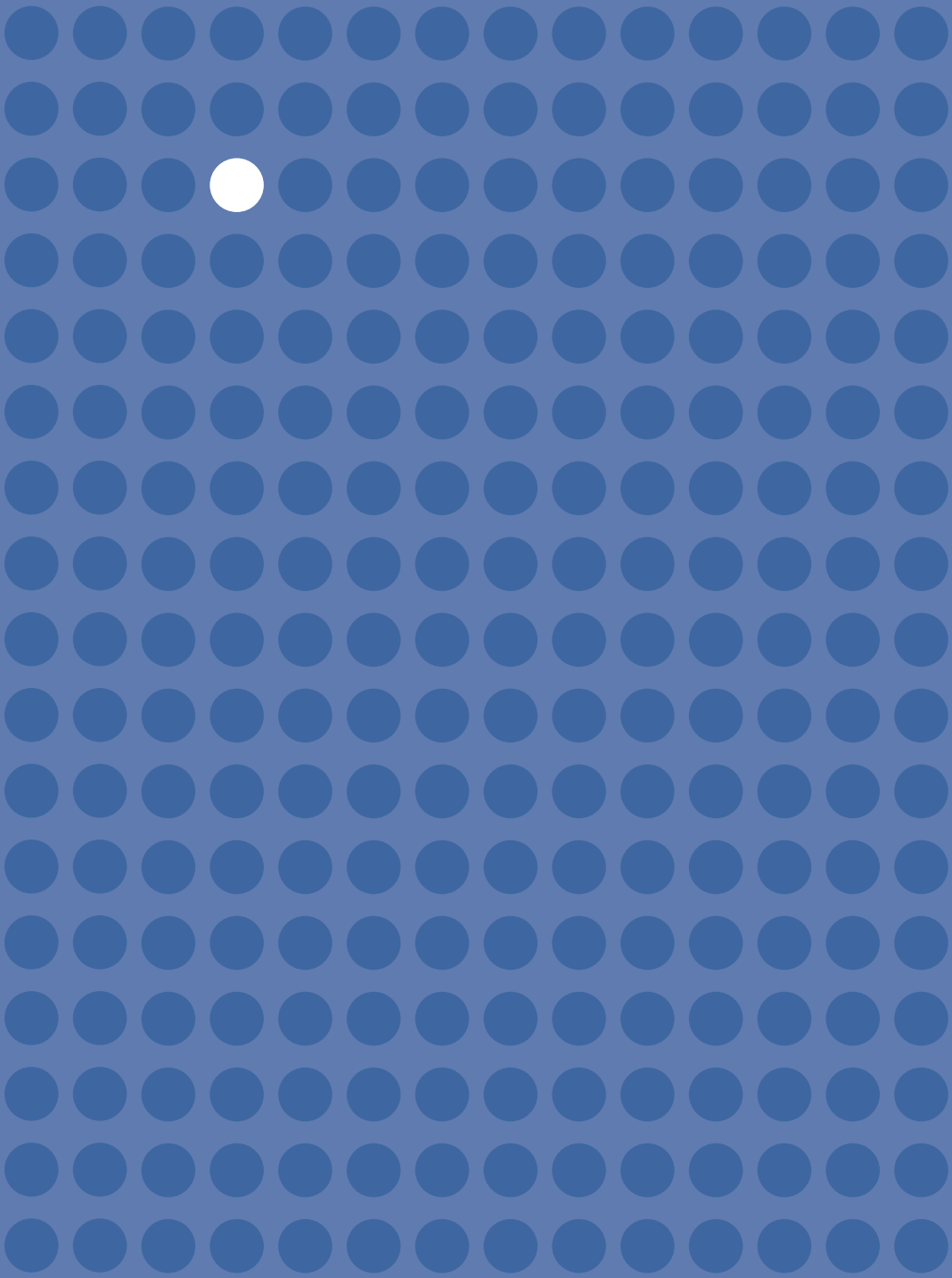


Cannabis powder can also be made on a larger scale. The commercially available device in Figure 1.9 incorporates a motorised rotating tumbler. Dried cannabis foliage and/or flowers are placed in the tumbler. When the tumbler is allowed to rotate for an hour or more, abundant trichomes are dislodged. The outer wall of the tumbler is made of fine mesh, which is coarse enough to allow dislodged trichome resin heads to fall through. The bulk of the plant material is retained within the tumbler. The collected powder can be removed and pressed.

Trichome separation and collection can also be performed in water. By adding ice to the water, the trichome contents harden and separation of the resin heads is facilitated (Jansen and Terris, 2002). These larger scale processes are normally performed on the so-called manicure waste, this being the foliar material separated from female flowers to produce the pure floral sinsemilla material usually preferred by the market. By using high-THC sinsemilla cannabis, the resin material produced is high in THC. Cannabidiol is almost totally absent. This unusual type of material has been called 'modern hashish', to distinguish it from traditional materials containing cannabidiol (Clarke and Watson, 2007). It has been reported that samples with a THC content of more than 60 % can be produced using these devices (Potter, 2009a). These techniques are used to make some of the highly potent resin materials now on sale in Dutch coffee shops.

Figure 1.9: A so-called pollinator device, used to collect trichomes from dry cannabis herbal material

Note: Loose dry cannabis is placed in the central drum and mechanically rotated. The powder of dislodged cannabis trichomes can be compressed to form 'modern hashish'.



Chapter 2: Producing for the European markets

Chapter 2: Producing for the European markets

Can global cannabis production be estimated?

Cannabis is the most widely cultivated illicit drug plant worldwide. In addition, it grows wild in many parts of the world, and in some regions, such as central Asia, wild, or 'feral', cannabis is reported to be potent enough to be used as a drug (UNODC, 2006a). Unlike the opium poppy or the coca bush, cannabis can be cultivated outdoors on a large variety of soils in most parts of the world outside the polar regions. Indoor cultivation is possible wherever there is access to water and electricity. The UNODC has estimated that cannabis was cultivated in 176 countries in 2004, based on data from its 195 Member States (UNODC, 2006a). Between 1996 and 2006, 150 countries reported the seizure of whole cannabis plants to the United Nations (UNODC, 2008) ([1]). The UNODC (2008) estimated that, between 2002 and 2006, herbal cannabis was produced in 122 countries and cannabis resin in 65 countries.

Cannabis production, however, is a highly variable phenomenon. The area under cannabis cultivation differs widely between countries and over time (Clarke, 1998). In addition, when cultivated outdoors, cannabis may be planted as a single crop or interspersed with other crops, such as maize and, although most outdoor cultivation allows only one crop a year, there are unverified reports of up to three harvests a year in some countries (Bloomer, 2008; Laniel, 1998; UNODC, 2006a). Indoor cultivation techniques, in contrast, may yield six or more harvests a year (Chapter 1).

The type of cannabis plant grown and cultivation methods used also vary, and affect yields. Plant density, water supply (irrigated or rain-fed crops), soil acidity or alkalinity and climatic conditions all affect the yields of outdoor crops, and some of these factors can differ markedly from year to year both within and between cannabis-producing countries, and even within growing regions in long-standing producer countries (Clarke, 1998; UNODC, 2006a). For instance, in 2005, the last UNODC field survey of the Rif region of northern Morocco found a more than 11-fold difference between the highest and the lowest estimated yields: from 2 128 kilograms per hectare (kg/ha) on irrigated land to 186 kg/ha on rain-fed land

([1]) Seizures of whole cannabis plants indicate that cannabis is grown in the country, since cross-border transportation of whole plants is both risky and impractical.

(UNODC, 2007a). Overall, the UNODC has estimated that annual yields may range from 5 kg/ha, in the case of feral cannabis, to 40 tonnes per hectare in the case of hydroponically grown plants (UNODC, 2008).

The two main cannabis products manufactured from illicitly grown cannabis are herbal cannabis (herb or 'marijuana'), which is usually made mainly from the flowering tops of the plants together with some leaves, and cannabis resin ('hashish'). These are the two cannabis products that are most widely available in Europe and also those most consumed worldwide ([2]). However, there are various types of cannabis resin and even more types of cannabis herb, and they may be distinguished in several ways, including by their content of delta-9-tetrahydrocannabinol (THC), the main psychoactive substance found in cannabis (Clarke, 1998).

Estimating the amounts of resin and dried marketable herb produced from cannabis crops requires data not only on crop acreages and yields expressed in number or in weight of plants harvested per surface unit, but also on the yield of marketable product obtained per plant (or per surface unit) and, therefore, on the methods used to make the final products and on the latter's composition. In the case of cannabis resin, two categories of production methods may be distinguished — hand-rubbing methods and sieving methods — with the latter reported to produce much more resin than the former, although in both cases several 'grades' of resin may be produced (Bouquet, 1950; Clarke, 1998; Moreno, 1997; UNODC, 2006a) ([3]).

The powder obtained by sieving needs to be pressed into a block of paste-like substance called hashish or charas. However, even resins produced by the same methods may not be readily comparable. This is the case, for instance, with the cannabis resins produced by sieving methods in Morocco and Afghanistan, which appear to be substantially different products (UNODC, 2010a). Moroccans call resin powder 'shira' and resin powder pressed into blocks 'hashish', whereas Afghans differentiate between 'garda' (powder) and 'charas' (block).

When the resin is poor quality (i.e. it contains a lot of non-resinous material such as leaves) it will fail to form a block naturally when pressed. Thus, a range of materials may subsequently be added to powder to increase its weight, change its appearance

([2]) Other products, such as 'cannabis oil' or 'bhang' (ground fresh cannabis leaves), are rarely found in Europe.

([3]) Some cannabis resin products are produced in western countries by extraction methods based on chilled water or the use of electric tumbler/sieving machines.

or facilitate the block-making process (e.g. paraffin) (Clarke, 1998; UNODC, 2006a). This, of course, amounts to adulteration, and the resulting substance is much less potent than 'real' hash containing only resinous material or a low proportion of non-resinous material.

In the case of seeded herbal cannabis, it may be important to know the content of non-usable components such as small branches and seeds in the mixture sold as 'marijuana'. Branches are reported to account for a little more than 40 % of the dry weight of the entire plant, and seeds represent just over 20 % (UNODC, 2006a). Although most branches will be removed from the product before it is marketed, most of the seeds will not and will only be removed by the user just before the drug is to be consumed. Therefore, herbal cannabis estimates should specify whether they refer to 'marketable product' (with seeds) or to 'consumable product' (without seeds) (UNODC, 2006a).

The near-ubiquity of cannabis cultivation internationally and the wide range of possible yields of consumable products are but two of the factors that make it extremely difficult to arrive at reliable estimates of the total quantities of cannabis products produced worldwide. Moreover, estimating how much THC, the main psychoactive principle of cannabis, is produced worldwide in any year verges on the impossible since the THC content of cannabis products may differ widely (see Chapter 4). Determining the THC content of any cannabis plant or consumable product requires sophisticated and expensive laboratory tests, and these are rarely carried out routinely except in a handful of western countries.

Recent attempts by the UNODC to estimate global cannabis production illustrate the difficulties in making estimates that would be sufficiently accurate to allow adequate monitoring of global cannabis output. In a special issue of the *Bulletin on Narcotics*, which focused on the world cannabis situation and the problems associated with monitoring cannabis production, the UNODC suggested that cannabis was cultivated on some 231 000 ha worldwide in 2003, with more than half of the area under cultivation reported to be in Morocco (UNODC, 2006a). This was based on available acreage estimates presented as 'reliable' for six countries (Afghanistan, Colombia, Mexico, Morocco, Paraguay and the United States) and on estimated seizure rates for these countries, said to be the source of about 78 % of the total quantity of cannabis seized worldwide. On this basis, the UNODC suggested that the 2003 world output of cannabis herb was about 30 000 tonnes while that of resin was just under 7 000 tonnes (UNODC, 2006a). However, the UN agency warned

that these figures did not include production in Africa (apart from Morocco), for which there are no reliable estimates (Chouvy and Laniel, 2006; UNDCP, 1997), but which is likely to be very large (Laniel, 1998; Leggett, 2002; ODCCP, 1999a). In addition, this estimate also excluded non-African countries that are likely to have been significant producers in 2003, such as Albania, Bolivia, Brazil, Canada, India, Jamaica, Kazakhstan, Lebanon, Nepal, the Netherlands, Pakistan and Thailand, among others.

A more recent UNODC estimate was published in the 2008 *World drug report*. The report warned that the global pervasiveness of cannabis impeded any practical and rigorous reckoning of world production, but went on to offer a new estimate for global cultivation and production in 2006. Combining national reports on estimated areas under cultivation, mentions of source countries for seized cannabis products and data on seizures of plants, it was estimated that, worldwide, cannabis crops occupied 520 000 ha (or between 470 000 and 600 000 ha), but that, if feral cannabis was included in the calculation, the estimate could be two to three times higher, that is, up to 1.56 million ha. The 520 000 ha thought to be planted with cannabis crops in 2006 was estimated to have yielded a total of 41 400 tonnes of marketable cannabis herb and 6 000 tonnes of cannabis resin (UNODC, 2008).

The UNODC's latest estimate was published in a detailed chapter on the global cannabis market in the 2009 *World drug report* (UNODC, 2009b). While noting that the data available on cannabis production were fragmented, non-standardised and not always scientifically founded, the UNODC estimated that an area of between 200 000 and 641 800 ha was cultivated with cannabis in 2008, resulting in an output of between 13 300 and 66 100 tonnes of herbal cannabis and of between 2 200 and 9 900 tonnes of cannabis resin. These estimates were based on the 'minimum and maximum levels from reported cultivation, production, seizures and user prevalence rates' (UNODC, 2009b).

To summarise, since the mid-2000s the UNODC has published estimates of the total area under cannabis cultivation worldwide, possibly reflecting mostly outdoor production, and of total quantities of cannabis herb and cannabis resin produced worldwide for the years 2003, 2006 and 2008. All three estimates were based largely on combinations of similar supply-side datasets of varying quality and reliability reported to the UNODC by its almost 200 Member States or obtained from the United States *International narcotics control strategy report* (Bureau for International Narcotics and Law Enforcement Affairs, 2009). The estimate published

Table 2.1: World cannabis production estimates

Year	Cultivated area (hectares)	Annual output (tonnes)	
		Resin	Herb
2003	231 000	7 000	30 000
2006	520 000 (up to 1.56 million)	6 000	41 000
2008	200 000–641 800	2 200–9 900	13 300–66 100

Source: UNODC (2006a, 2008, 2009a)

for 2008 also factored in a demand-side dataset: global rates of prevalence of use for 2007 (UNODC, 2009b) ([4]). Different methods have been used to combine the datasets and the results differ considerably, in terms of both the total area under cannabis and the total quantities of marketable products (see Table 2.1).

Such uncertainties in estimates published since the mid-2000s, together with the reliability issues affecting the data used to calculate the estimates (UNODC, 2009b), make it difficult to use them for monitoring purposes, especially in order to evaluate the impact of supply reduction activities. Currently, it is probably impossible to estimate the global production of cannabis with the degree of accuracy needed for practical purposes.

Extra-European supply sources

Although some of the cannabis products supplied to the European markets are made in Europe, a significant proportion is imported from extra-European source countries. Information on the sources of imported cannabis products is provided annually to the EMCDDA by the 30 national focal points of the Reitox network. Analysing Reitox data for the years 2008, 2009 and 2010, this section describes the principal non-EU sources of cannabis products consumed in Europe. Most of this information is likely to originate from intelligence obtained by national law enforcement institutions, largely in connection with seizures of cannabis products, and should be considered as expert opinion rather than scientifically validated data.

Over the period 2007 to 2009, countries from all continents except Oceania were mentioned by EMCDDA reporting countries as the sources of imported cannabis herb and resin. Of the 10 world regions containing countries cited as sources in the Reitox reports, five were mentioned more than 10 times (Figure 2.1) and may be viewed

([4]) In 2007, between 143 million and 190 million people worldwide were estimated to have used cannabis at least once during the previous 12 months (UNODC, 2009b).

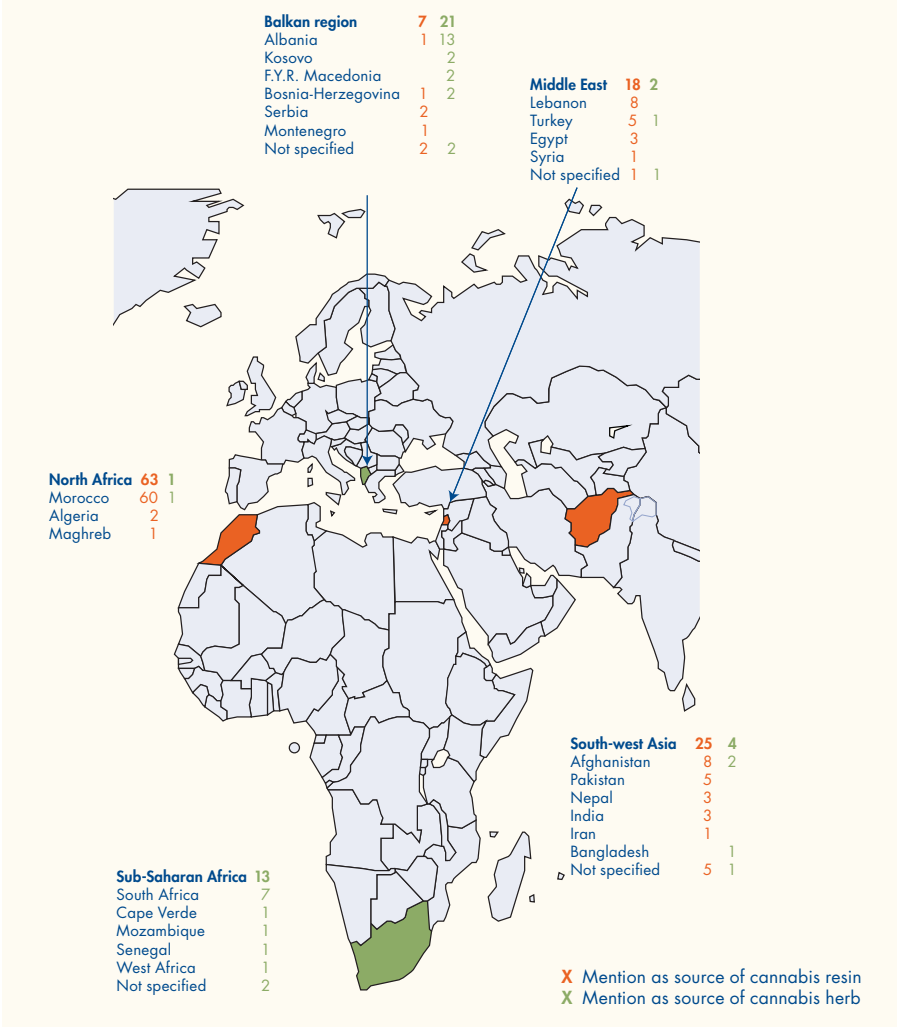
as the main sources of imported cannabis products available on European markets. These regions and their most often mentioned countries are:

- North Africa (64 mentions), including Morocco (61 mentions);
- south-west Asia (29), including Afghanistan (10);
- the Balkan region (28), including Albania (14);
- the Middle East (20), including Lebanon (8);
- sub-Saharan Africa (13), including South Africa (7).

This European ranking broadly corresponds to the world ranking of source countries for cannabis resin compiled by the UNODC based on mentions in annual report questionnaires for the periods 1999–2003 (UNODC, 2006a), 2003–05 and 2006–08 (UNODC, 2010b). In both the EMCDDA–Reitox and UNODC exercises, Morocco consistently ranks first. The main difference between the two sources is that in the UNODC world rankings for the three periods from 1999 to 2008, no other African country is listed (UNODC, 2006a, 2010b), whereas in the most recent world rankings (2003–05 and 2006–08) Spain is listed as a source (UNODC, 2010b), although it is very likely that the cannabis resin sourced in Spain is in fact produced in Morocco. This is likely to be part of the explanation for the decrease in the number of times Morocco is mentioned as a source in the 2010 and 2011 UNODC rankings.

In the case of three of the five main source regions (North Africa, south-west Asia and the Middle East), the product that is by far most frequently mentioned as a European import is cannabis resin. The Balkan region, in contrast, although also mentioned as a source of cannabis resin, is more frequently cited as a source of herbal cannabis. Sub-Saharan Africa is cited exclusively as a main source of cannabis herb. In contrast, in all five secondary sources (see Figure 2.1) the product mentioned as imported is cannabis herb, except for a mention of resin in south-east Asia.

Figure 2.1: Countries and regions reported as sources of cannabis products by Reitox national focal points for the years 2007 to 2009: cumulative number of mentions



Note: The map represents the number of mentions of countries and regions of the world as sources of cannabis resin (orange numbers) and cannabis herb (green numbers) found in the Reitox national reports submitted to the EMCDDA in 2008, 2009 and 2010 and referring to years 2007 to 2009. Also mentioned in the Reitox reports were countries elsewhere in Europe (5), south-east Asia (4), Caribbean (4), North America (3) and South America (1).

Source: EMCDDA and Reitox national focal points.

This predominance of resin among cannabis products imported into Europe is hardly surprising. Although Europe has been one of the world's largest and wealthiest consumer markets for cannabis resin for more than 30 years, little cannabis resin is produced there, and practically all consumption must be supplied from abroad. This is reflected in the quantities of cannabis products reported seized in Europe, with the quantity of resin seized in 2009 (594 tonnes) being almost six times the quantity of herb seized (99 tonnes), while in 2008 the difference was about ninefold and total quantities were higher (910 tonnes of resin compared with 97 tonnes of herb). Compared with cannabis herb, significant quantities of which are produced in European countries for sale on domestic markets, imported cannabis resin runs the risk of interception at Europe's external borders. Globally, it appears that cannabis herb tends be produced for sale on domestic markets and in neighbouring countries rather than for export outside the region. In contrast, it seems that cannabis resin is produced largely for export (UNODC, 2011a).

An additional factor is that law enforcement, especially in the south-west of Europe, has targeted Moroccan cannabis resin importation networks for several decades, acquiring experience and know-how that is likely to increase its efficiency in making resin seizures compared with seizures of herb. This does not necessarily mean that cannabis resin is at present the most widely consumed cannabis product in Europe, although there is little doubt that proportionally much more resin is consumed in Europe than in other comparable markets such as the United States and Australia. However, in the absence of reliable data on other regions likely to be major resin consumers (south-west Asia, North Africa or the Middle East, for instance), we cannot conclude at this stage that Europe is the largest market for cannabis resin in the world.

The 'big five'

What follows is an overview of the information available on cannabis production and exportation to Europe in the five regions most often mentioned as a source of cannabis products sold on European user markets.

Data sources and limitations

In general, reliable data on cannabis production are scarce for countries supplying Europe, and caution is required when analysing such information.

Many of the available national data on cannabis production concern Morocco and Afghanistan, the two most frequently mentioned sources of cannabis resin in the Reitox reports. In recent years the Moroccan and Afghan governments have conducted crop surveys of cannabis production with the assistance of the UNODC. UNODC-assisted crop surveys using satellite imagery may be more reliable than many other available sources of information on the extent of cannabis production, although they have their limitations too, and have been conducted in a limited number of countries and in some years only ([1]).

In addition, several detailed reports from non-UN sources are also available in the case of Morocco. However, much less information is available on the other three main source regions, including the Balkan region, especially Albania.

([1]) UNODC-assisted field surveys of cannabis production have been conducted in Morocco in 2003, 2004 and 2005 (UNODC, 2003a, 2005a, 2007a); in Afghanistan in 2009 and 2010 (UNODC, 2010a; 2011c); and in central Asia (Kazakhstan, Kyrgyzstan and Tajikistan) in 1998/99 (UNODC, 2006a, 2009b).

North Africa

North Africa is the most frequently mentioned source region (64 times, of which Morocco accounts for 61) ([5]) in the Reitox reports, followed by south-west Asia (29 times, of which Afghanistan accounts for 10). Although some cannabis may be cultivated in Algeria and Tunisia, Morocco is the largest cannabis producer in North Africa. Almost all the cannabis produced in Morocco comes from the underdeveloped Rif mountain region in the north of the country and close to Europe. Morocco is one of the world's largest producers of cannabis resin and has been Europe's main supplier of this drug for several decades (Afsahi, 2011; Chouvy, 2005a, 2008; Chouvy and Laniel, 2006; Labrousse, 1998; Labrousse and Romero, 2001; Moreno, 1997; OGD, 1994; UNODC, 2003a, 2006a, 2011a). This is the result of a long and eventful history both within Morocco and in its relation to Europe.

([5]) These 61 mentions include six mentions of Spain as country of origin.

The Rif stretches across five provinces and extends over approximately 20 000 square kilometres. It is one of Morocco's poorest regions (Joseph, 1973). In 2004, it was home to about 2.3 million of the national population of roughly 30 million, according to official statistics ([6]). Population density in the Rif is about three times as high as in the rest of the country, and the region has one of the highest rates of population growth in Morocco (Chouvy and Laniel, 2006; UNODC, 2007a). As a result of the hilly terrain, depleted soil, lack of industry and underdeveloped infrastructure the essentially rural, ethnic-Berber population has historically found it difficult to make a living locally beyond the bare subsistence level. Agriculture is traditional, and the soil is badly affected by erosion, due in part to the large-scale cultivation of cannabis. In this context, many Riffans have emigrated or sought alternative employment in trafficking in contraband goods and, especially since the 1980s, cannabis production. The long history of defiance and mistrust that exists between the region's Berber tribes and the central authorities in Rabat has led to episodes of violence and reinforced the relative isolation of the Rif vis-à-vis the rest of the country (Chouvy, 2008; Joseph, 1973; Moreno, 1997).

The cannabis plant was probably introduced to North Africa during the Arab invasions of the seventh century (Bouquet, 1950). Starting in the fifteenth century, its cultivation became established around the Riffan towns of Ketama and Chefchaouen, located in the present-day provinces of Al-Hoceima and Chefchaouen, although some cannabis was also cultivated elsewhere in the country (Afsahi, 2011; Benabud, 1957). By the late eighteenth century, the Rif may have become the main cannabis-producing region in Morocco (Afsahi, 2011). Until the mid-twentieth century, cannabis herb, locally known as 'kif', was almost the only consumable product to be derived from the cannabis plant in Morocco. Traditionally, chopped cannabis herb has been smoked in small pipes ('sebsi') mixed with chopped tobacco in a mixture that is also called 'kif'. It has also been ingested in sweets ('majoon') and tea by users seeking relaxing and exhilarating effects, while limited medicinal and religious uses have also been reported to exist (Benabud, 1957; Moreno, 1997; OGD, 1996; UNODC, 2003a).

In 1890, the sultan of Morocco enacted laws limiting cannabis trade and consumption in the country, but also explicitly authorising five Berber 'douars' (villages) of the Rif region to grow cannabis for self-consumption, although some of the harvests were sold in other parts of the country. In 1912, Moroccan territory was

([6]) http://www.hcp.ma/Recensement-general-de-la-population-et-de-l-habitat-2004_a633.html

divided into two protectorates administered by France and Spain. The Rif mountains made up most of the zone given to Spain, which authorised a number of Berber tribes to cultivate cannabis (Moreno, 1997; UNODC, 2003a). The rest of Moroccan territory was granted to France.

The Algeciras Treaty of 1906 granted a monopoly over purchases and sales of tobacco and kif in Morocco to a French-owned multinational company headquartered in the extra-territorial zone of the port of Tangier, the Régie marocaine des kifs et tabacs. The Régie initially bought cannabis from growers throughout Morocco. In 1932 a royal dahir (decree) banned cannabis cultivation in the country except in two specially designated areas, the plains around Kenitra and those around Marrakech, which supplied the Régie. However, cultivation continued in the Spanish-ruled Rif (Joseph, 1973). The French authorities acted vigorously to enforce the Régie's monopoly and prevent the smuggling of Rif-grown kif, but in vain (Benabud, 1957). The only period when cannabis cultivation drastically decreased in the region was probably during the 'Rif Republic' (1921–26), when the region briefly became an independent state (UNODC, 2003a). In 1954, a dahir prohibited cannabis production throughout the French zone, which was extended to the former Spanish zone in 1956, upon Morocco's independence. At that time, use of kif was apparently quite widespread in the Moroccan population and the newly independent Moroccan authorities wished to restrict it (Benabud, 1957). However, the government was gradually led to tolerate kif production in the five 'historic' Berber douars of 1890, in an attempt to placate repeated episodes of unrest in the Rif including the 'Revolt of the Mountains' suppressed by the military in 1959 (Chouvy, 2008).

After independence, the surface area dedicated to cannabis crops in the Rif gradually expanded outward from the five 'traditional' douars, but apparently remained somewhat limited until around the mid-1960s to early 1970s (Clarke, 1998). It seems that, at that time, most of the cannabis herb produced in the Rif was sold on the Moroccan domestic market (Moreno, 1997). In addition, it is likely that cultivation methods were different from those of today, which seek to maximise yields (Clarke, 1998). A key turning point was the introduction of cannabis-resin making by the sieving method, which led to an increasingly larger share of the kif grown in the Rif mountains to be transformed into hashish and exported chiefly to western Europe. It is difficult to determine precisely when the large-scale manufacture of resin started in Morocco, some dating it tentatively to the mid-1960s (Clarke, 1998; Chouvy, 2008) and others to the 1970s (Afsahi, 2011; Moreno, 1997), although some 'shira', as

cannabis resin in powder form is known in Morocco, was made in the country as long ago as the 1940s (Bouquet, 1950). Whatever the case, cannabis resin is more suited to international trafficking than cannabis herb, since it is much less bulky, much more malleable and devoid of the herb's pungent odour. Furthermore, resin is reported to survive storage better than herb (UNODC, 2006a).

This introduction of the sieving method, combined with a series of economic factors in the 1970s and 1980s, led to a new era of 'industrialisation' (Afsahi, 2011) of cannabis production in the Rif, with most of the crop being turned into resin and exported, mainly to nearby Europe, and only a small proportion being sold as kif (or as hashish) on the domestic market. A multifaceted economic crisis in Morocco in the 1970s followed by structural adjustment programmes in the 1980s led to a deterioration of living conditions in the Rif, pushing many farmers to seek alternatives in the informal or illegal sectors of the economy, especially cannabis production. To compound matters, restrictions began to be placed on immigration into Europe in the 1980s, which strongly limited access to a European labour market that, in previous decades, had absorbed many of the Riffans struggling to make a living locally (Afsahi, 2011; Moreno, 1997; UNODC, 2003a). Another important factor contributing to the high level of cannabis trade between Morocco and Europe is a tradition of trade in contraband goods between Europe and northern Morocco, especially through the Spanish enclaves of Ceuta and Melilla. Moroccan and European traffickers took advantage of (and further developed) these historical smuggling routes to export Rif-made cannabis resin to Europe and import European-made contraband goods into northern Morocco (Chouvy, 2005b; EMCDDA, 2008a; Hibou, 1996; Moreno, 1997).

Crucially, the period of economic hardship in the Rif coincided with the rapid expansion of demand for cannabis resin in western Europe starting in the 1960s (Afsahi, 2011; Chouvy, 2008; Moreno, 1997; UNODC, 2003a). The close geographic proximity and historical ties between Morocco and Europe, and especially with Spain and France, are likely to have facilitated the smuggling of Moroccan resin into Europe (Joseph, 1973). It seems that supply-side and demand-side factors interacted with one another in a way that stimulated both supply and demand. While increased European demand for cannabis resin was an incentive for Riffan farmers to expand production, the increased availability of resin in Europe made the emergence of new consumers more likely. Moroccan resin eventually became dominant on western European markets, at the expense of cannabis resins previously imported from Afghanistan and Lebanon (UNODC, 2003a).

The available estimates of the area dedicated to cannabis crops in the Rif indicate a strong, sustained expansion over a period of about 20 years. The estimated acreage increased more than 10-fold between 1980 and 2003, to a peak of 134 000 hectares. The first UNODC-assisted cannabis survey in Morocco confirmed earlier estimates (see Table 2.2). By way of comparison, the estimated area under cannabis in the Rif in 2003 was larger than that under opium poppies in Afghanistan (80 000 hectares) or coca in Colombia (86 000 ha) (UNODC, 2003b, 2005b). The UNODC also reported in 2003 that an estimated 96 600 families (about 800 000 people) were cultivating cannabis in the Rif (UNODC, 2003a), although an earlier estimate was even higher, at 200 000 families, or 1–1.5 million people (Moreno, 1997).

In 2005, however, the last UNODC-assisted survey estimated that the area under cannabis had dropped back to mid-1990s levels at 72 500 hectares, with about 89 900 families reported to be involved (UNODC, 2007a). By 2009, Morocco reported about 47 500 hectares under cannabis (UNODC, 2011a). This would imply a drop in cannabis cultivation in the Rif of about 46 % between the first UNODC-assisted survey in 2003 and the last in 2005, and of about 64.5 % between 2003 and 2009.

The UNODC attributed the apparent decline in cannabis cultivation in 2005 in the Rif to three factors: a severe drought; a campaign by the Moroccan government to raise awareness that cannabis cultivation should be abandoned; and eradication. According to the Moroccan government, some 15 160 hectares of cannabis plantations was mechanically and chemically suppressed, especially in the provinces of Taounate and Larache, where large-scale cannabis cultivation started after 1980 (UNODC, 2007a). It should be noted that few alternative development programmes have been implemented in the Rif, and those that do exist have apparently had little impact (Chouvy, 2008; Moreno, 1997). No information is available to explain the further decreases in cultivation reported in 2008 and 2009.

Table 2.2: Available estimates of areas under cannabis crops, and quantities of cannabis resin produced in the Moroccan Rif, 1980–2009

Year	Cultivated area	Resin production (tonnes)	Source
1980	5 000–10 000	Not available	Estimate by Pasqual Moreno (1997)
1992	50 000	Not available	Acreage mentioned in King of Morocco speech (Moreno, 1997)
1993	65 000–74 000	1 000–1 500	Both estimates by Observatoire géopolitique des drogues, acreage estimate based on Moroccan agriculture ministry data (OGD, 1994)
1995	79 846	Not available	Estimate by Pasqual Moreno (1997) based on data from PAIDAR-Med study (INYPSA, 1995)
1999	90 000	Not available	Estimate by Alain Labrousse based on Moroccan agriculture ministry data (Labrousse and Romero, 2001)
2001	100 000–120 000	1 600–3 000	Acreage estimate by unnamed Moroccan agriculture ministry officials; resin estimate by Alain Labrousse and Lluis Romero (Labrousse and Romero, 2001)
2003	134 000	3 080	UNODC-assisted field survey (UNODC, 2003a)
2004	120 500	2 760	UNODC-assisted field survey (UNODC, 2005a)
2005	72 500	1 066	UNODC-assisted field survey (UNODC, 2007a)
2008	64 377	877	Government of Morocco (UNODC, 2010b) ([1])
2009	47 500	646	Government of Morocco (UNODC, 2010b); resin estimate by EMCDDA ([2])

([1]) In its 2009 *World drug report*, the UNODC published another estimate of the area under cannabis crops in Morocco in 2008 of 60 000 hectares that was communicated officially by the Moroccan government (UNODC, 2009a). In the 2010 *World drug report*, this estimate was presented as 'harvestable area' after reported eradication of 4 377 hectares and sourced to the UNODC annual reports questionnaire 2008 (UNODC, 2010b).

([2]) The 2009 cannabis resin estimate was calculated based on the estimated 47 500 hectares under cannabis and on the indicative yield of 17 kilograms of resin per hectare for 2008 (see footnote 7).

The apparent decline in cannabis resin produced in the Rif is even more striking: 65 % between 2003 and 2005 and 79 % between 2003 and 2009. This is due both to the fall in the estimated area under cannabis crops and to a decrease of about 40 % in estimated average yields of cannabis resin per hectare between 2003 and 2009, according to EMCDDA indicative calculations ([7]). These estimates suggest that both the area under cannabis in the Rif and the resin yield of the crops halved in 7 years. As the evidence strongly suggests that Morocco is the largest source of cannabis resin consumed in Europe, this issue warrants careful attention.

([7]) To take into account the estimated 20 % of harvested cannabis plants that are sold in Morocco as kif (UNODC, 2007a), the EMCDDA has calculated indicative yields by dividing the figures for resin production by the area cultivated minus 20 %. The results are as follows: 2003: 28.73 kilograms per hectare; 2004: 28.63 kilograms per hectare; 2005: 18.37 kilograms per hectare; 2008: 17 kilograms per hectare.

The accuracy of Moroccan resin production estimates can be assessed by comparing them with reported seizures of the substance, focusing on data for Spain and Morocco (Table 2.3). It can be assumed that Spain is the main entry point into Europe for Moroccan resin, and that the substance is not produced in Spain (EMCDDA, 2008a; Spanish national focal point, 2009; UNODC, 2004, 2006a, 2010b, 2011a). Since the mid-1990s, Spain has seized the largest annual quantities of cannabis resin in Europe (and globally), accounting for about 75 % of the European total each year (EMCDDA, 2011b; ODCCP, 1999b; UNODC, 2006a, 2007b, 2008, 2009b, 2010b, 2011a). It can be safely assumed that all cannabis seized in Morocco is resin produced domestically. In 2007, Morocco ranked second in the world, after Spain, for reported quantities of cannabis resin seized (UNODC, 2009b), and in 2009 it ranked third after Spain and Pakistan (UNODC, 2011a) ([8]). It may be estimated that roughly half of the cannabis resin produced in Morocco in any year is exported that same year, while the remaining half is exported during the following year. All this suggests that practically all of the cannabis resin seized in both Morocco and Spain is manufactured in Morocco. As a result, it is possible to calculate rough interception rates by comparing the quantities of cannabis resin seized in Morocco and Spain with the estimated quantities of cannabis resin exported from Morocco.

Table 2.3: Estimates of cannabis resin production in and exports from Morocco and seizures in Morocco and Spain for 2003–09 ([1])

Year	Morocco: production (tonnes)	Morocco: exports (tonnes)	Morocco: seizures (tonnes) and interception rate (%)	Spain: seizures (tonnes) and interception rate (%)
2003	3 080	Not available	96	778
2004	2 760	2 920	87 (3 %)	794 (27 %)
2005	1 066	1 913	92 (5 %)	670 (35 %)
2006	Not available	Not available	88	459
2007	Not available	Not available	118	654
2008	877	Not available	114	683
2009	646	761	188 (25 %)	445 (58 %)

Note: Calculations of cannabis resin exports from Morocco are based on the assumption that half of the resin is exported in the year that the plants were harvested and the remainder the following year.
Interception rates are defined here as the quantity of resin seized by a country expressed as a percentage of the estimated quantity of resin exported from Morocco in the same year.
([1]) The 2009 cannabis resin estimate was calculated based on the estimated 47 500 hectares under cannabis and on the indicative yield of 17 kilograms of resin per hectare for 2008 (see footnote 7).
Source: UNODC (2003a; 2005a, 2007a, 2010b) for estimated production in Morocco; UNODC (2009a, 2010b) for quantities seized in Morocco; EMCDDA (2011a) for quantities seized in Europe and quantities seized in Spain. See Table 2.2 for the source of the 2009 resin production estimate.

([8]) No data are available from the UNODC on Morocco's ranking in the world in 2008.

Cannabis resin production in Morocco is estimated to have decreased by 2 434 tonnes (or 79 %) between 2003 and 2009. In the same period, European cannabis resin seizures decreased by 412 tonnes (41 %) and Spanish seizures by 333 tonnes (43 %), which means that much of the fall in European seizures was accounted by the fall in Spanish seizures, although the total amount intercepted in the rest of Europe also decreased. At the same time, Moroccan resin seizures increased by 91.3 tonnes (95 %). In the context of an apparent steep fall in quantities produced and exported from Morocco, these changes in seizure statistics result in sharp increases in the interception rates in both Spain and Morocco since 2005, when the last UNODC-assisted survey was conducted in the Rif (UNODC, 2007a). Thus, between 2004 and 2009, the Spanish interception rate more than doubled while the Moroccan rate increased eightfold. Combining Spanish and Moroccan seizures results in an aggregated interception rate of about 83 % in 2009, up from about 30 % in 2004. The only explanation for such a surge in interception rates over a 6-year period, especially in a context of falling resin production in Morocco and decreasing seizures in Europe, would appear to be the introduction of revolutionary innovations in law enforcement in both countries between 2004 and 2009, but this does not seem to have been the case.

The estimated steep decline in cannabis resin production in Morocco raises a second but related issue. If Spain and Morocco together intercepted 83 % of Morocco's resin exports in 2009, that would leave about 129 tonnes to be seized or consumed in the rest of the world, including western Europe, which has been the main market for Moroccan cannabis resin since the early 1990s. For instance, the UNODC (2006a) has estimated that about 80 % of the cannabis resin seized in Belgium, Denmark, Germany, Ireland, France, Italy, Portugal, Sweden, the United Kingdom and Norway comes from Morocco (UNODC, 2006a), which would amount to about 111 tonnes in 2009 (EMCDDA, 2011b). Even if only 50 % of the cannabis resin seized in these 10 European countries in 2009 came from Morocco, that would amount to 55.5 tonnes, and the remaining 63.5 tonnes would not be sufficient to allow for seizures of Moroccan resin made elsewhere. For instance, Algeria alone reported seizing about 75 tonnes of cannabis resin in 2009, which it identified as coming from Morocco (UNODC, 2011a,b). Furthermore, Algeria is not a producer of cannabis resin but shares a long border with Morocco and is located on a major trafficking route for Moroccan cannabis resin (UNODC, 2004,

2005a) ([9]). Adding the quantities seized in Algeria to those intercepted in Spain and Morocco in 2009 would leave no or only very little cannabis resin of Moroccan origin to supply the consumer markets of the 22 European countries mentioning Morocco or Spain as a source of this drug in the Reitox reports ([10]).

More information is needed to explain the anomalies that arise when the dramatic fall in estimated cannabis resin production in Morocco is compared with seizure data, especially after 2004. Overall, it is likely that cannabis resin production has declined in Morocco in recent years, although probably not to the extent suggested by the available information. However, it is also possible that, beginning in the mid-2000s, the dominance of Moroccan cannabis resin in European markets has been challenged by the re-emergence of resins from south-west Asia, the Middle East and possibly also the Balkan region. From the limited information available, the most serious contender appears to be south-west Asian cannabis resin.

South-west Asia

The second most frequently mentioned source region in the Reitox reports is south-west Asia, with 29 mentions. South-west Asia includes six countries, of which at least four, Afghanistan, Pakistan, Nepal and India, are known to have traditionally manufactured significant quantities of cannabis resin and to have exported cannabis resin to Europe in recent years (Clarke, 1998; Fisher, 1975; Hasan, 1975; Kan, 1975; UNODC, 2006a, 2011a). Some resin may also be made in Iran, but the quantity is likely to be very small and it is only rarely exported to Europe (Clarke, 1998). By contrast, Afghanistan (10 mentions), possibly in connection with Pakistan (five mentions), may be a non-trivial source for Europe. Most mentions refer to cannabis resin, whereas cannabis herb is mentioned only four times.

([9]) In the last 15 years Algeria has not been mentioned as even a minor cannabis resin producer by specialised United Nations agencies (ODCCP, 1999b, 2000, 2001; UNDCP, 1997; UNODC, 2003c, 2004, 2005c, 2006a, 2007b, 2008, 2009b, 2010b, 2011a). Clarke (1998) notes that hashish may have been made in Algeria prior to independence from France in 1962, but not since.

([10]) Morocco was mentioned as a source of cannabis resin by Belgium, Czech Republic, Denmark, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Malta, Austria, Portugal, Romania, Finland, Sweden, the United Kingdom, Croatia and Norway. Spain was mentioned as a source by Estonia, Lithuania and Latvia, although it is likely that this refers to the point of departure of consignments of cannabis resin originally manufactured in Morocco.

Afghanistan has a relatively long tradition of 'charas' (resin) manufacturing using sieving techniques, which probably dates back to the nineteenth century. However, it is likely that cannabis resin from central Asia, especially Turkestan, was widely used and traded in Afghanistan long before that. India, where the use of charas and other cannabis products for religious purposes among Hindus is ancient, was probably a significant market for hashish made in Afghanistan and central Asia in those days and well into the twentieth century. Indeed, this may still be the case, despite the fact that cannabis resin is also produced in India. Production of cannabis resin in Afghanistan, as in Nepal and Pakistan, began to change in the 1970s. From a cottage industry geared to supplying local and neighbouring long-standing 'traditional' markets, it became a commercial enterprise orientated towards large-scale exportation, especially to Europe and North America (Clarke, 1998). As a result, Afghanistan, along with Pakistan and Lebanon, became a major supplier of cannabis resin to Europe for a period of about 10 years before the large-scale arrival of Moroccan resin in the early 1980s and the concomitant expansion of European consumer markets (Clarke, 1998; Moreno, 1997; UNODC, 2003a, 2006a).

The Reitox reports (Reitox national focal points, 2009) and the UNODC (2011a) suggest that most of the cannabis resin now available in Europe continues to come from Morocco. Yet there are indications that the proportion of cannabis resin originating in south-west Asia, especially Afghanistan, may have increased. Two field surveys of cannabis cultivation and cannabis resin production in Afghanistan, carried out by the UNODC in 2009 and 2010, produced similar results ([11]). In 2009, the area under cannabis was estimated at between 10 000 and 24 000 hectares, yielding an estimated production of 1 500 to 3 500 tonnes of cannabis resin (UNODC, 2010a). The corresponding figures in 2010 were estimated to be 9 000 to 29 000 hectares and 1 200 to 3 700 tonnes of resin (UNODC, 2011c). According to the UNODC, only wide ranges could be presented because of the uncertainties attached to these estimates (UNODC, 2010a, 2011c). In contrast to Morocco, where cannabis cultivation is concentrated in a single region (UNODC, 2003a, 2005a, 2007a), in Afghanistan cannabis is cultivated in many, if not most, regions (Clarke, 1998; UNODC, 2010a, 2011c), which complicates estimation exercises. Furthermore, methodological differences between the UNODC-assisted surveys in Morocco and those in Afghanistan may limit the comparability of the estimates.

([11]) The UNODC estimates refer to single-crop cannabis fields and do not include cannabis grown in private gardens, along the edges of fields of other crops or in mixed culture with licit crops (UNODC, 2010a, 2011c).

According to the UNODC, Afghanistan is now the world's leading producer of cannabis resin, with Morocco occupying second place (UNODC, 2010a,b, 2011c). Although the estimated area under cannabis in Afghanistan in 2009 (24 000 ha) was, at most, only about half that in Morocco (47 500 ha), the average yield of resin per hectare in both 2009 and 2010 (145 kg/ha) is estimated to be more than three times the average resin yield achieved in Morocco in 2005 (40 kg/ha) (UNODC, 2009a, 2011c) ([12]). However, Moroccan and Afghan cannabis resins are probably not comparable products. Indeed, according to the UNODC (2010a), differences in processing, cultivation techniques, plant varieties and climatic conditions between Morocco and Afghanistan are such that 'the two countries actually produce different cannabis products'. As a result, resin powder produced in Afghanistan ('garda') may have 'very different properties' from that produced in Morocco ('shira') (UNODC, 2010a). Compared with its Moroccan equivalent, the cannabis resin powder from which Afghan hashish is produced, which includes a large proportion of ground cannabis leaves, is of much lower potency (UNODC, 2003a, 2011c). Furthermore, as Clarke (1998) explains, 'modern' hashish manufactured in Afghanistan since the early 1970s is a mixture of sieved resin powders and adulterating binders and is a much lower-potency product than traditional Afghan charas ([13]). It is therefore likely that the cannabis resin made in Afghanistan is less potent than that made in Morocco, although no definite conclusions can be drawn in this respect as no potency tests were carried out during the UNODC-assisted surveys in Afghanistan (UNODC, 2010a, 2011c). For this reason, comparisons based purely on quantities of marketable Afghan and Moroccan cannabis resins should be made with caution.

Cannabis plants and resin powders produced in Afghanistan, especially in the east of the country, may also be converted into hashish in Pakistan, often after being mixed with cannabis resin powders produced in Pakistan (Clarke, 1998; UNODC, 2006a). However, this is not taken into consideration in recent UNODC Afghanistan surveys (2010a, 2011c) and, thus, it may not always be possible to establish a clear distinction between Afghan and Pakistani cannabis resins. This probably explains

([12]) The original report on the 2005 cannabis survey in Morocco (UNODC, 2007a) did not provide an estimate of yields in terms of quantity of resin produced per hectare, and the basis of the 40 kg/ha figure is not clearly explained by the UNODC (2010a: 23).

([13]) Binders are used to make cannabis powders that contain a high proportion of non-resinous material hold together as a single block. Those reported to be used in Afghanistan include butter, paraffin, turpentine, vegetable lard and candle wax (Clarke, 1998).

why the UNODC mentioned Afghanistan and Pakistan as a single source of cannabis resin in the mid-2000s (UNODC, 2004). Although it is known that cannabis is cultivated throughout Pakistan, and that cannabis resin has been manufactured, traded and used there for more than a hundred years (Clarke, 1998; UNODC, 2004, 2006a), there are no estimates of the extent of production in the country. However, since the late 1990s, Pakistan, along with Spain, Morocco and France, has ranked among the world's top three countries (often in second place) for quantities of cannabis resin seized and, together with Morocco and Afghanistan, Pakistan has been regularly mentioned as a major source of cannabis resin by countries reporting to the UNODC (ODCCP, 2001, 2002; UNODC, 2004, 2006b, 2007b, 2009b, 2011a) ([14]). Furthermore, it has been reported that the machines used by traders in some Afghan regions to make cannabis resin are imported from Pakistan, which illustrates the close links existing between Afghan and Pakistani cannabis resin-making and trading networks (UNODC, 2010a). At any rate, Pakistan has been a major point of export for cannabis resin manufactured in south-west Asia for several decades (Clarke, 1998; UNODC, 2006a, 2010a, 2011c).

As indicated above, it is not clear how much of Afghanistan's resin production eventually ends up on European consumer markets. Europe is not mentioned as a potential destination for Afghan resin in recent UNODC publications (UNODC, 2010a,b, 2011a,c). However, in the Reitox reports analysed for this publication, Afghanistan is mentioned 10 times, by a total of eight countries, as a source of resin for Europe, whereas Morocco is mentioned 61 times by a total of 22 countries. This would suggest that Afghan cannabis resin is not as widely available as Moroccan resin. This seems to be confirmed by the latest international information available: data from UNODC Member States for the 2007–09 period show that Morocco is mentioned as a source of cannabis resin is almost twice as often as Afghanistan (UNODC, 2011a).

Europe is not the only likely consumer market for Afghan resin. Many countries of the Middle East, Arabian Peninsula, and central and south-west Asia (India, Pakistan, Iran, Turkmenistan, Uzbekistan, Tajikistan, Kazakhstan) have long-standing traditions of hashish use, are nearer to Afghanistan, possibly on ancient hashish trading routes, and may provide large consumer markets for Afghan-made cannabis resin (Clarke, 1998; UNODC, 2011a).

([14]) 'Source country' is not a direct indication that a country is a producer, but rather, that it has been identified as a source or as the last country of transit.

That said, a possible sign that some Afghan charas is finding its way into Europe is the steady increase in cannabis resin seizures in Turkey, from 1.8 tonnes in 2004 to 9.5 tonnes in 2009. Turkey is now one of seven European countries reporting annual seizures of 10 tonnes or more of cannabis resin. This sustained increase in Turkey has occurred at a time when amounts of cannabis resin intercepted in Europe have, overall, been decreasing (see Chapter 6).

Turkey's possible role as a key transit country between Afghanistan and the European consumer markets is well documented in the context of the Balkan route, along which heroin is trafficked into Europe (EMCDDA, 2008b; UNODC, 2011d). In addition, the UNODC indicates that cannabis production and opium production are closely related in Afghanistan (UNODC, 2010a, 2011c). It is therefore possible that some Afghan charas is transported to Turkey and then on to the EU through the Balkan route. However, more information is required before any definite conclusions can be drawn.

Overall, it is difficult to determine if the increase in seizures of cannabis resin in Turkey can be attributed to increased trafficking of hashish from Afghanistan. There are at least two other potential sources of the cannabis resin seized in Turkey. One is Turkey itself, a country with a long tradition of cannabis resin production and use (Clarke, 1998), and which is mentioned five times as a source of cannabis resin in the Reitox reports. In the early 2000s, Turkey reported some of the highest numbers of cannabis plants seized in Europe: between 20 million and 30 million plants every year (EMCDDA, 2011b). Some of those plants may be used to manufacture cannabis resin. However, it is not clear how much, if any, of the hashish manufactured in Turkey is exported and how much is consumed locally (see Chapter 5). A second potential source of the cannabis resin seized in Turkey is Lebanon, which is relatively near Turkey and where cannabis resin production may be on the rise. Lebanon is reviewed later in this chapter.

Balkan region

The Balkan region accounted for the third largest number of mentions as a source region (28) in the Reitox reports (with Albania, with 14 mentions, ranking first among the Balkan countries). The majority of the mentions refer to cannabis herb (21), and the remainder to cannabis resin. The Balkan region appears to be a significant source of cannabis products to the European markets.

Cannabis resin production was widespread in the Balkan region in the early twentieth century, with Greece reported as a major producer until about 1920, and later Albania and the former Yugoslavia, especially in what is now the former

Yugoslav Republic of Macedonia (Bouquet, 1950; Clarke, 1998; de Monfreid, 1933). Information on present-day cannabis production and trafficking in the Balkan region is limited. However, it appears that cannabis has been produced on a large scale in Albania for some time, and that most of the production is exported. Over the period 2003–09, Albania was consistently reported as a source country for cannabis products (both herb and resin) by UNODC Member States (UNODC, 2003c, 2004, 2005d, 2006b, 2007b, 2008, 2009b, 2011a). Furthermore, among the Balkan countries, Albania has seized the largest quantities of cannabis herb and the largest number of cannabis plants in recent years, reporting to the UNODC cumulative totals for the period 2005–09 of approximately 27.5 tonnes of cannabis herb and 780 000 individual cannabis plants (UNODC, 2011a). However, it reported no seizures of cannabis resin between 1998 and 2009 (UNODC, 2005c, 2011a).

Large-scale production of cannabis in the south of Albania is thought to have begun at some point in the mid-1990s, with the majority of Albanian produce being exported throughout the Balkan region (UNODC, 2006b). This seems to be confirmed by the Reitox reports, as, other than Italy, most countries reporting Albania as a source are in the Balkans. Based on available information, it appears that most cannabis cultivation in Albania occurs outdoors, with crops hidden in forests and in the mountains (Carpo Regional Project, 2007; Costes et al., 2009). Since 2006, the UNODC has consistently reported Greece and Italy as the primary destination countries for Albanian cannabis, with cannabis produced in the south of Albania reportedly cultivated specifically for export to the Italian markets (Carpo Regional Project, 2007; Costes et al., 2009; UNODC, 2006b). In 2006, the UNODC reported that the increases in Albanian production and export may, in part, be a result of increased law enforcement efforts against cannabis production in Greece. The same explanation is given by Bouquet (1950) to explain a shift in cannabis cultivation from Greece to Albania and Yugoslavia after 1920. The UNODC also reports that Albanian cannabis is supplied to Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Serbia, Montenegro, Slovenia, the former Yugoslav Republic of Macedonia and Sweden (UNODC, 2004, 2005c, 2006b). Another source has reported that cannabis production in Albania is run predominantly by criminal organisations, which export the product to Greece, Italy and unknown destinations (Costes et al., 2009).

To summarise, the Balkan region, and especially Albania, seems to be a significant source of cannabis products used on European markets, but probably more of herb than of resin. However, given the paucity of data on cannabis production in the region, this conclusion remains tentative.

Middle East

The Middle East region is the fourth most often mentioned source region in the Reitox reports, with a total of 20 mentions, eight of which are for Lebanon, and almost all of which refer to cannabis resin. The consumption, trade and production of cannabis resin is a long-standing phenomenon in the region, perhaps dating back to the thirteenth century. Some authors view the Middle East as the traditional home of hashish, where it is produced through the sieving technique (Bouquet, 1950; Clarke, 1998). Today, Lebanon is probably the largest producer of cannabis resin in the Middle East, although resin may also be produced in Syria and Turkey (Bouquet, 1951; Clarke, 1998). The limited information available on cannabis production in Lebanon suggests that production levels have fluctuated over time. Sources indicate that large-scale cannabis production occurred in Lebanon in the 1970s and 1980s, when it is estimated that cannabis crops covered between 11 000 and 16 000 hectares (Clarke, 1998; Joffe, 2000; UNODC, 2006b). Traditionally, cannabis in Lebanon has been cultivated in three main regions: the eastern, coastal Jebel Liban mountain range; the Jebel ash Sharqi mountains, near the eastern border with Syria; and especially in the Bekaa valley, in the north of the country (Bouquet, 1950; Clarke, 1998).

In 1975, the country was engulfed in a civil war, which continued until 1990. During this period, cannabis cultivation and exportation continued, with some interruptions, and Lebanon has repeatedly been identified as a major source country for the production and trafficking of cannabis (particularly resin), for the Near and Far East and for the European market (Hammer, 2001; UNODC, 2003c). Following the end of the civil war, and under pressure from the international community (DRCN, 2001a; Hammer, 2001), the Syrian and Lebanese authorities launched a campaign to eradicate cannabis crops in the Bekaa Valley in 1991–94 and to implement alternative development measures (Khalaf, 1997; UNODC, 2006b). This resulted in dramatic decreases in the reported levels of cannabis crops and farms in the country, with an almost complete cessation of cannabis cultivation.

Prior to eradication, cannabis cultivation and resin manufacturing in the Bekaa region alone was reported to provide a living to 25 000 families (DRCN, 2001a; Khalaf, 1997). However, efforts to establish alternative crops were unsuccessful, due in part to lack of international funding and support (DRCN, 2001a; Hammer, 2001; Khalaf, 1997). Media reports in the early 2000s also suggested that cannabis cultivation was re-emerging in the Bekaa region as a consequence of poverty among

farmers. As a result, it appears, according to reports, that the amounts of Lebanese cannabis resin seized have been increasing over the past decade (DRCN, 2001a,b; Hammer, 2001; Khalaf, 1997; UNODC, 2006b).

Lebanon has been mentioned by UNODC as a source country, particularly for cannabis resin, since 2001. Syria and Jordan suggested that 100 % of the resin available on their national markets in 2003 was of Lebanese origin (UNODC, 2006b), and in 2006 Turkey reported that about half of the resin that it seized was produced in Lebanon. In the same year, Syria reported that 100 % of the resin trafficked in the country was of Lebanese origin, with approximately 95 % of this in transit to the Gulf States (UNODC, 2006b). Despite these reports of Lebanese resin trafficking abroad, the Lebanese government reported that 98.8 % of the resin produced in Lebanon was consumed within the country, with only small amounts exported to Bulgaria and Dubai (UNODC, 2006b).

In recent years, Lebanon is once more consistently appearing in the UNODC and Reitox reports as a source country, probably indicating that cannabis production and exportation are on the rise (UNODC, 2011a). However, estimates suggest that cannabis resin production in Lebanon is lower than it was in the 1990s. According to the UNODC's 2011 *World drug report*, in 2009 all 1 310 hectares under cannabis in Lebanon was eradicated and no cannabis resin was produced in the country (UNODC, 2011a).

Sub-Saharan Africa

Sub-Saharan Africa is the fifth most often mentioned region (13 times) in the Reitox reports, with South Africa accounting for more than half of the citations (7). Unlike the other 'big five' regions mentioned as sources of cannabis products available on European markets, sub-Saharan Africa is mentioned only as a source of cannabis herb. This is notable, as trafficking in cannabis herb tends to be more intraregional than transcontinental, especially when compared with trafficking in cannabis resin (UNODC, 2011a).

Reliable information on cannabis production, trade and use is particularly scarce for sub-Saharan Africa (Laniel, 2006). There are no estimates of the quantities of cannabis produced in Africa south of the Sahara, but it may be assumed that cannabis is cultivated in most countries in the region, sometimes on a very large scale (OGD, 1998; Perez and Laniel, 2004). Although most of the resulting cannabis herb seems to be intended for local or regional consumer markets, which may be

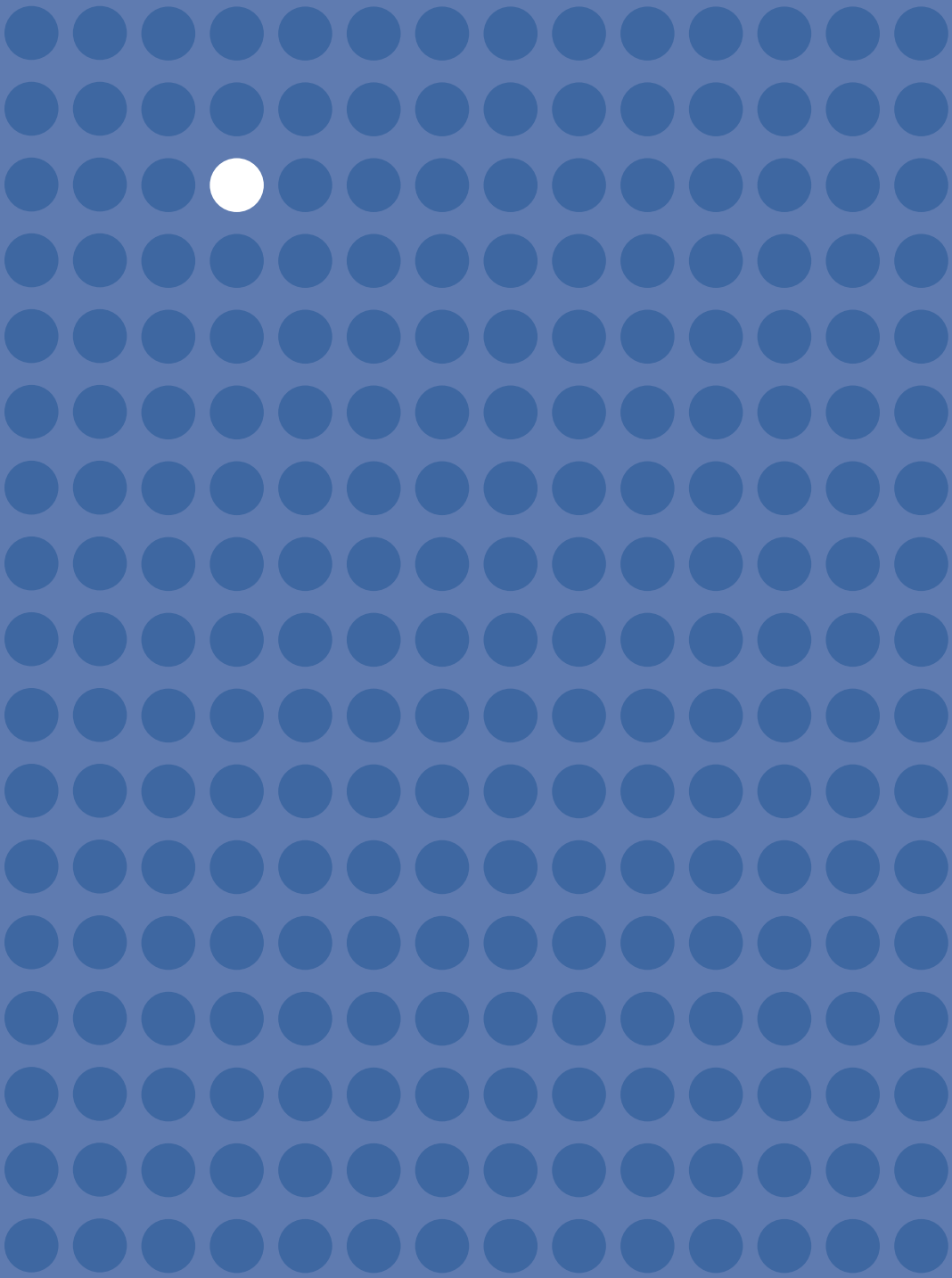
large, exports outside sub-Saharan Africa, especially to Europe, do occur (Laniel, 1997; UNODC, 2006a). For instance, Nigeria informed the UNODC (2011a) that cannabis herb produced in that country is exported to Italy and the Netherlands (as well as Japan), although much is consumed domestically. Hundreds of tons of cannabis are seized in Nigeria every year (UNODC, 2011a), yet the country is not mentioned as a source of cannabis in the Reitox reports reviewed for this publication. Since 2004, countries that have reported annual seizures of more than 20 tonnes of cannabis herb at least once include Ghana, Kenya, Malawi, South Africa, Tanzania and Zambia, and annual seizures of more than 2 tonnes of cannabis herb were reported at least once by Benin, Burundi, Burkina Faso, Cape Verde, Cameroon, Cote d'Ivoire, Guinea, Madagascar, Rwanda, Senegal and Sierra Leone (UNODC, 2011b). The African subregion reporting the second largest amounts seized every year to the UNODC is West and Central Africa, which in 2009 seized a total of about 120 tonnes (UNODC, 2011b). However, in the 90 Reitox reports reviewed here 'West Africa' is mentioned only once as a source, with two west African countries, Senegal and Cape Verde, each achieving one additional mention. Central Africa is not mentioned at all.

Southern Africa is the African subregion reporting the largest quantities of cannabis herb seized in 2009, about 174 tonnes, including almost 126 tonnes confiscated in South Africa (UNODC, 2011b). As in most of southern Africa, cannabis cultivation, trade and use is a long-standing phenomenon in South Africa, dating back to the fifteenth century and perhaps earlier (Du Toît, 1975). The plant is used traditionally for medical, recreational and other purposes in the region (Du Toît, 1975; Laniel, 1998; Leggett, 2002). Large-scale commercial cultivation of cannabis in South Africa seems to be especially prevalent in and around the Drakensberg mountain range, particularly in the provinces of Kwazulu-Natal and Eastern Cape. Available estimates of the area under cannabis crops in South Africa vary widely, from 1 000–2 000 hectares (UNODC, 2006a) to more than 35 000 hectares (Laniel, 2000). However, as the methods by which these estimates were arrived at are either unknown or unreliable, they should be viewed with caution.

Cannabis is also produced on a large scale in the two small, independent and landlocked kingdoms of Lesotho and Swaziland, which are located in the Drakensberg mountains or their foothills (Bloomer, 2008; Laniel, 1998, 2001; UNODC, 2006a). It is likely that most of the cannabis produced by these countries is exported to South Africa, where it may be consumed locally or exported onward

to Europe (and elsewhere) as 'South African' cannabis herb (Bloomer, 2008; Laniel, 1998, 2000; Leggett, 2002; UNODC, 2011a). It is also likely that large amounts of cannabis herb produced in Malawi are consumed in South Africa or are exported from South Africa (Laniel, 2000; Leggett, 2002; UNODC, 2006a). There are no estimates of the area under cannabis in Lesotho, Swaziland or Malawi. However, these countries have reported large annual seizures of cannabis herb. For instance, Lesotho reported seizing almost 17 tonnes in 2004; Swaziland 6 tonnes in 2009; and Malawi 27 tonnes in 2006. Finally, the large seizures of cannabis herb reported by Zambia since 2004 (38 tonnes in 2009) suggest that this country is yet another major southern African cannabis producer. It is likely that some of the cannabis herb produced in Zambia is trafficked to South Africa, and may be exported from there (Laniel, 2000), although no recent information is available to corroborate this.

In conclusion, South Africa is a source, consumer and transit country for significant quantities of cannabis herb. A proportion of the cannabis herb produced in South Africa as well as other southern African countries is likely to be exported from South Africa to Europe, reflecting the country's role as a regional transhipment hub for legitimate goods (Laniel, 2001; UNODC, 2011a).



Chapter 3: Domestic supply in Europe

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Background of domestic production

The 1970s saw the emergence of serious cultivation and breeding of cannabis plants, with growers in the United States, Canada and the Netherlands working to develop plants that could grow in a wider range of conditions, produce higher yields and higher-potency products (Decorte, 2010a; Hough et al., 2003; UNODC, 2006a). During the 1980s, cannabis cultivation in Europe increased substantially, with the Netherlands emerging as a centre of breeding, cultivation, production and export to other countries (Decorte, 2008).

Historical context and changes over time: the changing green tide

To begin to understand how cannabis cultivation production and trade became established in the Netherlands in the 1970s and 1980s, it is necessary to consider the cultural climate of the day and the policies that were in place. At that time there were no legal restrictions on experimentation in the development of new strains of cannabis, and producing seeds for cannabis plants was permissible by law, regardless of their potential THC levels (Decorte, 2010a). During this period, the Netherlands was a leader in intensive horticultural techniques; according to Potter (2008) these techniques were easily transferable to the cultivation of cannabis, thus stimulating the increase in domestically grown produce (in particular, indoor cannabis production). A series of changes to legislation, policy and relevant case law in the late 1970s through to the 1980s essentially decriminalised use and purchase of small amounts of cannabis. These changes paved the way for the establishment and toleration of cannabis retail outlets (coffee shops) (Decorte, 2007). Together, these factors created a climate in which the various components of the cannabis market could flourish, establishing the Netherlands as the centre of cannabis production and know-how in Europe.

Although the existence of coffee shops altered the landscape of cannabis use and purchase in the Netherlands, Jansen (2002) has observed that the existence of coffee shops in the early 1980s held back the expansion of demand for domestically produced cannabis, with coffee shops mainly selling foreign products. Jansen argued that an upsurge in the 1990s in media stories reporting extremely high THC levels (25 %) in Dutch-grown cannabis brought about a drastic change in the consumer

market, with the demand for cannabis produced in the Netherlands subsequently increasing at a rapid rate. Jansen (2002) referred to the resulting boom in domestic production and 'import substitution' that occurred in the Netherlands as the 'green avalanche', arguing that within 10 years of this turnaround approximately 80 % of the domestic demand for cannabis in the Netherlands was met by local product.

The knowledge and expertise that was developed during this time in the Netherlands became something of an export commodity, with various other countries linking their own cultivation knowledge, education and 'know-how' back to the Dutch (Decorte, 2007; Potter, 2008). This appears to still hold true today, with several countries indicating the Netherlands as a main source of information, equipment and 'know-how' for cannabis cultivation (Belgium, Hungary, Denmark, Germany, France, Latvia, Lithuania, Sweden, Slovakia, United Kingdom: Reitox national focal points, 2009). Jansen (2002) has argued that the boom in production in the Netherlands led to a 'competitive advantage', whereby not only the final cannabis product, but also Dutch seeds, technology and knowledge, were able to successfully compete on international markets and increase their market share at European level.

Over time, this export of Dutch knowledge in combination with the spread of technological developments appears to have led to a trend in several European countries towards 'import substitution', whereby domestic consumption is now increasingly being supplied by domestic production (Belgium: Decorte, 2007, 2010a; Denmark and Finland: Hakkarainen et al., 2011a; Netherlands: Spapens, 2009; United Kingdom: Hough et al., 2003; Potter, 2008). It has been argued that 'import substitution' has now become an irreversible trend in some cannabis markets (Decorte, 2010a; UNODC, 2010b). Although not within a European specific context, Chin et al. (2000) have also argued that the growth in domestic production can be viewed as a response by importers to the increased risk of detection by law enforcement.

Domestic production and import substitution

The landscape of the cannabis market has shifted dramatically within the last two decades and a trend towards import substitution has emerged. Belgium, Denmark, the Netherlands, Finland and the United Kingdom have all experienced steep growth in the levels of domestic production, and the Czech Republic, Germany, Ireland, Hungary, Poland, Slovakia and Norway have also reported increases in the levels of domestic production (Potter, 2008; Reitox national focal points, 2009).

While not suggesting that the United Kingdom is experiencing a 'green avalanche', Potter (2008) reported that the United Kingdom has experienced an upward trend in the phenomenon of import substitution. Factors relating to the cultural climate in the Netherlands at the time, such as access to stronger strains of cannabis, liberalisation of attitudes towards cannabis and increased access to and technological advancements in growing techniques, were also noted by Potter to exist in the United Kingdom. Included in this is the increase in the number of grow shops and the emergence of underground 'coffee shops', although these occurred in an illegal and unsanctioned context and most were shut down within days or months of opening (Potter, 2006, 2008). In addition to this, Potter has pointed to the role played by the Internet in spreading information, knowledge and expertise. The upward trend in domestic production has also been noted in recent reports from the Association of Chiefs of Police, with suggestions that the majority of cannabis is now domestically produced (ACPO, 2010, 2012).

Import substitution: the move from the Netherlands to neighbouring countries

As cannabis cultivation techniques have advanced and indoor cultivation has spread, the intra-European export market for cannabis has altered. This is particularly notable in Belgium, which appears to be emerging as a force in the commercial production of cannabis and the exportation of cannabis products. It is reported that cannabis grown in Belgium is intended primarily for export to the Netherlands, where it is sold in coffee shops and grow shops or shipped to third countries such as the United Kingdom and Scandinavian countries (Belgium: Reitox national focal points, 2009). It has also been suggested that part of the increase in cannabis production in Belgium can be attributed to the ready availability to Belgians of 'cultivation know-how' through Dutch grow shops (Decorte, 2010a; Vanhove et al, 2012a).

The apparent shift in intra-European production and trade from the Netherlands to Belgium may, to some extent, be a result of changes to Dutch policy relating to cannabis production and increased efforts by Dutch authorities in targeting organised crime in the Netherlands (Decorte, 2010b; De Ruyver, 2006; Fijnaut and De Ruyver, 2008; Spapens and Fijnaut, 2005). In addition, although efforts to target organised crime and cannabis cultivation in Belgium have been increased, Belgian law enforcement agencies were originally slower to react to commercial cultivation, potentially contributing to the displacement of commercial activities from the Netherlands across the border to Belgian territory (De Ruyver, 2006).

Evolution of the Dutch policy

The tolerance and regulation of the coffee shop phenomenon in the Netherlands throughout the 1980s and 1990s arguably led to a high level of professionalisation in the operation of the coffee shop industry, with a previous estimation of annual revenue suggesting a turnover of between €210 and €283 million (Korf, 2003).

It has been argued that this policy of tolerance and subsequent growth and professionalisation of the coffee shop industry created a stronger market for commercial cannabis suppliers in that the target market of coffee shops remained relatively secure and undisturbed by authorities (van de Bunt, 2006). This 'guaranteed market' is suggested to have increased the preponderance of the criminal element in the commercial cultivation of cannabis, in addition to creating 'drug tourism' associated with the coffee shops (in particular in border regions). Other unintended negative outcomes of the tolerance policy include the spread of non-tolerated selling premises and nuisance (De Ruyver, 2011).

These issues, and in particular the link between commercial cannabis cultivation and organised crime, were recognised in the 1990s, and enforcement efforts began to target cultivation practices more intensively.

Since 2004, the Dutch authorities have stepped up their efforts to suppress cannabis production, forming alliances with electricity companies (which are affected by electricity stolen to power cannabis factories) and housing associations (where some cannabis factories are located) to detect and dismantle cannabis production facilities (Decorte, 2007, 2010a; Fijnaut and De Ruyver, 2008; Wouters, 2008). Spapens (in Costes et al., 2009, p. 35) reported that a variety of methods, in addition to criminal prosecution, are used to deter cannabis cultivation in the Netherlands, such as imposing taxes on the revenue from cultivation, demanding payment for stolen electricity and evicting tenants who have been cultivating cannabis in housing corporation properties.

Although intended to target all forms of cannabis production, some authors have suggested that this policy, and in particular the emphasis upon possible eviction of home growers, might have led to a decline only in the number of small-scale growers, with large-scale cultivators simply shifting to privately owned property and commercial premises, where the threat of eviction is not a relevant factor (Decorte, 2008; Spapens in Costes et al., 2009). This, if true, may have resulted in continuation or perhaps reinforcement of a trend that started earlier, i.e. the displacement of small-scale growers to large-scale (organised) cultivation. It has also been suggested that this increased

focus on dismantling cannabis cultivation sites in the Netherlands may have contributed to the rise in cannabis production in Belgium, where law enforcement efforts against cannabis production were less developed (Decorte, 2007; De Ruvyer, 2006).

Policy changes in Belgium in relation to cannabis use, possession and cultivation may also have had some impact on the shift in production from the Netherlands to Belgium. In 2001, the Belgian government agreed to stop prosecution for use of cannabis and cultivation of cannabis for personal use, on the grounds that it did not constitute a nuisance and was not problematic (Decorte, 2007). However, it was not until 2003 that guidelines outlining what was permitted were implemented. Under the new guidelines, cultivation of cannabis for personal use (one female plant) and possession of up to 3 grams are no longer grounds for prosecution (Decorte, 2007). The action to be taken in cases of larger amounts is left to the discretion of the prosecutor, leaving the boundaries of cultivation limits unclear.

Cannabis production also appears to be spreading from the Netherlands to Germany. The German Reitox focal point noted that most German production sites have traditionally been located close to the Dutch border, and have predominantly been run by Dutch nationals. Based on police data, it has been estimated that, since 2004, there has been an increase in the number of cannabis cultivation sites within Germany and, in particular, in the North Rhine–Westphalia region which borders the Netherlands. In addition to this, recent reports suggest that plantations run by Dutch groups are moving their operations further east into Germany, to avoid detection by Dutch authorities in the border region (Germany: Reitox national focal points, 2009).

The role of the cannabis 'social movement'

In recent years, cannabis users and growers appear to have increasingly occupied a central position in European drug policy and practice. The pro-cannabis movement was born during the 1960s, but over time has become more influential and appears to have gained more economic and cultural weight (Calafat et al., 2000). This can be seen in a number of areas, one of them being the re-emergence of the 'user activist' (Chatwin, 2010; Mold and Berridge, 2008) and the increasing popularity of cannabis social movements in Europe (Gamella and Jimenez-Rodrigo, 2004).

A social movement can be viewed as a network of activist groups, individuals or organisations that is engaged in political or cultural conflict over social change. 'Cannabis social movements' advocate cannabis legalisation and agitate for changes in drug policy by participating in the drug debate.

Cannabis social movements:

> … essentially try to convert the heavily stigmatised position of drug users into one of legitimate actors that may form opinions on, contribute to, and collaborate with policies that directly affect them and that are supposed to be aimed at improving the health and wellbeing of drug users.
>
> (ENCOD, 2009)

A variety of actors can be involved in cannabis social movements, for example user groups, associations of growers, grow shop owners, members of the media, professionals, political parties and publishers of specialised magazines (Calafat et al., 2000; Gutierrez, 2010). Cannabis social movements campaign for greater citizen participation in European drug policy and demand that attention be given to the impact of drug policies at the level of citizens. They believe that if citizens were to become more involved in the development of (local) drug policy, there would be more effective interventions better suited to the culture and public opinion of a particular geographical area (Chatwin, 2007). Cannabis social movements exist at international level (e.g. International Network of People who Use Drugs), European level (European Coalition for Just and Effective Drug Policies, ENCOD) and national level (e.g. 'Federación de Asociaciones Cannábicas' (Spain), Akzept (Germany) and Cannabis Law Reform (United Kingdom)).

There are indications that, over time, cannabis social movements have become more vocal, articulate and popular in Europe (Gamella and Jimenez-Rodrigo, 2004). Some European cannabis social movements have participated in dialogues and consultations with authorities, sometimes on an incidental basis related to a particular issue (e.g. the writing of a policy document), sometimes on a more structural basis (Chatwin, 2007; ENCOD, 2009). In 2009, ENCOD examined 35 organisations that were described as social movements. The research suggested that the majority of the social movements participating in the drug policy debate considered the dialogue with authorities as positive. Opinions differed on whether their recommendations had been taken into account or resulted in any difference in opinion among the authorities (ENCOD, 2009).

Cannabis social clubs

Important actors within the cannabis social movements are the 'cannabis social clubs' (Arana and Montañès Sanchez, 2011; Gutierrez, 2010). As well as opposing prohibition policy, cannabis social movements also want to end the juridical uncertainty regarding cultivation, with the aim of finding a legal way to be self-

sufficient (Barriuso, 2011). Cannabis social clubs have recently emerged in several European countries, including Belgium (Trekt Uw Plant), Germany (East Side Growers), Spain (Ganjazz and Pannagh; Arana and Montañès Sanchez, 2011) and Switzerland (Verein Medical Cannabis). Cannabis social clubs are non-commercial organisations of users who get together to cultivate and distribute enough cannabis to meet the personal needs of the club members (Barriuso, 2011; Reuter, 2010).

It must be noted that each individual club can choose how it operates and thus they are not all the same; however, some generalisations can be made.

These social groups operate in a 'not-for-profit' fashion, with any extra income being put back in to the organisation. In some ways, they resemble large-scale illicit commercial cultivation, in that land, buildings and equipment can be purchased or rented to provide a space for cultivation. People are employed (or volunteer) to cultivate and maintain the cannabis as well as to harvest it. Cannabis is cultivated both indoors and outdoors, and in addition to herbal cannabis, resin and other products (oil, creams, etc.) may be produced. Cannabis social clubs follow the allotment principle, whereby members pool resources and distribute the harvest among themselves and apply strict guidelines, for example prohibiting re-sale.

Barriuso (2011, p. 5) suggested that part of the motivation for the emergence of cannabis clubs in Spain is that members achieve a degree of quality control over the cannabis: they are able 'to control the origin, quality and composition of what they are consuming'. This broad motivation for cannabis cultivation has also been noted by authors in other European countries (Spapens in Costes et al., 2009; Decorte, 2010b; Hakkarainen et al., 2011a). In addition to this, the creation of a space specifically for cannabis production and distribution allows for a true separation from the 'mainstream' criminal market (see also 'Cannabis growers and motivation', below).

The legal status of the clubs and how they operate is not always clear or well defined. Under Spanish legislation, the consumption of illicit drugs has never been considered a crime; however, in some circumstances illicit drug use may be considered an administrative offence (Spanish national focal point, 2009). There has been at least one court ruling in favour of these clubs in Spain: the Supreme Court decided that cultivation for personal use is not a crime when not destined for trafficking (Barriuso, 2011; Reuter, 2010).

Cannabis social clubs run the risk of infringing various laws, especially during cultivation and transportation (Barriuso, 2011), and while some may have arisen as a result of juridical insecurity regarding cultivation, others may reflect the desire of some

users to avoid contact with the criminal market. Members consider the clubs as a means of continuing to consume cannabis that is of known quality and origin. The members also claim that their membership of a cannabis social club enables them to consume cannabis without becoming involved in criminal markets and organised crime groups (Barriuso, 2011; Maalsté et al., 2010).

As far as we are aware, there have been no published scientific studies of the outcome of cannabis social clubs. Thus, it is difficult to assess whether they provide an effective means of finding a legal way to be self-sufficient, while at the same time avoiding the black market.

Interaction with the media

One indication that cannabis social movements and culture are becoming more popular in Europe is their increasing visibility in several forms of media. This is illustrated by the growing amount of advertising aimed at cannabis users and cannabis growers in Europe. Knowledge exchange is increasingly facilitated by the Internet, and knowledge of cannabis growing is more and more distributed through (online) handbooks, specialised websites, magazines and cannabis fairs (Decorte, 2010a; Gutierrez, 2010). This advertising is not without its economic benefits. Increasing numbers of people, including magazine editors, book authors, web hosting companies and equipment suppliers, are earning money from this booming industry.

Cannabis cultivation handbooks have played a part in the dissemination of know-how over the past decades, and are now sold over the Internet and at cannabis fairs.

Specialised websites, several of which are based in Europe, provide users and growers with information on cannabis cultivation. Some of the websites offer step-by-step guidelines, including forums on the topic where growers can exchange ideas or ask further information. Many of the websites also offer for sale seeds or starter kits. In addition, knowledge of cannabis cultivation is increasingly distributed through social media such as Facebook and YouTube.

Specialised magazines relating to cannabis are published on a regular basis, and provide general information and advice on cultivation. Much of the content of such magazines is devoted to advertisements for online shops selling cannabis seeds and smoking accessories (including vaporisers, pipes and scales), grow shops and 'cannabis fairs'. In addition, the magazines often include reports of previous cannabis fairs or of demonstrations or meetings on the cannabis issue and publish

political statements on the legalisation of cannabis as well as information on other hemp products. Examples of specialised magazines are *Soft Secrets* (published in eight European languages) and *A Folha* (published in Portuguese).

Cannabis fairs are organised regularly in several European cities. These fairs range from small-scale events to large 'expos' (with over 15 000 visitors). Fair organisers often forbid the exhibition of products containing THC or any other illicit substance. The products exhibited include seeds and seed banks, and advice on cultivation, smoking, devices for preparing and consuming cannabis products and hemp products (e.g. industrial hemp and hemp clothes) is also available. In 2010 and 2011, cannabis fairs were held in a number of European cities, including Prague (Cannafest and Cannabizz), Zurich (CannaTrade), Barcelona (Spannabis), Madrid (Expocannabis) and Vienna (Cultiva).

The role of the Internet

By facilitating ready and largely anonymous access to information and other resources, the Internet appears to have contributed to increased levels of domestic cannabis production and, in particular, the rise in small-scale non-commercial growers. Among the resources available on the Internet are discussion boards on cultivation, 'how to' pages, expert advice and information on the variety of strains that are available. In addition, the Internet also operates as a 'shop' where cannabis products such as seeds, cultivation equipment and cannabis paraphernalia can be bought and sold. The following countries have identified the Internet as playing a role in the sale of seeds and equipment and the dissemination of information (Reitox national focal points, 2009).

Seeds	**Equipment**	**Information**
Czech Republic	Czech Republic	Czech Republic
Germany	Germany	Germany
Latvia	Latvia	Latvia
Lithuania	Hungary	Hungary
Slovakia	Slovakia	Portugal
Finland	Finland	United Kingdom
Sweden	Sweden	
United Kingdom	United Kingdom	

Cannabis cultivation in Europe

Although cannabis is Europe's most commonly consumed illicit substance, information about the cultivation, production and distribution of the drug in the European Union is limited.

One of the concerns in relation to examining the extent of production and cultivation is the vast array of the different forms of cultivation that can occur. As previously mentioned, cannabis is a plant that lends itself to a variety of growing conditions and scales, ranging from indoor and hydroponic settings to growth in natural outdoor settings such as in fields and forests. In addition, the size of cannabis cultivation sites is extremely variable, ranging from home growers cultivating for personal consumption to large-scale commercial plantations capable of producing vast amounts of cannabis.

The challenges faced at global level when attempting to estimate cannabis production (see Chapter 2), apply also to the European context. Some indirect indicators have been suggested as a means to provide information on some aspects of cannabis production: the number and size of plantations discovered by law enforcement forces may provide an indication of how much is being grown; routine reporting on seizures of cannabis plants may point to countries where cannabis is being grown; changes in cannabis strains and potency may suggest changes in production methods and techniques; and the country of origin of seized products may indicate where cultivation is taking place. However, these indirect indicators may not accurately reflect the state of the market.

Information on domestic cannabis cultivation and production has commonly been gleaned from reports of seizures of cultivation sites by law enforcement agencies. Although this can be a valuable source of information on the state of the cannabis market, seizures can also be an indication of law enforcement priorities and may not accurately reflect varying levels of production. For this reason, data on seizures should be interpreted with caution. Additional concerns in relation to seizures data are explored below.

What is a plantation?

The methods used to report data on seizures of cannabis plantations vary considerably across Europe. The wide variety of ways in which plantations can be recorded may result in difficulty when attempting to estimate the scale of cannabis

production in Europe. Even the definition of a cannabis plantation is problematic, with the majority of European countries appearing to lack a clear definition of what constitutes one.

There is no commonly accepted 'lower limit' on the number of plants that are required for a site to be regarded as a 'plantation'. Some countries appear to define a site growing any amount of cannabis plants as a plantation (Portugal and Finland), while others require at least two (Belgium) or three plants (Estonia, Latvia) (Hakkarainen et al. 2011b; Reitox national focal points, 2009; Van Camp 2008, cited in Decorte, 2010a, p. 273). Since January 2010 the Czech Republic has classified the cultivation of five plants or fewer for personal use a misdemeanour, an infraction not punishable in criminal law. Germany, however, appears to set the lower limit for a 'plantation' at 20 plants (Reitox national focal points, 2009). The United Kingdom takes a different approach to the definition of plantations and instead classifies a 'farm' or a factory as a premises (or part of a premise) that has been adapted for cultivation so that normal use of the area is not possible (ACPO, 2009, 2012). In addition, in 2010 an agreement was reached between police and the Home Office in the United Kingdom that a grow site containing evidence of 25 plants or more at any stage of growth (inclusive of germination and of previously harvested plants) would be classified as a commercial operation (see later in this chapter for a definition of commercial cultivation) (ACPO, 2012).

Some countries provide a scaling of plantations, placing them into categories based on the number of plants that are recorded (Belgium, Czech Republic, Germany, Hungary, Poland). However, there is little agreement between countries in classifying plantations by size. For example, a 'small' plantation may have 50–249 plants in Belgium, 20–99 in Germany, 1–10 in Hungary or 1–50 in Poland (Table 3.1).

In the Netherlands, growing up to five plants for personal use is not a prosecutable offence, although plants will be confiscated. A regulation in the Czech Republic also allows growth of up to five plants for personal use (Spapens, 2011; Wouters, 2008; Czech Republic and Netherlands: Reitox National Focal Points, 2009). Prior to 2011, it was not a criminal offence in the Netherlands to operate a fully constructed plantation provided it did not contain any cannabis plants or cuttings (Dutch law not distinguishing between cannabis plants and cannabis cuttings) (Spapens, 2011). However, changes to the Opium Act implemented in July 2011 criminalised the acts of preparing or facilitating illegal large-scale cultivation of cannabis plants.

Table 3.1: Plantation classifications in selected countries

Country	Label	Number of plants
Belgium	Micro	2–5
	Mini	6–49
	Small	50–249
	Medium	250–499
	Large	500–999
	Industrial	≥1 000
Czech Republic	–	1–50 (until 2009)
	–	6–50 (from 2010 onwards)
	–	51–100
	–	>101
Germany	Small	20–99
	Large	100–999
	Professional	>1 000
Hungary	Small	1–10
	Medium	10–100
	Large	>100
Poland	Small	1–50
	Medium	50–500
	Large	>500

Source: Reitox national focal points (2009).

Wouters (2008) argued that previously in the Dutch context, the absence of clear guidelines for recording cannabis plantations may lead to substantial inaccuracy if one wants to estimate levels of production based on plantation seizures. Some of the issues pointed out in her research on the dismantling of cannabis plantations by police include (Wouters, 2008, pp. 55–56):

- not making a distinction between plants and seedlings;
- some locations are counted as plantations even if there are no plants or seedlings;
- no distinction between propagation sites (where cuttings and seedlings are produced) and cultivation sites where plants are grown to maturity,
- only some distinction between drying facilities (where the plants have been harvested and are drying) and plantations.

While the above-mentioned examples have been noted in the specific context of the Netherlands, they point to broader issues in relation to the limitations of seizures data on cannabis plantations throughout Europe.

Cannabis seizures in Europe: plants and plantations

Data on cannabis seizures may provide an indication of cannabis production in a country, although it is sometimes difficult to know whether they reflect law enforcement targeting practices rather than levels and trends in cannabis cultivation.

Data sources and limitations

Number of plantations seized: There is no common definition of what constitutes a plantation and there are wide variations in reporting across Europe.

Area of cultivation sites discovered: The area occupied by a cultivation site may be used as an indication of the scale of production. However, the way in which space is utilised (density of plants per square metre) may vary.

Number of seizures of cannabis plants: Seizures of cannabis plants are usually assumed to provide an indication of production in a country. However, there is often a lack of contextual information, for example whether the seizure occurred directly as a result of plantation detection or in some other situation, such as in transit or seized at a border.

Number and weight of plants seized: Although these measures might provide general indications of levels of production, they should be interpreted with caution, as one large seizure in a year may distort the overall picture in a country. There may be inconsistency in relation to what is actually recorded as a 'plant', with seeds, seedlings and plant cuttings potentially being recorded as a plant. Methods used to estimate the number of plants in large cultivation sites where counting them is not possible may also vary. Weighing seized cannabis plants does not account for the stage of growth that the plants may be in, with plants seized at the beginning of a growth cycle weighing less than those at the end stage of growth. Often there is no indication of whether the plant material is 'wet' (unharvested) or 'dry' (harvested and prepared for distribution). Here, too, there may be different practices in relation to what material is weighed, with seeds, seedlings and cuttings sometimes accounting for a non-negligible share of the total weight of the cannabis plants reported.

These limitations can result in difficulty in attempting to estimate the levels of production. In the following section, only instances where specific plantations, farms or factories were mentioned are included.

Seizures of cannabis plantations

Overall, data on the number of cannabis plantations discovered would seem to point to an increase in cannabis domestic production in most countries reporting data since 2004. Bucking this trend, the Netherlands reports a decline in the number of plantations detected (Table 3.2). This may reflect a shift in policy in the Netherlands, where since 2004 there has been an increased focus on detecting cannabis plantations (discussed above). The literature suggests that a large portion of the cannabis production industry has shifted its facilities to Belgium. A notable increase in the number of plantations detected is reported by the United Kingdom, which may reflect reports of a rise in domestic production and import substitution (discussed above). The Association of Chiefs of Police (ACPO) in the United Kingdom has suggested that commercial cultivation of cannabis has been increasing since 2004. It noted that over the period 2004–07, on average, 800 cannabis factories were discovered each year. Since then, there has been a steep increase in detections of cannabis cultivation sites, to almost 7 000 in 2009/10 and almost 8 000 in 2010/11 (ACPO, 2009, 2012).

Table 3.2: Numbers of cannabis plantations seized over 2004–09 in selected European countries

	2004	2005	2006	2007	2008	2009
United Kingdom				3 032	4 951	6 866
Netherlands		6 000	6 000	5 200	4 700	
France				1 583	2 106	
Bulgaria			658	748	1 104	
Belgium	50	172	246	466	666	732
Germany				420	517	409
Poland			10	128	123	422
Czech Republic				34	79	84
Hungary			50	70	73	
Denmark				23	32	
Estonia	27	26	17			
Latvia		1		3	6	3
Lithuania		1		6	2	
Luxembourg					1	

Note: Countries are listed in order of the highest reported number of seizures in any year during the period.
Source: Reitox national focal points (2009, 2010).

Seizures of cannabis plants

The number of reported seizures of cannabis plants in Europe added up to at least 25 100 in 2009 ([15]). Half of these were accounted for by the United Kingdom, followed a long way behind by Finland, France, Germany and Italy. Over the 5 years up to 2009, the number of reported seizures generally increased, with a number of countries reporting that the trend appeared to be accelerating in the last 2 years (Bulgaria, Czech Republic, Ireland, Spain, France, Hungary, Austria, Portugal, Finland, United Kingdom).

Countries report the quantity seized either as an estimate of the number of plants seized or by weight. Owing to the heterogeneity of reporting among countries, it is not possible to convert data from one measure to the other reliably. As a result, the two data sets are analysed separately.

Total seizures in Europe, reported as number of plants, increased from 1.7 million in 2004 ([16]) to about 2.5 million in 2005–07. However, in the absence of recent data from the Netherlands, a country previously reporting major seizures, it is not possible to describe current European trends.

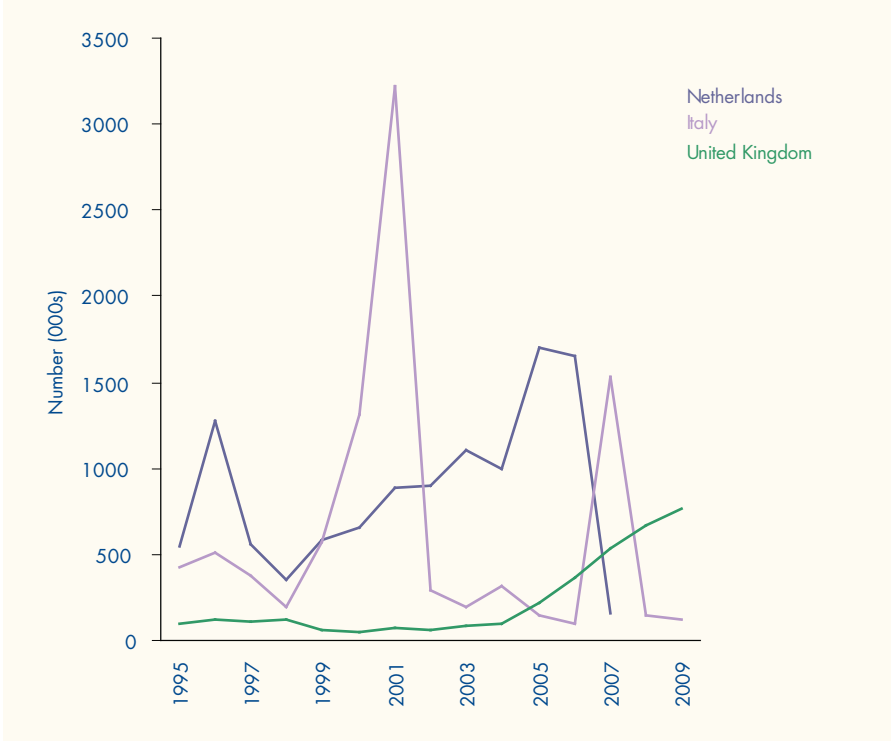
In recent decades, the country reporting the largest seizures of cannabis plants in Europe has been Turkey, with over 20 million plants being seized each year between 2001 and 2004 (peaking at 31 million in 2003); however, more recent data are not available.

Within the European Union, the Netherlands, Italy and the United Kingdom stand out in terms of the reported number of cannabis plants seized. In most years since the mid-1990s, the Netherlands has registered the largest number of seized cannabis plants in the EU, with between 0.9 million and 1.7 million plants seized each year over the period 2001–06 (Figure 3.1). The lack of data since the dramatic drop to 160 000 plants seized in 2007 prevents any further analysis for that country. Second is Italy, where annual seizures of several hundreds of thousands have been reported since the mid-1990s, and of more than 1 million in 2000, 2001 and 2007. Seizures in the United Kingdom, which had been in the region of 50 000 and 100 000 plants a year since 1995, have risen dramatically since 2005, and in 2009 stood at more than 750 000 plants.

([15]) This should be considered as a minimum estimate as not all countries were able to report such data.

([16]) Turkey is not included in the 2004 total as data for subsequent years are not available.

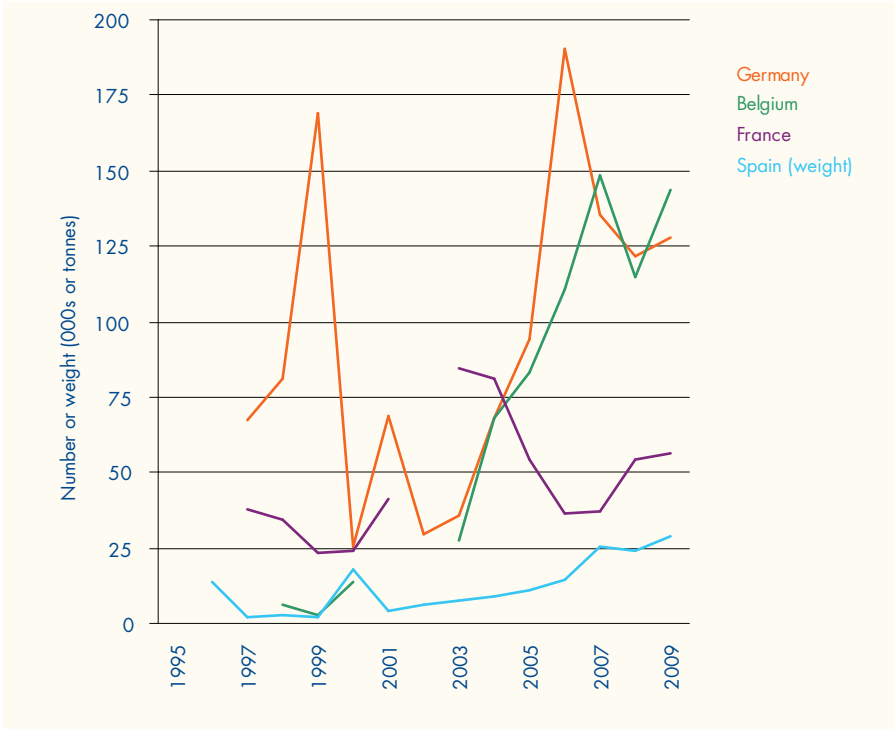
Figure 3.1: Quantities of cannabis plants seized in Italy, the Netherlands and the United Kingdom, 1995–09



Note: The figure represents the number of cannabis plants reported seized each year in Italy, the Netherlands and the United Kingdom.
Source: EMCDDA and Reitox national focal points.

Seizures reported by weight of plants increased by a factor of 3.5 between 2004 and 2008 in Europe and stabilised in 2009 at 42 tonnes. As in previous years, Spain accounted for most of the total amount intercepted (29 tonnes), and reported seizing increasing quantities of cannabis plants over the last decade, with an acceleration of the trend since 2006 (Figure 3.2). Bulgaria came second after Spain, with record amounts seized in 2008 and 2009 (15 and 10 tonnes).

Figure 3.2: Quantities of cannabis plants seized in other countries in Europe reporting major seizures between 1995 and 2009



Note: The figure represents the number of cannabis plants reported seized each year in Belgium, Germany and France and the weight of plants seized in Spain.
Source: EMCDDA and Reitox national focal points.

Average size of cannabis plant seizures

Although the link is usually not made in the reported data, it is likely that the cannabis plants reported to be seized originate from cultivation sites discovered by law enforcement agencies. As such, they might provide some indication of domestic cannabis cultivation in a country. Caution, however, is required as such data may also reflect law enforcement priorities and awareness regarding domestic cannabis cultivation, rather than the true extent of and trends in cannabis cultivation.

The average sizes of cannabis plant seizures (calculated by dividing the quantity seized by the number of seizures) might give an indication of the size of the cultivation

sites uncovered by law enforcement, which is likely to reflect both the size of the cultivation sites operated in the country and the targeting of law enforcement agencies.

Very large plantations would seem to have been seized in 2001–04 in Turkey, averaging several thousand plants. However, in the absence of additional data it is difficult to know whether this was the result of law enforcement targeting (with smaller plantations existing but not being targeted) and whether such large plantations still exist today.

In other countries, the average size of cannabis plant seizures is many times smaller (20- to 30-fold). Since 2004, the highest average number of plants per seizure (175–500) has been reported by Belgium, though Belgium is not among those countries reporting the largest total numbers of cannabis plants seized. In a country which experienced import substitution of resin by herb for the domestic market two decades ago, this result may lend support to the recently reported criminalisation of production (Reitox national focal points, 2009) for export to other European countries (particularly to the Netherlands) (Decorte, 2007).

Bulgaria and the Czech Republic have at times reported relatively high averages of 150–600 cannabis plants per seizure, which might indicate that substantial production is taking place there. In Bulgaria, data point to very large plantations being discovered in the period 2000–06. This is consistent with reports of a tradition of large-scale outdoor cultivation of cannabis in that country (see next section). The Czech data may point to a major increase, from 2007 onwards, in the size of the cultivation sites seized. Future data will indicate whether or not this is sustained.

In the absence of data on the number of seizures, and assuming that the plants seized came from the sites dismantled, whose number is available (see Table 3.2, above), the plantations seized in the Netherlands contained on average just under 300 plants each in 2005 and 2006, before dropping to 30 in 2007 (Figure 3.1).

In the four other countries reporting high levels of seizures of cannabis plants, the average size of the seizures has been stable since the mid-2000s, generally at around 100–200 plants in Italy, 80–100 in Germany, and at lower levels in France and the United Kingdom.

Analysis of cannabis plants seized and reported by weight shows that in the country reporting the largest annual amounts seized, Spain, the average size of seizures remained stable at 15–35 kilograms. This was also the case in Slovakia, and in Bulgaria and Lithuania, although in these two countries it was at times 10 times higher (Bulgaria: 2006–07; Lithuania: 2003–05).

Thus, excluding Turkey and the Netherlands, for which current data are not available, it would seem that the countries reporting the highest number of cases and the largest amounts recovered are not necessarily those where the average size of seizures is largest. One could also argue that a few large cases are more likely to increase the average size of seizures in countries reporting a low number of seizures in general than in those reporting over a thousand seizures (Germany, Italy, Spain, Finland and the United Kingdom). In four of these five countries, Germany, Spain, Italy and the United Kingdom, all leaders in terms of annual volume seized in Europe, the average number of cannabis plants seized per plantation is comparatively low, which suggests that in these countries cannabis plantations, at least those detected by law enforcement, tend to be of moderate size. At the extreme end of this scale is Finland, which comes second in terms of number of cases (2 600 in 2009) but averages only about five plants per seizure ([17]): it would seem that most seizures in Finland are of plants grown for personal use or to supply a closed social network (see section on growers' motivations below). At the opposite extreme is Bulgaria, which, for example, in 2002 and 2003 reported only 40 and 35 seized plantations, respectively, but with an average of 500–600 plants per site.

The predominance of small-scale growers in Finland has been documented (Hakkarainen and Perälä, 2011; Hakkarainen et al., 2011a), whereas it is not clear whether the large farms dismantled in Bulgaria are representative of the cultivation practices there or the result of law enforcement targeting strategies. It has, however, been shown that criminal organisations are involved in the distribution of domestic herb in Bulgaria (CSD, 2007), and it is plausible that they source their supply from large-scale plantations rather than small-scale ones. In Belgium, the relatively large average amounts recovered (about 200 plants per site) in the 700 plantations reported in each of the last 2 years suggest that medium to large plantations are being routinely dismantled there. In addition, it is likely that small-scale growers, as evidenced by Decorte (2010a), now co-exist with large-scale operations run by criminal gangs (Vanhove et al., 2012a) that have been displaced from the Netherlands.

([17]) It is likely that differences in what constitutes a seizure in the data reported have an impact on the number of seizures recorded, and therefore on average size of seizures. For example, in Finland, plants discovered on the same premises but in different rooms are recorded as different seizures, which is likely to decrease the average size of Finnish seizures compared with some other countries where plants in different rooms would be recorded altogether within the same seizure.

A common trend in a number of countries is a recent increase in the average size of seizures — since 2004 in Belgium, since 2005 in Germany and the United Kingdom, and since 2007 in the Czech Republic. This trend may point to an increase in the size, and a professionalisation, of the cannabis plantations in these countries. Caution in interpretation of this trend is required as it may also reflect changes in law enforcement targeting priorities and practices.

Indoor versus outdoor cannabis cultivation

European overview

Successful outdoor cannabis cultivation depends on appropriate natural daylight cycles, as the plant flowers only when daylength grows shorter. This can be problematic in northern Europe, where daylength in the summer is longer and the period of optimum daylength occurs either before the plant has reached maturity or around the time, in autumn, that frosts, which ultimately kill the plant, begin to set in (UNODC, 2006a).

It has been suggested that cannabis cultivation can be divided into four broad categories (UNODC, 2006a, p. 18):

- Feral and semicultivated cultivation. In some places, cannabis grows in the wild and can be gathered (feral cultivation). Alternatively, cannabis seeds can be quickly sown and the results harvested with very little work in between (semicultivated cultivation).
- Traditional field cultivation. Cannabis is cultivated in the same way as other farm crops and, at least during the growing season, its cultivation is a full-time job.
- Modern outdoor cultivation. Field growing using the latest know-how. This category also includes 'guerrilla' cultivation whereby cannabis is grown on land not owned by the cultivator.
- Modern indoor cultivation. Cultivation of plants in soil and under hydroponic conditions.

Feral and semicultivated cultivation is virtually impossible to detect and, as a result, it is not possible to comment on its spread, although recorded instances of small-scale cultivation of cannabis hidden in woods and among crops have been recorded in Slovenia. Traditional field cultivation also takes place in Europe, with Romania, Germany, Turkey and Croatia all producers of licit cannabis crops for a variety of

purposes. Bulgaria has reported the use of traditional outdoor field cultivation for illicit purposes, noting that growing cannabis has become the main source of income for some people in some of the villages in Petrich (Reitox national focal points, 2009). The last two categories (modern outdoor and modern indoor) are discussed below.

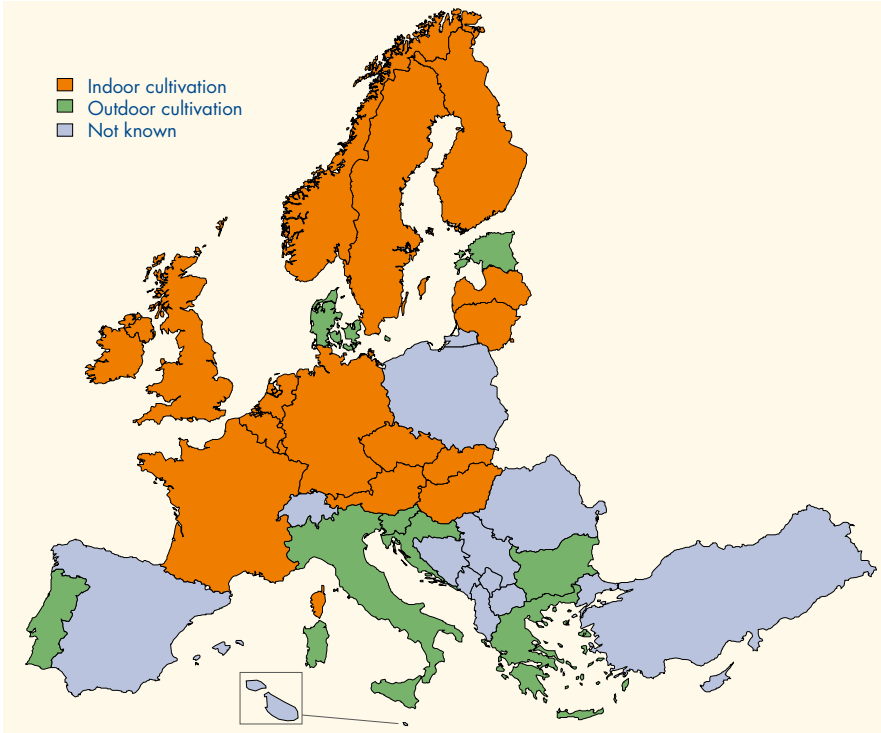
Of the 30 reporting countries, 29 provided information on the forms of cannabis cultivation; no information was available from Malta. Outdoor cultivation of cannabis was reported in 25 countries. However, it cannot be concluded that cannabis is not grown outdoors in the four countries that did not specifically mention this type of cannabis cultivation (Ireland, Latvia, Lithuania, United Kingdom).

Indoor cultivation was reported in 26 countries, with 12 countries making specific reference to the existence of hydroponic set-ups (Belgium, Czech Republic, Ireland, Greece, Latvia, Luxembourg, Hungary, Netherlands, Romania, Slovenia, Slovakia, United Kingdom). Estonia was the only country to specifically state that there was no evidence of hydroponic cultivation. Slovakia reported that most of the cannabis herb produced there is the result of hydroponic cultivation, and is therefore grown indoors. Eleven countries mention whether the seized indoor plantations are a product of soil-based growing techniques or hydroponics (Belgium, Czech Republic, Ireland, Greece, Latvia, Luxembourg, Hungary, Romania, Slovenia, Slovakia, United Kingdom).

From the available information it appears that cannabis is mainly grown outdoors in eight countries (Figure 3.3). Slovenia, however, has recorded increases in instances of hydroponic cultivation together with an increase in the sale of cannabis seeds and equipment needed for growing. These changes may point to an increase in the use of indoor production methods in Slovenia, and to a potential shift from outdoors to indoors.

Indoor cultivation techniques were identified as the dominant method of production (Figure 3.3) in 16 countries. Indoor cannabis production was reported to have increased in recent years in the Czech Republic, Germany, France, Latvia, the United Kingdom and Sweden, with France reporting that approximately three out of four cases of illicit cultivation are indoor (Reitox national focal points, 2009). Hydroponic cultivation was noted to have increased in the Czech Republic and Slovakia.

Figure 3.3: Preferred cultivation methods across Europe



Source: Reitox national focal points (2009).

Although the Spanish Reitox report did not specify the preferred method of cannabis cultivation, a rise in the levels of THC in herbal cannabis, as well as an increase in the number of grow shops, was reported, which may suggest that domestic cannabis cultivation in Spain is mainly indoor.

Outdoor cannabis production

Although indoor cultivation of cannabis has been reported in east European countries, the information provided by the Reitox national focal points suggests that outdoor cannabis production predominates in this region of Europe. This may be partly due to the more favourable weather conditions experienced in this region, with Bulgaria reporting that weather conditions in 2008 assisted in producing a

higher yield of cannabis than in previous years (Reitox national focal points, 2009). In addition, Bulgaria has noted the occurrence of guerrilla farming, with outdoor cannabis crops reportedly sown in hard-to-reach and uncultivated areas, and also on land owned by elderly people.

Spapens (in Costes et al., 2009) reports that the climate in the Netherlands is not suitable for outdoor production, resulting in cannabis with a lower THC level than that produced via indoor methods. Referring to earlier research conducted with police, Spapens et al. (2007, cited in Costes et al., 2009) noted that, in the Netherlands, outdoor cultivation of cannabis carries an inherent risk of loss of the harvest if persistent rain or colder temperatures occur close to the harvest, with the buds most likely to rot.

Indoor cannabis production

Indoor cannabis cultivation techniques are thought to have evolved into professional practices in the Netherlands in the mid-1980s as a result of attempts to avoid detection by authorities and also as a means to circumvent negative climatic conditions that restricted the ability of growers to produce consistent crops all year round (Jansen, 2002; Toonen et al., 2006).

More generally, it has been suggested that the continued and increasing motivation to use indoor cultivation techniques can be attributed to the lower risk of detection (Bouchard, 2007; UNODC, 2006a; Wilkins et al., 2002), the ability to control growing conditions and obtain higher yields and the ability to manipulate strains and obtain produce with higher potency (Leggett and Pietschmann, 2008; UNODC, 2006a, 2010b). Indoor cultivation allows for climatic control, thereby circumventing the difficulties associated with outdoor production (such as reliance upon natural daylength cycles and threats of cross-pollination and frost). Traditional modes of growing cannabis outdoors can at best produce two harvests a year. However, indoor techniques have allowed for a substantial increase in the annual number of harvests, with some growers achieving between four and six harvests per year (UNODC, 2006a).

Indoor cannabis cultivation varies widely in terms of scale, from small-scale home cultivation (e.g. one or two plants) to highly developed and professional operations involving numerous people. As a result of this there is a wide variety of techniques that are used for indoor cultivation (UNODC, 2006a).

Determining the extent of indoor cannabis plantations can be challenging. Methods used to estimate the extent of outdoor production of cannabis and other illicit crops (e.g. cocoa plant and opium poppies), such as aerial surveys, cannot be applied to indoor cultivation (Bouchard, 2008; Reuter and Greenfield, 2001).

In 2006, Toonen et al. (2006), analysed plant samples collected from 77 separate indoor cultivation sites in 10 different police regions throughout the Netherlands. A minimum of 12 plant samples were taken from each site and sent for analysis within 24 hours of seizure. In addition, details of the indoor cultivation site were recorded, including the number of plants; the size of the growing area; the proportion of the growing area occupied by plants; the developmental stage of the plants; the type of substrate; the type of heating used; pest controls; ventilation systems; wattage of the lamps used; additional CO_2 in use; and use of fertilisers. The results suggested that, at that time, the median number of plants in a Dutch indoor grow room was 259. The authors estimated an average yield of female flower buds per plant of 33.7 grams and an average yield per square metre of 505 grams. The Dutch Criminal Assets Deprivation Bureau suggested that the lower limit of the one-sided 95 % confidence interval be applied, which in this instance was 28.1 g/plant or 399 g/m^2 (Toonen et al., 2006).

More recent research on indoor production conducted within a Belgian context has demonstrated that the main yield-determining factor is the strain of cannabis used, although light intensity (see Chapter 1) and plant density are also important factors (Vanhove et al., 2011). Vanhove et al (2012b), in their indoor growth experiment, found that cannabis yield differed significantly between strains of plants and suggested that the lower bound of the one-sided 95 % confidence interval of an indoor cannabis plantation be set at 575 g/m^2.

Although the above results are applicable only to Belgium and Dutch indoor cannabis cultivation (which is unique in many respects), and cannot be applied within a wider European context, these studies provide an insight into an otherwise relatively unknown market and give some indication of the possible production capacity of indoor cultivation plantations. In addition, the research highlights some of the complexities associated with assessing and measuring cannabis production facilities (such as variation in growth phases, lighting and climate control).

Direct and accurate data on indoor cannabis cultivation are difficult to obtain; however, it has been suggested (Leggett and Pietschmann, 2008) that an examination

of other market variables may assist in providing an indication of increases in indoor production. One such example is that of 'grow shops'.

Grow shops

One potential indicator of the increasing spread of domestic production of cannabis, and of indoor cultivation in particular, is the apparent rise in the number of 'grow shops' (Potter, 2008) in Europe in the last decade. Grow shops is the term that is applied to horticulture shops whose focus is on selling products for the indoor cultivation of plants. The relationship that exists between the cannabis cultivation industry and the grow shop industry is a complex one, in part because the equipment used for licit indoor cultivation of plants such as flowers or vegetables can also be used to cultivate illicit produce such as cannabis. It has been suggested that, in some ways, the cannabis cultivation industry and the grow shop industry have come to exist in a 'symbiotic relationship' whereby the industries appear to benefit from the existence of each other (Bouchard and Dion, 2009).

Bouchard and Dion (2009) have argued, in the case of Quebec in Canada, that the rise in the popularity of grow shops paralleled that of cannabis cultivation seen through the 1990s, in turn suggesting a positive relationship between the two industries. Potter (2008) has also tentatively suggested that this may have occurred in the United Kingdom, noting that there has been a large and steady increase in the numbers of grow shops in existence since the 1990s. Decorte (2010a) has also recognised a link between grow shops and cultivation, noting that the rise in grow shops in the Netherlands has assisted growers in Belgium in gaining access to expertise, knowledge and equipment. The same author also reports that changes in Belgian policy, decriminalising cultivation for personal use in 2001, resulted in an influx of Belgian citizens frequenting Dutch grow shops with the aim of starting their own cultivation.

Information provided by the Reitox national focal points indicates that grow shops exist across Europe. Fifteen countries reported the existence of grow shops in their territory in 2009 (Austria, Belgium, Czech Republic, Germany, Estonia, Spain, France, Hungary, Netherlands, Poland, Portugal, Slovenia, Slovakia, Finland, United Kingdom: Reitox national focal points, 2009). Only in Romania and Sweden were grow shops reported not to exist.

This cross-over of industries has created a niche market in which licit products are being used for illicit purposes; some grow shop operators in Europe appear to have capitalised on this market, and have extended their business to include the provision of

information on cannabis cultivation and the supply of cannabis consumption utensils. Jansen (2002) suggested that the rise in grow shops has played an important role in the spread of cannabis cultivation in the Netherlands, acknowledging that the act of producing cannabis indoors requires knowledge and know-how, which can be supplied in these stores. He also suggested that information may be more important than the equipment itself, and referred to grow shops as 'centres of learning'. This provision of knowledge and sharing of information has also been reported elsewhere in Europe, with seven countries specifically identifying the existence of cannabis cultivation literature in grow shops (Belgium, Germany, Spain, Hungary, Netherlands, Portugal, United Kingdom: Reitox national focal points, 2009).

It has even been reported that some operators of grow shops have entered the criminal market and have engaged in activities such as providing cannabis seeds, buying harvests produced by their customers, assisting in the disposal of the waste produced, and selling cannabis products, with the Netherlands recently increasing its policy focus on the connection between commercial cultivation and grow shops (Fijnaut and De Ruyver, 2008; Belgium, France, Netherlands, Austria: Reitox national focal points, 2009). However, the existence of such shops does not automatically mean that they have been set up with the intent to cater for the cannabis culture.

Cannabis growers and motivations

Growers and typologies

Data sources and limitations

The information contained in this section is primarily based on sources derived from targeted research, the results of which were disseminated in the academic literature. Cannabis cultivation is a hidden industry and, as a result, the majority of its players remain hidden, with detailed typologies hard to achieve. There have been attempts to study the kinds of people who grow cannabis, but they have typically been conducted in one country (and all in western Europe) and comprised samples that are very specific, confined to certain subsets of growers (e.g. small-scale or criminal large-scale), or growers recruited in a range of different ways (e.g. web based, criminal convictions, closed police files), therefore limiting comparisons between studies. Although a number of themes that emerge from the research results will be explored in this section, in most instances these results cannot be generalised outside the study context.

Where possible, information from the Reitox national focal points has been included.

Much like in any other (licit) horticultural industry, the players involved in growing and cultivating cannabis vary widely in demographics, technical knowledge, intent and skill, ranging from the small 'hobbyist' or 'organic gardener' to the large-scale plantation producer.

Evidence from both Europe and around the world seems to suggest that there is no set universal typology of people who grow cannabis, but rather culturally specific typologies drawn up in an ad hoc way by a variety of researchers in different countries (Hakkarainen et al., 2011a; Hough et al., 2003).

Existing typologies usually refer only to the situation in a specific country; they have been developed from studies carried out in the United States (Weisheit, 1992), the Netherlands (Bovenkerk and Hogewind, 2002; Spapens et al., 2007, cited in Costes et al., 2009), Belgium (Decorte, 2010b), Finland and Denmark (Hakkarainen et al., 2011a) and the United Kingdom (Hough et al., 2003; Potter, 2006, 2008). However, it is difficult to know if the situations described in these studies can be readily applied to other national settings, especially as similar studies are not available in most European countries. Furthermore, some of the existing typologies have been constructed based on specific information, for example data gathered from police statistics, from profit-driven large-scale growers or from small growers, and, as a result, may not reflect the broad spectrum of types and numbers of cannabis growers that would be present in a country (Decorte, 2010b).

Despite this, one common theme that can be extracted from the existing typologies is that any examination of growers and any subsequent categorisation must be developed from an understanding of the motivations that drive the growers and their production. By separating the growers within the market according to their intent (e.g. commercial or non-commercial), it is possible to develop a better understanding of the different kinds of categories of cannabis growers, as well as the dynamics that operate within each group.

Existing research has recognised the diversity among cannabis growers, and has attempted to separate grower motivations in an effort to create and define relevant categories, although these categories can differ substantially according to the market in which the cultivation and production is occurring.

One of the earlier attempts to develop grower typologies was conducted by Weisheit (1992) in the United States and was based on interviews with commercial growers and law enforcement agencies. The typologies developed by Weisheit sought to

divide the growers on the basis of their motivations and resulted in the categories of hustlers, pragmatists and communal growers. According to Weisheit, hustlers were primarily motivated by the desire to make money and viewed cannabis cultivation as a business in which money could be made. The pragmatists category consisted mainly of people who engaged in cannabis growing as a means to earn money in an attempt to overcome financial hardship (e.g. farmers, the unemployed, those incurring medical expenses). The final category constructed by Weisheit, communal growers, was defined by their motivation to grow primarily for personal consumption, but also by their desire to share and sell the produce among acquaintances and friends. These growers were also noted to have engaged in the growing process for the pleasure of doing so.

The first attempt at constructing a European typology of cannabis growers based on motivations was an ethnographic study conducted by Hough et al. (2003). Using data from their study on cannabis growers in England and Wales, Hough et al. (2003, p. ix) created the following generalised typologies:

- sole-use grower: cannabis is cultivated in order to save money, for a hobby or for personal use or sharing with friends, or both;
- medical grower: grows cannabis for therapeutic benefits;
- social grower: motivated to grow affordable good-quality cannabis for themselves and friends;
- social/commercial grower: growing for self-supply, to supply friends and to supplement an income;
- commercial grower: growing to make money, selling to anyone.

This typology was based on an extension of categories that had been suggested during a criminal court appeal in which all but the medical grower were specified (cited in Hough et al., 2003, p. 8). Although this typology is specific to England and Wales, it introduces some general themes and categories that are relevant in the context of examining cannabis growers, and which will be explored in detail below.

Potter (2006), discussing cannabis cultivation in the United Kingdom, has argued that typologies should be developed based around a profit/non-profit motive basis. Drawing on Weisheit's research (1992) and further building upon the typologies constructed by Hough et al. (2003), Potter has created three broad groupings of growers according to profit motivations.

The first group are primarily motivated by factors relating to the cannabis product itself, namely ensuring the quality of the plant, supplying for their use, avoiding the criminal element of the illicit market (including 'drug dealers'), and growing as a political statement or for medical purposes (Potter, 2006, 2008).

The second grouping of growers are still predominantly motivated by the factors mentioned above, but have also realised the potential of making a profit from the excess cannabis produced by their crops, with most supplying to friends or acquaintances. Potter (2006, 2008) noted that this category of growers would be most likely to continue growing cannabis if the profit was removed, but suggests that the scale of production would be significantly reduced.

The third grouping refers to the growers whose primary motivation is profit, suggesting that without the motivation for financial gain these growers would not engage in cultivation. This group refers to criminal/commercial producers and will be explored below. Potter (2006, 2008), however, suggests that some elements of non-financial motivation may exist, such as ensuring quality in the crop, although these are not among the primary motivations.

Drawing on this typology and other existing typologies within the literature, we suggest dividing growers into two very broad categories: non-commercial growers and commercial growers. Below is a brief examination of some of the main themes that emerge under these categories.

Non-commercial growers

Evidence from various studies (Decorte, 2010b; Hakkarainen et al., 2011a; Potter, 2006) suggests that the majority of cannabis growers are not motivated by financial gain, but instead are driven to cultivate cannabis by a variety of factors existing outside the realm of money, some of which are explored briefly below.

Home growing for personal use and sharing

Research into the cultivation of cannabis has suggested that the majority of people engaged in cultivation do so primarily to source their own supply or to supply family and friends, as opposed to for financial gain (Decorte, 2008; Frank, 2009; Hakkarainen et al., 2011a). In his study of small-scale cultivators in Belgium, Decorte (2010b) found that 74 % of the study sample reported that cultivation for personal use was an important motivation. Hakkarainen et al. (2011a) found that personal use was

an even more common motive among their samples, with 94 % of Danish respondents and 88 % of Finnish respondents identifying it as important or very important.

Hough et al. (2003) reported that, among their study sample in England and Wales, only a small number of people grew cannabis solely for personal consumption, with the majority preferring to either sell or give away the surplus. This was also the case in the sample of cannabis growers examined by Decorte (2010b), among whom, on average, approximately 67 % of the harvest was for personal consumption, approximately 23 % was given away and only a small amount (9 %) was sold.

Seven countries (Denmark, Spain, France, Latvia, Poland, Portugal and Finland) reported that in the majority of cases cannabis is grown for personal use or for distribution within the growers' networks (Reitox national focal points, 2009). In France, this was inferred from police seizures data, with 50 % of seizures in 2007 being of fewer than five plants and only 10 % of seizures involving more than 50 plants (Reitox national focal points, 2009). A recent report from the United Kingdom indicates an increase in the number of cannabis offences related to personal use and cultivation, as well as an increase in the numbers of cannabis seeds and items of growing equipment being purchased. This may suggest an increase in non-commercial growers in that country (ACPO, 2012).

Quality and integrity of the product

One of the themes emerging from the literature is that control over the quality and integrity of the cannabis product is an important motivation to grow cannabis (Spapens in Costes et al., 2009; Decorte, 2010a,b; Hakkarainen et al., 2011a; Hough et al., 2003), and this is echoed in the reports of some of Reitox national focal points (Belgium, Denmark, Poland, Netherlands, United Kingdom, Finland).

A perceived decline in the quality of cannabis and, in particular concerns about chemical adulteration of the product have been noted as factors relevant to the increase in non-commercial growing (Decorte, 2010b; Hakkarainen et al., 2011a; Hough et al., 2003). In the study of growers in the United Kingdom by Hough et al. (2003), two-thirds of the sample stated that their motivation to cultivate arose from dissatisfaction with previously purchased resin as well as concerns relating to 'adulterated' produce. In line with this, concern that reported increases in potency are the result of chemical enhancement of the product has also been noted as a motivating factor for the increase in non-commercial growing (Decorte, 2010b; Hakkarainen and Perälä, 2011).

In line with this, there appears to be a trend towards organic cultivation of cannabis, with an increasing number of consumers wanting to avoid products that have been tainted with chemicals, and with preference being given to cannabis that is grown 'naturally' (Decorte, 2010b; Hakkarainen et al., 2011a; Spapens, 2011; Wouters, 2008). Decorte (2010b, p. 361), in a web-based survey of 659 non-commercial cannabis growers in Belgium, also observed this trend, reporting that '… home growers seem to be more worried about unhealthy substances (pesticides, moulds, etc.) in the cannabis bought elsewhere (including in Dutch coffee shops), than about the strength of the product'.

In the same study, 47 % of growers reported that a desire for healthier, organic cannabis was a motivating factor in their decision to grow. And in their study of Finnish and Danish growers, Hakkarainen et al. (2011a) also identified the desire for control over the product as an important motivating factor, with 76 % of Finnish and 57 % of Danish cultivators perceiving cannabis grown non-commercially as 'healthier'.

In the majority of cases, as the intent is to produce for personal use, non-commercial growers will tend to cultivate cannabis within the confines of their own home and in small quantities. However, Spapens (2011) notes the existence of a niche market for 'organic' forms of cannabis, leading some non-commercial growers to expand their cultivation beyond mere personal use to sell their product to friends and coffee shops.

Avoiding the 'criminal' element

Another suggested motivation for ideological growers is the desire to avoid the 'criminal element' of the illicit drug market. The wish not to be involved in the criminal market is reported as a motivation to grow cannabis in several studies carried out in western European countries (Decorte, 2010b; Hakkarainen et al., 2011a; Hough et al., 2003).

Both Finnish (88 %) and Danish (87 %) small-scale growers reported the avoidance of criminals as an important or very important motivation for home cultivation (Hakkarainen et al., 2011a). In Belgium, 46 % of respondents reported that avoidance of the 'illegal' circuit was an important factor in their motivation for self-cultivation (Decorte, 2010b). This motivation was also recorded in England and Wales, with Hough et al. (2003) reporting that one-third of their sample grew their own cannabis to avoid the criminal market.

In some respects, this echoes the philosophy prevailing in the Netherlands, where coffee shops are tolerated in an effort to create a separation in the drug market between 'soft' (e.g. cannabis) and 'hard' (e.g. heroin) drugs. In addition to the above-mentioned studies, several focal points have also identified avoidance of the 'criminal' market as a motivation for growing (Denmark, Germany, France, Finland: Reitox national focal points, 2009).

Cultivation saves money

The desire to save money has been identified as a further motivation for cannabis non-commercial growing in several sources of information. Hough et al. (2003), in their study on domestic growers in England and Wales, reported that half of the study's participants were motivated to begin home growing in order to avoid the high prices that were charged by dealers. In his study on growers in Belgium, Decorte (2010b) reported that 79 % of respondents identified the desire to save money as the most important motivator for cannabis cultivation. Similar results were also found in Finland and Denmark where respectively 76 % and 66 % of the growers rated the fact that self cultivation was cheaper as important or very important among their motives for growing cannabis.

France, Poland, Slovakia and the United Kingdom referred to home cultivation occurring as a result of attempts to save money, while Portugal suggested that home cultivation has increased in the country as a result of the financial crisis (Reitox national focal points, 2009)

Enjoyment of gardening

It has also been suggested that some people derive pleasure from growing cannabis, much like other gardeners enjoy growing their favourite plants (Decorte, 2010b, 2011; Lefour, cited in Costes et al., 2009, p. 20). In their study on cannabis growers in England and Wales, Hough et al. (2003) note that a general love of the plant and an enjoyment from growing were important factors driving initiation of cultivation. In line with this, Decorte (2008, 2010b), reported that 40 % of his sample mentioned 'the beauty of the plant' as an important motivation for growing. And while Decorte (2010b) reported that 55 % of respondents cited 'growing is fun' as an important motivation, an even higher proportion of cultivators (88 %) in both Finland and Demark reported that the 'pleasure of growing' played an important or very important role in their motivation to cultivate cannabis (Hakkarainen et al., 2011a).

Some growers have been noted to take pride in the development of new skills and in their achievements as horticulturalists. In examining the positive aspects associated with growing cannabis, 58 % of Decorte's sample rated the development of 'green fingers' (skills such as tending and harvesting the crop) as important, and 50 % stated that obtaining a sense of achievement from creating a producing plant was important (Decorte, 2010b).

Growing for medical purposes

Although less common as a motivation for home (or ideological) growing, cultivation for medical purposes is mentioned in some instances (Dahl and Frank, 2011; Hakkarainen et al., 2011a; Hough et al., 2003; Potter, 2006). In his sample of cultivators, Potter (2006) examined medical motivations for cannabis growing suggesting that a variation in levels of medical growing exists. The levels he identified vary from the grower who supplies himself and/or a friend or relative, to a grower who will supply an extended group (for example, a group of multiple sclerosis sufferers) and also includes growers who are motivated by supplying to a larger medical using public. In the examples provided by Potter, the supply of medical cannabis by individuals to the wider public is generally structured to ensure that potential users have been given support or approval by a member of the medical profession (e.g. a letter from a general practitioner). Expanding on this last category, Potter (2006, p. 151) has also suggested that 'medical marijuana cooperatives' operate in a formal and structured manner with multiple growers providing for users who can provide evidence that they are suffering from a medical condition.

In Denmark, research on small-scale growers has suggested that 24 % grow cannabis for medical reasons, whereas the figure is 59 % in Finland (Hakkarainen et al., 2011) ([18]). Hough et al. (2003) also reported cultivation for medical purposes in England and Wales. Their sample included five people identified as growing cannabis for medical purposes, with three of those being categorised as 'true' medical growers, that is individuals who would cease cultivation if it were no longer necessary for medical reasons. One of them grew cannabis for his wife, who was suffering from multiple sclerosis (MS), and had begun to supply other MS sufferers with the cannabis he produced. He stated that he would not sell cannabis to any other category of person. One of the non-'true' medical growers cultivated cannabis

([18]) Respondents could provide more than one answer in relation to motivations in the study carried out in Denmark and Finland (Hakkarainen et al., 2011).

to support his own use, and would give away the excess or sell it at cost price to friends; he supplied four friends with MS or other diseases 'more or less' for free (Hough et al., 2003, p. 10).

Dahl and Frank (2011) studied a subset of 19 growers in Denmark who reported that their engagement in growing activities was either specifically due to health issues or that medical issues formed a part of their motivation. However, of the 19 growers, only two had begun to grow their own cannabis after acquiring their health issue, with the majority of the sample already previously engaging in growing prior to the identification of health concerns.

Overlap between categories of growers

There exists a grey area between the growth of few plants for the grower's personal consumption or to share with friends free of charge and large-scale operations run by criminal organisations involving the cultivation of thousands of plants for distribution on the illicit market and exportation. In this area small-scale growers sell their produce within a close circle of friends and acquaintances, and the profit constitutes an important source of income. These growers do not fit easily in either of the two broad categories mentioned here, that is, non-commercial and commercial growers. As such growing occurs within a social context, they may arguably be viewed as closer to those who grow cannabis for personal use (Potter, 2008), and can be regarded as existing in a market somewhat separate from the more commercial and more professionalised facet of the illicit production market.

When examining the spread of cultivation in Belgium, Decorte has argued that the media focus on large-scale growers may lead to a skewed perception of the cannabis cultivation sector and, in particular, underestimate the prevalence of small-scale personal or ideological growing (Decorte, 2010a). He also argued that underestimation of small-scale growers may occur as a result of a blurred definition of what constitutes a professional cannabis operation. The increasing use of sophisticated indoor cultivation techniques has led to the labelling of many small-scale growers as 'professional' despite there being a lack of a profit motive in most instances (Decorte, 2010a; Wouters, 2008).

Outside Europe, Bouchard and Nguyen (2011) have sought to reconcile this gap between categories by attempting to create a structural profile of cannabis growers based on a combination of level of skill and level of commitment (Table 3.3).

Table 3.3: Categorisation of cultivators based on skill and commitment level

		Skill level	
		High	Low
Commitment level	High	Professionals	Average career criminals
	Low	Pro-ams	Amateurs

Source: Bouchard and Nguyen (2011, p. 111).

Drawing on previous research conducted by other authors, Bouchard and Nguyen (2011) suggest that the majority of cannabis growers could be classified as 'pro-am'. This category is defined by motivation related primarily to the intangible rewards of growing, such as ensuring the quality of the product. Although 'pro-ams' may devote large amounts of time and effort to growing cannabis, they are not motivated by the desire to make a living out of crime (Bouchard and Nguyen, 2011).

'Guerrilla growers'

'Guerrilla growers', who typically grow their cannabis in outdoor settings on land that does not belong to them, make up a small subset of growers (Potter, 2006). They may be further categorised as 'activists' or 'chancers'. In general, the activist grouping are not interested in tending or harvesting the plants, but instead engage in 'growing' predominantly as a political statement or as a way to promote cannabis. Some of the methods of cultivation used by this subcategory include random scattering of seeds in public spaces; the use of seeds placed in helium balloons to scatter the seeds wherever the wind takes them; and the use of 'seed balls' – the placement of seeds into balls of heavy soil designed to assist in the growth of seeds.

Chancers, on the other hand, while employing some of the same cultivation methods, generally intend to collect a harvest. One example provided by Potter was of a group of mountain bike riders who planted cannabis seeds at various points along their riding trail.

Commercial growers

Limitations and sources

The information available on commercial cannabis production largely relates to police seizures and may not be representative of the sector as a whole. In the section below, the situation in the Netherlands is described in detail, as most of the research on this activity has been conducted in that country. Information from the Reitox national focal points has been included where relevant.

In his research into cannabis growers in the United Kingdom, Potter (2006) explored the variety of levels of 'commercial' growing that can occur, ranging from the 'one-off opportunist' to large-scale professional operations. Like other authors who have examined growers, Potter employed the use of motivation as a way of categorising commercial growers, utilising the concept of growing for 'need' or growing for 'greed' as a tool to create a demarcation between the groups.

Examining the smaller-scale growers, Potter noted that some growers enter the commercial realm (selling) to dispose of excess produce before it loses potency, or in response to temporary financial stress, predominantly falling into the category of growing for 'need'. The majority of growers in Potter's study appeared to grow cannabis primarily for personal use, but even most of those who were classified in the 'commercial' category engaged in selling surplus cannabis solely to friends, with some respondents growing cannabis specifically to pay for university education or as a means to support themselves while not employed. Among the sample, there was a perception that the number of plants grown may impact upon the level of punishment if caught, with the majority of respondents (including police officers) suggesting that approximately 10 plants is a 'safe' limit to avoid a custodial sentence.

This general rule of thumb relating to 10 plants was also employed in what Potter (2006) terms growing 'cooperatives' consisting of a group of people, each growing approximately 10 plants, who work together to harvest and sell their produce, with the group staggering their growing cycles to ensure a continuous supply. Potter (2006) also mentions one grower creating 'franchises' whereby he would supply equipment, cuttings and advice to individual growers in return for a share of the profits.

At a higher level of integration than the cooperatives, Potter described growers working in relatively organised groups involving specific and hierarchical roles (e.g. gardener, electrician, dealer) and motivations based upon 'greed', which he classed as 'corporate'.

One of the more well-studied examples of this commercial cultivation within the European context is that of the commercial sector within the Netherlands, discussed below.

Typologies of commercial growers in the Netherlands

The review provided in this section is predominantly based on the work conducted by Spapens and colleagues in the last 5 years (Spapens et al., 2007 cited in Costes et al., 2009; Spapens, 2011; Spapens and van de Bunt, 2011). Based on an analysis of 19 closed police files of large-scale cannabis investigations and of interviews with 16 professional cannabis growers, Spapens and colleagues have developed typologies of commercial growers within the Netherlands. Similar to Potter's analysis (2006), this research suggests that within the Netherlands there exist several subcategories of commercial growers, who vary in the range and intensity of their growing and cultivation practices. Spapens and colleagues identified that the main motivation for this group of growers is monetary gain. Compared with non-commercial growers, commercial growers place less emphasis on the quality and integrity of the product, focusing instead on strains of cannabis that grow faster and produce higher yields.

The first group of professional growers identified by Spapens and colleagues are self-financed, independent growers, who usually grow between 100 and 1 000 plants in private homes. These growers focus primarily on the financial turnover that can be gained from production, and thus choose strains of cannabis that will produce more harvests per year. One side-effect on focusing on strains that provide a quick turnover is that the quality of the product may be reduced, leading to the harvests being sold at a lower rate than other, more potent (and longer developing) strains. However, it has been noted that, despite being sold at a lower price, growers are still able to make a profit owing to the higher number of harvests that such strains of cannabis are able to produce. Spapens and colleagues reported that the medium- and lower-quality cannabis harvests will not be sold in the coffee shops but rather, exported to other countries or sold to 'drug tourists' who are seeking amounts above the 5 grams limit enforced in coffee shops.

The second group identified consist of large-scale independent growers usually cultivating over 1 000 plants, mostly in commercial premises. They utilise part of their profit from cultivation to expand their business. This is done by securing extra locations, such as houses or commercial buildings (either via purchase or renting), in order to set up more plantations. The role of these kinds of commercial growers is not restricted to the realm of growers or the grow room itself, but may also encompass the role of 'producers', who employ individuals to farm the cannabis for them. This may

include financing the set-up of the project (purchasing or leasing a space in which to grow the plantation and purchasing the equipment) and employing people to cultivate, cut, dry and maintain the plants. It is reported that this grouping of professional growers are most likely to sell the produce to coffee shops or criminal networks that are responsible for exportation of cannabis, and may sell to foreigners directly.

The third group are identified as 'operators'. In general, these are experienced growers who have been approached by someone within their social network who wants to offer the space for the plantation in exchange for some of the profit. They may help to set up and operate a number of plantations managed by independent growers, usually in private dwellings, and then take a percentage of the profits generated.

At the 'top end' of the commercial growers are the organised crime groups which operate on a large scale and typically run grow shops as well as large-scale plantations (over 5 000 plants) and may also be involved in trafficking operations. This group can often have multiple growing locations in existence at the same time, producing large amounts of cannabis on a regular basis, with research suggesting that a turnover of 100–200 kilograms per week is not unusual. As a result of this motivation to produce a high turnover, the quality of the cannabis is not viewed as a priority. Spapens suggested that most of this product is used for export, although some is sold to Dutch coffee shops.

As in any large-scale industry, a number of professional specialisations have emerged. Specialists are contracted to carry out very specific tasks within the chain of cannabis production from tending the plants to preparing the final products (e.g. cutting buds, drying the yield, packaging or producing ready-made joints). Spapens and colleagues have noted that the way in which the cannabis production industry has developed has also led to the creation of 'grow room builders', a term used to describe a specialised team that can be 'hired' to set up and run plantations.

Spapens and colleagues reported that most of those involved in the large-scale production of cannabis run by organised crime groups have criminal histories, with convictions for offences such as illegal contracting, armed robbery, the production of synthetic drugs and murder. In addition, it has been suggested that a culture of violence exists within this sector of growers, in particular 'horizontally' between criminal groups. In general, violence results from disputes over non-payment, failure to honour agreements or plantation theft. Interviews with growers conducted by Spapens and colleagues have suggested that people caught in the act of stealing from plantations are treated with extreme violence.

Overall, the research conducted by Spapens and colleagues confirmed the earlier research by Bovenkerk and Hogewind (2002, cited in Decorte, 2008) that criminal groups were operating large-scale professional cannabis cultivation operations in the Netherlands. Spapens and colleagues have also suggested that the manner in which these groups operate does not differ from the methods used by the criminal syndicates that are involved in 'hard drugs' trafficking, ecstasy production and other serious crime (Spapens and van de Bunt, 2011).

Other research involving interviews with 18 large-scale growers and entrepreneurs in the Netherlands has also suggested that the landscape of cannabis cultivation within the Netherlands has become increasingly 'criminal', with weapons, threats and 'snitching' being noted as characteristics of criminal culture. This rise in criminality was partly attributed to the adoption of a more restrictive policy in the Netherlands in relation to cannabis cultivation (Maalsté and Panhuysen, 2007, cited in Decorte, 2008).

Commercial growing within the Netherlands

The Netherlands appears to be one of the largest commercial producers of cannabis herb in Europe, and it has been suggested that there is a substantive criminal element operating in relation to the cannabis market (Bielman and Snippe, 2006; Bovenkerk and Hogewind, 2002, cited in Decorte, 2008, 2010b; De Ruyver, 2006; Maalsté and Panhuysen, 2007; Spapens et al., 2007, cited in the Dutch national report: Reitox national focal points, 2009) ([19]). In 2002, research conducted by Bovenkerk and Hogewind (cited in Decorte, 2010b) showed that small-scale domestic cultivations accounted for only a small and insignificant proportion of cannabis cultivation in the Netherlands, and suggested that the business of cannabis cultivation was largely the domain of professional and organised crime syndicates. However, this study was based on interviews with police officers working in the Netherlands, and therefore may not provide an entirely representative picture of the situation.

This research suggested that cannabis production is highly criminalised, with socially disadvantaged people placed under pressure to make their homes available to criminal organisations for cultivation purposes. However, in later research conducted

([19]) Information in this section is drawn from the study by Bovenkerk and Hogewind (2002) and from that by Maalsté and Panhuysen (2007): it relies upon secondary sources in English, as the original reports in Dutch could not be understood by the authors of the section.

by Spapens et al. in the Netherlands (2007, cited in Costes et al., 2009), little to no evidence of such coercion was found.

As a result of their research, Bovenkerk and Hogewind recommended that the investigative and prosecutorial focus should be on the larger criminal organisations rather than smaller growers. And, although not directly linked to the publication of this research, a shift in policy did take place in the Netherlands in 2004, such that cannabis cultivation was targeted more aggressively than previously (Decorte, 2008, 2010b; Spapens et al., 2007, in Costes et al., 2009). However, it has been suggested that, in practice, this strategy, which involved the cooperation of electricity supply companies, housing corporations and local authorities (see p. 73), resulted in the dismantlement of a large number of small cultivation sites rather than the larger criminal sites in operation (Decorte, 2008; Spapens et al., 2007, cited in Costes et al., 2009).

To support this argument, Decorte cited as evidence reports from coffee shop owners of a decline in the general supply of cannabis and a decrease in the availability of home-grown 'organic' cannabis in 2005. Spapens et al. (2007, cited in Costes et al., 2009) reported that, rather than reducing the number of large-scale cultivation sites, enforcement of this policy has resulted in the displacement of large-scale cultivation operations to privately owned property and commercial premises, where the threat of eviction is not a relevant factor.

In addition, Wouters (2008) has suggested that Dutch law enforcement agencies appear to put more effort into investigating smaller forms of cannabis cultivation than large-scale operations.

Links to the Belgian market

With the emergence of Belgium as a major cannabis herb-producing country, possibly linked to the targeting of cannabis cultivation in the Netherlands (see p. 74), it has been noted that the levels of criminality and organised crime in the Belgian cannabis production sector appear to have increased (Decorte, 2007, 2010a). Reports suggest that the number of large-scale (500 or more plants) plantations detected has increased over the past few years, from 18 in 2003 to 108 in 2008 (Belgium: Reitox national focal points, 2009). It appears that the majority of large-scale cultivation sites detected in Belgium are in the east/north-east of the country, on the Dutch border. Police report that a substantial number of Dutch citizens are involved in commercial cannabis cultivation in Belgium, operating in various roles such as growers, suppliers of material or as organisers (Decorte, 2007, 2010a; De Ruyver and Surmont, 2007; Netherlands: Reitox national focal points, 2009).

The majority of large-scale professional cannabis cultivation sites are reported to be located in non-residential buildings, such as industrial estates, sheds, warehouses, farms, and disused factories (Belgium: Reitox national focal points, 2009). Reports of increasing use of pesticides and various security measures to protect plantations (such as booby traps) point to increasing professionalisation and criminalisation of cannabis cultivation in Belgium (Decorte, 2007). However, as most of the information is based on police data, caution must be exercised in its interpretation, with Decorte (2007, 2010a) suggesting that Belgian police reporting may reflect policies and priorities in operation at the time and may not provide an accurate representation of the market.

Commercialisation of cannabis production

Increases in the use of houses/properties

Several other countries have reported the existence of commercial cannabis producers, with Bulgaria, Denmark, Germany, France, Hungary, Italy, Slovakia, Sweden, the United Kingdom and Norway making specific reference to the involvement of organised crime in their country (see Reitox national focal points, 2009).

The use of private houses or commercial properties for cannabis production is a possible indicator of the existence of commercial growing and of the involvement of organised criminal gangs. This phenomenon may be increasing in a number of countries, as Denmark, Germany, Sweden, the United Kingdom and Norway report increases in the number of houses or commercial properties in which large-scale cannabis production sites have been uncovered in recent years.

There appears to be a trend among some commercial cannabis growers towards operating multiple small-scale plantations simultaneously (e.g. plantations of approximately 250 plants or fewer) as opposed to one large-scale plantation housing a large number of plants. This trend can be seen among professional indoor cultivation groups in Belgium, the Netherlands and the United Kingdom. This approach is used for several reasons:

- to avoid detection (because less space is required and less electricity is needed);
- the penalties for running a smaller plantation are less than those for running a large plantation; and
- having smaller multiple plantations in several locations reduces the financial loss that may be incurred as a result of theft, fire or detection (Belgium, Netherlands: Reitox national focal points, 2009; Decorte, 2008).

Stratification of roles

Several countries have noted increased professionalisation and organisation of cannabis cultivation (Denmark, Latvia, Poland), with Italy noting that the Mafia have taken over cannabis production at the domestic level (Reitox national focal points, 2009). France, in particular, has detailed the existence of professionalisation and stratification of roles in the production process, outlining the 'players': the criminal network boss who finances the project; the 'front man' who rents the property and organises the day-to-day running of the facility; the 'expert', who advises on the appropriate cultivation needs; and the 'gardener', who is responsible for the maintenance and care of the plants (Reitox national focal points, 2009).

Both the Netherlands and Belgium have identified that there can be some overlap between non-commercial and commercial growers. This appears to occur in the context of home growers supplying the space for plantations or being employed by the professional or criminal groups as caretakers, gardeners or maintenance workers. This trend is also noted in Bulgaria, although in reference to outdoor plantations in the south-west region, where it has been noted that elderly people may hide cannabis plants among other agricultural crops or grow the crops as a main source of income (Reitox national focal points, 2009).

In Hungary, an increasing number of Dutch citizens have been identified in large-scale operations as 'operators', as defined by Spapens (et al., 2007, as cited in Costes et al., 2009). There, Dutch citizens are reported to be responsible for the setting up of plantations and providing the knowledge, financial capital and technology needed to operate large-scale cultivation sites. Hungarian residents are reported to participate by providing finance and the labour needed to operate the plantation (Reitox national focal points, 2009). France also reports that Dutch nationals have been identified as providing 'expert assistance' in the operation and set-up of large-scale cannabis production operations (Reitox national focal points, 2009).

Both Sweden and the United Kingdom have noted that the 'gardeners' in the plantations can be undocumented immigrants, with the United Kingdom also observing that there have been reports of minors being trafficked from other countries and subsequently being put to work in large-scale cannabis plantations (Reitox national focal points, 2009).

Similar to the information that was reported by Bovenkerk and Hogewind (2002), it has recently been suggested that in Liverpool, United Kingdom, commercial/criminal

cannabis producers have been 'recruiting' families in housing estates to set up small-scale cannabis farms in their homes (Rossington, 2011).

Discussion

Cannabis growing and its 'players' is a changing and dynamic phenomenon that is susceptible to a myriad of influencing factors, including shifts in policies and targeted policing. Studies from Europe have pointed to the 'push and pull' effect that seems to exist between levels of commercial and non-commercial cannabis production. It has been suggested that, as the number of non-commercial cannabis growers increases, the commercial elements of the market tend to decline and levels of criminality and involvement of hierarchal criminal organisations fall (Decorte, 2008; Potter, 2008; Wouters, 2008).

However, some commentators have argued that the shift in Dutch policy that occurred in 2004, towards an intensification of investigation efforts against cannabis cultivators, could have had an unintended cyclical effect on cannabis production ([20]). The focus on dismantling cultivation sites in the Netherlands may have had more of an impact on small-scale growers as a result of fear of eviction, and less of an impact on large-scale growers, who merely shifted their activities to sites where they would not be in danger of eviction. The result of this would have been a decline in both production of home-grown cannabis, particularly organic cannabis, and its supply to coffee shops (Decorte, 2008). It is suggested that the shortfall in supply was filled by large-scale cannabis growers, possibly at the expense of the quality of the cannabis produced (Decorte, 2010b; Spapens et al., 2007). As has been shown in various studies in Europe (Decorte, 2010b; Hakkarainen et al., 2011a; Hough et al., 2003), ensuring the quality and integrity of the cannabis product is a primary motivation for cannabis cultivation among small-scale growers. As a reaction to the perceived low quality of cannabis supplied by large-scale operations or fear of contaminated produce, home and non-commercial cultivation may now be rising, although research efforts may also have raised the visibility of such a phenomenon.

([20]) Although the displacement of small-scale growers to large-scale (organised) cultivation started before the change in cannabis policy in 2004, and was attributed, among other reasons, to intensified investigation efforts, it is possible that this policy change might have resulted in a continuation of this trend or a potential reinforcement.

Intra-European trafficking

All existing transportation routes, whether by land, sea or air, are potential routes for the trafficking of illicit drugs, and cannabis products are no exception to this rule. Information on trafficking of cannabis products to and within Europe is generally of poor quality, in that it is usually of anecdotal nature (no systematic data collection) and is biased. It is based on cannabis seizures and therefore reflects the methods and routes used in the trafficking operations stopped by law enforcement (which may not be representative of those operations which are successful from a trafficker's perspective).

Information on country of origin and last known country of transit is usually used as an indicator of trafficking routes. It is sometimes supplemented by information on the modi operandi used within Europe to transport and conceal the drug. This information should be interpreted with caution and considered indicative only.

Cannabis resin routes

Most of the cannabis resin on the European market appears to be imported from Morocco (see Chapter 2). The available information suggests that cannabis resin largely enters Europe through the Iberian Peninsula and the Netherlands and Belgium, from where it is distributed to the rest of Europe. Other than nominating the initial point of entry into Europe (e.g. Spain), little information exists about specific resin trafficking routes, and it appears that resin may follow the same routes as herb (discussed below). Spain and the Netherlands have been identified as the dominant transit and distribution countries for intra-European trafficking of resin imported from Morocco, with France also being identified is an important transit country.

No detailed information is available on the specific routes used for the importation and trafficking of cannabis resin originating from countries outside Europe other than Morocco. In an era in which traffickers are multi-commodity orientated, it is likely that smuggling routes developed for importing other drugs, such as heroin from south-west Asia, into Europe are also used for resin.

Cannabis herb: domestic produce and exportation

Historically, the Netherlands has been the main source of cannabis herb supply within Europe. More recently, however, it appears that there has been some shift in the market as domestic production has increased throughout Europe. Jansen (2002) has labelled this shift 'import substitution', meaning that increases in levels

of domestic production have reduced demand for imported cannabis products (discussed above). Despite this shift, the Netherlands remains the most frequently identified source of cannabis products in Europe, with the majority of countries indicating importation of some kind of cannabis product including seeds, resin and, in particular, herb. In the case of herbal cannabis, this finding is in line with the shift witnessed in the Netherlands from 'import substitution' to 'competitive advantage', whereby most of the Dutch herb is now exported (Jansen, 2002).

Eastern Europe appears to be experiencing growth in relation to domestic production and subsequent intra-European exportation. Bulgaria suggests that cannabis is produced within its borders for the consumer market in Greece, where it can be sold for up to four times the price that it would fetch in Bulgaria (Reitox national focal points, 2009). Also in Eastern Europe, the Czech Republic has been identified as an exporter of domestically produced cannabis, reporting that small amounts are sold to Belgium, Germany, the Netherlands and Poland (Czech Republic: Reitox national focal points, 2010). Latvia has also been identified as a source country, with an estimated 80–90 % of the cannabis herb produced there being exported, predominantly to Sweden and Estonia, and to a lesser extent to other Scandinavian countries and Lithuania (Lithuania, Latvia: Reitox national focal points, 2009)

Modi operandi

In general, it appears that cannabis resin is moved within European countries in the same manner as cannabis herb that has been imported from outside Europe. A broad spectrum of modi operandi exists in relation to the transport of cannabis products, with all forms of sea, land and air transport being utilised throughout Europe. It appears that the main method of transport is by road using lorries, coaches and so-called 'go fast' cars. For example, Greece reported that over 80 % of the seized herbal cannabis is trafficked via lorries (Reitox national focal points, 2009).

Irrespective of the mode of transport, great lengths are taken to conceal the drug. Among the measures that have been reported are specially built spaces, compartments, walls, floors and tanks designed to avoid detection (Belgium, Estonia, Ireland, Greece, Latvia, Portugal, Croatia). Some Member States (Czech Republic, Estonia) report that mail and other delivery services are used to import cannabis products from other countries. Yachts, small vessels and converted fishing vessels may be used for the importation of resin shipments from Morocco and to the shores of western Europe (e.g. Ireland). There is increasing awareness of the use of general

aviation for smuggling cannabis into Europe. In addition, it would seem that coaches are increasingly used for intra-European transit of cannabis products (Belgium). Last but not least, human couriers, although mostly mentioned in connection with the importation of cocaine from South America, appear to be used in the trafficking of cannabis, for example between the Netherlands and Germany (Spapens et al., 2007).

Hungary provides a specific example of how cannabis is transported from the 'acquisition point' in the Netherlands, suggesting that the mode of trafficking will differ according to the amount of the product that is being smuggled. In the case of quantities over about 10 kilograms, it seems that there is a division of role between the person who acquires the product and the person who transports it back to Hungary, whereas in the case of smaller amounts the same person performs both tasks (Reitox national focal points, 2009).

Distribution

Like its production, cannabis distribution can be viewed as a multilayered activity involving people at all levels, ranging from social distributors (e.g. 'giving' cannabis to friends) to large-scale suppliers who may ensure distribution of the drug through different levels of the market from wholesale traffickers to retail dealers. Information on the structures of commercial cannabis distribution is sparse and often based on anecdotal evidence, and therefore must be interpreted with caution. Dynamics within the distribution chain result from complex interactions among a range of players. For example, recent research has noted that upper-level dealers purposely cultivate a perception of trust and friendship with other dealers to achieve a higher profit, suggesting the use of social bonding as a strategy in higher levels of the distribution chain (Surmont et al., 2011).

Social distribution

It has been suggested (UNODC, 2006a) that the use of cannabis is largely a social and communal activity, with the drug often shared among the using group. In addition, it is believed that the majority of cannabis transactions occur within social groups and networks, and therefore may not be dominated by 'professional' networks of sellers ('dealers'). This form of cannabis distribution can be viewed as 'social distribution'.

Social distribution is extremely hard to measure because of its informal nature. Information about the actors and networks involved in this process is very limited and should be interpreted with caution. However, some insights into the context

of cannabis transactions can be gained from user reports of how cannabis is purchased, used and distributed.

Research conducted in the United States has suggested that most cannabis users are distributors, not sellers, indicating that a separation exists between the two within market (Caulkins and Pacula 2006; Parker, 2000).

In line with this, there is some suggestion from various Reitox national focal points that the use and acquisition of cannabis most commonly occurs within a social context, away from the 'criminal' networks. The Czech Republic, Germany, Hungary, Ireland, France, the United Kingdom, Norway and Turkey all report instances of people purchasing, sharing and using cannabis mainly within a social or communal context (Reitox national focal points, 2009). According to the 2008 Czech Republic General Survey, over 70 % of cannabis users reported that, on their most recent occasion of use, they received the drug for free, gave it away or shared it, and friends, relatives or partners were most often cited (61 %) as the source of the free or shared cannabis (Reitox national focal points, 2009). France has also noted high levels of apparent social distribution, with 78 % of regular users stating that they obtain their cannabis from friends, 65 % of whom reported that it is obtained free of charge (Reitox national focal points, 2009).

In some respects, social distribution of cannabis can be viewed as a continuation of the motivations that have been noted to drive non-commercial growers of cannabis (discussed previously), with the evidence seeming to suggest that the purpose of much non-commercial cultivation is social supply. The typologies and research in relation to (mainly small-scale) cannabis growers in Belgium, Denmark, the United Kingdom and Finland, have consistently recorded the desire to supply cannabis within social networks as a motivation for the cultivation of cannabis.

A study conducted by Duffy et al. (2008), in the United Kingdom, examined cannabis supply among 182 young people aged between 11 and 19 who had used the drug in the previous 3 months or brokered supply or sold it in the previous 6 months. Although the findings cannot be generalised to other social groups and countries, the study provides some insight into the dynamics of cannabis distribution and supply that may occur among young people. The main theme to emerge from this study was that the manner in which cannabis was obtained was more strongly influenced by social networks and friendships than by the illicit drug market, with purchasing, selling and consumption all completed mainly within close social networks. In addition, most of the young people who were involved in the selling or brokering of cannabis did not necessarily perceive themselves as being involved in cannabis 'dealing', in some respects leading

to a dissociation and distancing between the 'criminal market' and social distribution networks. The authors reported that sellers of cannabis were often referred to in terms of their link in the social network (e.g. 'good friend') before they were described as a sellers. This idea of a distinction of between friends who sell cannabis and 'dealers' has been noted in other research in the United Kingdom (Parker, 2000).

In agreement with the results reported in other countries (see above), purchasing of cannabis was most commonly done in conjunction with a friend (70 %), with almost a quarter of respondents reporting that they viewed it as a social activity. The vast majority of people in the study (78 %) reported that, in the month prior to interview, they had shared cannabis approximately five or six times.

In his 2006 PhD dissertation, Potter explored the concept of cannabis use, cultivation and distribution for medicinal purposes in the United Kingdom. He noted the existence of growers and distributors who had joined together to form 'cooperatives' that were designed to cultivate and distribute cannabis for medicinal purposes. In general, cannabis would be supplied only to those with evidence of an existing medical condition, and the drug would either be sold at lower than average price or, in some instances, provided for free (Potter, 2006). In some respects, this may come under the umbrella of social distribution.

Commercial distribution

The majority of reporting countries note the existence of some kind of commercial distribution of cannabis, with organised and complex distribution networks appearing to exist in Belgium, Bulgaria, Denmark, Ireland, France and the Netherlands (Reitox national focal points, 2009). Luxembourg reported an increase in the levels of professional cannabis distribution, and noted an increase in disputes between competing distribution networks (Reitox national focal points, 2009). An increase in the numbers of organised syndicates operating in the cannabis market was mentioned by Hungary (Reitox national focal points, 2009). Latvia noted that commercial cannabis distribution appears to be organised in a 'pyramid-like' structure, whereby distributors are designated specific roles (Reitox national focal points, 2009). Of particular note are reports from Denmark, Sweden, Finland and Norway indicating that professional cannabis distribution in the region is linked to motorcycle gangs (Moeller, 2009; Reitox national focal points, 2009).

As shown above, variations exist among countries in relation to the levels of commercial cannabis distribution and the way in which the systems operate. Thus,

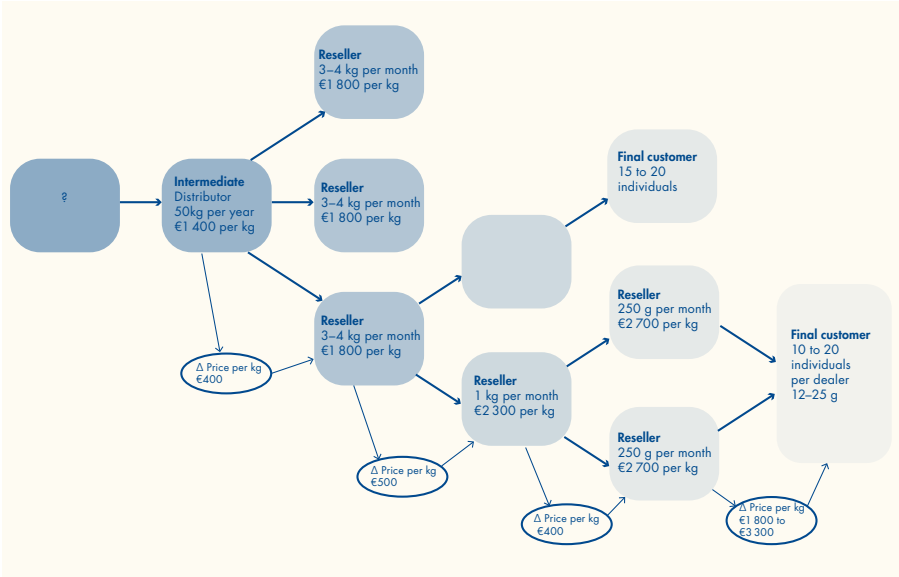
outlines of cannabis distribution systems must be understood within national contexts, and cannot be generalised. Some country-specific examples of commercial cannabis distribution are discussed below.

An example from western Europe: France

One of the more detailed descriptions of the structure of commercial cannabis distribution was provided by Lalam (2001). It was based upon Lalam's field research on cannabis resin distribution networks that existed in underprivileged districts in several of France's largest urban areas in the 1990s. Although this structure is region specific and cannot be applied in a wider context, it is presented here as an example of commercial cannabis distribution.

In the layered distribution chain described by Lalam (Figure 3.4), the transaction chain begins with the 'semi-wholesaler' — suggesting that no information on the importer can be provided. From the semi-wholesaler, cannabis passes along the chain through the other three levels, with the price per kilogram increasing with each level.

Figure 3.4: Resin distribution chain in France



Note: Original prices were updated by Ben Lakhdar (2007), to reflect prices at the time of his publication.
Source: Lalam (2001) as cited in Ben Lakhdar (2007).

Table 3.4: Levels of cannabis distribution in France, as estimated by Ben Lakhdar

Category of distributor	Amount of cannabis distributed (kg/year)	Monetary turnover (EUR/year)	Estimated numbers
Wholesaler	138–302	253 000–552 000	689–1 504
First intermediary	16–35	35 000–77 000	35 000–77 000
Second and third intermediaries	1–3.6	4 500–10 000	58 000–127 000

Source: Ben Lakhdar (2007).

Building upon Lalam's research (2001), Ben Lakhdar (2007) attempted to estimate the number of people involved in commercial distribution in France for the year 2005. In addition, using a combination of ethnographic observations and economic modelling, he estimated the amount of cannabis sold and the monetary turnover associated with commercial cannabis distribution (Table 3.4).

The wide ranges of the estimates point to the level of uncertainty surrounding this aspect of the market. The results suggest that fewer people are involved at the upper levels of the distribution chain, but they reap higher profits.

An example from eastern Europe: Bulgaria

Information sources

The information reviewed below is based primarily upon the 2007 report *Organised Crime in Bulgaria: Markets and Trends*, produced by the Centre for the Study of Democracy (CSD), and information from the Bulgarian Reitox national focal point (2009). Although based on limited information, it has been included to provide an insight into a market that for the most part remains hidden.

Until the late 1990s, cannabis distribution in Bulgaria was predominantly conducted on a social and small-scale level, with only a small amount of commercial distribution. This was partly because Bulgaria's climate is favourable for home cultivation of cannabis plants. It has also been suggested that commercial distribution was unattractive because of the 'low profit' and unstable consumption levels of cannabis. Since 2003, however, evidence suggests that social distribution of cannabis has been replaced by distribution through commercial and organised networks.

Increased police targeting of cannabis plantations and production in the late 1990s and early 2000s impacted upon small-scale distributors. At that time, small-scale distributors would purchase small amounts of cannabis (1 kilogram) directly from

growers on an occasional basis, with a view to selling to friends and other users. The increased police focus upon cannabis producers that then occurred is believed to have reduced the ability of small-scale distributors to access and purchase cannabis on an occasional basis, leading to a 'capturing' of the market by commercial distributors. In addition, changes to the Bulgarian Criminal Code may have dissuaded small-scale distributors from continuing to operate. In 2004, those caught in possession of a 'single dose' of cannabis were no longer exempt from criminal prosecution. This change in legislation and subsequent fear of prosecution may have led to a drop in the number of independent distributors operating within the market.

It has been suggested that the more sophisticated and complex procedures of operation used by the commercial distributors were harder to detect, with these distributors being at less risk of control and arrest than small-scale ones. Furthermore, the organised crime syndicates already operating the 'hard' drug trade responded to the increased demand for cannabis, and began to take over distribution of the drug throughout Bulgaria. Organised criminal gangs are reported to have worked to eliminate small-scale distributors, for example by providing information to police leading to the dismantling of their plantations. 'Street-level' distribution became professionalised, with the recruitment of experienced sellers (usually amphetamine dealers or those used to selling in schools), local 'offenders' and in some instances people who, prior to the takeover of the market by criminal groups, were independent sellers of cannabis. It has been suggested that the commercial distribution market in some parts of Bulgaria operates in a similar manner to licit sales organisations, with for sample test purchases being used to provide feedback on the quality of the cannabis being sold further down within the supply chain and the set-up of a 'hotline' for complaints (CSD, 2007).

Three forms of commercial distribution structures whose patterns differ according to the localities in which they operate have been identified (CSD, 2007, p. 67):

> 'The first one is highly centralised with distinct branches by type of drugs, all accountable to the top level. Organised drug dealing in Bourgas up to the spring of 2007 had precisely this structure. Marijuana distribution is thus one of four main substructures, managed by a 'lieutenant' responsible for cannabis supplies and dues collection; another lower-level lieutenant supervises the dealers. Bourgas and small nearby towns (Nesebar, Slanchev Bryag, Pomorie, Sozopol and other smaller coastal villages where the available population in the tourist season doubles) have formed a market with

a single clear-cut organisational pyramid with monopoly undisputed over the last decade. Thus, the profits from the separate drug submarkets flow into the same hands at the top. In Varna and the several distinct zones in the capital Sofia, marijuana was integrated into a zoning pattern of distribution. It is a compound structure where each zone's boss sells strictly within the bounds of his zone through a well-developed area network of dealers, and buys it in large from a single or several supply channels. Smaller towns (Blagoevgrad, Pleven, Dobrich, Haskovo, Sliven, Razgrad, Silistra, etc.) have a totally different model based on the control over independent dealer groups. These small groups have their own supply channels and rules of profit distribution. However, they are made to pay dues to the town supervisor authorised by one of the few drug lords of national influence.'

An example from Scandinavia: Denmark and 'Fristaden Christiania' ([21])

Within the past decade, Danish policy on the use and distribution of cannabis has shifted towards a more restrictive approach (Frank, 2008).

Before 1996, Denmark predominantly adhered to the concept of 'separation of markets', and treated possession, small-scale distribution and use of cannabis with a set of responses including warnings and fines (Frank, 2008). In the mid-1990s, street-level distribution of cannabis was relatively open, but, as sellers would normally carry only an amount that would result in a warning or a fine, difficult for police to combat. As a result of the increasing visibility of the market, together with rising complaints from citizens, penalties were increased for repeat offenders involved in cannabis distribution (Frank, 2008).

Although not causally linked to the shift in legislation, in the mid-1990s a movement of 'cannabis clubs' or 'hash houses' developed in some of the larger cities in Denmark. These were establishments that operated at private residences where people could gather to purchase, distribute and consume cannabis. The cannabis laws at the time lacked an adequate response to the hash house phenomenon, and in 2001 legislation was introduced aimed at prohibiting owners or residents of properties from receiving visitors to such events and stopping visitors if they were perceived as a threat or a nuisance (Frank, 2008). However, these laws also failed to reduce the hash house distribution system, with many distributors ignoring the fines

([21]) The information in this section relies upon secondary sources in English, as the original reports in Dutch could not be understood by the authors of the section.

or simply moving location. Moreover, the new laws focused on the resident, so an enforcement made against an individual did not prevent the hash house reopening in the same location with a different person running the distribution (Frank, 2008). In 2005, amendments to the law made it increasingly difficult to operate a hash house, with police estimating that in 2009 only two hash houses remained in operation in Copenhagen (Reitox national focal points, 2009).

Perhaps the most open display of commercial cannabis distribution in Europe is to be found in the Christiania area of Copenhagen. Christiania is an abandoned army barracks that has been occupied by squatters since 1971. In 1976, a court ordered the removal of the squatters from the area; however, this order was never enforced as a result of the Danish Parliament creating a law allowing for Christiana to continue its existence under the notion of a 'social experiment' (Krarup, 1977, cited in Moeller, 2009, p. 338).

An integral part of the lifestyle and philosophy of Christiania was the acceptance of cannabis use and distribution as a part of the culture. This resulted in the development of what was known as 'pusher street', a part of Christiania where approximately 40 outdoor stalls were set up, dedicated to the open market selling of cannabis (Frank, 2008; Moeller, 2009, Reitox national focal points, 2009). In line with other Scandinavian countries, it is reported that in the late 1980s to early 1990s, criminals with connections to motorcycle gangs moved in to the area and gradually took over the cannabis distribution market (Reitox national focal points, 2009). Tentative estimations at that time suggested that the revenue from cannabis distribution in Christiania was approximately EUR 40 million annually (as cited in Moeller, 2009, p. 338). In 2000, the police estimated that each day approximately 10 000 people purchased cannabis in Christiania (Reitox national focal points, 2009). In 2003 police estimated that two-thirds of the Copenhagen cannabis distribution market was fed by Christiania and that the annual turnover was approximately EUR 85 million. However, these figures are based on police estimations and as such should be interpreted with caution. Christiania has also been identified as a potential source of cannabis supplied to other Scandinavian countries (Moeller, 2009).

In 2003, policy relating to illicit drugs underwent a major change, when the Danish government launched a drug action plan called 'the fight against drugs' (Frank, 2008). This campaign adopted a more restrictive approach to drugs, with Christiania, and 'pusher street' in particular, becoming the subject of more intense focus than previously. Between October 2003 and March 2004, police placed

Christiania under video surveillance and monitored communications. The evidence collected during this time suggested that the commercial distribution system in Christiania was well organised. Police estimated that 3.6 tonnes of cannabis was distributed during this period; however this amount was later deemed by the courts to be too uncertain (Frank, 2008). 'Pusher street' was shut down in a large police operation in March 2004.

An unintended effect of the sudden closure of 'pusher street' was an opening up of the commercial cannabis distribution market in Christiana and surrounding areas, including Copenhagen. This gap in the market saw an influx of criminal gangs seeking to establish control of the market, and reportedly resulted in an escalation of violence and 'turf wars' among drug distribution groups, with reports of people being killed (Frank, 2008; Moeller, 2009). It has been suggested that the closure of 'pusher street', while eradicating a blatantly open and visible cannabis distribution market in Christiana, simply resulted in the trade in cannabis being dispersed to other parts of the city (Frank, 2008).

The cannabis retail market: coffee shops in the Netherlands

Despite its illicit status, cannabis remains a commodity and, as such, is bought, sold and traded in a variety of ways. However, because of its illicit status, the ways in which the distribution markets operate have, for the most part, remained hidden. One exception is the example of the retail market in the Netherlands, explored below.

As mentioned earlier in this chapter, the Netherlands has a central role in the distribution of cannabis in Europe. Korf (2002, 2008) has argued that cannabis distribution in the Netherlands can be viewed as having evolved through four distinct phases.

Phase 1

Cannabis use started to spread in the Netherlands in the 1950s and climbed steadily until the 1960s, when its popularity increased rapidly, in part as a result of a growing youth subculture (Korf, 2002, 2008; Spapens and van de Bunt, 2011; Wouters and Korf, 2009). During this time, cannabis distribution took place 'underground' (Korf, 2002, 2008; Wouters and Korf, 2009).

Phase 2

The early 1970s saw increasing numbers of cannabis users in the Netherlands and a shift in the forms of distribution, with cannabis selling moving to fixed locations

such as homes and youth centres (Korf, 2002; Spapens and van de Bunt, 2011; Wouters and Korf, 2009). This was accompanied by the concept of the 'house dealer', whereby youth activity centres or other youth-based venues (e.g. music venues) 'hired' regular cannabis sellers in an attempt to reduce competition and potential conflicts between drug suppliers operating in the area (Spapens and van de Bunt, 2011). The Dutch authorities reportedly tolerated this phenomenon as a kind of experiment in relation to the distribution markets (Korf, 2002, 2011; Spapens, 2011). In the early 1970s, two separate commissions were set up to determine what strategies could be employed to prevent the spread of drug addiction in the Netherlands. Both commissions recommended that cannabis be distinguished and treated separately from other drugs (Spapens and van de Bunt, 2011).

This suggestion was based on the commissions' unique interpretation of what is known as the 'gateway hypothesis', which proposes that there is a relatively set progressive pathway of drug initiation, whereby use and exposure to one drug, in this case cannabis, increases an individual's risk of exposure to and initiation to other, harder, drugs. Although this concept could, in principle, apply to all kinds of drugs, including tobacco and alcohol, it has been most often used to describe a (potential) link between cannabis and other drug use. In some countries, such as the United States, the hypothesis is believed to reflect some kind of pharmacological link between cannabis and other drug use (MacCoun, 2010). However, in the Netherlands, the link is usually thought of being more of a sociological one, related to the distribution market. Based on the idea that the escalation of drug use from cannabis to other harder drugs is facilitated by a distribution system in which all illicit drugs were to be found together, the Dutch authorities sought to separate the market for 'soft drugs' (e.g. cannabis) from that of 'hard drugs' (e.g. heroin).

In line with the recommendations made by the commissions and the existing acceptance of 'house dealers' at the time, the separation of markets was formalised in 1976 with the revised Opium Act. This law essentially decriminalised the use and possession of amounts of cannabis for personal use (at that time, up to 30 grams) and created a clear distinction between cannabis and other 'unacceptable risk' drugs (Korf, 2002, 2011; MacCoun, 2010; Spapens and van de Bunt, 2011; Wouters and Korf, 2009; Wouters et al., 2010).

It is important to note that the sale and distribution of cannabis was never decriminalised, and is still prohibited today. The mechanism that allows for the small-scale distribution and sale of cannabis lies in the *Official National Guidelines*

of Investigation and Prosecution, which came into force in 1979 (Korf, 2002, 2008, 2011; MacCoun, 2010; Wouters and Korf, 2009). These guidelines are based on the 'expediency principle', which allows for authorities to abstain from prosecution without the need for approval from the courts, and can be applied in two ways, as outlined by Korf (2002, 2008):

- prosecution of certain offences, unless certain conditions are met; and
- no prosecution of offences unless it would be in the public interest.

Both of these practices are applied in instances of small-scale sale distribution of cannabis within the Netherlands. In general, prosecution of cannabis-related offences is not considered to be in the public interest. In 1979, a set of guidelines for the small-scale sale of cannabis were developed that 'house dealers' were required to adhere to if they were to avoid prosecution — commonly referred to as the AHOJ-G criteria (Korf, 2002, 2008; Wouters et al., 2010):

- no overt advertising;
- no 'hard drugs';
- no nuisance;
- no underage clientele (defined as under 16);
- no large quantities (limit set at 30 grams).

Breaches of these guidelines would result in prosecution and also the closure of the establishment.

Phase 3

During the 1980s a new form of cannabis distribution evolved in the Netherlands. The guidelines and legislation that were originally intended to formalise and support the operations of 'house dealers' were used by café establishments to create a new form of distribution known colloquially as 'coffee shops'. Originally disallowed, a series of case law judgements paved the way for coffee shops to exist under the same guidelines as the house dealers, and by the end of the 1980s the coffee shops had essentially captured the cannabis retail distribution market; indeed, Korf (2008) has suggested that 'house dealers' are now practically non-existent.

Phase 4

The fourth phase as outlined by Korf (2002, 2008) relates predominantly to the shifts in policy that occurred in the mid-1990s, mainly as a result of the continued increase in cannabis-selling coffee shops, with reports that the number of establishments had reached approximately 1 500 in 1990 (Korf, 2002, 2008; Spapens and van de Bunt, 2011; Wouters and Korf, 2009). In an effort to reduce the number of shops operating, a variety of changes were implemented to the policies governing coffee shop operations throughout the 1990s. In 1992, Amsterdam became the first city to begin a licensing system for coffee shops, with operators having to renew their licence every 5 years (Jansen, 2001, cited in Spapens and van de Bunt, 2011). In addition, Spapens and van de Bunt (2011) reported that regulations in Amsterdam stipulate that breaches of the guidelines that result in closure of a coffee shop will also result in the revocation of the licence for both the operator and the establishment itself, ensuring that a coffee shop cannot be reopened in the same location under new management. In the mid-1990s, the AHOJ-G criteria were also amended such that the minimum age of shop patrons was increased to 18 and the amount of cannabis an individual customer could purchase at any time was reduced from 30 grams to 5 grams (MacCoun, 2010; Spapens and van de Bunt, 2011). However, according to Wouters and Korf (2009), closing a coffee shop because it breached guidelines was difficult to achieve, especially on the grounds of creation of nuisance.

In 1996, one of the more influential policy changes in relation to cannabis retail outlets occurred, with local governments being given the power to decide whether or not to accept cannabis coffee shops in their area (Korf, 2002, 2008, 2011; Spapens and van de Bunt, 2011; Wouters and Korf, 2009; Wouters et al., 2010). If the local council decides not to allow coffee shops, then, provided this decision is recorded in an official document, existing coffee shops can be closed down — even if there has been no breach of the AHOJ-G guidelines (Wouters, 2008; Wouters and Korf, 2009; Wouters et al., 2010). Evidence seems to suggest that since the 1990s, the numbers of cannabis coffee shops has steadily declined, to almost half in 2006, with the number of coffee shops reported to be still operating in 2009 being 666 (Bieleman and Nijkamp, 2010). Currently only one-quarter of Dutch municipalities allow coffee shops to operate in their area (Bieleman et al., 2008).

Moving to phase 5

The alternative approach to cannabis and the subsequent development of the coffee shop phenomenon in the Netherlands has ultimately led to a gap in policy in relation to supply issues. Known as the 'back door' problem, existing cannabis policy in the Netherlands allows for the sale of small amounts of cannabis to individuals who purchase the product at a coffee shop, yet does not allow for the supply of the larger amounts that are needed to supply coffee shops. Thus, the sourcing of cannabis for tolerated sale at specific places such as coffee shops is illegal and subject to law enforcement (Korf, 2011).

In an attempt to address this issue, the city of Utrecht is now defining the lines of an experimental model called a 'closed club' ([22]). The objective is to provide cannabis users with an alternative to purchasing and using cannabis at coffee shops. The project is based on small-scale production for the use of its members only. The conditions being currently discussed include a limit of five plants per member and membership limited to recreational users, aged 18 or over. A temporary exemption order from prosecution would be granted by local authorities. The project, which is being developed as a scientific experiment, will be assessed against different outcomes, including levels of THC and other ingredients found in the cannabis produced by the club; limitation of supply to users only; ability to maintain a closed circuit; degree of alternative to coffee shops; potential issues of public nuisance; and the feasibility of being also a place for prevention and information.

In response to concerns relating to drug tourism and associated nuisance (in particular in border regions), new changes to the AHOJ-G regulations governing coffee shops are currently being implemented. In addition to the creation of the 'closed club' trial, coffee shops will now be obliged to adhere to a 'resident criterion' for customers. Essentially, this means that persons wishing to access a coffee shop need to register as a customer, by using their passport to prove both residency of the Netherlands and proof of age as over the age of 18 (Korf et al., 2011). Customers will be allowed to register at one coffee shop only. These measures were introduced on 1 May 2012 in the southern provinces of the Netherlands and as of 1 January 2013 will be implemented throughout the country ([23]). After this initial period it is

([22]) This text is based on a communication given by V. Everhardt (representing the city of Utrecht) at the Conference of the International Society for the Study of Drug Policy, May 2011, Utrecht.

([23]) Information provided by the Trimbos Institute (April 2012).

expected that a limit will be placed on the number of registered users that each shop may have. In addition, it is expected that in 2014 a distance limit will be set such that coffee shops will not be allowed to operate within 350 metres of a school (Korf et al., 2011; Dutch national focal point, 2009).

In recent research involving coffee shop owners and managers and cannabis users in Amsterdam and recent (last month) cannabis users nationwide, Korf et al. (2011) ([24]) examined perceptions related to the AHOJ-G changes. Coffee shop owners and managers in Amsterdam tended to view the changes as detrimental to their business, citing concerns such as potential customer reluctance to register and also suggesting that the exclusion of tourists may be discriminating. In addition, coffee shop owners and managers in Amsterdam suggested that reluctance of customers to register may ultimately lead to a revival of unregulated cannabis dealing (street dealing), thereby negating the original purpose of the coffee shops. Although the majority interviewed perceived the changes as potentially damaging for business, it was noted by a few that the regulation requiring users to register at one shop only did ensure customer 'loyalty'.

Feedback from both users in Amsterdam and those in the national sample indicated a general opposition to the registration obligation, with results seeming to indicate that a displacement of the cannabis market may occur. Broadly, respondents suggested that if registration was imposed, they would source their cannabis by other means, such as getting other registered users to purchase for them, seeking alternative suppliers (such as home growers or street dealers), or starting home cultivation themselves. However, 10 % of respondents indicated that they would stop using cannabis if registration was enforced.

Unintended consequences

Wouters and Korf (2009) conducted research into the retail aspect of cannabis distribution in the Netherlands in an attempt to determine if the presence (or absence) of cannabis coffee shops influenced purchasing patterns. The study involved 773 cannabis users with varying degrees of exposure to cannabis coffee shops in

([24]) Interviews were based on 66 coffee shop owners/managers operating within the Amsterdam region. The Amsterdam cannabis users (n = 1214) were surveyed on site within 59 coffee shops and are not representative of all coffee shop customers in the city. Coffee shop customers interviewed were fluent in Dutch. From May to mid-July 2011, a nationwide survey called Sex & Dugs was conducted online. A total 3 257 people completed the questionnaire, of whom 1 049 identified themselves as recent (last month) cannabis users.

seven Dutch cities. The majority of the sample (70 %) in this study purchased some cannabis at a coffee shop, whether or not one existed in their city, although those who lived in a municipality without a coffee shop purchased significantly less of their cannabis at coffee shops. The study indicated that the higher the number of coffee shops that existed in a municipality, the less likely it was that purchases would be made from the 'criminal' market. Age played a significant role in purchasing patterns, with young people under the 'legal' age (18) of entrance and purchase in coffee shops twice as likely to purchase their cannabis on the criminal market than from coffee shops.

The authors showed that an unintended effect of restricting access to the cannabis coffee shops would appear to be an increased risk of involvement in the 'illegal market' and potential exposure to a number of other ('harder') drugs. Users in this study report that, although the majority of illicit dealers sell mainly cannabis products, some of them also sell other illicit drugs, thereby filing to exhibit the 'separation between markets' that the cannabis coffee shops would appear to have achieved. These results would seem to support some of the concerns raised by coffee shop owners and managers in Amsterdam in relation to the new AHOJ-G regulations (see above).

Although these findings may not be representative of the Dutch situation, and cannot be extrapolated to other countries, they lend support to the argument that the existence of the 'legitimate' retail distribution of cannabis, while not completely eliminating a criminal market, may have reduced it. The criminal market seems to exist to meet the demand of users who cannot purchase their supply by other means, for example because they are under the age limit permitted in coffee shops.

Transactions

Acquisition and delivery

As is the case with the other elements of the cannabis market, there are large variations in how cannabis products are sold, in terms of scope, method and sophistication, ranging from casual interactions among friends or family to more elaborate and organised methods. Among the locations for sale reported by Reitox national focal points are sellers' homes, purchasers' homes, pubs/clubs/bars, public spaces including streets, parks, train and bus stations, cars, schools and known 'acquisition points'.

Several countries have reported details in relation to the locations that have been identified as being the most common for cannabis transactions. In the Czech Republic (based on information from the 2008 general population survey), the most common places for cannabis transactions are bars, clubs or restaurants (36 %), followed by private events or homes (31 %), public places (20 %) and sellers' homes (13 %) (Reitox national focal points, 2009). In Ireland, most users report that their last use or transaction of cannabis occurred at a friend's house (57 %), followed by in a street or a park (12 %), at a disco/club/bar (8 %), and via phone orders (5 %) (2006/07 drug prevalence survey in Ireland: Reitox national focal points, 2009). In Hungary, streets and public places (54 %) came first as the most common place of transaction, before sellers' apartments (14 %) and 'recreational settings' (13 %) (2007 ESPAD data in Hungary: Reitox national focal points, 2009).

Bulgaria provides examples of some more elaborate methods of transaction, with the CSD (2007) reporting that taxi drivers are used as delivery agents: they pick up clients from a designated address and then supply them with cannabis before dropping them further down the street. A transaction method called 'Gotse Delchev' is also reportedly used in some districts in Bulgaria: a seller transits a specific route at a specific time, information that is known to clients, who wait along the route (Reitox national focal points, 2009).

Prices and profits

Transaction sizes at user level

As for other illicit drugs, cannabis may, depending on the market, be sold either by the weight, at a fixed price (e.g. 'EUR-10 bag', the content of which, but not the price may vary) or by the unit or the dose.

Information on transaction sizes at retail level is not standardised and relatively scarce. It would seem, however, that buying 1 gram or less each time is the most common practice for a majority of buyers in the Czech Republic, Estonia, Latvia and Hungary, and that 2 grams would be considered as a maximum in most cases. In Luxembourg, Poland and the United Kingdom, a majority of buyers would seem to purchase slightly larger quantities, on average, up to 4 grams (Reitox national focal points, 2009). Quantity discounts are likely to be obtained when buying in bulk, and therefore the largest amounts ever purchased can be rather large. For example, findings from a 2009 survey carried out in the United Kingdom among 520 cannabis users reveal that

28 % of buyers bought 9 ounces ([25]) or more (over 250 grams) at some point in the past (as cited in United Kingdom: Reitox national focal points, 2009).

The type of cannabis product bought is probably a factor to consider when considering transaction sizes. In the case of cannabis herb, although the sinsemilla material on sale can generally be consumed completely, other herbal products contain varying amounts of inert elements such as seeds or stalks, which must be removed prior to consumption.

Similarly, although this aspect is not systematically documented, it is likely that transaction sizes will be influenced by whether cannabis is purchased within a social context, from a friend, or within a more criminal setting, from a street dealer for example.

Retail prices

Data sources and limitations

Data on cannabis retail prices are routinely reported to the EMCDDA by its Reitox network of national focal points. Data on retail drug prices are collected using a wide range of methods and the comparability of the methods and their ability to provide results that are representative of the different segments of the retail market in a country are generally unknown. Although most of the available data originate in law enforcement practice (e.g. intelligence, interrogation of arrestees, eavesdropping, test purchases), some come from surveys among drug users. Data collection may be routine and standardised in some countries, but not in others. The extent to which the national averages reported reflect the overall market is generally thought to be unclear, and for this reason data on retail prices should be interpreted with caution.

The analysis in this section refers to data on the mean retail price of cannabis products. Other available measures of central tendency (e.g. median, mode) were used in the absence of mean data. Trend analysis was performed on prices adjusted for inflation.

Adjusting retail prices for the potency of the cannabis products sold at that level of the market is not feasible across Europe. Except for the Netherlands, where systematic and standardised data collection of both prices and potency takes place at retail level, there is no guarantee that the potency data available in other countries are representative of the cannabis retail market across the territory.

([25]) Cannabis resin sold as a 'nine bar'.

Cannabis resin

In 2009, the mean retail price of cannabis resin ranged from EUR 3 to EUR 19 per gram across Europe. There was, however, an extremely large variation in the reported individual retail prices per gram across countries, from EUR 1.5 to EUR 120.

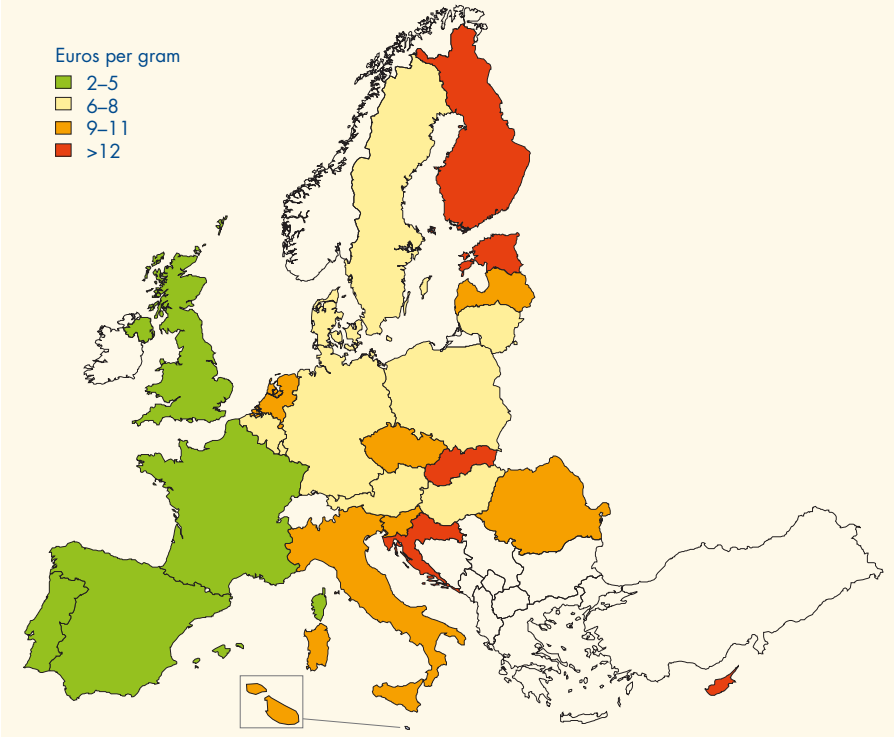
The available data suggest that the distribution of the mean prices of cannabis resin across Europe (Figure 3.5) may be largely governed by two factors: proximity to the source of supply and the size of the local market. Overall, there seems to be a gradient from lower prices in the western part of Europe to higher prices in the eastern part of the region. Western Europe is geographically closer to Morocco, the main source of supply for cannabis resin in Europe; this is particularly true for Portugal, Spain, France and the United Kingdom, where the lowest prices were reported, but relatively low prices were also reported in Belgium, Denmark, Germany and the Netherlands ([26]), where distribution and trafficking of cannabis resin, imported either directly or via the Iberian Peninsula and France, is also taking place. The lowest prices are found in countries where the markets for resin consumption are the largest (see Chapter 5). This general interpretation would not seem to hold true for Italy, where the mean price of resin appears to be comparatively high for a country that is very close to Africa, and where the market for resin is estimated to be rather large.

Overall, the retail price (adjusted for inflation) of cannabis resin in Europe appears to have declined since the end of the 1990s, with a convergence over the years between reporting countries. However, recent data would seem to indicate that this decline has now come to a halt, with a stabilisation (and in some instances an increase) being reported in most countries over the last 5 years.

The overall decline in the price of resin across Europe since the end of the 1990s is likely to be the result of a combination of factors, including the widespread availability of the substance, the effect of globalisation and of the Internet on information sharing and the facilitation of transportation, the opening of borders within Europe and increasing competition with other cannabis products (e.g. domestic herb). The stabilisation of the prices since the mid-2000s is more difficult to

([26]) Once adjusted for potency, the price per gram of imported resin sold in the Netherlands at retail level would come down to a level similar to that found in neighbouring countries. The monitoring of potency in cannabis products at retail level in the Netherlands has shown a positive correlation between price and potency (see Chapter 4).

Figure 3.5: Retail prices of cannabis resin, 2009



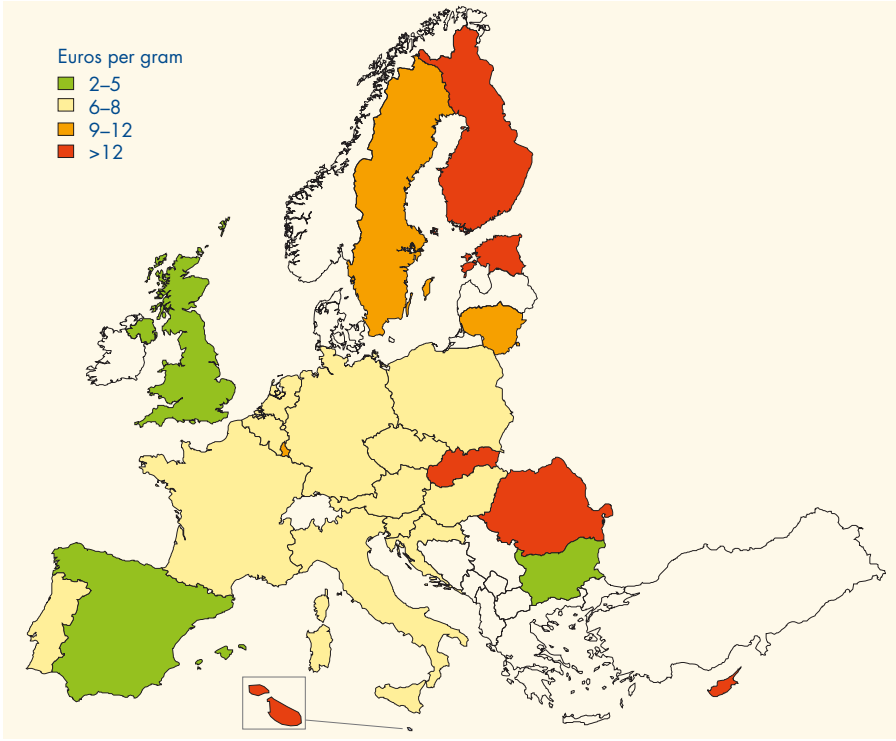
Note: Countries for which data were not available are not coloured. Data refer to mean prices, except in France, Cyprus, Austria, Poland, Romania and Finland, where modal or median values were used instead. Where 2009 data were not available, 2008 data were used (Romania, Slovakia).
Source: EMCDDA and Reitox national focal points.

explain without additional data on issues such as the quality of the resin available, the level below which prices cannot fall, competition between operators on the illicit market and their potential move towards the production of domestic herb, and the priorities, strategies and practices of law enforcement in their fight against cannabis supply.

Cannabis herb

The mean retail price of herbal cannabis ranged between EUR 2 and EUR 70 per gram in Europe in 2009 (Figure 3.6). As for resin, there is a very wide variation in the individual prices reported, from EUR 0.5 to EUR 100 per gram.

Figure 3.6: Retail prices of cannabis herb, 2009



Note: Countries for which data were not available are not coloured. Data for the Netherlands refer to locally produced 'nederwiet', as this material is much more readily available than imported herb. Data refer to mean prices, except in France, Cyprus, Austria, Poland and Finland, where modal or median values were used instead. Where 2009 data were not available, 2008 data were used (Romania).
Source: EMCDDA and Reitox national focal points.

Although the range of mean values is larger for herb (EUR 2–70) than for resin (EUR 3–19), more than half of the countries reported herb prices of between EUR 6 and EUR 8 in 2009.

The lowest prices (EUR 5 per gram or less) were reported in a number of countries, and in particular in those which can supply their own domestic market, such as Belgium, Bulgaria, the Netherlands and the United Kingdom. The mean price of 'nederwiet,' reported at EUR 8.1 per gram in the Netherlands, would come under this threshold once adjusted for potency (high compared with other European countries).

Assuming that the increasing links between cannabis production in the Netherlands and Belgium have resulted in the same types of products being sold on both sides of the border, a similar adjustment (based on the potency of 'nederwiet' sold in the Netherlands) was done for Belgium.

This group of countries is characterised by the dominance of herb over resin within their consumption market, and by indications that the supply of herbal material sold on the market, although also provided by small-scale (social) growers, would seem to be mainly in the hands of professional operations run by criminals. Low prices in these countries may be the result of lower distribution costs ([27]), as herbal material is consumed closer to the source of production.

Spain also reported very low prices for cannabis herb, on par with the countries mentioned above, but the extent of domestic production there, except for the existence of over 100 cannabis social clubs (cultivating their own cannabis), is less documented. Unlike the first group of countries, demand for herb in Spain would be marginal compared with that for resin, and would appear to be mostly met within a non-commercial and social environment, which in turn would help to keep the prices low.

The Netherlands is the only country that is able to distinguish between imported product and the locally produced 'nederwiet' (mainly made of sinsemilla). Although the inflation-adjusted retail price of imported cannabis seems to have remained relatively stable since the late 1990s, that of nederwiet has been slightly increasing over the same period. In 2011, the price of a gram of imported herb averaged EUR 4.2 compared with EUR 8.3 for 1 gram of 'nederwiet'. The fact that the latter was reported to contain on average 2.5-fold more THC than the former (16.5 % vs. 6.6 %) (see Chapter 4) may account for most of the difference in the prices reported.

Compared with resin, inflation-adjusted retail prices of cannabis herb in Europe have remained stable overall since the late 1990s, although a decline was reported in a few countries. As for resin, data suggest that this downward trend ceased in the mid-2000s. Since then, however, retail prices of herbal cannabis appear to have increased in most of the countries reporting data.

([27]) The term 'distribution costs' is used in a broad sense, and includes, for example, costs related to transportation and logistics, but also those incurred by exposure to, and the risk of being caught by, law enforcement (e.g. bribery of officials, cost of replacement of arrested dealers).

Possible links between the apparent recent increases in the price of herbal cannabis in many countries and the increasing domestic cultivation of cannabis within Europe warrant further investigation. The development of new strains and cultivation techniques with a view to increasing the potency of the herbal cannabis produced in Europe may have had an impact on the price paid at retail level, although available data on potency are not conclusive (see Chapter 4). Further analysis would certainly be needed to investigate whether, in some countries, the increasing visibility of domestic cannabis cultivation may have triggered increasing pressure from law enforcement, which in turn could have impacted on the availability of locally produced herbal material, which appears to have been the case in the Netherlands since 2004 (Decorte, 2007, 2010a; Wouters, 2008).

Wholesale prices and profits

The wholesale level of the cannabis market is what is to be found between the import level, or production level where production is domestic, and retail distribution. Depending on specific cannabis markets and their context, it may cover a plurality of sublevels, layers and situations that together make up the wholesale distribution of cannabis. As a consequence, it is likely that there is no such thing as an average wholesale price at country level, and that instead there are a number of average wholesale prices, each of them corresponding to a specific segment of the market in wholesale trafficking. In the absence of routine standardised data, the available information points to large variation in the prices charged at wholesale level in Europe, with reported wholesale prices of cannabis resin differing as much as 20-fold (EUR 500–10 000 per kilogram), and those of herb more than 10-fold (EUR 800–9 000 per kilogram) in 2008 (Reitox national focal points, 2009).

Wouters et al. (2007, cited in Korf, 2011) reported that the price of cannabis at wholesale level in the Netherlands has been driven up by reductions in supply resulting from dismantling of cultivation sites and adverse climatic conditions. Reporting on information provided by coffee shops in the three largest cities, a steady rise in wholesale prices was noted between 2004 and 2006, with the price per kilogram increasing from EUR 2 600–2 800 in 2004 to EUR 3 200–3 600 in 2006 (Korf, 2011). In 2010, 'nederwiet' was reported to have reached EUR 3 500–4 000 per kilogram (Korf, 2011).

Profit margins between wholesale and retail levels, where they can be inferred from the rare wholesale prices data available in Europe (Reitox national focal

points, 2009), would also seem to vary widely: from no profit at all in some instances to a 550 % mark-up between the wholesale and retail levels for resin, and up to 900 % for herb. Mark-ups of between 150 % and 300 % seem to be the most common for both cannabis products, although for herb the spectrum would seem to be wider, with more cases falling outside this range. The real profits made by traffickers are likely to be lower, once distribution costs are taken into account.

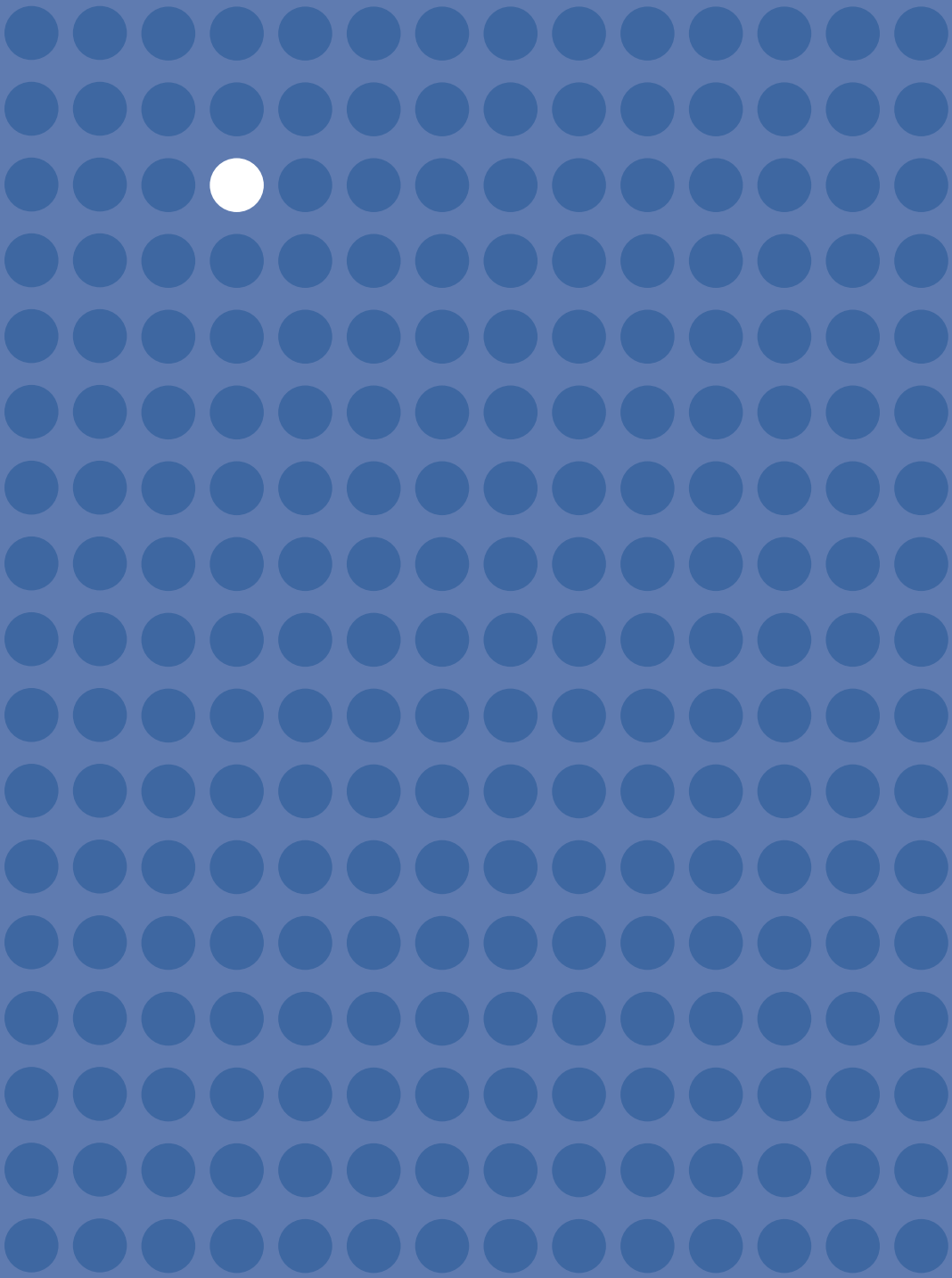
Pricing mechanisms in 'marihuana' markets in Belgium ([1])

Vanhove et al. (2012a), in their research on the yield of indoor cannabis plantations on Belgian territory, also addressed issues around prices and pricing mechanisms in the distribution chain of cannabis products issued from domestic cultivation. In 2010, they surveyed 27 respondents selected through snowball sampling and identified as players in cannabis supply networks (Surmont et al., 2011).

The findings revealed that price setting at grower level was determined by a number of factors, predominantly relations among different actors in the distribution chain and the type of network that each actor was able to develop. In particular, the size of the high-level contact's network appeared to be a determining factor: the larger the number of growers with whom an upper-level supplier does business, the more control over price that supplier has, as it is possible to play growers off against each other. The study also revealed that certain quality features play a role. Positive quality criteria are dry crops, firm 'buds' and high potency, whereas wet crops and fully ground or low-potency crops were considered to be of inferior quality.

Vanhove et al. (2012a) found that, at grower level, price ranged between EUR 3 and 4.25 for a gram of cannabis herb. This was confirmed by an analysis of the judicial files of 15 cases of dismantling of indoor cannabis plantations carried out in parallel with the survey. At other levels in the distribution chain, it was found that quantity discounting, that is a price decrease with increasing transaction volumes, was the predominant price-determining mechanism. Furthermore, geographical characteristics of the customers seemed also to play a role in marijuana price setting at the middle and retail levels of the market: customers living in areas where the availability of cannabis herb is low (rural areas and, for this research, France) were charged higher prices. At retail level, suppliers appeared to use marijuana prices in Dutch coffee shops as a reference for the unit price of cannabis herb produced in Belgium. At that level of the market, the price per gram was found to vary between EUR 7 and 8.

([1]) This box is a special contribution from Tim Surmont, Institute for International Research on Criminal Policy, Ghent University, Belgium.



Chapter 4: Cannabis potency in Europe

Chapter 4: Cannabis potency in Europe

Cannabinoids

Cannabinoid chemistry and psychoactivity

Cannabis sativa is unique in being the only plant species to produce a family of chemicals called cannabinoids. These are sometimes more specifically called phytocannabinoids, to distinguish them from endocannabinoids, which are structurally dissimilar and found in animal tissue. At least 70 of these plant compounds have been identified. Many of them exhibit pharmacological activity, and in some cases this includes psychoactive effects. The best known and most intensively researched cannabinoid is delta-9-tetrahydrocannabinol, alternatively known as Δ9-THC or simply THC. THC exhibits the greatest psychoactivity of all the cannabinoids (Mechoulam and Hanuš, 2000). Two other important cannabinoids are cannabidiol (CBD) and, to a lesser extent, cannabichromene (CBC), which along with THC are formed from a common precursor, the cannabinoid cannabigerol (CBG). Within living plant material, these cannabinoids are biosynthesised as cannabinoid acids, e.g. tetrahydrocannabidiolic acid (THCA), each containing a readily detachable carboxyl group. The loss of this carboxyl group from the acid molecule produces a neutral cannabinoid (e.g. THCA → THC). This decarboxylation occurs naturally as the harvested material ages, and is accelerated by heat and light (ElSohly and Slade, 2005; de Meijer et al., 2003). Smoking or cooking cannabis results in almost complete decarboxylation. This has important implications for cannabis users, because the cannabinoid acids THCA and CBDA are much less pharmacologically active than their decarboxylated neutral counterparts, THC and CBD. The biosynthesis and decarboxylation of the two most important cannabinoids THC and CBD are shown schematically in Figure 4.1. It is common practice in publications on cannabinoids to refer to them at all times by the name of their neutral forms only. That pragmatic approach is generally adopted for the rest of this chapter.

The CBG molecule, which contains a pentyl (five-carbon) side chain, is biosynthesised following the condensation of geranyl pyrophosphate (GPP) with olivetolic acid. A propyl analogue of CBG (with a three-carbon side chain) also exists, called cannabigerovarin (CBGV). This is formed following the condensation of GPP with diverinic acid, and this in turn is converted within the plant to the propyl cannabinoids THCV, CBDV and CBCV. It has been suggested that THCV has some

psychoactivity, although much less than THC (Gill et al., 1970; Hollister, 1974). The decarboxylated cannabinoids exhibit varying degrees of stability, but all undergo some oxidative degradation with age. THC oxidises to cannabinol (CBN), which is not synthesised naturally in the plant (UNODC, 2009a). CBN can be found in large quantities in aged cannabis. Indeed, the relative proportions of THC and CBN in cannabis have been used as an indication of the age of the material (Ross and ElSohly, 1997).

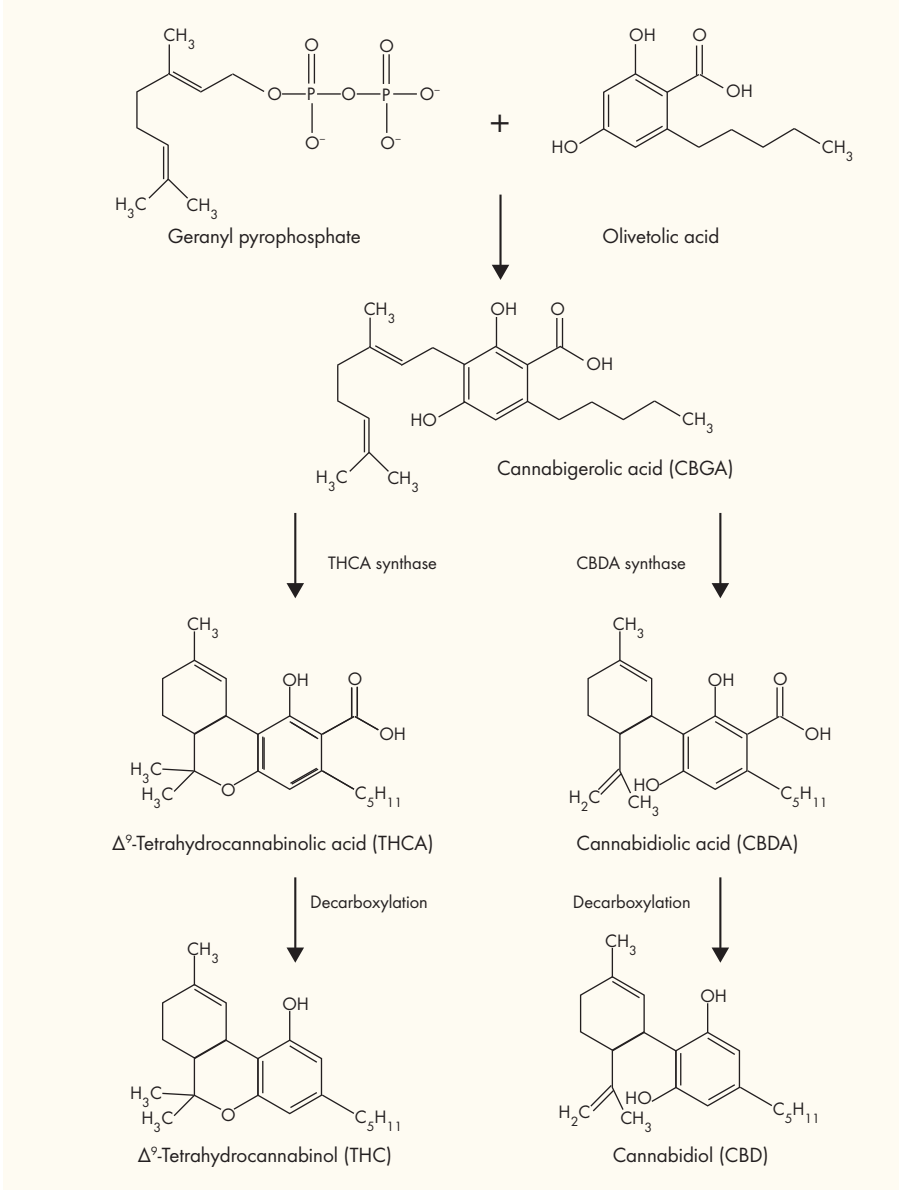
CBD exhibits very different pharmacology to THC. It is notable for not being psychoactive (Pertwee, 2006), and actually having some antipsychotic properties (Zuardi et al., 2006). Thus, any variation in the relative proportions of THC and CBD in illicit cannabis may have implications for the overall psychoactive potential of the material. There are also implications for the potential harm that could be caused by cannabis containing large quantities of THC and little CBD (Smith, 2005; UNODC, 2006b). CBC and the propyl cannabinoids occur in only relatively small amounts in most sources of mature cannabis (de Meijer et al., 2009). In a study of the cannabinoid content of over 500 illicit cannabis plant and resin samples in England in 2004/05, the median contents of THCV, CBC and CBG were all below 0.5 % (w/w), and only rarely exceeded 1 %. With such a minor presence, it is suggested that these cannabinoids had little influence on the overall effect of cannabis circulating at the time (Potter et al., 2008).

CBN, however, was present in much higher quantities, exceeding 4 % in some herbal cannabis and resin samples. CBN has some psychoactive activity, although evidence suggests that it is just 10 % that of THC (Pertwee, 2006) when applied alone. Musty et al. (1976) concluded that CBN has no psychoactivity, but observed that it has a sedating effect when used in combination with THC.

Cannabis genetics

Research performed by de Meijer et al. (2003) suggested that the ability of a plant to efficiently produce psychoactive THC and/or antipsychotic CBD is governed by the inheritance of either of two co-dominant genes with the proposed names B_T and B_D. A proportion of plants in a natural cannabis population will have inherited a B_T gene from each parent, and these plants will produce an enzyme called THC synthase. This enables them to biosynthesise THC in quantity, while producing CBD at near undetectable levels. Others will have only inherited the B_D gene, and these will produce an enzyme called CBD synthase, enabling them to efficiently produce CBD,

Figure 4.1: Synthesis and decarboxylation of the predominant cannabinoids THC and CBD from geranyl pyrophosphate and olivetolic acid, via CBGA



and minimal THC. A third, heterozygous, category will have inherited one copy of each gene, and these will produce both enzymes before going on to biosynthesise a more equal mixture of THC and CBD.

For decades, a proportion of illicit producers have grown cannabis crops, and preferentially retained seeds, or taken cuttings, from those plants that gave the greatest psychoactive effect. As a result, the gene that encodes CBD synthesis has been selected against. The impact of this is seen in the contrasting concentrations of THC, CBD and CBN in sinsemilla, outdoor-grown herbal cannabis and resin acquired in the very differently sourced cannabis markets of the Netherlands, England and the United States between 2003 and 2005 (Table 4.1).

In all three studies, sinsemilla and herbal cannabis were found to contain minimal quantities of CBD owing to the absence of the B_D gene. Resin, however, contained much higher levels of CBD because of the more balanced genetics of the source materials. In the Dutch and US samples, the THC to CBD ratio averaged approximately 2:1. In the English study, the ratio was approximately 1:1, but the average CBN–THC ratio was much higher than observed in the Dutch and US samples. This indicated that the samples were much older, or environmentally stressed, and proportionally more of the THC had degraded. Taking into account the greater stability of CBD, compared with THC, it has been calculated that the likely original THC to CBD ratio in the predominantly Moroccan plants used to make the resin was closer to 2:1, as observed with the Dutch and US samples (Potter, 2009b). The significantly greater proportion of CBD in resin is attributed to the fact that growers of cannabis plants for resin manufacture tend to make seed selections on the basis of resin yield rather than potency. These will include a mixture of genotypes producing THC and/or CBD (Clarke and Watson, 2007). In the past, traditional hashish (resin) from such countries as Nepal and Kashmir would have been made

Table 4.1: Cannabinoid contents of sinsemilla, herbal cannabis and resin in the Netherlands, England and the United States between 2003 and 2005

	Netherlands, 2004				England, 2004/05				United States, 2003			
	n	THC %	CBD %	CBN %	*n*	THC %	CBD %	CBN %	*n*	THC %	CBD %	CBN %
Sinsemilla	62	20.4	0.2	0.0	256	14.0	0.1	0.2	538	11.2	0.2	0.2
Herbal	17	7.0	0.2	0.7	35	2.1	0.1	0.6	1893	5.0	0.5	0.3
Resin	53	18.2	8.1	1.5	169	3.5	4.2	1.6	816	9.2	3.9	1.8

Note: *n*, the number of samples analysed within each category.
Source: Netherlands, Pijlman et al. (2005); England, Potter et al. (2008); United States, Mehmedic et al. (2010).

with natural landrace plant populations, most likely having an approximately equal THC–CBD ratio. However, it is believed that, as a result of western demand, growers in Afghanistan have imported varieties selected for, among other things, their proportionally higher THC content (Clarke, 1998). Growers have likely affected the cannabinoid balance for the same reasons in other major resin-making regions.

Effects of plant breeding on THC–CBD ratios

In the twenty-first century, as a result of past discrimination against CBD genetics, growers who want to propagate mixed THC- and CBD-producing varieties would experience great difficulties in accessing the necessary seeds. Potter (2009a) analysed the THC and CBD content of plants grown from the seeds of a random selection of commercially available recreational varieties. Recently updated results revealed that 48 out of 52 varieties produced entirely THC-dominant seedlings and four varieties produced a few plants with a mixed THC–CBD profile. In total, only 3 % of plants were not THC dominant. None of the varieties was advertised as containing CBD. In marked contrast, all commercial hemp varieties grown in Europe are of the CBD-producing B_DB_D genotype, attracting an EU subsidy payment only if the THC content is less than 0.2 % (Mechtler et al., 2004). These varieties are of no use for recreational purposes and as they typically contain less than 2 % CBD (de Meijer, 1994), hemp inflorescences are also unsuitable as a source of CBD for mixing with high-THC material.

The health concerns surrounding potent CBD-free high-THC sinsemilla, highlighted in the UNODC's 2006 *World drug report*, have received increasing levels of publicity. Discussions within the grey literature commonly acknowledge the difficulty in acquiring seeds of varieties that produce a mixed THC–CBD profile. This suggests that such varieties may become a feature within seed catalogues in the years ahead.

Limited research from the United Kingdom shows that it is possible to produce mixed THC–CBD varieties that perform well when grown indoors or outdoors (Potter, 2009b). Like the more common high-THC varieties, the overall potency of the plants is significantly affected by growing conditions. Interestingly, it was observed that growing environment could also affect the THC–CBD ratio of some of these varieties (Potter, 2009b).

Measuring potency

In forensic studies of cannabis, potency has routinely been described in a pragmatic way, by simply reporting the THC content in per cent by weight. It should be

recognised that this is not a universal approach across the scientific disciplines. In pharmacology, potency is a measure of drug activity expressed in terms of the amount required to produce an effect of a given intensity (Page et al., 2006). A doubling of THC concentration in cannabis will not necessarily double the impact on a recipient, because the effect of a drug is not always linearly proportional to the dose given. As described earlier, the other major cannabinoids, CBD and CBN, can interact with THC, and their likely impact needs to be taken into account when considering cannabis potency.

Cannabis potency varies widely depending on genetic varieties, growing environments (climate, soil), cultivation techniques, processing methods, the freshness of the products (age), packaging, transportation and storage. As a result, potency varies widely not just among cannabis products, but also among samples of products present on the market, depending on the different varieties (strains) from which they are produced. In Europe, where various cannabis products (resin, sinsemilla, seeded herb) are offered and where domestic production takes place in various settings, a wide variation in the potency of cannabis is to be expected both between and within countries.

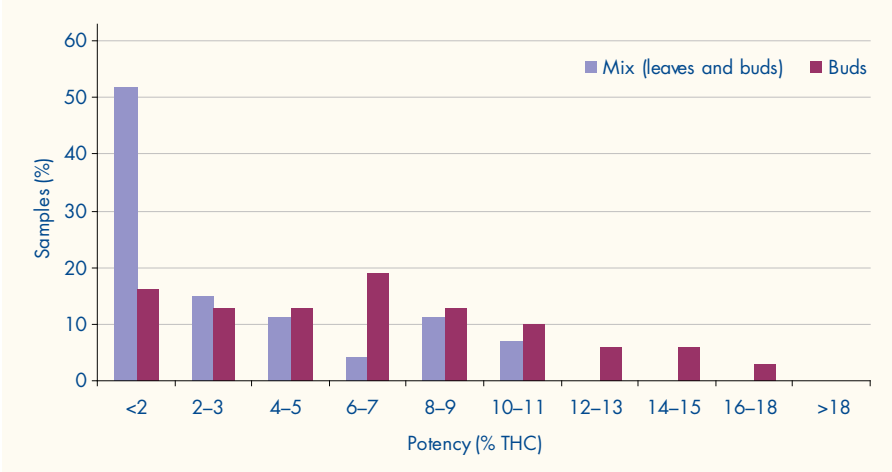
Heterogeneity and sampling issues

Cannabis herb, and to a lesser extent cannabis resin, is an extremely inhomogeneous material. THC is mainly located in the flowering tops of the female plant, whereas leaves contain less THC, and stalks and seeds none or negligible amounts. The relative proportion of flowering tops, leaves and other parts of the plant varies greatly between different cannabis materials. Even within a well-mixed single large batch of crude material and following removal of 'unwanted' matter, different aliquots could lead to quite different analytical results (EMCDDA, 2004).

Atmospheric exposure results in the oxidation of THC to CBN and other substances. In the case of resin, which is usually found in the form of blocks of compressed material, exposure to light and heat may cause material on the surface of the block to be oxidised to a greater extent than material in the interior. Differing practices in sampling blocks of resin could thus lead to different analytical results.

Sampling is crucial for determining cannabis potency (Figure 4.2). Guidelines and recommendations exist (ENFSI, 2003; SWGDRUG, 2007; UNODC, 2009a) to ensure representative sampling, and laboratories seem to be aware of them. However, a 2009 survey of 17 forensic science laboratories from 14 countries in Europe carrying out

Figure 4.2: THC content in cannabis herb samples analysed depending on sampling constitution, France, 2008



Source: French forensic science laboratories, Costes et al. (2009).

analyses of cannabis showed varying practices (Costes et al., 2009). Nine laboratories reported separating buds from leaves, whereas six mixed them together before analysis. Interestingly, most of the laboratories did not seem to distinguish between sinsemilla and seeded herbal material. Methods of determining the size of a sample to be taken from a plantation site also varied greatly, with some laboratories analysing the bulk of the material found (although this is less feasible when quantities are large) and others sampling either a specified quantity (either a number of plants or a mass) or an amount derived by a standard formula. Practices vary also in terms of the methods used to select which material (plants) from the site will be sampled.

An additional issue arises from the fact that in a majority of European countries, information on cannabis potency is based on forensic analysis of selected samples of seized cannabis, which is not necessarily representative of the market. It is likely that the average potency of seized products will differ from that of cannabis preparations available at user level. This may be particularly true in countries where a large proportion of the demand is met by domestic cultivation: where the supply is closer to end-users, interception by law enforcement agencies is less likely. Furthermore, seized material may be at various stages of the growth cycle, and this would also

result in differences in potency. Similarly, the THC content of cannabis seized in transit may differ from that of cannabis available on the domestic market.

Analytical issues

There are a number of issues besetting quantitative analysis of THC in cannabis products, and different quantification practices could potentially lead to different potency results.

Although THC is usually extracted from samples into a solvent, different methods may be used to determine the THC concentration. In the 2009 survey mentioned above, most laboratories reported using gas chromatography with flame ionisation detection, two used gas chromatography with mass spectrometry and one used liquid chromatography (Costes et al., 2009). THC concentration can be measured either as total THC (which includes free THC and THCA), as in most responding laboratories, or as free THC, as reported by one laboratory in 2009.

King (EMCDDA, 2004) noted that issues of precision (reproducibility) and accuracy (closeness to the 'true' value) of the measurement process may also arise in the analysis of THC, and provided the example of Poortman et al. (1999), who, in a series of proficiency tests organised in 1997 in 30–40 European laboratories, found a relative standard deviation of about 29 % ([28]) for cannabis potency (much higher than for cocaine and amphetamine). More recently, a proficiency test on cannabis resin performed by the Drug Working Group of the European Network of Forensic Science Institutes in 2008 revealed a relative standard deviation of about 22 % among the 48 responding European laboratories (Costes et al., 2009).

Possible differences between the reference standards used to quantify THC are another factor that can reduce the reliability and comparability of the results; for example, the THC concentration of some commercial solutions is only 90 % of the concentration of other commercial standards. As THC reference material is not easily available and degrades rapidly, many analysts now use another reference material, for example CBN, to quantify THC (UNODC, 2009a).

In addition, THC's propensity to be adsorbed on to unsilanised glass surfaces can lead to its loss from dilute solutions (Moffat et al., 2004), both reference material and samples, if sufficient precautions are not taken during analysis.

([28]) Two-thirds of the THC results were within the range of ±29 % of the mean value.

THC content (potency) in cannabis products in Europe

Data sources

Data on cannabis potency are routinely reported to the EMCDDA by its Reitox network of national focal points. Although some countries provide potency data for cannabis products at retail level, in the majority of cases the data reflect the potency of cannabis material seized at all levels of the market. Analysis may be systematic in some countries, but not in others. As a result, the extent to which the samples analysed reflect the overall market is unclear, and for this reason data on potency should be interpreted with caution.

The analysis in this section refers to data on the mean potency of cannabis products. In the absence of such data, other available measures of central tendency, such as the median, were used.

Cannabis resin

Available data suggest diverging trends across Europe in the mean potency (% THC) of cannabis resin in recent years, with a decrease or a stabilisation reported in 11 countries since 2004, and an increase in five other countries (see Table A2 in the Appendix). There has always been a wide variation in the THC content of the individual samples analysed (from 0.1 % to 41 % in 2009), and in 2009 the mean THC content of cannabis resin ranged between 3 % and 17 % across Europe. Over the 10-year period 2000–09, the lowest THC levels, up to 5 %, were reported in Bulgaria, Estonia and Hungary, and the highest, over 10 %, in Belgium, Spain, the Netherlands and Slovakia.

Cannabis herb

The potency of herbal cannabis appears to have remained relatively stable in a majority of European countries in recent years, with a stable trend reported in eight countries since 2004, a decline in two countries, and an increase in five countries (see Table A3 in the Appendix).

The mean potency of cannabis herb is usually lower than that of resin. In 2009, this was confirmed in all reporting countries, with a few exceptions (Germany, Estonia, Italy, Slovenia, Slovakia). As for resin, the variation in the THC content of individual samples is usually very large, ranging from less than 0.1 % to 40 % in 2009.

The mean potency of herbal cannabis ranged from 1 % to 12 % for the material not reported as sinsemilla. The lowest mean potencies over the last decade (2000–09), up to 5 %, have been reported in Bulgaria, the Czech Republic, Hungary, Portugal, Finland and Turkey, and the highest ones, around 10 % or over, in Belgium and Luxembourg.

Few countries are able to distinguish between sinsemilla and other herbal cannabis material. Except in the Netherlands ([29]), data for which are analysed in depth below, reports of the potency of sinsemilla are available only for Germany (11 % in 2009) and Romania (2 %).

Detailed results from a limited number of studies in Europe

Detailed data on the potency of different cannabis products, and on their non-THC cannabinoid content, are available from studies carried out in a small number of European countries.

The Netherlands

The concentration of THC ([30]) and other cannabinoids in cannabis products sold in Dutch coffee shops has been monitored since 2000 by the Trimbos Institute for Mental Health and Addictions. The data indicate that the THC content of resin products is consistently higher than that of herbal products of the same origin (Dutch or imported), and that Dutch products are more potent than imported ones. The data also show that potency levels of all cannabis preparations have been increasing over the last decade (Figure 4.3).

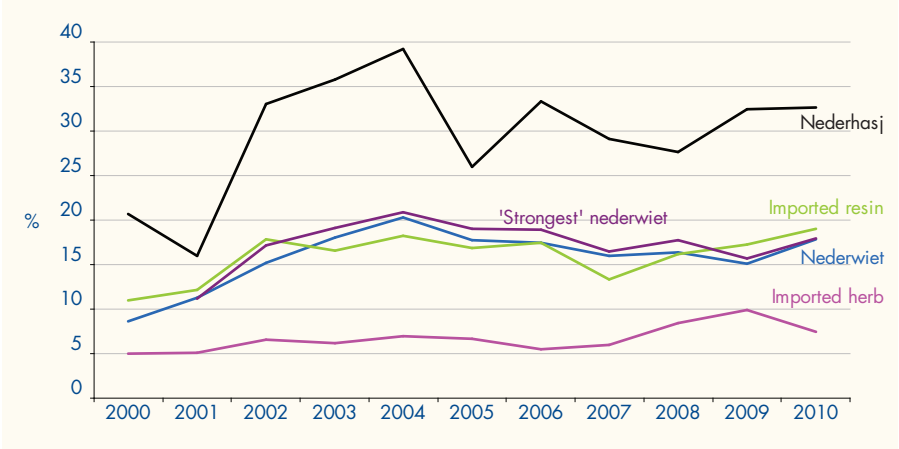
Of the various cannabis products analysed since 2000, the most marked increases in THC content were observed in Dutch domestic herb (nederwiet) and resin derived from Dutch domestic herb (nederhasj) ([31]). The THC content of these products doubled between 2000 and 2004, to reach mean values of 20.4 % (median 21.5 %, range 8.1–29.4 %) and 39.3 % (median 39.8 %, range 18.0–62.8 %) respectively. In comparison, the potency of imported resin, although increasing significantly over the same period, to an average of 18.2 % in 2004

([29]) Most of the herbal cannabis produced in the Netherlands ('nederwiet') is made up of sinsemilla.

([30]) Measured as all available THC (neutral and THC acids).

([31]) Experts estimate that nederhasj is only used by a small fraction of cannabis users in the Netherlands, around 1 %.

Figure 4.3: Trends in mean potency (% THC) of cannabis products sold in coffee shops in the Netherlands, 2000–11



Sources: Niesink et al. (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008), Rigter et al. (2009), Rigter and Niesink (2010, 2011).

(median 18.5 %, range 4.8–29.0 %), was half that of nederhasj. Since 2004, the potency of Dutch products, though remaining high overall, has fluctuated at lower levels, with mean values in 2011 of 16.5 % (median 16.7 %, range 6.8–23.2 %) for nederwiet and 29.6 % (median 30.8 %, range 6.5–45.0 %) for nederhasj. The mean potency of imported resin has remained relatively stable since 2004, and was reported to be 14.3 % (median 14.3 %, range 1.7–28.4 %) in 2011. The mean potency of imported herb has remained much lower than the potency of all other products, showing an upward trend over the decade, with a peak at 9.9 % in 2009, followed by a decline since then (mean 6.6 % in 2011, median 6.4 %, range 2.0–12.0 %).

In the case of nederwiet preparations collected up to 2009, samples were purchased twice a year, in January and September. The results point to a seasonal variation in the potency of nederwiet sold in coffee shops, in agreement with the earlier findings of Korf et al. (1994). The study consistently found that samples of nederwiet bought in September contained less THC than those bought in January, although the difference decreased substantially after 2005. One proposed explanation for these findings is that cannabis herb on sale in January is likely to have been grown

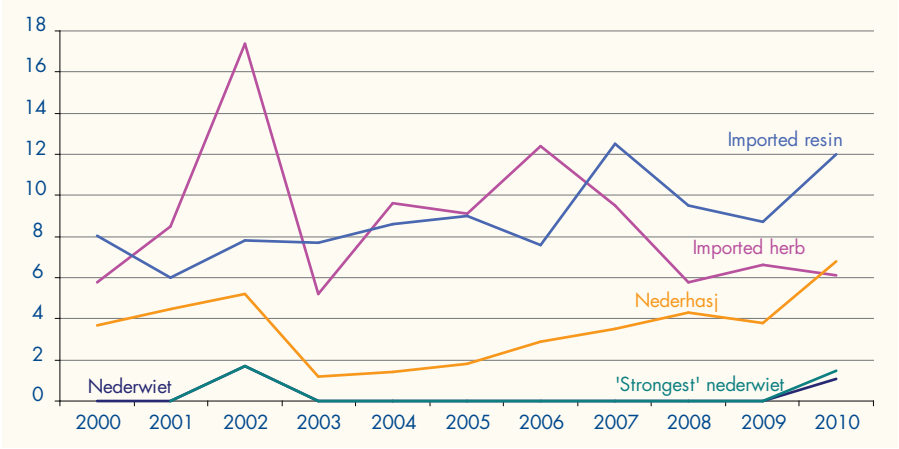
indoors, whereas the product on sale in September has been grown outdoors in summer, and this is likely to account for the lower THC levels in the latter (Pijlman et al., 2005) ([32]). Pijlman et al. also noted that many different varieties of nederwiet are sold to cannabis users, and that potency varies much more within than between varieties, making it difficult to predict the potency from the name of a variety. In particular, this means that over time users will be exposed to cannabis with quite different levels of potency.

The analysis of the cannabinoid content of cannabis products collected between 2000 and 2011 revealed that the levels of CBD in imported resin (median 6.7 %, range 0.3–8.9 %, in 2011) were much higher than those found in other cannabis preparations (medians of between 0.3 % and 1.4 % in 2011). As stated earlier, this would reflect the fact that such resin would more likely have been made with landrace (wild) cannabis, which remained exempt from artificial selection until recent times. CBN content was also found to be higher in imported resin (median 2.3 %, range 1.1–5.3 %, in 2011) than in other preparations over the period 2000–11, although the 2010 and 2011 results reveal similar levels of CBN in samples of domestic resin (nederhasj: median 2.0 %, range 0.2–5.5 %, in 2011). The concentrations in CBD and CBN do not appear to have changed much over the years.

Over the last decade, the concentration of CBN relative to THC (see Figure 4.4) has consistently been found to be much higher in imported herb and imported resin than in nederhasj and nederwiet, which is not surprising as imported products, because of the longer time period between harvest and sale, are usually less fresh.

([32]) Studies in southern England have shown that, if harvested when fully mature in October, some cannabis varieties can produce equally good sinsemilla whether grown indoors or outside (Potter, 2009b). However, harvesting early will have a detrimental effect on potency. Material grown outdoors and harvested and sold in September would be unlikely to have reached its maximum potential potency.

Figure 4.4: CBN–THC ratio (×100) of cannabis products sold in Dutch coffee shops, 2000–11



Sources: Niesink et al. (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008), Rigter et al. (2009), Rigter and Niesink (2010, 2011).

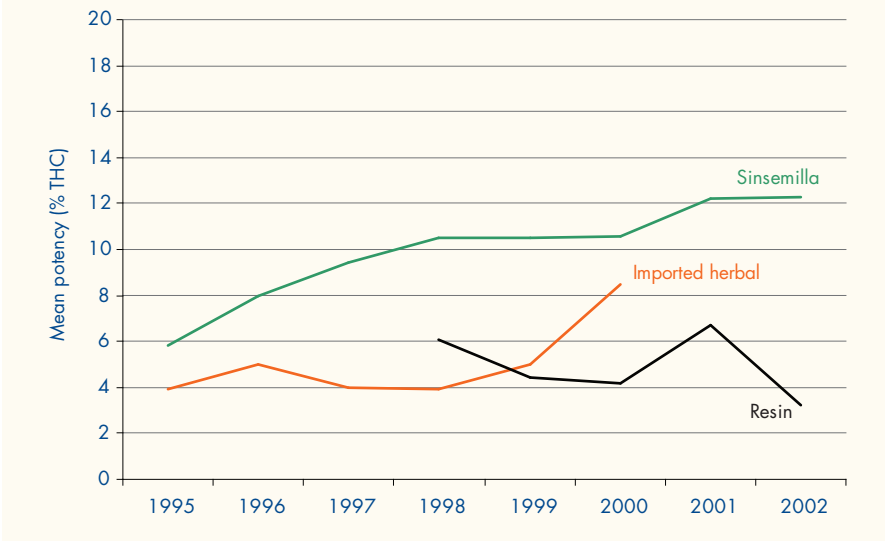
The Dutch study has also been collecting data on the price of the samples analysed, and is therefore able to investigate whether pricing might be linked to potency. Analysis of the measurements made between 2000 and 2011 revealed that price has usually increased with potency, although to varying degrees across different products.

United Kingdom

Findings from three analyses of cannabis material seized by law enforcement agencies in the United Kingdom in the last decade, although not directly comparable as the methodologies used were not identical, might point to an increase in the market share of cannabis products attributed to sinsemilla, together with an increase in its potency.

Tests carried out by the Forensic Science Institute on cannabis material seized by the police between 1995 and 2002 (Figure 4.5) showed an increase in the mean potency of sinsemilla over the period from around 6 % to 12 %. However, no clear evidence was found of a change in the mean potency of either resin (4–5 %, 1998–2002) or imported herb (4–6 % 1995–2000) (EMCDDA, 2004).

Figure 4.5: Mean potency of cannabis products examined in the United Kingdom (Forensic Science Service, 1995–2002)



Source: EMCDDA (2004).

In a subsequent study, Potter et al. (2008) analysed the cannabinoid content of cannabis products seized by police forces in five locations in England in 2004–05. Over half (55 %) of the material analysed was sinsemilla, followed by resin, and then by imported outdoor-grown herbal cannabis, which was present in very low proportions in all localities, except London, where it accounted for 19 % of the cases analysed. THC content varied widely across areas and across samples of each of the cannabis products analysed. The results showed that mean potency was highest for sinsemilla, at 13.3 % (median 13.9 %, range 1.1–23.2 %), followed by resin at 3.7 % (median 3.5 %, range 0.5–10.8 %) and imported herb at 3.1 % (median 2.1 %, range 0.3–11.8 %). One sample of cannabis powder, retrieved from a herb grinder, contained 40.6 % THC.

Potter et al. (2008) compared the potency distribution of sinsemilla samples from 1996–98 analysed by the Forensic Science Institute (EMCDDA, 2004) and their own samples from 2004–05 (Figure 4.6) and found that the potency of the latter was significantly higher ($P < 0.0001$). They estimated that the median potency of sinsemilla increased by nearly five percentage points between 1996–98 and 2004–05.

Although some of the sinsemilla samples had been in police storage for up to 1 year before analysis, the relatively low CBN concentrations (median 0.2 %) indicated the freshness of this product, confirming closeness to the source of production, compared with imported herb and resin (median of 0.6 % and 1.6 %, respectively) (Potter et al., 2008).

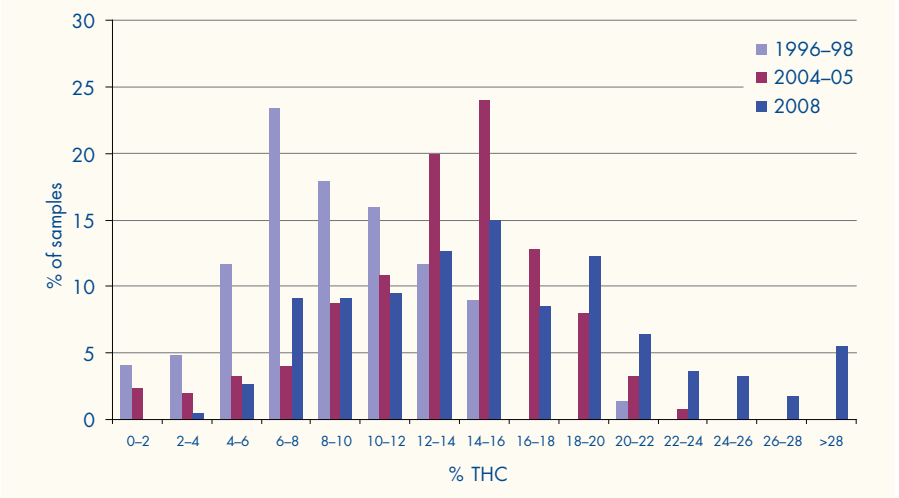
Potter et al. (2008) found that CBD was present at only very low concentrations (median <0.1 %) in both sinsemilla and imported herb, but that CBD levels in resin samples (median 4.2 %, range 0.4–6.9 %) were similar to those of THC (median 3.5 %, range 0.4–10.8 %). The analyses showed that resin samples, despite their uniform appearance, varied greatly not only in THC content, but also in the ratios of THC to CBD and THC to CBN. Such variations in cannabinoid content would be expected to lead to very different pharmacological and psychoactive effects (Potter, 2009b) as a result of both the wide range of THC content and the various degrees to which THC, CBD and CBN would interact ([33]).

More recently, in a study carried out in 2008, Hardwick and King (2008) analysed seizures of cannabis products made by the police in England and Wales. Most of the cannabis analysed was sinsemilla (81 %), followed by resin (15 %) and imported herb (4 %). As in the two earlier studies (EMCDDA, 2004; Potter et al., 2008), the mean THC content was highest in sinsemilla samples, at 16.2 % (median 15 %, range 4.1–46 %), and significantly higher than the THC level in sinsemilla analysed by Potter et al. in 2005 ($P < 0.0001$). In contrast to the 2004–05 findings, the mean potency of imported herb, at 8.5 % (median 9 %, range 0.3–22 %), was higher than that of resin, at 5.9 % (median 5 %, range 1.3–27.8 %).

The maximum THC content of sinsemilla in Hardwick and King's 2008 study (46 %) was much higher than that observed (23 %) in the previous study, by Potter et al. (2008). These very high-THC samples fell outside what otherwise appeared a natural distribution pattern, reaching a maximum of approximately 28 % THC. It is likely that these anomalously high-potency samples had been enriched with cannabis trichome powder. As reported in Chapter 1, herb grinders, which produce a trichome powder

([33]) It should be acknowledged that police storage for up to 1 year may have had a greater effect on the degree of degradation of THC to CBN in resin than in sinsemilla and herbal cannabis. Previous studies have acknowledged that THC is less stable in resin than in other cannabis products. As CBD is estimated to have a half-life three times that of THC, the ratio of residual THC to CBD would change during the ageing process (Martone and Della Casa, 1990).

Figure 4.6: Comparison of the ranges of THC contents in sinsemilla samples examined in the United Kingdom in 1996–1998, 2004–05 and 2008



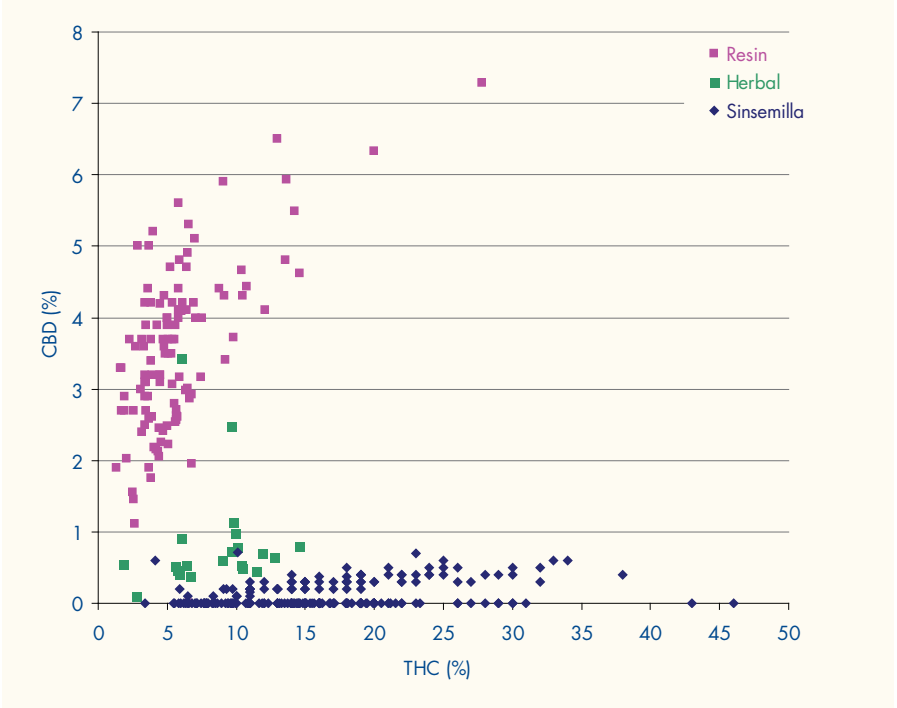
Sources: Hardwick and King (2008), Potter et al. (2008).

that can be used to boost cannabis potency, are increasingly available on the market.

Hardwick and King's (2008) findings on the CBD content of cannabis material agreed with those of Potter and colleagues (2008): very low CBD content in sinsemilla and imported herbal cannabis and much higher content in resin (mean 3.5 %). However, given the higher THC content of these resin samples compared with the 2004–05 study (Potter et al., 2008), these could no longer be considered as CBD dominant. The higher ratio of THC to CBD in these samples is likely to be at least partly due to their having spent less time in storage before analysis, with proportionally less of the THC being oxidised to CBN and other degradants.

The marked variation in the THC–CBD ratios of sinsemilla, herbal cannabis and resin is illustrated in Figure 4.7. As CBD has been found to have antipsychotic properties and is said to mitigate the psychoactive effects of THC, any variation in the relative proportions of THC and CBD may have implications for the overall psychoactive potential of the material.

Figure 4.7: THC and CBD concentrations in samples examined in England and Wales, 2008



Source: Hardwick and King (2008).

Chapter 5: Cannabis demand in Europe

Chapter 5: Cannabis demand in Europe

Prevalence, trends and patterns of use

Cannabis is by far the most widely used illicit drug in Europe, and the most recent estimates suggest that it has been used at least once (lifetime prevalence) by over 78 million Europeans, that is by over one in five of all 15- to 64-year-olds ([34]) (EMCDDA, 2011a).

The overview of prevalence and patterns of cannabis use presented in this chapter gives strong indications of the consumer demand for cannabis in Europe and, as such, it provides an important backdrop for assessing the amount of cannabis consumed in the European Union.

Key data sources

Drug use in general populations is measured through representative national surveys routinely reported to the EMCDDA by national focal points. These surveys provide estimates of the proportion of individuals who self-report having used specific drugs over defined periods of time — at least once during their lifetime (lifetime prevalence), during the last 12 months (last year prevalence) or during the last 30 days (last month prevalence). The last two are sometimes referred to as 'recent use' and 'current use', respectively. Lifetime prevalence includes use on any occasion, even if it occurred in the distant past.

Data on frequency of use in the last 30 days are available from 14 European countries, which account for 65 % of the adult population of the European Union and Norway.

([34]) Prevalence estimates for Europe presented in this chapter relate to the 27 EU Member States and Norway, which participates in EMCDDA activities by special agreement. They are computed from national prevalence estimates weighted by the population of the relevant age group in each country. To obtain estimates of the overall number of users in Europe, the EU average is applied for countries lacking prevalence data (representing not more than 3 % of the target population). Populations used as basis: 15–64, 336 million; 15–34, 132 million; 15–24, 63 million. As European estimates are based on surveys conducted between 2001 and 2009/10 (mainly 2004–08), they do not refer to a single year.

Prevalence

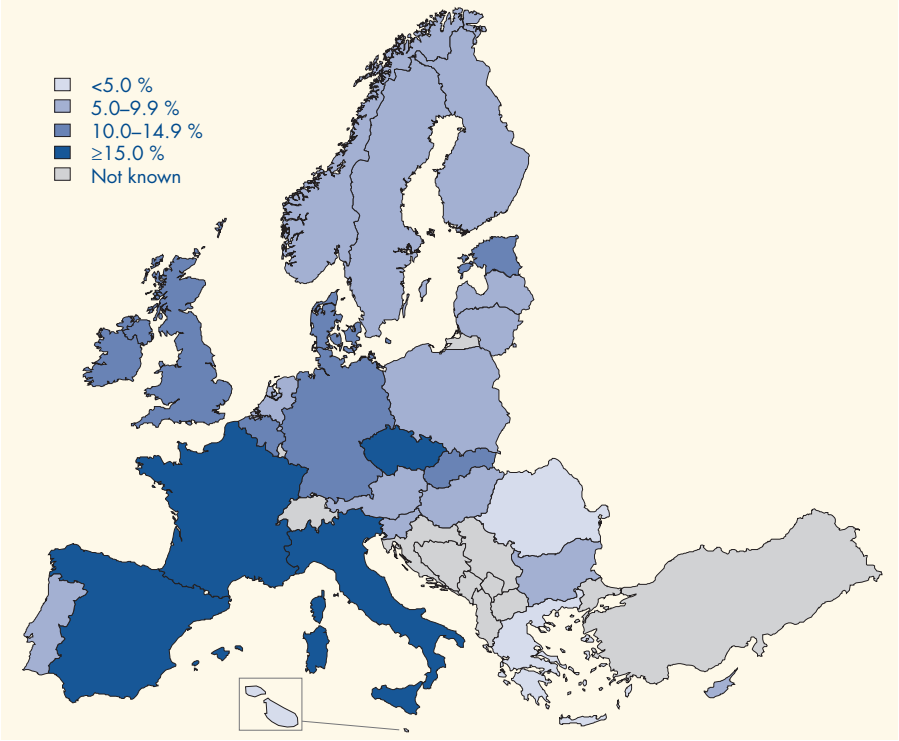
An estimated 22.5 million Europeans have used cannabis in the last year, or on average 6.7 % of all 15- to 64-year-olds, and about 12 million Europeans have used the drug in the last month, on average about 3.6 % of all 15- to 64-year-olds. Estimates of last month use include individuals who use the drug regularly, though not necessarily on a daily or intensive basis. Following the patterns of market demand in the field of alcohol and tobacco, it could be tentatively assumed that daily cannabis users account for most of the cannabis consumed in Europe. However, detailed data collection and analysis are required to verify such an assumption. Surveys consistently indicate that the majority of daily cannabis users are young and male; however, there are differences between countries.

Similarities and differences between countries

Estimates of lifetime cannabis use in the majority of European countries are between 10 % and 30 % of all adults. The lowest lifetime prevalence levels are reported by Romania (1.5 %), Malta (3.5 %), Bulgaria (7.3 %) and Hungary (8.5 %), and the highest levels by Denmark (32.5 %), Spain (32.1 %), Italy (32.0 %), France and the United Kingdom (both 30.6 %).

When considering more recent cannabis use (last year prevalence) among young adults (15–34 years old), the highest levels are concentrated in the south-west of Europe and in the Czech Republic. Other countries where prevalence of last year cannabis use is above the European average of 12.1 % are Slovakia, Estonia and Denmark. In the rest of central and eastern Europe and in Greece and Malta, last year prevalence of cannabis use is low (see Figure 5.1). The geographical distribution of cannabis use shown in Figure 5.1 is generally confirmed by data from school surveys (Hibell et al., 2009).

Figure 5.1: Last year prevalence of cannabis use among young adults (aged 15 to 34)



Source: EMCDDA and Reitox national focal points.

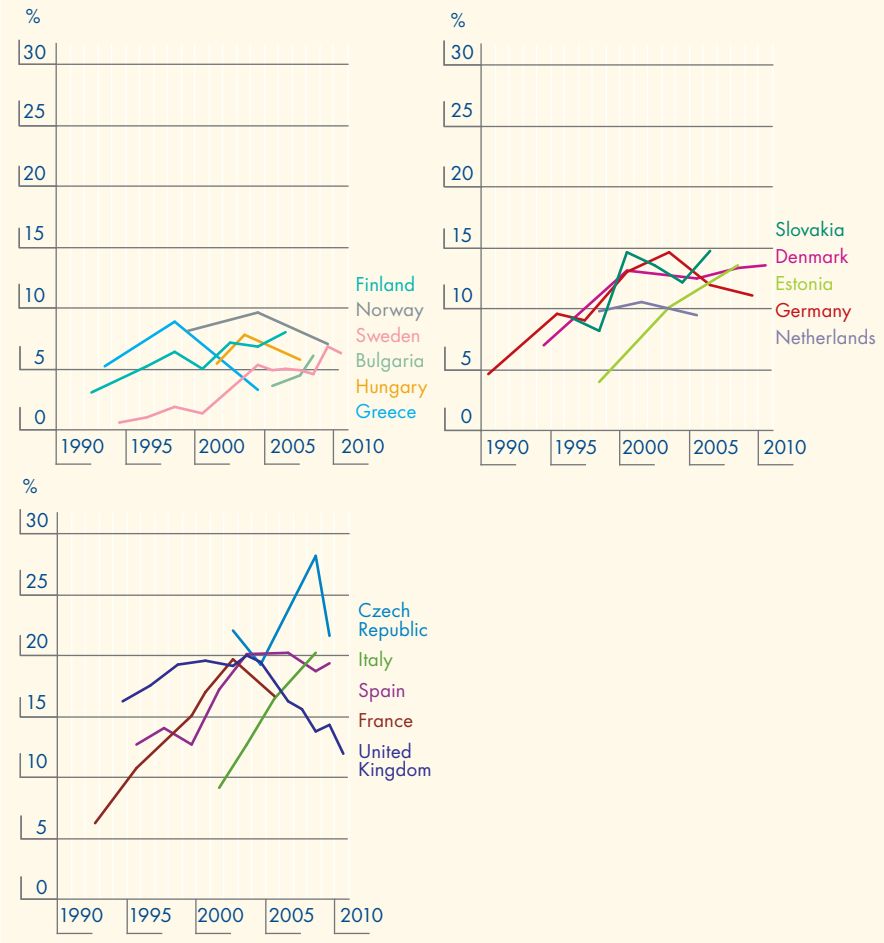
Trends in cannabis use

There were notable increases in cannabis use in many European countries from the mid-1990s until the early 2000s. However, in more recent years (2004–09/10), the European picture has become more complex. During this period, many countries have reported that cannabis use is stabilising or even decreasing, although a small number of countries may be witnessing an increase. Levels of use remain high compared with other illicit drugs.

Trends in 16 countries can be grouped according to prevalence levels (Figure 5.2). Among the five countries recording the highest prevalence levels in the past decade, the United Kingdom and, to a lesser extent, France have reported a decrease in last year prevalence of cannabis use in their most recent surveys, and Spain has reported a relatively stable situation since 2003. Italy and the Czech Republic have

both reported increases followed by decreases in this period. It is worth noting the particular case of the United Kingdom, where in 2010 last year prevalence of cannabis use fell below the EU average for the first time since European monitoring began.

Figure 5.2: Trends in last year prevalence of cannabis use among young adults (aged 15 to 34)



Notes: Data presented for countries with three surveys or more, grouped according to highest prevalence level (below 10 %, 10–15 %, above 15 %). The Czech Republic is exploring reasons for the wide variability in survey results, which seem in part to be related to changes in methods. The data are provided for information, but comparisons should be treated with caution.

Sources: EMCDDA and Reitox national focal points (2010), taken from population surveys, reports or scientific articles. See Figure GPS-4 in the 2011 *Statistical bulletin* for further information.

Another group of five countries (Denmark, Germany, Estonia, Netherlands, Slovakia), located in different parts of Europe, reported last year prevalence of cannabis use of between 10 % and 15 % in their latest survey. All of the countries in this group, except the Netherlands, reported notable increases in use in the 1990s and early 2000s. With the exception of Estonia, these countries have reported stable trends in the period 2004–09/10.

A group of six countries (Bulgaria, Greece, Hungary, Finland, Norway, Sweden), located mainly in north and south-east Europe, have always reported levels of last year prevalence of cannabis use below 10 % among 15- to 34-year-olds. The recorded low levels of cannabis use found in this group of countries refer to last year use, which include mainly recreational patterns of use. However, it remains unclear as to whether intensive (daily use) and long-term use have also remained low.

Mainly stable or decreasing trends in cannabis use among school students (15–16 years old) in Europe can be observed in the surveys carried out by the European School Survey Project on Alcohol and Other Drugs (ESPAD) between 1995 and 2007 (Hibell et al., 2009).

Patterns, characteristics and context

Available data do not suggest a clear relationship across European countries between levels of cannabis use and the types of cannabis products consumed. High levels of cannabis use prevalence are reported both in countries where cannabis herb is the predominant form of the drug (Czech Republic) and in countries where consumption of resin is predominant (Spain, France, Italy) (see Figures 5.1 and 5.4).

General population and school surveys have seldom addressed the distinction between cannabis resin and herbal cannabis from the perspective of demand. In 2009, new questions were introduced in the United Kingdom general population survey to identify the prevalence of the use of herbal cannabis, including 'skunk' ([35]). The 2009/10 British Crime Survey estimated that around 12 % of adults have ever taken what they believed to be 'skunk'. Although the proportions of cannabis users reporting lifetime use of herbal cannabis (50 %) and cannabis resin (49 %) are similar, those using the drug in the last year are more likely to have used herbal cannabis (71 %) than resin (38 %) (Hoare and Moon, 2010). These estimates cannot

([35]) 'Skunk', a generic term for any intensively grown sinsemilla; see Chapter 1 for a definition of sinsemilla.

be generalised to other populations in Europe, but the findings may illustrate a shift in the United Kingdom towards more consumption of herbal cannabis in recent years, and lend support to the suggestion in the last section of this chapter that cannabis herb is increasingly gaining ground at the expense of resin in western Europe.

High levels of lifetime prevalence of cannabis use in the general population, together with little or no gender differences in those among the younger age groups reporting infrequent use, suggest that infrequent cannabis use has become a relatively normalised behaviour for young people in some countries. However, more regular or frequent cannabis use is typically associated with specific socio-demographic groups operating within local leisure 'scenes', which are culturally, spatially and pharmacologically distinguished. For example, targeted surveys conducted in nightlife or electronic dance music settings in several European countries consistently report prevalence levels of cannabis use that are much higher than in the general population. A recent United Kingdom study of 323 dance club customers in a large English city reported that over 50 % had used cannabis in the past month and 26 % had taken cannabis on the day of the interview (Measham and Moore, 2009). Furthermore, even under the umbrella of electronic dance music, significant differences in levels of cannabis use are reported by customers attending clubs playing different music genres. A study of drug use in electronic dance music clubs in Hungary found higher cannabis use — but lower ecstasy, amphetamine and ketamine use — at clubs that play a specific genre of music (drum and bass) compared with other genres (trance, techno and house clubs) (Demetrovics, 2009).

Daily and dependent use

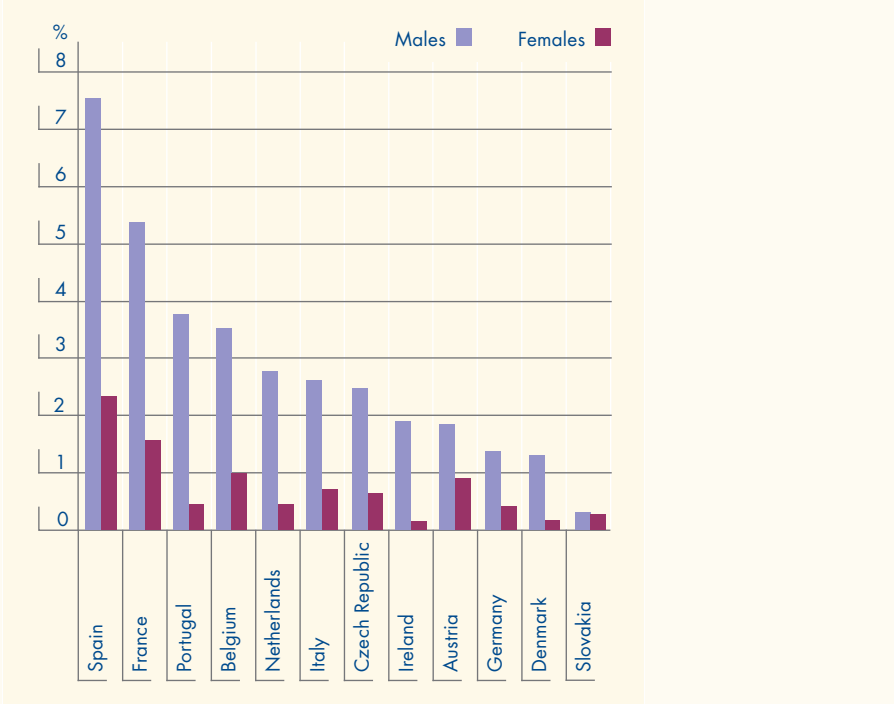
Available data point to a variety of patterns of cannabis use, ranging from experimenting to daily use or dependence. Many individuals tend to discontinue their cannabis use after one or two experiments; others use it occasionally or during a limited period of time. Of those aged 15–64 who have ever used cannabis, on average 30 % have done so during the last year. Among those who have used the drug in the last year, on average, nearly half have done so in the last month. These proportions, however, vary considerably across countries, ranging from 17 % to 47 % and from 21 % to 67 %, respectively.

Data on frequency of use in the last 30 days are available from 14 European countries, which account for 65 % of the adult population of the European Union

and Norway. The largest proportion, almost half, of those who used cannabis in the last month had consumed the drug on 1–3 days during that month; about one-third reported using cannabis on 4–19 days in the past month and one-fifth on 20 days or more. Based on these data, it can be concluded that about 1 % of all European adults (close to 4 million), predominantly males (Figure 5.3), are using cannabis daily or almost daily.

The ESPAD study conducted in 2007 among 15- to 16-year-old school students reveals that, on average, 4 % of respondents have used cannabis on 10 or more occasions during the last 12 months, with Spain, the Czech Republic and the Netherlands reporting the highest percentages, and 2 % have used the drug six times

Figure 5.3: Prevalence of daily or almost daily cannabis use among young adults (15–34) by gender



Notes: Those who declared having used cannabis in 20 days or more in the 30 days previous to the interview are referred to as 'daily or almost daily users' in the text.
Source: EMCDDA and Reitox national focal points.

or more during the last 30 days, with the same countries as well as France and Italy leading the list (Hibell et al., 2009).

Dependence is increasingly recognised as a possible consequence of regular cannabis use, even among younger users, and the number of individuals seeking help for their cannabis use is growing in some European countries. Among users of all illicit drugs entering treatment in Europe, those mentioning cannabis as their main problem drug are the second largest group. Identifying people with problematic patterns of cannabis use is important work in progress at the population level.

A longitudinal Dutch study on the dynamics of cannabis dependence, in which participants were recruited by respondent-driven methods, revealed that networks of frequent cannabis users are largely heterogeneous. However, within certain groups, gender, ethnicity and frequency of cannabis use can predict cannabis dependence (Liebregts et al., 2011). Assuming that cultural and social contexts are determinants of forms of dependence and drug use patterns (Spooner, 2009), some insight into the prevalence of problematic forms of use of cannabis in Europe can be derived from the 2007 ESPAD study, in which 14 Member States included a short-scale Cannabis Abuse Screening Test (CAST) in their questionnaires. The proportion of high-risk ([36]) users among those 15- to 16-year-olds who have used cannabis in the last 12 months varied in most countries between 10 % (Poland) and 19 % (Greece), with lower proportions in Germany (8 %), Belgium and Austria (both 9 %). However, taking into account the number of last year cannabis users in each country, levels of high-risk cannabis users among all 15- to 16-year-olds were highest in the Czech Republic (4 %) and Italy (3 %) (Hibell et al., 2009).

Attitudes and perceptions

Ever since drug use surveys were instituted across Europe, cannabis has been reported to be the most popular and accessible illicit drug. When people have friends who use cannabis, their access to the substance is made easier. Similarly, when people have friends who appear to use cannabis without adverse health effects, their negative perceptions about cannabis use are likely to soften. Surveys in the United States have shown that trends in cannabis use and trends in perceptions about how easy it is to acquire cannabis tend to mirror one another, so that, as cannabis use rose during the 1990s in the United States, reported availability

([36]) Following the original proposal (Beck and Legleye, 2003), those who scored 4 or more in the CAST were considered high-risk cannabis users.

increased as well (Johnston et al., 2010). Similarly, trends in perceptions about the health risks of cannabis use tend to be inversely related to trends in use. So, as cannabis use rises, reported perceptions about negative health risks of cannabis use decrease. In July 2011, the European Commission reported the results of a Flash barometer survey, conducted in all 27 EU countries and involving over 12 000 (aged 15–24 years) respondents, which explored youth attitudes about access to illicit drugs and health risks associated with use (Eurobarometer, 2011).

Perceived availability of cannabis

The 2011 Flash Eurobarometer survey found that over half (57 %) of the respondents in the EU thought that obtaining cannabis within 24 hours was 'fairly easy' or 'very easy'. Respondents in the Czech Republic expected to have the least difficulty in obtaining cannabis: 51 % thought it would be very easy and 24 % fairly easy to obtain this substance, while a minority (12 %) said it would be very difficult or impossible. Italy and Spain were close to the Czech Republic, with 73–74 % of respondents choosing the 'very easy' and 'fairly easy' responses; however, focusing only on the proportions of 'very easy' responses, young people in Denmark, the Netherlands and Slovakia were more similar to the Czechs (43–45 % 'very easy' responses).

Only in one European country (Cyprus) did more than half of 15- to 24-year-olds say there would be a problem in acquiring cannabis (44 % 'impossible' and 19 % 'very difficult' responses).

Young women were more prone to say that it would be very difficult or impossible for them to acquire cannabis (28 % compared with 20 % of young men), whereas more young men expected that it would be very easy to obtain cannabis (34 % compared with 25 % of young women).

Young people who had used cannabis were more likely than their counterparts who had not used the substance to say that cannabis was easily accessible. For example, 58 % of respondents who reported having used cannabis in the past year said it would be very easy for them to get hold of the drug; this proportion dropped to 20 % for those who had never used cannabis.

Young people's place of residence also influenced their perceived access to drugs. Rural dwellers were more likely than urbanites to answer that it would be very difficult or impossible for them to acquire cannabis. For example, 28 % of rural residents said it would be very difficult or impossible to acquire

cannabis if they wanted to, compared with 23 % of urban residents and 19 % of metropolitan residents.

In terms of drug control and regulation, the majority of respondents (59 %) still support cannabis prohibition, but this number has declined from 67 % in 2008.

Health risks of cannabis

The Flash Eurobarometer survey reported that although 91 % of young people recognised the health risks (medium or high) associated with regular use of cannabis, just two-thirds (67 %) thought it might pose a high risk to a person's health. The proportions of young people who reported that they thought regular use of cannabis would pose a high risk to a person's health were the largest in Malta, Lithuania, Romania, Hungary and Cyprus in ascending order (77–81 %). In most Member States, the proportion of respondents who said that regular cannabis use might pose a high risk to a person's health was significantly smaller than the proportion believing that about ecstasy.

Young people who had used cannabis also perceived the health risks associated with its use to be less serious. Just 36 % of those who had used cannabis in the past 12 months thought that the health risks associated with regular use of this drug were high; this proportion increased to 55 % for respondents who had used cannabis but not in the past 12 months, and to 75 % for respondents who had never used cannabis.

Turning to young people's perceptions about the health risks associated with occasional cannabis use, in most EU countries respondents who thought that there was a low health risk or no risk when using cannabis once or twice outnumbered those saying this involved a high risk to someone's health. The only exceptions were Romania (55 % 'high risk'), Cyprus and Greece (both 38 % 'high risk'). Czech respondents reported the least concern about the impact of occasional cannabis use on a person's health: just 7 % thought that this might pose a high health risk compared with 39 % who thought it would pose a low risk and 31 % who perceived no risk from this level of cannabis use. Other countries where more than half of young people selected the 'low risk' or 'no risk' responses were Slovakia (65 %), Spain (61 %), Belgium, the United Kingdom and Ireland (all 56 %), the Netherlands (54 %) and Denmark (52 %).

Estimates of cannabis consumption

Estimating the size of cannabis markets, whether in terms of the annual volume of cannabis consumed or of the monetary value it represents, is necessary to inform public policy decisions. Such knowledge contributes to a better understanding of the demand for cannabis and complements data on the prevalence of cannabis use. Consumption estimates may be used to qualify prevalence estimates. For example, if the overall numbers using cannabis (prevalence) remain stable, but intensive use becomes more frequent, quantities consumed would be expected to increase. Information on volumes consumed could indicate a change in the nature of the problem; it could be taken as an indicator of harm and may be used to assess the effect of specific interventions. Estimates of consumption may also be used to contextualise and review supply reduction strategies by looking at interception rates and at the relative size of production against consumption.

What are drug consumption estimates?

Consumption estimates are composite indicators based on several other measures.

Two types of approach may be used:

Demand-side approaches are based on estimates of drug use prevalence and estimates of average individual consumption of drugs (or on estimates of individual expenditure on drugs) in different groups of users, and allow the estimation of the volumes used in a year (or retail expenditure).

Supply-side approaches are based on estimates of quantities of drugs produced, imported or exported, and of losses (e.g. seizures); they allow the estimation of the volumes available for consumption.

Both approaches can yield a monetary value, using information on drug retail prices.

Although good-quality information is available on the prevalence of cannabis use in the general population across Europe, it is still difficult to identify and estimate the size of different groups of users based on patterns of use. Supply-side approaches are also difficult to execute as, except for seizures, many of the data needed are not available.

In the absence of routine, reliable and comprehensive data sets, estimates of cannabis consumption are based on several assumptions. Final estimates, which are highly dependent on the assumptions and data sources used, should be treated with great caution (Casey and Hay, 2009).

National estimates of cannabis consumption in Europe

Since 2000, national attempts to estimate cannabis consumption have been carried out in only a few European countries: Bulgaria, the Czech Republic, France, the Netherlands, Finland and the United Kingdom. In addition, recent attempts to estimate cannabis consumption in Europe (Costes et al., 2009; Kilmer and Pacula, 2009) have also produced estimates for these countries: they are reproduced here for comparison. Table 5.1 reviews the national estimates of cannabis consumption available in Europe.

Table 5.1: Estimates of cannabis consumption, by amount or expenditure, in several European countries

Country	Reference	Year	Method	Consumption (tonnes/year)	Expendiutre (millions of euros/ year)
Bulgaria	Bulgarian national focal point, 2009	2007	Not mentioned	15–20	26–34 (1)
	Costes et al., 2009	2007	Based on prevalence and individual consumption	Low: 5.5 Average: 6.3 High: 7.1	–
Czech Republic	Czech national focal point, 2009	2008	Based on prevalence and individual consumption	–	108
	Costes et al., 2009	2004	Based on prevalence and individual consumption	Low: 49 Average: 56 High: 63	–
	Kilmer and Pacula, 2009	2005	Based on prevalence and individual consumption	Low: 30 Best: 68 High: 141	Low: 210 Best: 470 High: 978
France	Legleye et al., 2008	2005	Based on prevalence and individual consumption	186 (2)	746 (2)
			Based on retail expenditures	208 (2)	832 (2)
	Costes et al., 2009	2005	Based on prevalence and individual consumption	Low: 262 Average: 299 High: 335	–
	Kilmer and Pacula, 2009	2005	Based on prevalence and individual consumption	Low: 178 Best: 399 High: 830	Low: 997 Best: 2 232 High: 4 647
Netherlands	Smekens and Verbruggen, 2005	2001	Not mentioned	100	600
	Van der Heijden, 2007	2006	Based on prevalence and individual consumption	62–81	–
			Based on coffee-shop sales	57–79	–
	Costes et al., 2009	2005	Based on prevalence and individual consumption	Low: 31 Average: 35 High: 39	–
	Kilmer and Pacula, 2009	2005	Based on prevalence and individual consumption	Low: 33 Best: 73 High:152	Low: 173 Best: 387 High: 805

Table 5.1: (continued)

Country	Reference	Year	Method	Consumption (tonnes/year)	Expendiutre (millions of euros/ year)
Finland	Hakkarainen et al., 2008	2004	Demand-side	1.7–4.3	–
	Costes et al., 2009	2006	Based on prevalence and individual consumption	Low: 7.6 Average: 8.6 High: 9.7	–
United Kingdom: Scotland	Casey and Hay, 2009	2006	Based on prevalence and individual consumption	86.3	390 ([3])
United Kingdom	Pudney et al., 2006	2003/4	Demand-side	412	1 489 ([4])
	Costes et al., 2009	2007/8	Based on prevalence and individual consumption	Low: 255 Average: 290 High: 325	–
	Kilmer and Pacula, 2009	2005	Based on prevalence and individual consumption	Low: 201 Best: 450 High: 937	Low: 676 Best: 1 515 High: 3 149

([1]) The original estimates in Bulgarian lev (BGN 50 million and BGN 66 million) were converted into euros using the average exchange rate of January 2009 (BGN 1 = EUR 0.5113) accessed at: http://www.x-rates.com/d/EUR/BGN/hist2009.html. Note that the average exchange rate for 2007 was not available.
([2]) These estimates do not account for cannabis products that are not bought. They may therefore underestimate the total amount of cannabis used.
([3]) The original estimate in pounds sterling (GBP 267.5 million) was converted into euros using the average exchange rate of January 2006 (GBP 1 = EUR 1.45862) accessed at: http://www.x-rates.com/d/EUR/GBP/hist2006.html
([4]) The original estimate in pounds sterling (GBP 1 031 million) was converted into euros using the average exchange rate of January 2004 (GBP 1= EUR 1.44446) accessed at: http://www.x-rates.com/d/EUR/GBP/hist2004.html

European estimates of cannabis consumption

There have been several attempts to produce estimates of European cannabis consumption during the past decade (see Table 5.2). These estimates, in addition to referring to different geographical areas and different years, also differ greatly in the assumptions and data sets on which they are based. It is likely that these methodological differences have had a substantial impact on the final results, hence the large differences in the estimates presented.

Table 5.2: Estimates of cannabis consumption at European level

Regional coverage	Reference	Year	Method	Consumption (tonnes/year)	Expenditure (millions of euros/year)
European Union and Norway (1)	Costes et al., 2009	2003–07 (5)	Based on prevalence and individual consumption	Low: 1 565 Average: 1 781 High: 1 996	–
European Union (2)	Kilmer and Pacula, 2009	2005	Based on prevalence and individual consumption	Low: 1 153 Best: 2 580 High: 5 368	Low: 6 041 Best: 13 524 High: 28 151
European Union	Van der Heijden, 2007	2006	Based on prevalence and individual consumption	2 055–2 875	–
			Based on production and seizures	2 160–3 020	–
West and central Europe (3)	UNODC, 2005d	2003	Demand-side	Herb: – Resin: 2 891	Herb: 18 000 (6) Resin: 19 513 (6)
			Supply-side	Herb: 3 160 Resin: 3 212	–
South-east Europe (4)	UNODC, 2005d	2003	Demand-side	–	Herb: 1 625 (7) Resin: 310 (7)
			Supply-side	Herb: 355 Resin: 114	–

(1) 23 EU Member States not including Luxembourg, Malta, Romania and Slovenia.
(2) All EU Member States except Bulgaria (26 countries).
(3) 26 EMCDDA reporting countries and Iceland, Liechtenstein and Switzerland.
(4) Four EMCDDA reporting countries (Bulgaria, Croatia, Romania, Turkey), Albania, Bosnia and Herzegovina and the former Yugoslav republic of Macedonia.
(5) This estimate is not attributed to a particular year since the population surveys were conducted across Europe between 2003 and 2007.
(6) The original estimate in US dollars (USD 19 116 million and USD 20 723 million) was converted into euros using the average exchange rate of January 2003 (USD 1 = EUR 0.941605) accessed at: http://www.x-rates.com/d/USD/EUR/hist2003.html
(7) The original estimate in US dollars (USD 1 726 million and USD 329 million) was converted into euros using the average exchange rate of January 2003 (USD 1 = EUR 0.941605) accessed at: http://www.x-rates.com/d/USD/EUR/hist2003.html

The results of the different studies displayed in Table 5.2 point to an annual consumption of cannabis in Europe of between 1 000 and 7 000 tonnes.

The lowest European estimates are those by Costes et al. (2009), possibly because of the smaller number of countries on which it is based. However, when comparing results by country with the estimates from Kilmer and Pacula (2009), those from Costes et al. (2009) remain lower. Although the assumptions made in the two studies differ in several respects, a major difference is that Kilmer and Pacula (2009) allowed for 20 % under-reporting in population surveys and applied a correction factor of 25 % to obtain their 'best' estimate. Once inflated by the same correction

factor, the average national estimates calculated by Costes et al. (2009) become much closer to those of Kilmer and Pacula (2009), although estimates for a few countries (Italy, Netherlands, Poland, Sweden, United Kingdom) remain much lower.

The UNODC's (2005d) estimates lie at the higher end of the range. They cannot be disaggregated by country, so comparisons remain very general. They include a larger number of countries, but the differences with the other two estimates are of such a magnitude that the reason is likely to be found elsewhere. The UNODC estimates are based on production estimates in different regions of the world, from which seizures are then deducted, to obtain estimates of the quantities available for consumption. In the case of cannabis, and herbal cannabis in particular, the UNODC recognises the limits of the exercise, noting that substantial information is missing, with a number of countries 'frequently identified by others as important source countries' but for which estimates of cannabis production are not available. It is likely that the method adopted by the UNODC leads to an overestimation of the quantities of cannabis available for consumption in Europe.

Discussion of consumption estimates

These results, at both national and European level, show that there is no standard method for estimating the size of the cannabis market in Europe. Some of the methods used are relatively sophisticated, but they are also based on extensive and complex sets of data that were available at the time at national level (e.g. Pudney et al., 2006). Other methods are rather simple, some of which based on assumptions that may still need to be backed up by empirical data. This is the case of the European estimates based on demand-side approaches (Costes et al., 2009; Kilmer and Pacula, 2009), which, although they may distinguish between regular and occasional users, usually apply the same estimate of average individual consumption to the prevalence of all the countries included in the final estimate. Thus, these approaches cannot allow for the substantial differences that exist between countries in patterns of use (frequency and amounts), and the effects these will have on consumption.

Based on the estimates of market size (Table 5.1) and the amounts of cannabis resin and herb seized each year, estimated interception rates were calculated. At national level, the interception rates obtained range from below 1 % in the Czech Republic, to 3–22 % in Finland, 6–25 % in the Netherlands, 7–26 % in the United Kingdom, 9–33 % in France and 78–93 % in Bulgaria.

These results raise a number of issues. First, calculating interception rates in this way may be questionable at national level. Interception rates in some countries appear to be artificially inflated by the seizure of substantial amounts of cannabis in transit or destined for export. This is because estimates of market size based on demand approaches take account of only the quantities consumed within the country, whereas seizure data may include some cannabis that was not destined for the domestic market, the result of which is an increase in the calculated interception rate.

Second, the wide ranges of some calculated interception rates show that these interception estimates are very sensitive and far from being stable. They are highly dependent on the quantities of cannabis seized, which can vary substantially from one year to another, making interception rates very volatile. They are also highly dependent on the estimates of market size, which may vary substantially according to the methodology used, and in particular depending on the assumptions made on the parameters used for generating estimates. In this context, it is not possible to provide robust national estimates of interception rates for cannabis products in Europe.

At European level, the results from the few studies conducted (Table 5.2) suggest that between 15 % and 45 % of combined cannabis resin and herb destined for the European illicit drug markets could be intercepted. The limitations listed for national estimates apply here too, making any attempt to reduce this range a rather speculative exercise.

Market shares of cannabis products in Europe

Estimated market shares

Cannabis cultivation seems to have increased sharply from the early to mid-1990s in some western European countries, partly as a response of cannabis consumers to the perceived poor quality and high price of imported resin, which was at that time the most widely used cannabis product. Around the beginning of the millennium, two clear groups of countries could be distinguished in Europe, depending on whether herb or resin was the most commonly consumed cannabis product (EMCDDA, 2004). Of the countries for which information was available, resin was the most commonly used form of cannabis in Germany, Ireland, Portugal and the United Kingdom, whereas herb was the most common cannabis product in Belgium, Estonia, Czech Republic, Estonia, Austria and the Netherlands. Since then, however,

the situation appears to have changed in some countries, and a substantial share of users may now be consuming domestically produced herbal cannabis.

This section aims to map out the market shares at consumption level of the different cannabis products across the 30 EMCDDA reporting countries. The focus is mainly on the relative market shares of resin and herb, and where possible a distinction is made between imported and domestic products. The market share of cannabis oil, consumption of which is considered to be very marginal in Europe, is not addressed in this analysis, nor is that of 'legal highs' that may contain THC.

Sources of information

In the absence of a standard methodology to estimate the market shares of different cannabis products across Europe, various sources and indirect indicators were drawn on for presenting this overview.

Data on annual seizures of cannabis resin and herb are available in all European countries. The shares of resin and herb between 2000 and 2009 in each country, in terms of both the number of seizures and the amounts intercepted, were analysed. In over half of the countries, it was possible to further disaggregate the data sets between police and customs seizures. Police data, which usually include a large number of small seizures, may provide some insights into the substances that are available at retail level, whereas customs data, which usually comprise a small number of large seizures, may be seen as a reflection of what is trafficked at wholesale and import levels.

Where available, data from general population surveys on illicit drug use and substance preferences were used, together with results from more targeted studies on cannabis users, complemented where possible with experts' opinions. Forensic data were also occasionally available; they may be useful in distinguishing between conventional herb and sinsemilla.

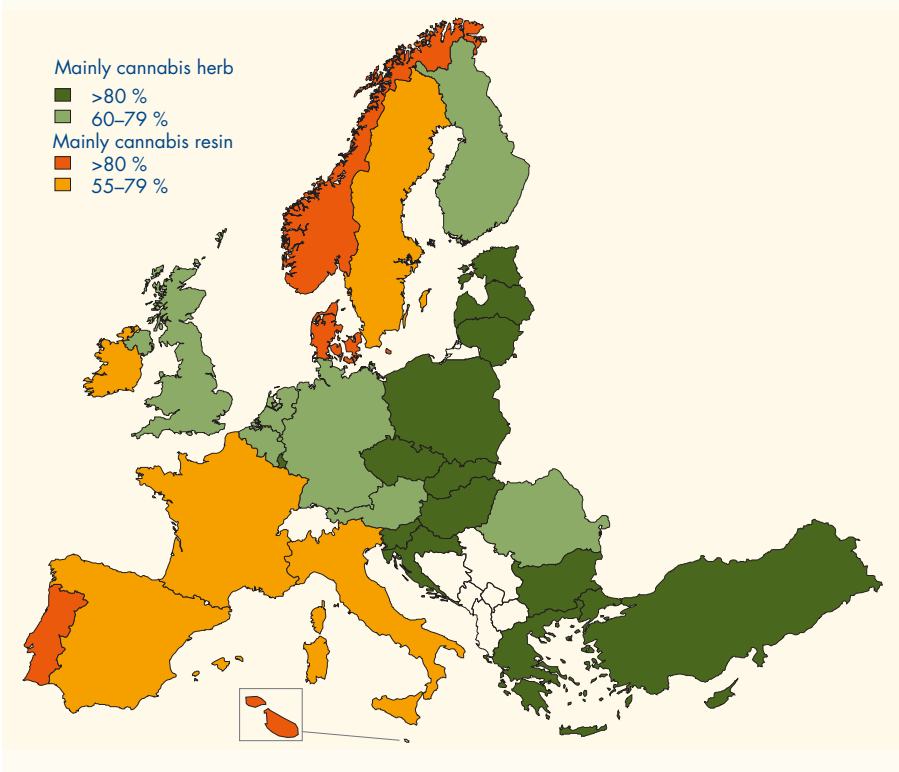
The data obtained from the above-mentioned sources are affected by a number of biases, and may not provide a representative picture of the market shares of different cannabis products consumed within a country. Data from these sources were not taken at face value, and confirmation by triangulation with other information sources was systematically searched for.

The analysis presented in this chapter is based on routine data submitted to the EMCDDA on cannabis seizures (2000–09) and on the information (from various sources) that was submitted by EMCDDA reporting countries in their national reports in 2009 (Reitox national focal points, 2009). It was supplemented, where possible, by information from the literature.

Cannabis herb in two-thirds of Europe

The data available from various sources point to a predominance of cannabis herb throughout Europe in 2009: cannabis herb appears to be the most used cannabis product in two-thirds of the 30 reporting countries, whereas cannabis resin is the product of choice in the remaining one-third (see Figure 5.4). Although these market shares appear to have remained stable over time in some countries, and may reflect long-established consumption patterns, in other countries they are the product of more recent changes.

Figure 5.4: Estimated market shares of cannabis products consumed in Europe, 2008/09



Notes: Estimates of market shares by country are available in Table A1 in the Appendix.
Source: EMCDDA analysis (based on Costes et al., 2009; EMCDDA, 2011b; Reitox national focal points, 2009).

High predominance of cannabis herb

In 14 countries (Figure 5.4), mostly located in central and eastern Europe, herbal cannabis is used by at least 80 % of cannabis users.

In 10 of these countries (Bulgaria, Czech Republic, Greece, Lithuania, Luxembourg, Hungary, Poland, Slovenia, Slovakia, Croatia), it is estimated that 90 % or more of the cannabis consumed is herbal. Resin is practically non-existent in these countries at user level ([37]). However, customs authorities in a number of these countries (Bulgaria, Czech Republic, Greece, Lithuania, Poland) report at times a higher predominance of resin in the quantities of cannabis intercepted, indicating that resin, intercepted at the border, may be trafficked at wholesale level, possibly in transit to other consumer markets.

Trend data suggest that the market share of cannabis herb has been increasing over the last decade in Bulgaria, the Czech Republic and Poland, and that it may have declined in Croatia.

The herbal cannabis consumed in these countries may originate inside or outside the country. Domestic production is thought to account for all herbal cannabis consumed in Slovakia (Costes et al., 2009), and most of that consumed in the Czech Republic (with just over half grown indoors and the rest outdoors). In Hungary, users report that the use of domestically grown herb, as opposed to the imported variety, has been increasing over the last decade, and now represents about half of the herbal material consumed. In Poland, the share of imported herb appears to be higher, with domestic herb accounting for 30 % of the herbal products consumed in the country, although increases in domestic production have been reported there.

Many of the group of 10 countries characterised by a very high prevalence of cannabis herb are located in east and south-east Europe, close to Albania, which has been portrayed as an exporter of herbal cannabis in spite of a lack of data on cannabis trafficking within the region (see Chapter 2). An exception is Luxembourg. However, Luxembourg has borders with Belgium and Germany, where cannabis herb although having a smaller share of the market, appears to be predominant.

([37]) Resin is, however, reported to predominate in a particular region of Slovakia that is traditionally visited by nationals from Arabic countries (Reitox national focal points, 2009).

In three other countries (Estonia, Cyprus, Latvia), herbal cannabis would account for, on average, 85–90 % of the cannabis market at user level. In Estonia, it is estimated that 80 % of the cannabis herb consumed is grown locally, whereas imported cannabis dominates the herbal market in both Cyprus (90 %) (Costes et al., 2009) and Latvia (80–90 %). In the latter, although imported herb is generally considered of better quality by cannabis users, the market share of domestic herb is reported to be increasing.

Lastly, in Turkey, estimates suggest that around 75–85 % of the cannabis market is herbal. Although herb (mainly of domestic origin) (Costes et al., 2009) is more popular in most regions, the use of resin dominates in east and south-east Anatolia. Resin is also predominant in the seizures reported by the customs authorities in Estonia and Turkey: some of the resin trafficked through the former is most likely destined for Finland and Russia, whereas resin intercepted in the latter probably originates locally, in south-west Asia and in the Middle East, and is destined for consumers in Turkey or is in transit to other markets.

Moderate predominance of cannabis herb

Herbal cannabis also appears to be dominant in a number of other countries (Belgium, Germany, Netherlands, Austria, Romania, Finland, United Kingdom), but to a lesser degree.

In the Netherlands, the increasing use of herbal cannabis can be traced back to the mid-1980s and the start of the 'import substitution' phenomenon, which saw a dramatic increase in the domestic production of cannabis herb (Jansen, 2002). Herbal cannabis, nearly all of it grown domestically ('nederwiet'), mostly indoors, has displaced imported resin in the Netherlands; it is now estimated to account for 60–70 % of cannabis consumption (Doekhie et al., 2010; Nabben et al., 2010; Schubart et al., 2011).

A similar pattern has been observed in Belgium, with imported resin predominating until the early 1980s, since when there has been a shift towards herbal cannabis (Decorte, 2007). It is likely that, initially, herbal cannabis on the Belgian market originated mainly in the Netherlands. However, it seems that herbal supply was soon sourced also from domestic production in Belgium. Today, given the strong links between the two countries in this area ([38]) (see Chapter 3), there is a blurring of the boundaries between these two domestic markets.

([38]) The links between the two markets for domestic herbal cannabis take several forms: Dutch nationals operate cannabis cultivation sites in Belgium, some of the cannabis grown in Belgium is sold to coffee shops in the Netherlands and some Belgian cannabis users obtain their supply from Dutch coffee shops.

In the United Kingdom, a shift towards the use of cannabis herb has been witnessed since the beginning of the millennium. Data from different sources indicate that the market share of cannabis products accounted for by resin fell from 70 % in 2002 to less than 30 % in recent years, paralleled by an increase in the market share of herbal cannabis from around 30 % (of which half was imported) in 2002 (EMCDDA, 2004; Hough et al., 2003) to 70–85 % (of which 80 % would be of domestic origin) in 2008–10 (Hardwick and King, 2008; Hoare and Moon, 2010). This development is likely to be the result of the partial replacement of imported resin by domestically grown herb (mostly indoors), similar to that which occurred in the Netherlands in the 1980s (see Chapter 3), although it would seem that this development started later in the United Kingdom and took place in two phases. The first phase, in which one imported product (resin) was partly replaced by another (herb), appears to have occurred in the late 1990s; the second phase, in which imported herb was replaced by domestic produce, began in the mid-2000s, and can be linked to the increase in domestic cultivation at that time, as suggested by seizure data (see Chapter 3). It should be noted, however, that this situation did not hold true for the whole of the United Kingdom: it appears that the cannabis market in Northern Ireland is more similar to that of Ireland (see below), where the dominance of cannabis resin persisted for much longer than in the rest of the United Kingdom.

In Austria, the predominance of cannabis herb over resin seems to date back to the late 1990s. Around the beginning of the new millennium, herbal cannabis accounted for an estimated 50 % (based on seizure data) to 70 % (EMCDDA, 2004) of the market; by 2009, it is estimated to have increased to about 75 %. Caution, however, is required here as the latter estimate is based on the number of cases of cannabis seizures; as these are mainly small seizures at retail level, confirmation against other information sources would be necessary.

Various sources of information in Germany seem to indicate that herbal cannabis as a proportion of total cannabis consumption has also increased there: from just below parity with resin in the late 1990s (EMCDDA, 2004) to about 70 % of the cannabis market today.

The use of resin is less marginal in this group of countries. Although the proportion of domestic resin, also called ‘nederhasj’, consumed in the Netherlands has remained stable, at about 1 % of total cannabis consumed, recent reports may point to a possible increase in the market share of imported resin (around 30 % or over).

The predominance of resin, in terms of quantities of cannabis intercepted, in Belgium and the Netherlands may indicate that, although herb is more often consumed there, substantial amounts of resin still transit through these countries destined for neighbouring countries, such as France or Germany, and for Nordic countries, where the use of cannabis resin is more prevalent. It may also simply reflect the higher exposure to interception of imported products (resin) than of the product of choice of cannabis users in these two countries (domestic herb), which is locally grown, closer to the end-users, and therefore probably less likely to be seized by law enforcement agencies.

Finland is the only Nordic country where consumption of herb appears to have become more frequent than consumption of resin among cannabis users (Hakkarainen et al., 2011b). The cannabis market, which used to be dominated by imported resin smuggled via Denmark, seems to have become increasingly supplied by domestic cultivation (Hakkarainen et al., 2011a). A variety of sources point to about 60–70 % of Finnish cannabis consumers using herb. The predominance of resin in the quantities of cannabis seized in Finland may be the result of a number of factors, including a higher risk of interception for resin (see Belgium and the Netherlands above), and the fact that Finland has lately become a transit country for resin, especially to Russia and to some extent also to other Nordic countries, where resin use remains predominant.

Seizure data place Romania within this group, suggesting that 60–85 % of cannabis users consume herb rather than resin, but this would need to be confirmed by other information sources.

Resin in a few western countries

In nine countries, all located in western Europe, resin consumption appears to be predominant, although signs of relative decline are reported in many of them.

High predominance of cannabis resin

Cannabis resin is estimated to represent at least 80 % of the cannabis products consumed in a small number of countries situated on the periphery of Europe.

Denmark and Norway appear to be the European countries where resin accounts for the highest market share of cannabis products, around 90 %. Seizures data may point to a slight decrease over time in the predominance of resin in Denmark

(in particular at user level), whereas the predominance of herb in police seizures in Norway might indicate that a shift towards a more herb-dominated cannabis market is currently taking place there.

These two countries would appear to be followed by Portugal, which, because of its proximity to the main trafficking route of Moroccan resin through the Iberian Peninsula, has always included a relatively large proportion of consumers of resin among its cannabis-using population. A recent decline in the relative proportion of resin in cannabis seizures could indicate, however, an increasing consumption of herb. Although cannabis herb is predominant in seizures reported by the customs in Portugal, pointing to the traditional importation of 'liamba' from former Portuguese colonies in Africa, this seems to account for a negligible proportion of the cannabis consumed in the country.

Data available on Malta are not conclusive: the strong predominance of resin in seizure cases points to a highly predominant use of resin (80 %), whereas the predominance of cannabis herb in quantities intercepted could indicate some transit of herbal material.

Moderate predominance of cannabis resin

In five countries (Ireland, Spain, France, Italy, Sweden), resin seems to dominate the consumer market for cannabis in proportions varying between 55 % and 80 % of the cannabis used. Some of these countries appear to have experienced a shift from a market nearly entirely dominated by resin to one in which herb is increasingly present.

Ireland seems to have experienced a substantial increase in the use of cannabis herb, though to a lesser extent than some parts of its neighbour, the United Kingdom. At the end of the 1990s, resin was used by an estimated 90 % of cannabis users in Ireland (EMCDDA, 2004). Data from different sources for the period 2002–07 point to around 60 % of cannabis users consuming resin and 40 % herb. More recently, there are indications that the difference in the relative proportions of herb and resin may have narrowed further (Arnold, 2011).

France has also seen an increase in the market share of herbal products among cannabis users in the last decade, most likely linked to a possible increase in home-grown cannabis cultivation in the country. Although over 85 % of cannabis seizures are of resin, surveys suggest that 60–70 % of cannabis consumers use resin and

30–40 % herb. It is estimated that at least 30 % of herbal cannabis used in France is of domestic origin (Costes et al., 2009).

The cannabis market in Spain, because of its proximity to Europe's main cannabis resin supplier (Morocco) and its location on the main trafficking route of Moroccan resin to other western European markets, has long been dominated by resin consumption. The market appears, however, to be changing. Available data indicate that herbal cannabis products have been gaining popularity in the last decade (e.g. through the spread of social clubs growing cannabis), and it is thought that 20–30 % of the cannabis consumed in Spain could be now herbal.

Seizures data appear to suggest that the Italian cannabis market is dominated by resin. Although resin accounts for 65–75 % of cannabis seizures, triangulation with other information sources is needed, as relatively large cannabis cultivation sites have been dismantled in Italy within the last decade, which may point to a higher use of herb.

In Sweden, different sources converge to estimate that resin represents around three-quarters of the cannabis used there. Herbal cannabis used in Sweden is believed to originate from domestic cultivation (Costes et al., 2009).

Discussion and implications for consumption estimates

The above analysis shows the market share of cannabis herb is increasing across Europe at the expense of cannabis resin. Herbal products, which already dominate the cannabis market in eastern and central Europe, and in some western countries (Belgium, Germany, Luxembourg, Netherlands, Austria, Finland, United Kingdom), are increasingly gaining ground in the west.

In the early 1990s, most cannabis users in Europe were to be found in western Europe, and were mainly using imported resin, predominantly from Morocco, but also from Afghanistan, Lebanon and Pakistan.

During the 1990s, in the post-communist countries, democratisation, the transition to a market economy and the opening of the borders were accompanied by the spread of cannabis use beyond the few closed groups that might have been using it before the fall of the Iron Curtain (e.g. in the Czech Republic). Whether because they were relatively far from the trafficking routes of Moroccan resin to the main markets of west and north-west Europe, and geographically closer to the Albanian export-driven production of cannabis herb, or because traditional hemp cultivation for

industrial (textiles, rope) and other (traditional medicines, religious rituals) purposes was already present in some countries in the region (Czech Republic ([39]), Greece, Slovakia, Turkey), the increase in cannabis consumption witnessed in eastern and central Europe over the last two decades mainly involved herbal cannabis.

At the same time and during the first years of the new millennium, the increase in domestic cannabis cultivation in a few west European countries (see Chapter 3) led to the partial replacement in some major European markets of imported resin by herbal material produced within Europe.

However, a crude calculation, based on the estimated average market shares of the two cannabis products and last year prevalence data from the latest general population surveys (EMCDDA, 2011b), suggests that resin is still being used by about half of cannabis users in Europe. Of the 22.5 million estimated to have used cannabis in the last year in the European Union and Norway (EMCDDA, 2011a), it is estimated that about 11.3 million would have used resin and 11.2 million would have used herb.

Based on estimates of annual cannabis consumption at individual level elicited by Kilmer and Pacula (2009) — 150 grams for last month users and 15 grams for last year (but not last month) users ([40]) — around 940 tonnes of cannabis resin and 860 tonnes of cannabis herb could be consumed annually in the EU and Norway. Assuming a 20 % under-reporting of cannabis use (Kilmer and Pacula, 2009), these tentative estimates would increase to around 1 270 and 1 180 tonnes,

([39]) In the Czech Republic, and possibly in other countries in the region, outdoor cannabis growing was in place before the transition period. It would seem, however, that it is now indoor growing that drives the market in that country.

([40]) As a point of comparison, a qualitative study in six cities in Europe (Eisenbach-Stangl et al., 2009) estimated that average monthly consumption of cannabis herb consumed in the different cities varied from 15 to 31 grams among socially integrated users and from 10 to 46 grams among marginalised users. In the only two cities reporting average monthly consumption of cannabis resin, this was estimated to be 9 and 26 grams among integrated users and at 46 and 63 grams among marginalised users.

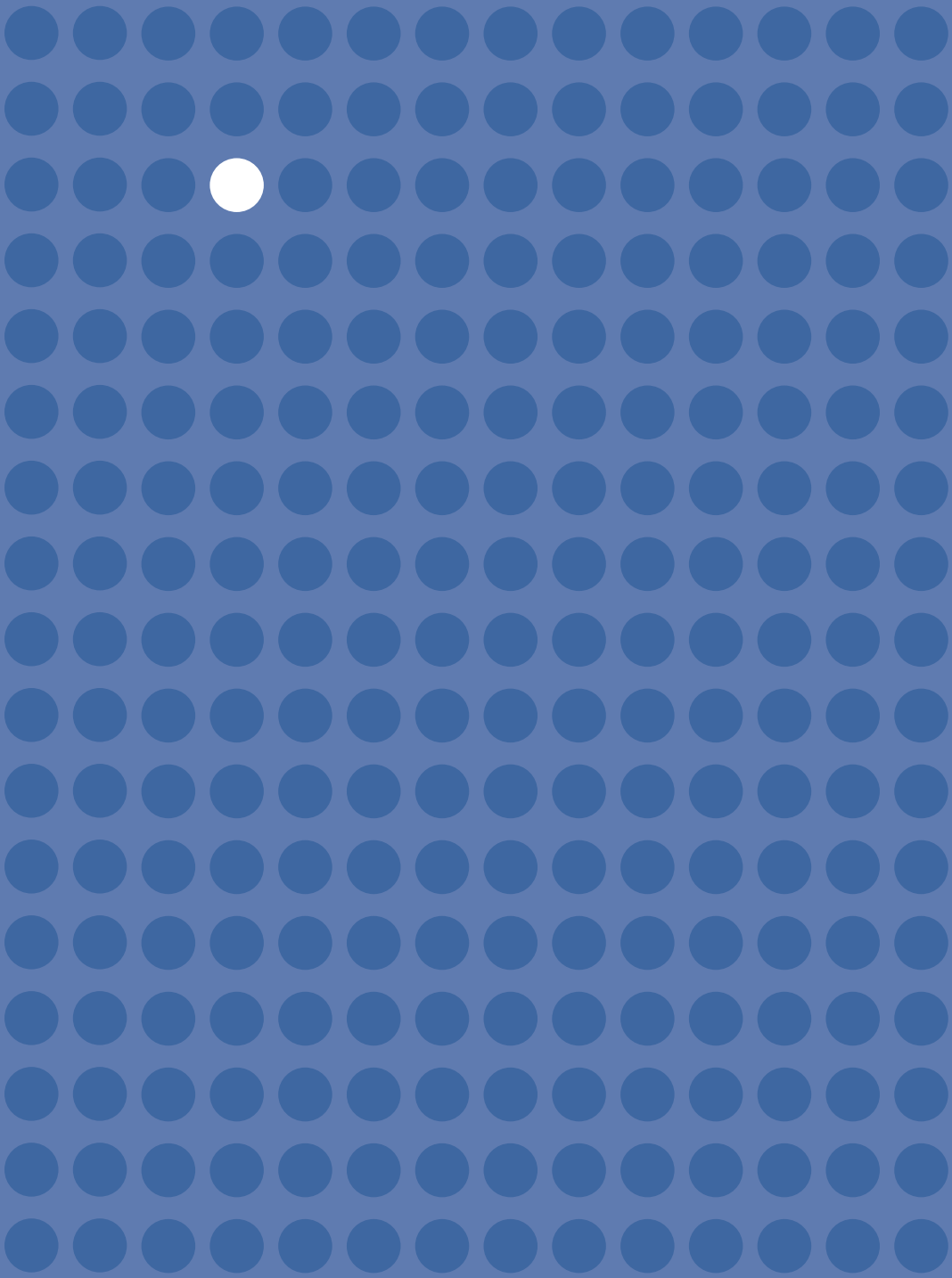
respectively ([41]). The corresponding national estimates point to cannabis resin consumption being concentrated in a few countries, with three-quarters of the estimated total being consumed in only three countries — Italy (31 %), Spain (27 %) and France (21 %) — followed at a distance by Germany (6 %) and the United Kingdom (4 %). Estimates of the consumption of cannabis herb suggest a more even spread across Europe, with the United Kingdom being the largest market and accounting for 21 % of total European consumption, followed by Germany (16 %), Italy (14 %), France (12 %) and Spain (10 %). The Czech Republic, the Netherlands and Poland each account for about 4–5 %.

These are tentative estimates, for which the precision cannot be defined. The caveats mentioned earlier in this chapter (see 'Estimates of cannabis consumption') apply here too. In particular, extreme caution is required as this type of calculation, which assumes the same average individual consumption for both cannabis products across Europe, does not account for the likely differences between countries in terms of patterns of use (frequency and amounts) and structure of the cannabis-using population (beyond the distinction between last year and last month users). Nor does it account for potential differences in consumption patterns between users of resin and users of herb, which is probably a major limitation. In addition, under-reporting may also differ across cultures and social groups.

As a final remark, the above estimates (both of the size of the using population and of total annual consumption), in particular for cannabis herb, could be increased substantially if Turkey were included in the calculations ([42]).

([41]) Estimated total quantity of resin consumed (kg) = {(LMPC × 0.150 kg) + [(LYPC – LMPC) × 0.015 kg)]} × MSR × *N*, where MSR = market share of resin (%), LMPC = lifetime prevalence of cannabis use (%), LYPC = last year prevalence of cannabis use (%), LMPC = last month prevalence of cannabis use (%) and *N* = population size. A similar calculation was performed for herb by substituting the market share of herb by that of resin in the formula. The results were multiplied by 1.25 to correct for potential under-reporting of 20 %.

([42]) The lack of population survey data for Croatia and Turkey prevented these countries from being included in the estimates mentioned in this section.



Chapter 6: Responses to cannabis supply in Europe

Chapter 6: Responses to cannabis supply in Europe

Legislation controlling cannabis cultivation and supply

Developments in international control of cannabis have influenced national laws as all EU Member States and candidate countries are party to the international system. Analysis of the current legislation in the different European countries suggests differences in how legislation is used to address cannabis cultivation and supply, as well as in how it is interpreted and enforced.

International level

Cannabis was first placed under international control by the 1925 International Opium Convention, following a proposal from Egypt at the Second League of Nations Opium Conference. The drug had been proposed for inclusion in the First Opium Conference in 1911 by French and Italian delegates, but that proposal was subsequently withdrawn. In the 1925 Convention, cannabis was referred to as 'Indian hemp' (Article 1), which covered only the dried or fruiting tops of the pistillate (female) plant, as these were considered to be 'particularly rich in the pharmaceutically strong active resin' (United Nations, 1973). The 1925 Convention prohibited the export of cannabis resin to countries that prohibited its use (Article 11(a)), as well as 'internal' control, including unauthorised possession, of cannabis extract and tincture (Articles 4 and 7). The Convention outlined that breaches of national laws should be punished by 'adequate' penalties (Article 28). The process behind the inclusion in the Convention was not without controversy; it is now accepted that delegates were given little time to conduct due diligence on materials.

By 1953, the Commission on Narcotic Drugs supported the view from the World Health Organization (WHO) representative that the term 'cannabis' should be used instead of 'Indian hemp'. Thus, the United Nations Single Convention on Narcotic Drugs of 1961 used the term 'cannabis', which it defined as 'the flowering or fruiting tops of the cannabis plant (excluding the seeds and leaves when not accompanied by the tops) from which the resin has not been extracted, by whatever name they may be designated' (Article 1(1)(b)). The limitation to female plants was removed, as it was considered that law enforcers would not be able to easily distinguish between male and female plants; subsequent studies found that the 'male and female plants contain similar amounts of cannabinols per weight' (United Nations, 1973). The

cannabis plant was defined as 'any plant of the genus *Cannabis*', removing the debate over whether *Cannabis indica* L. was a separate species to *Cannabis sativa* L., and any future such debates should a new variety be discovered. It also did not consider the yield or potency of resin, thus including plants grown for fibre, though the requirements of the 1961 Convention should not apply to cultivation of the plant for industrial purposes (Article 28(2)). Cannabis resin was defined as resin separated from the plant. The leaves themselves are excluded from the above definition of cannabis, but Article 28(3) of the Convention required countries to adopt measures as necessary to prevent misuse of and traffic in the leaves.

If a country permits cultivation of cannabis plants for production of cannabis or resin, it should establish a national agency to oversee this (Article 28(1–2)). Countries should prevent illicit traffic (Article 35), which is defined as including cultivation (Article 1(1)(l)); the process of separating cannabis from the plant is considered as 'production' (Article 1(1)(t)). Subject to any constitutional limitations, countries should make unauthorised possession of cannabis a punishable offence, and serious offences shall be liable to adequate punishment, particularly imprisonment (Article 36). However, with the signing of the 1988 UN Convention against illicit traffic, these criminal offences for supply-related offences became mandatory (Article 3, paragraph 1(a)(iii), 1988 Convention).

European Union level

Council Resolution of 16 December 1996 on measures to combat and dismantle the illicit cultivation and production of drugs within the European Union invited Member States to pay special attention to the prevention and detection of illegal cultivation and production of drugs, to consider banning the sale of cannabis seeds for the purpose of illicit cultivation, and to ban protected or indoor cultivation of cannabis. Subsequently, Council Resolution of July 2004 (CORDROGUE 59, 11267/04) encouraged Member States to take measures against cultivation and trafficking of cannabis within the European Union, and to consider taking measures against Internet sites providing information on cultivation.

Illegal drug supply was then addressed in the EU Council Framework Decision 2004/757/JHA of 25 October 2004. This established a maximum penalty of at least 1–3 years for basic supply offences including cultivation and production offences. When offences involve large quantities of drugs, or drugs that cause the most harm to health or have resulted in significant damage to the health of a number of persons, the penalty should be a maximum of at least 5–10 years.

Nevertheless, legal cultivation and supply of cannabis plants for fibre is possible in the European Union, provided the yield of delta-9-tetrahydrocannabinol (THC), the main psychoactive constituent, is low. Industrial hemp in the European Union has a maximum permitted content of THC, fixed in accordance with Article 52 of Regulation (EC) No 1782/2003, which was changed in 2006 to read 'Article 52: Production of hemp. 1. In case of production of hemp, the varieties used shall have a THC content not exceeding 0.2 %. Member States shall establish a system for verifying the tetrahydrocannabinol content of the crops grown on at least 30 % of the areas on hemp. However, if a Member State introduces a system of prior approval for such cultivation, the minimum shall be 20 %.' Aid from the European Union may be used to subsidise high-quality hemp production (within the above limits) for fibre and perhaps for other industrial uses.

National level

As far as the classification of cannabis at national level is concerned, the variety of laws and procedures within the European Union reflect both the stringent requirements suggested by the UN Conventions and the 'room for manoeuvre' allowed at Member State level. Legislation may be divided into those legal systems in which cannabis is considered fundamentally different from other drugs and those in which cannabis is treated on a par with all other drugs, but where prosecutorial instructions or even judicial discretion in practice apply a distinction between substances.

First, in certain countries, lists or classes established in or directly linked to the laws are used to determine different legal degrees of severity in control and prosecution of offences. Cannabis is often included among those drugs that do not incur the maximum legal response. For example, in Cyprus, the Netherlands and the United Kingdom, illicit drugs are categorised and legal penalties for offences relating to the supply of cannabis are less severe than those demanded by offences related to other substances. In Italy, cannabis, in 1993, was in a category of drugs that attract punishments of less severity than other drugs; however, a law enacted in 2006 eliminated this difference on the assumption that all illicit drugs are dangerous. Strikingly, no other substance listed in Schedule IV of the 1961 Convention — which lists substances particularly liable to abuse and to cause ill-effects — attracts lower penalties in this way. By contrast, in Bulgaria and Romania, cannabis is listed as a substance that carries a higher degree of risk than those in other categories, and the established penalty for supply offences related to cannabis is much higher.

The penal laws of six other European countries include clauses that increase the penalty for supply offences for certain drugs. In Denmark, Spain, Italy, Malta and Finland, an increased penalty is prescribed for offences relating to substances generally referred to as more dangerous or harmful, in line with the EU Framework Decision's reference to 'drugs which cause the most harm to health', while Turkey specifies an increased penalty for offences involving cocaine, heroin, morphine or morphine base. However, prosecutor or sentencing directives, and reports of jurisprudence, suggest that cannabis is not judged as a more dangerous substance in these countries.

Finally, 18 of 30 countries (the 27 EU Member States, Croatia, Turkey and Norway) treat supply of all controlled substances equally under the law, and it would be for judicial discretion to decide how the sentence should be weighted according to the substance involved.

National control is not obligatory for cannabis seeds, but they are specified as subject to the drug control laws of Cyprus and Portugal. In other countries, supply of cannabis seeds for cultivation might be covered by a more general offence of 'facilitating drug production' or similar.

At first glance, there is considerable variation in maximum penalties for cannabis supply offences. However, it would be misleading to state only the fact that maximum penalties for basic or minor cannabis supply offences range from 2–3 years in Denmark, Estonia, Spain, Sweden, Finland and Norway to life imprisonment in Ireland, Cyprus and Malta. The first group of countries have established a scale of offences with graduated punishments, within which aggravated supply may attract maximum sentences of 15–20 years in prison, whereas countries in the second group have one maximum sentence for any supply offence, and allow judicial discretion to play a wider role. The penalty range allowed in countries' laws may depend on a variety of defined aggravating circumstances, not just the substance involved, and this makes direct comparison between countries much more difficult. Analysis of the laws only reveals that factors affecting the penalty imposed include the amount of drug involved (most countries except France, Cyprus, Luxembourg, Malta, Slovenia and the United Kingdom), the involvement of organised crime or gangs (most countries), the motive (in Germany, the Netherlands, Austria and Poland a distinction is drawn between profit-seeking or commercial behaviour and other supply) and the court in which the offender is tried (Ireland, Malta, United Kingdom). Analysis of prosecutor directives and sentencing guidelines would reveal further nuances. The

variations in laws and guidelines can be clearly illustrated by considering one of the more important factors: the quantity involved.

Threshold quantities

Analysis of quantity distinctions between drugs in the national legislations shows that weights may be given as total weight or weight of the active principle, with the latter adjusted for purity/potency (EMCDDA, 2011c). In some countries, quantities are mentioned in the law as small or large, but no quantitative limits have been set out in legislation or police/prosecutor guidelines; rather, these terms are interpreted by expert opinion or judicial precedent. In general, the results of the analysis illustrate that quantities may be established at different legal levels (laws, guidelines), and for many or just for a few drugs; and there is little consistency between countries.

When considering cannabis cultivation, only a few countries define quantity limits in terms of the numbers of plants permitted. In Belgium, cultivation of no more than one plant should be a minor offence resulting in a fine, and in the Netherlands, cultivation of not more than five plants would normally not be prosecuted, whereas in Cyprus three or more plants is presumed to constitute a supply offence. In Denmark, 100 grams of cannabis plants is considered the limit for possession for personal use. In Portugal, where drug use and personal possession offences were decriminalised in 2001, cultivation of any amount, even for personal use, remains a criminal offence; similarly, in Finland, any cultivation will be considered as a narcotics offence, which is more serious than an offence of unlawful narcotics use. In the United Kingdom, the drug offences sentencing guideline, published by the Sentencing Council (2012), which took effect on 27 February 2012, proposes sentence starting points for cultivation of nine plants (fine or community order, depending on involvement) and 28 plants (community order or 1 year's custody, depending on involvement), as well as for commercial and industrial operations. Only in the Netherlands has guidance been issued on what would be considered a large amount: cultivation of more than 200 plants will be subject to a higher sentencing range.

No comprehensive comparison of cannabis supply prosecution or sentencing guidelines has been carried out to date. Nevertheless, when considering possession of cannabis, rather than cultivation of plants, a cursory analysis of offence sentence ranges and quantity threshold data already available from a few countries is instructive.

For example, amounts of less than 1 kilogram apparently attract significant sentences in Hungary, Lithuania and Slovakia. In Hungary, possession of more than 20 grams

of THC (e.g. 200 grams of resin with a potency of 10 %) increases the range of the possible sentence from 2–8 years to 5–20 years. In Lithuania, possession of more than 25 grams of resin or 500 grams of herbal cannabis increases the sentence range from 2–8 years to 8–10 years. In Slovakia, a trafficking offence (or possession of more than 10 doses) of any substance is to be punished with a range of 4–10 years' imprisonment, but this rises to 10–15 years if the offence was on a 'larger scale' according to the penal code. An offence on a larger scale is considered to involve an amount of drugs with street value of about EUR 2 700; with 2008 street values reported at EUR 15–34 per gram, that would imply an increase in sentence for a quantity of more than 100–200 grams.

In Denmark, Spain, Austria and Finland, penalties are increased when amounts of the order of kilograms are involved. In Austria, the penalty increases from a maximum of 5 years to a range of 1–10 years if the quantity is more than 300 grams THC. In Spain, jurisprudence shows that more than 2.5 kilograms of resin or 10 kilograms of herb will result in activation of the penal code's provisions to increase the basic sentence of 1–3 years by 'one or two grades'. In Finland, judicial practice is that an individual found with more than 1 kilogram of resin will be sentenced for an aggravated narcotics offence (1–10 years' imprisonment) rather than a standard narcotics offence (up to 2 years in prison). A higher level is found in Denmark; the Danish Director of Public Prosecutions' notice, revised in 2008, states that the guide quantity for prosecution under the penal code (up to 10 years in prison) rather than under the Act on Euphoriant Substances (up to 2 years in prison) is about 10 kilograms of resin or 15 kilograms of herb.

At the other end of the scale is the concept of minor supply. Although some laws consider the (lack of) profit motive of the offender in general, there have been specific attempts to consider the nature of joint or group use, where the practice of sharing a cannabis cigarette amounts to an offence of supply which may require a proportional response. Belgium removed 'drug use in a group' as a criminal offence in 2003, and Malta, acknowledging that a minimum penalty of 6 months for supply was disproportionate in such cases, changed the law in 2006 to permit exclusion of that punishment for a first offence, if 'the offender intended to consume the drug on the spot with others'. In Hungary, a clause introduced to the drug control sections of the penal code in 2003 allowed suppliers to qualify for diversion to a treatment alternative to punishment if the offence 'involves a small quantity offered or supplied to be consumed jointly', but the following year the Constitutional Court struck down the clause, on the grounds that the word 'jointly' was too vague to form the basis of a criminal law.

Regulated supply of cannabis: the Netherlands

The Netherlands is the only country in Europe that has a nationwide system for regulated supply of psychoactive cannabis. In fact, it has separate systems for supply of cannabis for medical and non-medical purposes.

Coffee shops are cannabis sales outlets licensed by the municipality, based on a practice of tolerance first set out in national guidelines in 1979. About three-quarters of municipalities do not allow coffee shops, and the number of coffee shops across the country is steadily decreasing, from 846 in 1999 to 666 in 2009. The sale of small quantities of cannabis in coffee shops is technically an offence, but is tolerated in the attempt to keep young adults who experiment with cannabis away from other, much more dangerous drugs. Prosecution proceedings are instituted only if the operator or owner of the coffee shop does not meet the criteria issued by the Prosecutor General:

- not more than five grams per person may be sold in any one transaction, and the coffee shop is not allowed to keep more than 500 grams of cannabis in stock;
- no 'hard drugs' may be sold;
- drugs may not be advertised;
- the coffee shop must not cause any nuisance;
- alcoholic beverages may not be sold;
- no drugs may be sold to minors (under the age of 18), nor may minors be admitted to the premises.

Municipalities may also instigate their own criteria, such as a minimum distance from schools (generally 250 metres). Two new criteria were introduced in the three southern Dutch states in May 2012, and will be implemented across the Netherlands from January 2013. Coffee shops should be closed clubs with no more than 2 000 registered members, and those members must be resident in the Netherlands. From January 2014 the minimum distance from schools will be 350 metres. The mayor may order a coffee shop to be closed if these criteria are disregarded (Article 13a of the Opium Act). The ultimate result may also be the prosecution of the offender, whether the proprietor of the coffee shop, the client, or both.

Since 2003, the Office of Medicinal Cannabis has been the government agency with a monopoly on supplying medicinal cannabis to pharmacies and general practitioners within the terms of the 1961 UN Convention. Three types of cannabis are available, varying in THC (about 6 %, 12 %, 19 %) and CBD (<1 %, 7.5 %) content, at a cost of about EUR 45 for 5 grams. These may be prescribed for relief of symptoms arising from multiple sclerosis, HIV/AIDS, cancer, long-term neurogenic pain, and tics associated with Tourette's syndrome. In 2010, about 500 people were using this medicinal cannabis.

Cannabis-related offences

Initial reports on drug law offences, mainly from the police, are the only data on drug-related crime routinely available in Europe ([43]). These data usually refer to offences related to drug use (use and possession for use) or drug supply (production, trafficking and dealing), although other types of offences may be reported (e.g. related to drug precursors) in some countries.

Data sources and limitations

Data on drug law offences are a direct result of law enforcement initiatives and activities, since they refer to consensual crimes, which usually go unreported by potential victims. They are often viewed as indirect indicators of drug use and drug trafficking, although they include only those activities that have come to the attention of law enforcement. Additionally, they are also likely to reflect national differences in legislation, priorities and resources. Furthermore, national information systems differ across Europe, especially in relation to recording and reporting practices. For these reasons, it is difficult to make valid comparisons between countries, and it is usually considered more appropriate to compare trends rather than absolute numbers.

The EMCDDA routinely collects national aggregated data on drug law offences through its network of Reitox national focal points. All 30 reporting countries (the 27 EU Member States, Croatia, Turkey, Norway) submit annual data sets, although recent data may not be available in some cases. Where possible, a breakdown by drug and broad type of offence (use related, supply related) is provided. As far as cannabis is concerned, no distinction is made between the different products (e.g. resin, herb). Data by drug type date back to the last decade in most reporting countries, although in a few exceptions series may start earlier (mid-1990s).

Depending on the reporting practices, data may refer to all offences or only to the principal ones, and to all substances involved or only to the principal ones. In both cases, however, the rules governing the attribution of the qualification 'principal' may differ across Europe.

The stage in the criminal justice system at which the data are collected is likely to influence the profile of the country. In most countries, the available data are initial reports by law enforcement agencies, whether for criminal or administrative offences.

([43]) For a discussion of the relationships between drugs and crime and a definition of 'drug-related crime', see EMCDDA (2007).

However, in a few exceptions, data may be collected at a later stage in the process, when criminal proceedings are commenced; this may have the effect of excluding those offences that did not result in a charge, possibly disproportionately affecting offences attracting lower sanctions (e.g. consumption offences) ([1]).

Most of the analysis in this section is based on this routine data collection ([2]). Trends are analysed from the start of each series in each country.

([1]) For example, formal warnings for cannabis possession, in use in the United Kingdom since 2004, are not included in the data reported in this section. This results in an underestimation of the share of cannabis, and cannabis consumption, among drug law offences in that country.

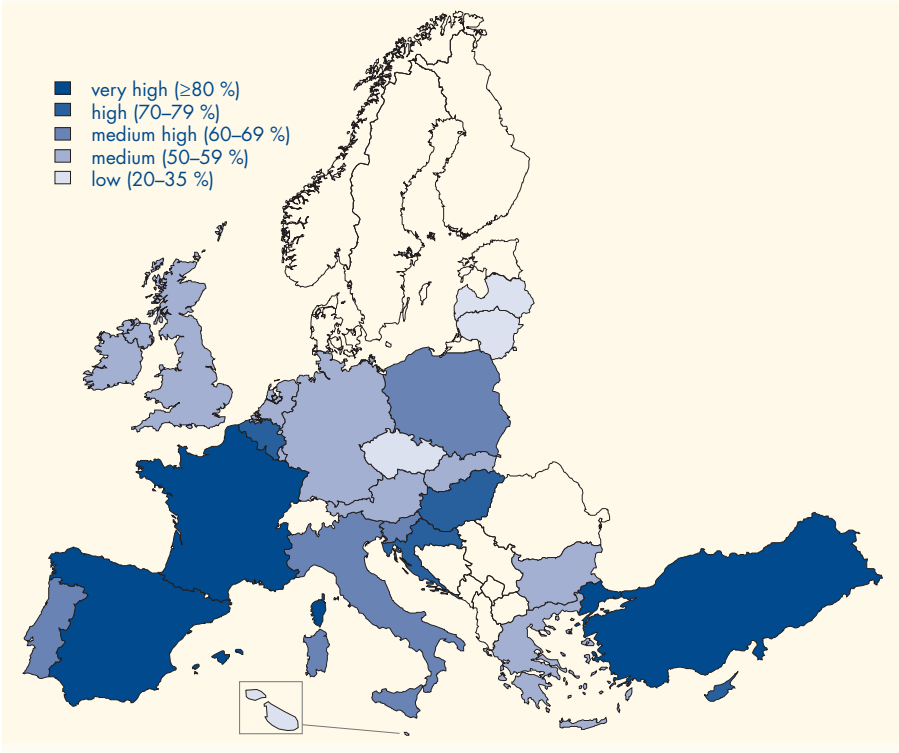
([2]) Detailed data on drug law offences by country in Europe can be accessed in the 2011 EMCDDA *Statistical bulletin*, available at: http://www.emcdda.europa.eu/stats11

The overall number of drug law offences in Europe has generally been on the increase since the mid-1980s, when the first national series started to be reported. A European index, based on data provided by 21 EU Member States (95 % of the population aged 15–64 in the European Union), shows that the number of drug law offences increased by an estimated 21 % in the last 5 years. This increase would be of 216 % if Turkey were included. An analysis of national data over the period 2004–09 reveals upward trends in 18 countries and a stabilisation or an overall decline in 11.

Cannabis: a major share of drug law offences

Cannabis offences make up the majority of drug offences reported in Europe today, as was the case 15 years ago in the few countries reporting detailed data. In most countries, offences involving cannabis accounted for between 50 % and 79 % of reported drug law offences in 2009. The highest proportions were reported in Spain, France and Turkey (Figure 6.1). Offences related to other drugs exceeded those related to cannabis in only three countries: the Czech Republic and Latvia with methamphetamine, and Malta with both cocaine and heroin.

Figure 6.1: Predominance of cannabis offences in reported drug offences in Europe, 2009



Notes: The map represents the proportion of drug law offences attributed to cannabis.
In the absence of 2008 and 2009 data, 2007 data were used for Ireland.
Data were not available for Denmark, Estonia, Romania, Sweden, Finland and Norway.
Source: EMCDDA and Reitox national focal points.

Historical data, in some cases from the mid-1990s, show an increasing predominance of cannabis offences over time in Germany, Spain, France, Lithuania, Luxembourg, the Netherlands, Portugal and Turkey. This trend seems to have accelerated in recent years in Spain and Turkey, two countries where the proportion of drug law offences attributed to cannabis was already among the highest in Europe. In most of the other countries, the proportion of offences related to cannabis has not changed markedly. Cannabis as a proportion of all drug law offences has declined in four countries: in Malta and Slovenia, where it appears to be the result of a decrease in the number of cannabis offences recorded since 2001; and in Ireland and Austria, where it is likely to reflect a comparatively greater increase in offences related to other substances.

Over the last 15 years, the number of cannabis offences has increased in most European countries reporting data ([44]). In three countries (Spain, Portugal, Turkey) this trend showed signs of accelerating in 2008–09, whereas cannabis offences in Germany and the Netherlands, although increasing overall since the second half of the 1990s, have declined slightly from peak levels reached in 2004. Data from Italy, Malta, Slovenia and Croatia, on the other hand, point to a decline over the period (EMCDDA, 2011b).

Cannabis offences: largely related to use rather than supply

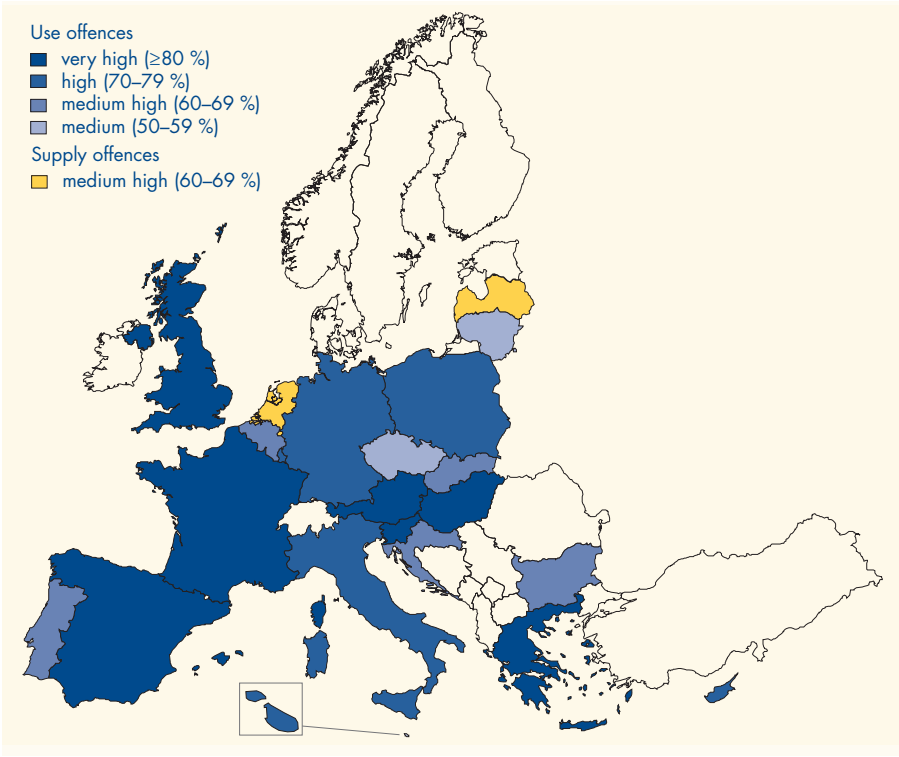
Offences related to drug use and possession for use have historically accounted for most reported drug offences in Europe. This was the case in 23 out of 25 European countries with sufficient data in 2009. The highest proportions (over 80 %) were reported in Estonia, Spain, France, Hungary, Austria and Sweden. In both the Czech Republic and the Netherlands, offences related to drug supply predominate. In most reporting countries, both the number of use and the number of supply-related offences increased from 2000 to 2009, although the increase in the latter generally occurred at a much lower pace and since 2006 their number has stabilised at European level.

Analysis by substance reveals that most of the cannabis offences reported in Europe over the last 15 years were related to use or possession for use. Data for 2009 show that in 19 out of 22 countries with sufficient data a majority of cannabis offences were related to use, with proportions varying between 51 % and 96 %; in only two countries, Latvia and the Netherlands, did supply offences reportedly predominate among reported cannabis offences (Figure 6.2).

Trend analysis shows that these proportions have remained relatively stable over time in most countries with sufficient and comparable data. In some other countries, the predominance of use in cannabis offences has increased: since the mid-1990s in Spain, France, Germany and Italy, and since the mid-2000s in Poland. In the Netherlands, the high proportion of supply-related cases in reported cannabis offences has slightly decreased in the last 3 years (2007–09).

([44]) In the absence of sufficient and comparable data, trend analysis in the number of cannabis offences could not be performed in Bulgaria, Denmark, Estonia, Latvia, Hungary, Romania, Finland and Norway.

Figure 6.2: Predominance of use or supply offences in reported cannabis offences in Europe, 2009



Notes: The map shows the proportion of all cannabis offences accounted for by offences related to drug use and possession for use in countries where these offences predominate, and the proportion of all cannabis offences accounted for by offences related to drug supply in countries where these offences predominate.
Data were not available for Denmark, Estonia, Ireland, Romania, Finland, Sweden, Turkey and Norway.
Source: EMCDDA and Reitox national focal points.

The number of offences related to the use of cannabis increased in 9 of the 18 countries with sufficient data for analysis over the last decade, remained relatively stable in six and declined in three (Bulgaria, Slovenia, Croatia). The most dramatic change observed was a fivefold increase in Spain.

Similar trends were found in offences for cannabis supply over the same period, with increases in 9 out of 19 reporting countries, stable trends in seven and a decline in four (Bulgaria, Italy, Netherlands, Poland).

Clusters of countries

Most of the European countries that are able to provide sufficient data are characterised by a predominance of offences related to cannabis consumption in their reported drug law offences. Spain and France lead this group, reporting ([45]) that cannabis-related offences account for the highest proportions (over 80 %) of both drug law offences in general and drug consumption offences. In both of these countries, the predominance of consumption offences among cannabis offences has increased over the last decade to around 90 %. The number of cannabis consumption offences also increased over the first 10 years of the millennium in these two countries.

In the Czech Republic, Lithuania and Malta, cannabis is much less predominant, accounting for around 40 % of all drug offences in the Czech Republic and around 30% in the other two countries. However, as in the main group of countries mentioned above, the majority of cannabis offences are related to consumption in Lithuania and Malta, whereas in the Czech Republic the relative proportions are more equal ([46]). As a proportion of all drug offences related to consumption, cannabis is the drug most often mentioned in the Czech Republic and Lithuania, whereas it comes after cocaine and heroin in Malta. Supply offences are largely dominated by methamphetamine in the Czech Republic, and by both heroin and cannabis in Lithuania, while in Malta cocaine is predominant.

Latvia and the Netherlands appear atypical in Europe, in that most (over 65 %) of the cannabis offences reported in these countries are related to supply. The predominance of supply offences in the Netherlands results from the absence of targeted investigations with regards to use and possession for personal use there. In Latvia, where cannabis accounts for less than one-third of all reported drug offences, methamphetamine is sometimes as frequently or more often reported, dominating together with heroin in consumption offences, and together with cannabis in supply offences.

The Netherlands differs from Latvia in that, like the first large group of countries above, cannabis would seem to be involved in a majority of drug cases, with 'soft

([45]) In the United Kingdom, it is likely that offences related to cannabis consumption would represent a much larger share of drug law offences, possibly giving it a profile similar to that of Spain or France, if the cases attracting a warning were included in the data reported in this section.

([46]) Data for 2009 (including administrative offences) point to a rather balanced situation (51 % for consumption vs. 49 % for supply), but this would need to be ascertained over time (data were not available for previous years).

drugs' (likely to include mostly cannabis) ([47]) accounting for 53 % of all drug offences. 'Soft drugs' account for 37 % of offences not reported as supply offences, and in the absence of additional data it is not possible to know which 'hard drugs' are frequently involved in these offences. In the case of drug supply offences, 'soft drugs' dominate, accounting for 60 % of such offences. Other data suggest that drug cases represent around three-quarters of investigations into organised crime in the Netherlands each year (Reitox national focal points, 2009), and that, over time, the proportion of such cases involving 'hard drugs' has declined, concomitant with an increase in involvement of 'soft drugs'. The proportion of organised crime investigations involving only offences related to 'hard drugs' declined from 69 % to 33 % between 2004 and 2009, while those involving only 'soft drugs' offences increased from 11 % to 28 %. Similarly, over the same period, investigations of other crimes but involving 'hard drugs' together with other crimes decreased from 84 % to 72 %, while those involving 'soft drugs' and other crimes increased from 27 % to 67 %. It appears that three-quarters of such investigations concern the trafficking and cultivation of domestic herbal cannabis ('nederwiet') and one-quarter the trafficking of cannabis resin.

Discussion of cannabis offences

From the above analysis, it would appear that drug law enforcement in Europe is mostly directed at cannabis consumption. This result is not surprising as cannabis is the most widely available and used illicit drug in Europe, both geographically and socially.

Cannabis for the European markets is mainly produced in Europe or in a number of neighbouring countries. The bulk of cannabis resin consumed in Europe originates not far away in Morocco, whereas cannabis herb is being increasingly grown in Europe. Cannabis is now found all over Europe, where it is the most consumed illicit drug. In many countries, cannabis has now spread throughout the social spectrum. Its consumption is therefore likely to be found everywhere and, as a consequence, law enforcement agencies are more likely to arrest cannabis users than users of heroin or cocaine, who are usually confined to a limited number of specific and less easily reachable social subgroups.

([47]) Available data in the Netherlands do not distinguish between different substances but do distinguish 'soft drugs' and 'hard drugs'. Although the first category includes a number of substances, such as sedatives and hallucinogenic mushrooms, it is likely that a very high proportion of the offences related to 'soft drugs' concern cannabis products. The term 'hard drugs' includes other substances such as heroin, cocaine, amphetamine, methamphetamine, ecstasy and GHB.

It has been argued that the method of management through performance indicators, with the setting of annual statistically measurable objectives, which has spread over Europe during the last two decades, may have had the unintended consequence of pushing law enforcement agencies to focus their activity on some types of offences rather than on others. Drug offences, especially drug use offences, but in some settings cannabis production offences, may be an example of this (Cour des comptes, 2011; Lalam and Laniel, 2011; Wouters, 2008). Drugs offences are consensual crimes, which become visible and recorded in law enforcement statistics only as a result of law enforcement initiatives, as there is usually no 'victim' to report them (EMCDDA, 2009). In order to meet performance targets, law enforcement forces may prioritise drug offences, thus increasing the volume of reported crimes and, especially, improving their general clearance rate (Matelly and Mouhanna, 2007). Unlike drug supply cases, which often demand long, complex and resource-demanding investigations, while not always producing statistically measurable results such as arrests and drug seizures, drug consumption cases are far simpler to pursue, may be recorded immediately, and appear overall as more 'statistics friendly'. Thus, for instance, by arresting two individuals caught smoking a joint, an officer may be able to record two offences; depending on the national legislation, check two individuals into police bail; make a drug seizure; and record two cases cleared (a clearance rate of 100 %).

Seizures of cannabis products in Europe

At European level, cannabis resin is the most seized illicit drug, before cannabis herb. In 2009, about 400 000 seizures of resin and 350 000 of herb were reported, with quantities intercepted totalling an estimated 600 and 100 tonnes, respectively. As a point of comparison, the next most seized illicit substance in Europe, cocaine, was only reported in about 100 000 cases and the total amount seized was 60 tonnes ([48]).

At national level, the relative importance of cannabis seizures, compared with seizures of other illicit drugs, may vary. Data for 2009 show that cannabis herb is the most frequently seized drug in 15 out of 28 reporting countries, and resin in only six. In terms of quantities intercepted, cannabis herb is the most seized drug in 14 out of 30 reporting countries, whereas resin is the most seized drug in 10. In three countries (Ireland, Lithuania and Romania), heroin apparently outranks both cannabis products in terms of quantities seized, while the illicit drug accounting for the largest quantities intercepted is cocaine in Romania, amphetamine in Estonia and methamphetamine in Lithuania.

([48]) The figures in this paragraph should be read as estimates, as missing data had to be extrapolated from previous years.

Data sources, methods and limitations

Drug seizures are a direct indicator of the activity of law enforcement authorities. Some of them may be the result of long and resource-demanding targeted investigations, while others may result from routine controls. They have long been viewed as an indirect indicator of the presence and flows of illicit drugs across a territory. However, caution is required when interpreting the data, as interception rates may vary widely depending on products and markets, and across time, as a result of a number of factors, including the priorities of and the resources available to law enforcement agencies.

The EMCDDA routinely collects national aggregated data on drug seizures through its Reitox network of national focal points in Europe. Data on quantities of cannabis resin and cannabis herb (provided in kilograms) are available in all 30 reporting countries (the 27 EU Member States, Croatia, Turkey, Norway), although recent data may be missing in some cases. In the case of missing data, data from adjacent years were substituted to estimate European totals. Information on the number of seizures is available from all but two countries (Netherlands, Poland). Since 2007, United Kingdom seizures data do not include seizures in Scotland.

A number of countries provided breakdowns of their 2008 resin and herb seizures by size category (<150 grams, 150 grams to 1 kilogram, 1 to 50 kilograms, over 50 kilograms): Denmark, Spain, France (only for resin), Cyprus, Luxembourg, Hungary, Austria, Poland (only for herb), Portugal, Slovakia, United Kingdom (England and Wales).

In the absence of detailed data on the distribution of seizures by weight over the years, average sizes of seizures based on aggregated annual data were used. However, caution is required, as high averages may be the result of a few exceptionally large seizures.

To eliminate the effect of exceptional annual variations, several indicators are based on 3-year averages calculated from 2007–09 data (e.g. average size of seizures; proportion of domestic consumption that is intercepted).

Estimates of national consumption are arrived at using a demand-side approach (based on prevalence of use data and individual consumption estimates), detailed in the last section of Chapter 5.

Interception rates ([1]) were calculated at European level, as it may be safely assumed that cannabis seized in Europe is destined for European markets. At national level, however, it cannot be assumed that cannabis seized in a country is destined for the national market, in particular because there is much intraregional trafficking of cannabis products within Europe. For this reason, an analysis of the relative size of national seizures (total quantities intercepted) compared with the estimated size of the national market (total consumption) was preferred.

([1]) Interception rates are calculated by dividing the quantity seized by the sum of estimated consumption with quantity seized.

Predominance of resin or herb in seizures: varying patterns

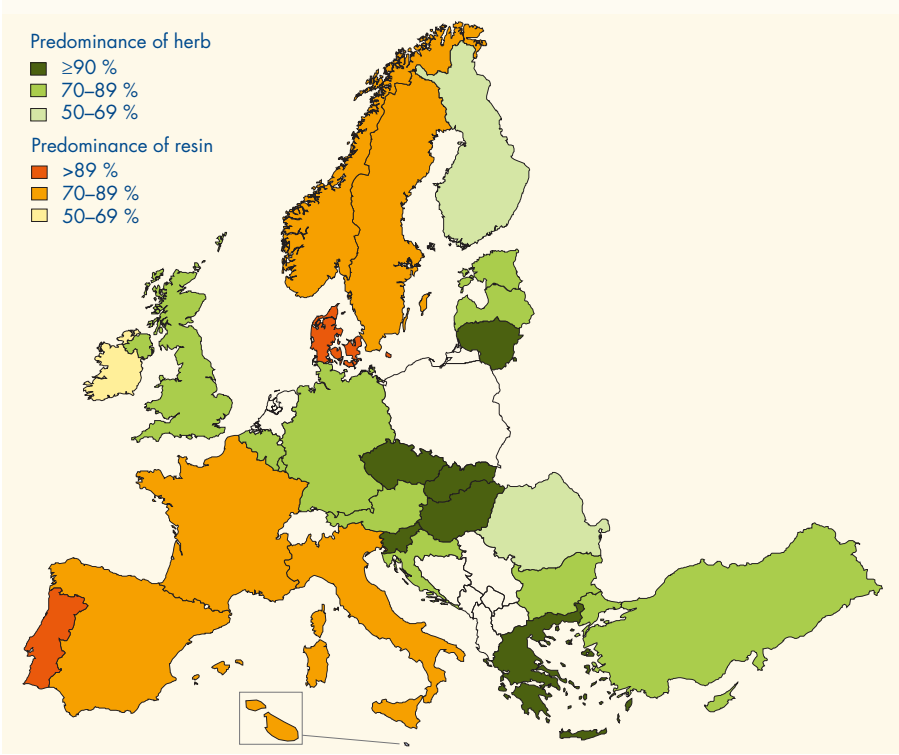
Analyses of the number of seizures and of the quantity intercepted may provide different insights into the state of the cannabis market.

The number of seizures, which usually includes a large majority of seizures of small quantities, may be considered as an indirect indicator of trends at the lower levels of the supply chain. An analysis of 2008 data from 10 countries has confirmed that almost all seizures of resin (between 90 % and 100 %) are of less than 150 grams of the drug. Similar results were found for herb: in 2008, 88–99 % of the countries analysed in nine countries were below the 150 grams threshold. The exception was Poland, where law enforcement agencies could be targeting the higher levels of the herbal cannabis supply chain: in 2008 over half of the 54 seizures of herbal cannabis analysed were between 1 and 50 kilograms and over one-third were between 150 grams and 1 kilogram.

The total annual quantity intercepted, in contrast, may be strongly influenced by a few very large seizures and thus might be considered an indirect indicator of trends at wholesale and importation levels.

Figures 6.3 and 6.4 show the predominance of resin or herb in the number of seizures and the quantities intercepted in 2009. Seizure data suggest that at retail level (Figure 6.3), herb is the predominant cannabis product in eastern and central Europe, whereas resin predominates in western Europe and Scandinavia. Figure 6.4 shows a rather similar picture, although the higher predominance of resin in several countries (compared with Figure 6.3) could indicate that substantial amounts of resin are trafficked at higher levels in the supply chain.

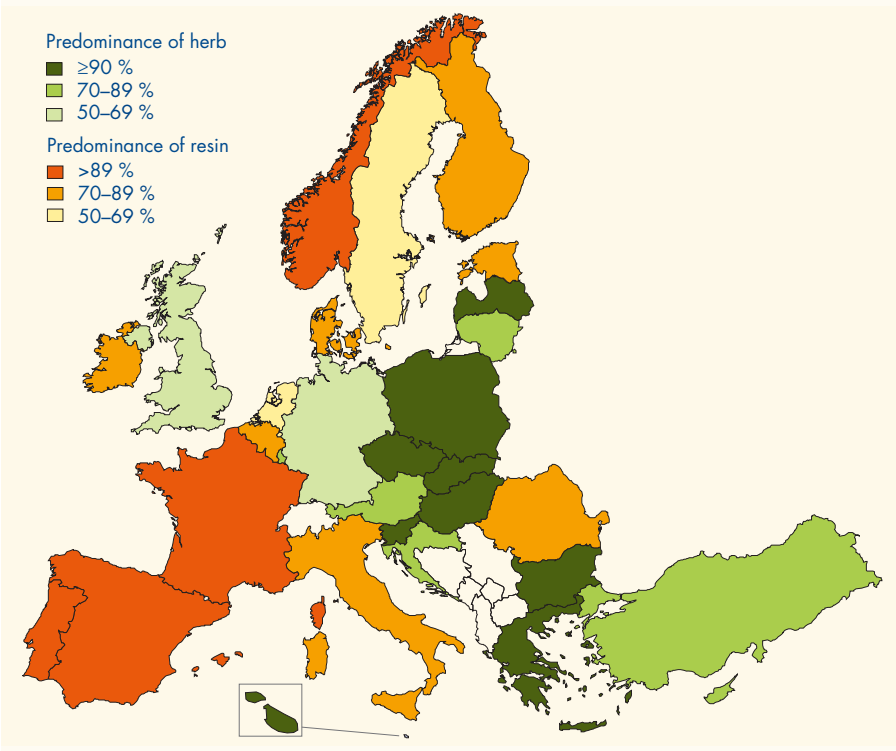
Figure 6.3: Predominance of resin or herb in numbers of cannabis seizures across Europe, average 2007–09



Notes: The map shows the average, over 2007–09, proportion of cannabis seizures accounted for by resin in countries where resin seizures predominate, and the average proportion accounted for by cannabis herb in countries where herb seizures predominate. Cannabis seizures include seizures of both resin and herb (plants are not included). In the absence of 2009 data, 2006–08 data were used in France. Data were not available in the Netherlands and Poland.

Source: EMCDDA and Reitox national focal points.

Figure 6.4: Predominance of resin or herb in quantities of cannabis seized across Europe, average 2007–09



Notes: The map shows the average, over 2007–09, proportion of seized cannabis, by quantity, accounted for by resin in countries where quantities of resin predominate, and the average proportion of herb seized in countries where quantities of herb predominate. Quantities of cannabis seized include seizures of both resin and herb (plants are not included). In the absence of 2008 and 2009 data, 2005–07 data were used in the Netherlands.
Source: EMCDDA and Reitox national focal points.

A comparative analysis of the relative proportions of the two indicators — numbers of seizures and quantities seized — accounted for by resin and herb seems to delineate two groups of countries ([49]).

([49]) For this comparative analysis, the categories used in Figures 6.3 and 6.4 may be misleading. For this purpose, only differences of more than 5 percentage points between the share of resin (or herb) in the number of seizures and that share in the quantities seized are considered.

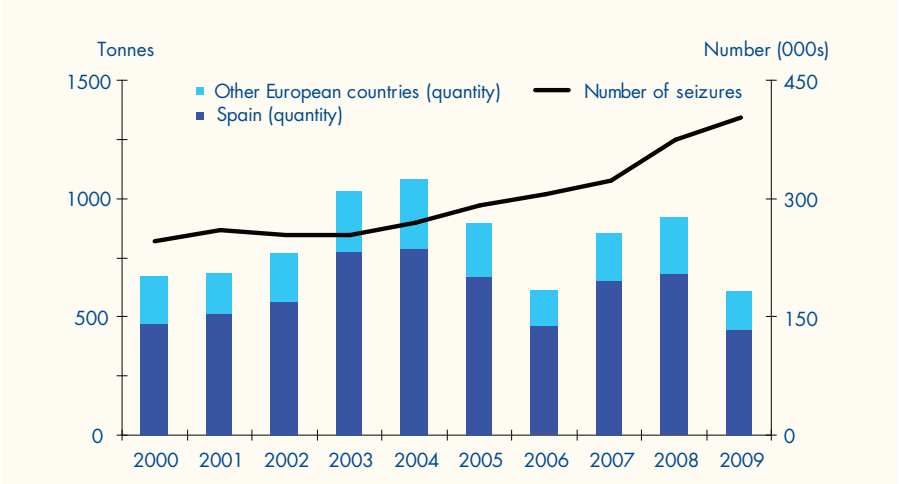
A first group of 12 countries is characterised by a similar predominance of resin (Denmark) or herb (Czech Republic, Greece, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Slovakia, Slovenia, Croatia, Turkey) in both measures. This could indicate that the predominance of one or the other cannabis product is relatively stable and homogeneous throughout the different levels of the cannabis market in these countries.

In a second group, also of 12 countries, resin accounts for a higher proportion of quantity of cannabis seized than of the number of seizures, whereas the opposite situation is true of herb. In six of these countries, resin is predominant in both measures (Ireland, Spain, France, Italy, Portugal, Norway), and in two herb is predominant in both measures (Germany, United Kingdom). However, in Belgium, Estonia, Romania and Finland, there is a higher discrepancy between the two indicators, with the number of cannabis seizures being dominated by herb and the quantity of cannabis seized dominated by resin. In the first subgroup of six countries, where resin is still the predominant cannabis product at all levels of the market, such results might suggest that herbal cannabis products are present at retail level to a greater extent than seized quantities suggest. This may be due to herbal cannabis being produced locally, closer to the end-user, and therefore less likely to be intercepted in bulk. The increasing share of herb in cannabis cases reported in Ireland, Spain, Portugal and Norway would, in particular, lend support to the argument that herbal products are gaining ground at retail level in these countries. This is likely to also hold true for Germany and the United Kingdom, where most of the consumption is of herb, but where the market for resin would still be large in terms of size compared with most countries (see end of Chapter 5). In the last subgroup comprising Belgium, Estonia, Romania and Finland, all characterised by the predominance of herb in cannabis consumption, the fact that larger quantities of resin are intercepted may reflect the use of these countries as transit or redistribution points for resin destined to other European countries.

Cannabis resin seizures

The number of seizures of cannabis resin has been increasing during the last decade in Europe, whereas the amount intercepted has fluctuated (Figure 6.5). Data show an increase from over 650 tonnes in 2000 to an all-time peak at 1 080 tonnes in 2004, followed by a decrease to 600 tonnes in 2006, another peak at over 900 tonnes in 2008 and a decrease to 600 tonnes in 2009.

Figure 6.5: Trends in seizures of cannabis resin in Europe, 2000–09



Notes: The figure shows the total amount of cannabis resin seized in Europe (bars) and the total number of seizures of cannabis resin reported (line) by year over the period 2000–09. As some missing data had to be extrapolated at country level from data from adjacent years, 2008 and 2009 European totals of numbers of seizures and quantities intercepted should be considered as estimates.

Source: EMCDDA and Reitox national focal points.

Trends at European level largely reflect those in Spain. This country consistently accounted for three-quarters of all cannabis resin intercepted in Europe during the 10-year period from 2000 to 2009; over the same period the number of reported cannabis seizures accounted for by Spain increased from one-third of the European total in the first few years of the millennium to half since 2006. Since 2005, between 450 and 700 tonnes of cannabis resin have been recovered annually in Spain and the number of reported cases has increased from 120 000 to 230 000.

Behind Spain, but accounting for only one-tenth of the quantity of cannabis resin seized in Spain over the period 2007–09, lies France, followed by Portugal (Figure 6.6). As in Spain, quantities intercepted in these two countries have been fluctuating, with annual figures since 2005 varying between 35 and 85 tonnes in France and between 8 and 60 tonnes in Portugal. Although recent trends are difficult to interpret, overall, amounts of cannabis resin recovered in Spain, France and Portugal have been on the increase since the mid-1990s.

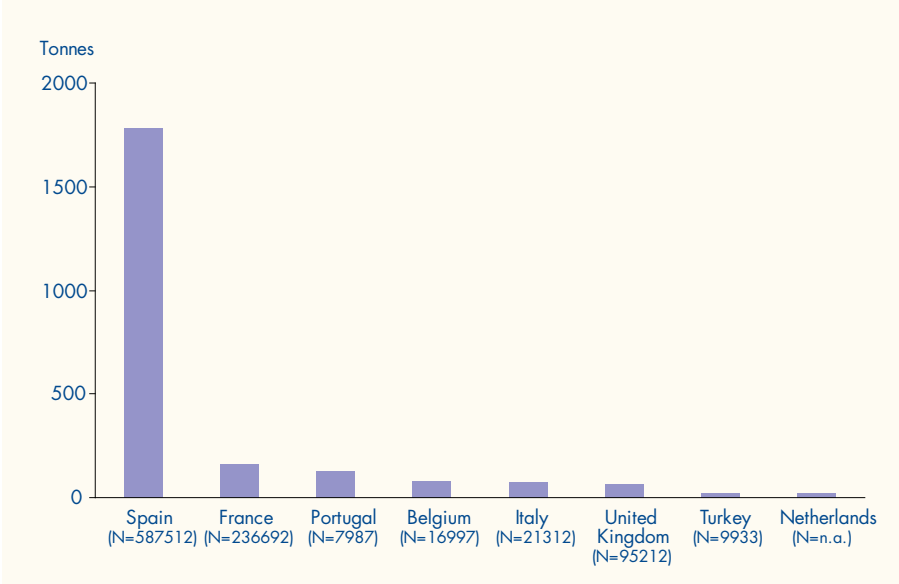
Belgium, Italy and the United Kingdom are the countries reporting the next highest quantities of seized cannabis resin. In Belgium and Italy, fluctuations seem to be the norm and no clear trend can be observed over the last decade: the degree of fluctuation is greatest in Belgium, where the annual quantity of cannabis resin seized has varied form a couple of hundred kilograms to 60 tonnes. In Italy, annual seizures have varied between 15 and 45 tonnes. In the United Kingdom, however, data point to a substantial decrease in the amounts intercepted, from an annual average of 75 tonnes in the second half of the 1990s to around 25 tonnes a year since 2005.

An overall decrease in the amount of resin seized has also been observed in Germany since the end of the 1990s and in the Netherlands since 2000 (though more marked since 2004). However, the lack of recent data prevents any analysis of trends after 2007 for the Netherlands.

Two countries seem to be out of step with the rest, having observed an overall increase in the quantities of resin intercepted every year over the last decade: in Sweden, the quantity intercepted has increased from a few hundred kilograms in the mid-1990s to over 1.5 tonnes in 2009 and in Turkey it has risen from 300 kilograms in 2001 to nearly 10 tonnes in 2009, with an acceleration of this upward trend in 2007.

The largest number of annual cannabis resin seizures is reported by Spain, with 230 000 seizures of resin in 2009, followed by France with 85 000 cases (2008) and the United Kingdom with 25 000; Belgium, Denmark, Italy, Sweden and Norway all report between 5 000 and 10 000 cases a year. Analysis of trends since the second half of the 1990s in countries reporting over 1 000 seizures reveals an increase in the annual number of seizures of resin in Spain, France, Portugal and Sweden, and a long-term decline in Germany, Austria, Finland and the United Kingdom. It is interesting to note that increasing trends are reported in countries where cannabis consumption is dominated by resin, while downward trends are reported in countries that have, over the last decade, seen resin partly replaced by herb in terms of consumption and where herb would seem to be now more frequently consumed than resin (see Chapter 5).

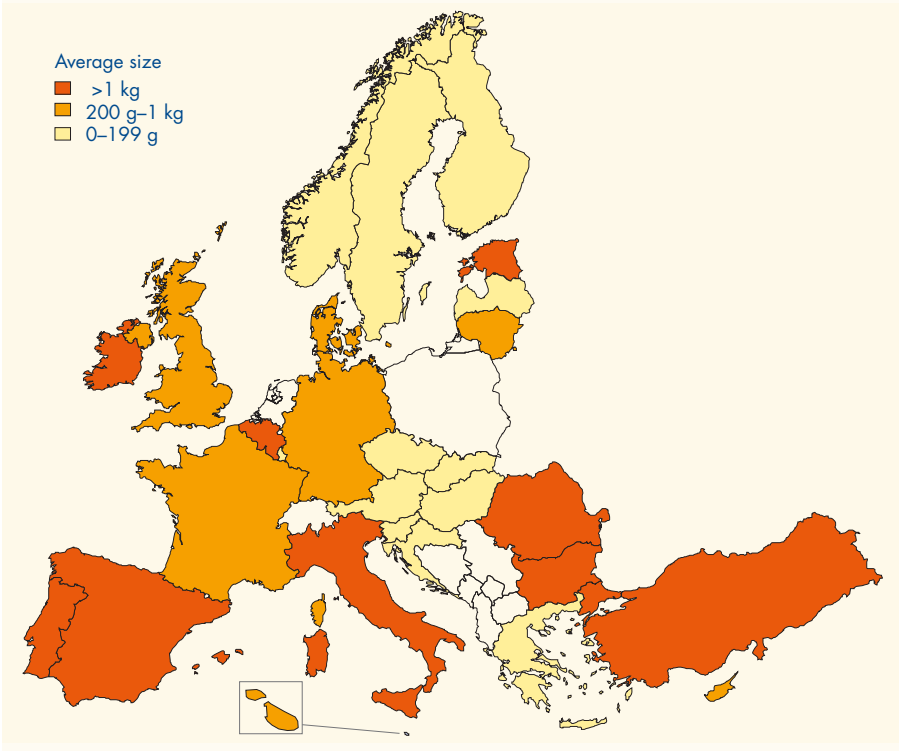
Figure 6.6: Cumulative amounts of cannabis resin intercepted over 2007–09 in the eight countries reporting the largest seizures in Europe



Notes: *N* is the total number of reported seizures of cannabis resin over the period 2007–09. The values for the Netherlands are for the period 2005–07, as data for 2008 and 2009 are not available. In France, 2008 data were used in place of unavailable 2009 data to estimate the total number of cases.
Source: EMCDDA and Reitox national focal points.

The largest average seizures of cannabis resin tend to be found in countries that are relatively close to producing areas, or are major entry points to Europe (Figure 6.7). In the case of resin originating in Morocco, the Iberian Peninsula has historically been used as a point of entry into Europe; Italy lies just across the Mediterranean Sea; and Ireland is an entry point for resin destined for the Irish or United Kingdom markets. Belgium's role is probably as a distribution hub, as its market for resin would seem to be limited. Among east European countries, Estonia, Romania and Bulgaria are likely to be transit points towards the west for resin originating in Asia; Turkey may play a similar role, although it is also both a producer and a consumer market for resin.

Figure 6.7: Average size of seizures of cannabis resin, 2007–09



Notes: The map shows the aggregated average size of seizures of cannabis resin over the period 2007–09, obtained by dividing the total amount seized by the total number of seizures reported during the period. In the absence of 2009 data on the number of resin seizures in France, the average size refers to the period 2006–08 in that country. Data were not available for the Netherlands and Poland.

Source: EMCDDA and Reitox national focal points.

Data available for the 2007–09 period suggest that the largest seizures of resin in Europe usually occur in Portugal, with the average resin seizure amounting to nearly 16 kilograms. Data from previous years confirm the large size of seizures in Portugal, compared with those in other countries, over the last decade. In comparison, the average size of resin seizures in Belgium since 2007 has been 4.6 kilograms, while Spain and Italy report average resin seizures of about 3 kilograms and Ireland 1 kilogram.

The quantities of resin seized in Turkey are also relatively large, with the average seizure being at least 10 kilograms in the years 2006 to 2008, possibly reflecting the transit of relatively large amounts of resin originating in Afghanistan, Pakistan and Lebanon, or domestic production in Turkey, and destined for other countries in Europe or for the Turkish consumer market. In 2009, however, the average seizure dropped sharply to 1 kilogram. This reflects a 12-fold increase in the number of resin seizures from 2008 to 2009, whereas the total quantity seized increased by a mere 20 %. It is not clear whether this reflects an change in the activity of law enforcement agencies, with a possible shift of focus to the lower segments of the resin market, or a change in reporting.

The average size of resin seizures in Romania, Bulgaria and Estonia, where total annual resin seizures usually amount to less than 50 kilograms, appears also to be relatively high, at around 1.5 kilograms over the period 2007–09. These findings might represent the interception in these countries of a few large consignments of resin (most likely from Turkey, the Middle East and/or south-west Asia) in transit to other European countries both inside and outside the EU.

At the other end of the spectrum lie Latvia, Luxembourg, Slovenia, Slovakia and Croatia, where the average sizes of resin seizures have been less than 100 grams for many years. These countries usually seize only small amounts of cannabis resin, typically less than 10 kilograms per year.

Cannabis herb seizures

Over the last decade, the number of seizures of cannabis herb in Europe has been increasing steadily, and in 2009 was 3.5 times the initial number in 2000.

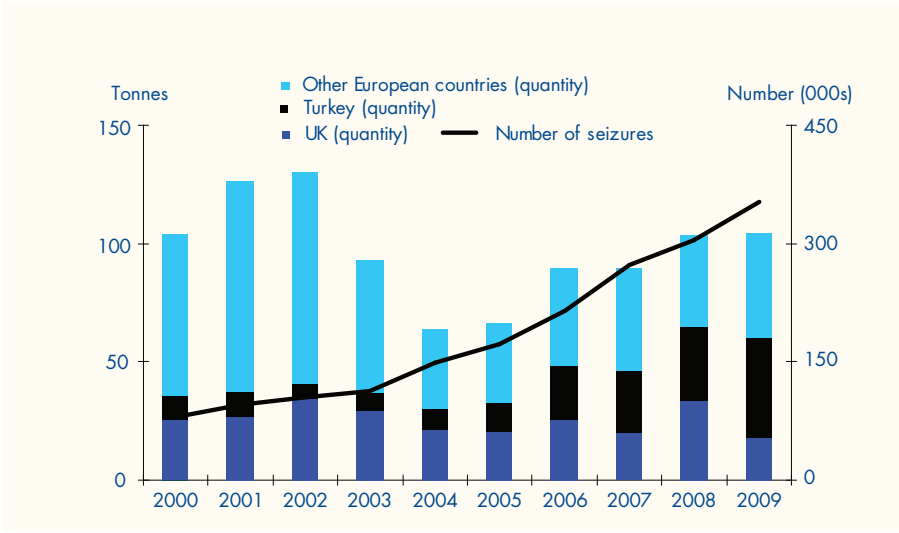
Historically, the largest number of herbal cannabis seizures has been reported by the United Kingdom. Germany was the country ranking next highest on this indicator until, in 2006, it was overtaken by Spain, and then, in 2009, by Turkey. In 2009, the United Kingdom reported 146 000 seizures of herbal cannabis, followed by Spain (86 000) Turkey (27 000), Germany (24 000) and Belgium (22 000). In these and in most of the other reporting countries trends over the last decade have all been upwards. Sharp increases were noted in the United Kingdom between 2005 and 2008, likely to reflect the introduction of the cannabis warnings in 2004 ([50]), but also in 2008–09 in Spain and in 2009 in Turkey.

([50]) The introduction in 2004 of formal warnings for cannabis possession (renamed cannabis warnings in 2007) has given police a mean to deal with these offences in a way which is not overly time consuming. The increasing use of this measure (Mulchandani et al., 2010) is likely to have led to an increase in the number of small seizures from users.

The amount of cannabis herb intercepted in Europe has been fluctuating over the last decade, with a peak at 130 tonnes in 2002 and a low of around 65 tonnes in 2004–05, followed by an increase since then (see Figure 6.8). However, trends at country level have been diverging.

This is particularly the case in the three countries that, at different times, have accounted for the largest amounts of cannabis herb seized in Europe: Italy, the United Kingdom and Turkey. Italy has seen annual seizures of herbal cannabis fall from European peak levels of 20–40 tonnes during the late 1990s and until 2001 to 2.5–7 tonnes since 2004. Interceptions of herbal cannabis in the United Kingdom have fluctuated between 15 and 35 tonnes over the last 15 years, without any clear trend. Turkey, which has recorded the largest seized quantity of herbal cannabis each year since 2006, saw recovered amounts increase from less than 10 tonnes a year at the beginning of the new millennium to 41 tonnes in 2009, with a sharp increase since 2006.

Figure 6.8: Trends in seizures of cannabis herb in Europe, 2000–09



Notes: The figure shows the total quantities of cannabis herb seized in Europe (bars) and the total number of seizures of cannabis herb reported (line) by year over the period 2000–09. As some missing data had to be extrapolated at country level from data from adjacent years, 2008 and 2009 European totals of numbers of seizures and quantities intercepted should be considered as estimates.

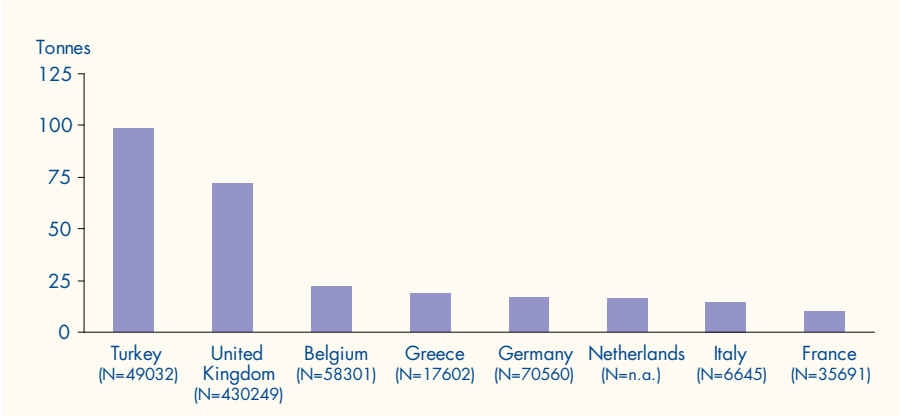
Source: EMCDDA and Reitox national focal points.

Greece would seem to be a major seizing country, although there has been a general decrease in annual quantities from 12 tonnes or more between 1997 and 2002 to an average of 7 tonnes a year since 2004. A decline has also been reported in the quantities intercepted in the Netherlands, from 10 tonnes or more at the beginning of the new millennium to around 5 tonnes a year over the period 2005–07 (Figure 6.9); however, more up-to-date data are not available, making it impossible to comment on recent trends.

Quantities intercepted in Belgium and Germany have been fluctuating since the late 1990s, with annual seizures of 15 tonnes or more at times. In France, seizures of herbal cannabis have remained relatively stable since 1995, generally about 3–4 tonnes a year.

Data at European level show that seizures of cannabis herb are usually smaller than those of cannabis resin. Herbal products generally weigh less than resin for an equal volume. In addition, as local production of cannabis herb is increasing in Europe, it is likely that trafficking is taking place closer to the end-user and in smaller quantities. European aggregated data show a relatively stable trend over the last 5 years with

Figure 6.9: Cumulative amounts of herbal cannabis intercepted over 2007–09 in the eight countries reporting the largest seizures in Europe



Notes: *N* represents the cumulative number of reported seizures of herbal cannabis over the period 2007–09. The values for the Netherlands refer to the period 2005–07, as data for 2008 and 2009 are not available. In France, 2008 data were used in place of unavailable 2009 data in the cumulative number of cases.
Source: EMCDDA and Reitox national focal points.

seizures of herb weighing between 300 and 400 grams on average and those of resin weighing between 2 and 3 kilograms.

Analysis points to Bulgaria as the country reporting the largest average annual herbal cannabis seizures over the period 2007–09, at about 22 kilograms. Although this appears to be very high and is likely to be the result of an exceptionally large amount of herb recovered in 2007, the average size of seizures in previous years was also high, between 2 and 49 kilograms from 2000 to 2006.

Other countries reporting relatively large average seizures of herbal cannabis include Italy and Turkey, where average seizures have fluctuated between 1 and 4 kilograms over the last 5 years, and Greece, where since 2002 average seizures have typically been between 1 and 2 kilograms (Figure 6.10). However, the larger average sizes of herbal cannabis seizures calculated for Malta (17 kilograms) and Portugal (6 kilograms) over the period 2007–09 are not typical of these two countries. Rather, they appear to reflect exceptionally large quantities of herb intercepted in 2009 in both of these countries. Between 2004 and 2008, average seizure sizes were in the range 20–330 grams in Malta and 150–680 grams in Portugal. However, earlier, between 2000 and 2003, the average size of herbal cannabis seizures in Portugal was larger, varying from 1.5 to 2 kilograms.

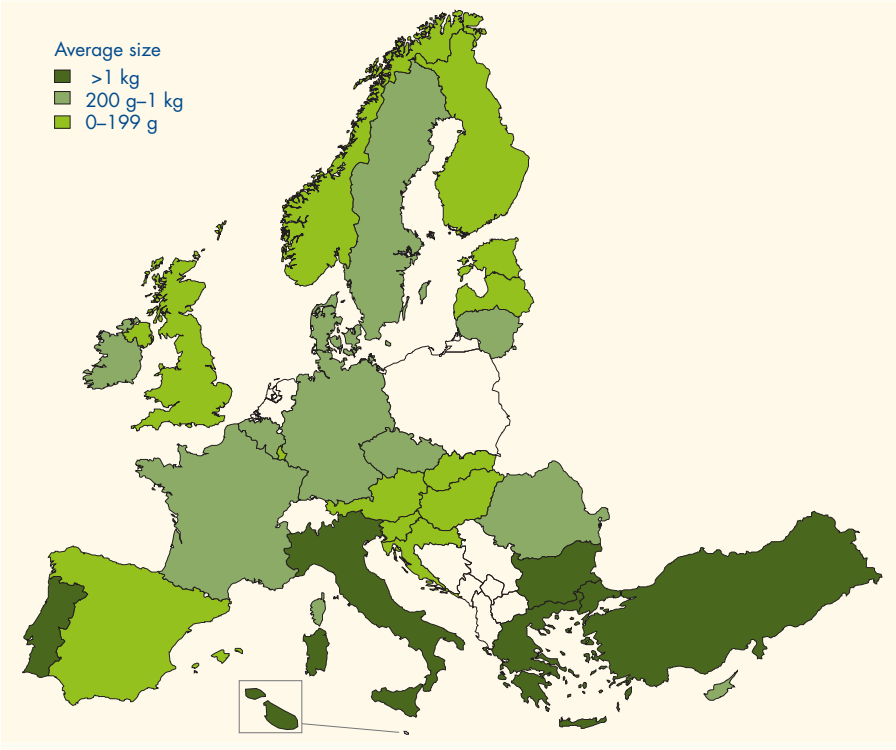
At the other end of the spectrum lie Estonia, Spain, Latvia, Luxembourg, Slovakia, Finland, Croatia and Norway, where the average size of cannabis herb seizures has consistently been below 100 grams over the years.

Cannabis seizures: clusters of countries

The analysis presented in this chapter suggests that cannabis accounts for a substantial proportion of drug law enforcement activities, at least those resulting in seizures ([51]). It also suggests that law enforcement approaches targeting cannabis supply may have national characteristics, with activity in most countries (as reflected in seizures) appearing to be concentrated more on one type of cannabis product than the other. In addition to the focus of law enforcement, the two main products differ in their vulnerability to interception. Cannabis resin is imported into Europe, and it is estimated that about 40 % could be intercepted; herbal cannabis seems to

([51]) There may be long and resource-demanding investigations that do not result in seizures but consume a sizeable share of law enforcement resources and contribute to reduce drug supply within Europe. In the absence of information on these activities, analysis is limited to seizures.

Figure 6.10: Average size of seizures of cannabis herb, 2007–09



Notes: The map shows the aggregated average size of seizures of cannabis herb over the period 2007–09, obtained by dividing the total amount seized by the total number of cases reported during the period. In the absence of 2009 data on the number of resin seizures in France, the average size refers to the 2006–08 period in that country. Data were not available for the Netherlands and Poland.
Source: EMCDDA and Reitox national focal points.

be produced mainly within Europe, closer to the point of sale, and only an estimated 10 % would be seized.

Focus on cannabis resin

In a minority of European countries, 8 out of 30, the fight against drug trafficking would seem to be centred primarily on cannabis resin. In six of these countries (Denmark, Spain, France, Portugal, Sweden, Norway), cannabis resin is the most seized illicit drug, while in two (Ireland, Italy), although not the most seized drug,

it is still intercepted more than herb. These countries would also appear to have a larger domestic market for resin than for herb, although the predominance of resin in cannabis consumption might be diminishing in some of them (see Chapter 5) ([52]).

Spain and Italy are the largest European markets for imported resin, with annual consumption estimated at between 300 and 400 tonnes (see last section of Chapter 5). Whereas Spain's resin seizures, the largest in Europe (and the world), would be equivalent to about twice the amount consumed in the country, interceptions in Italy would represent only a small fraction (less than 10 %) of national consumption. This confirms Spain's key role in the transit of resin to other European countries, and suggests that Italy plays a more limited part in resin transit.

France is also a major market for resin, with an estimated 200–300 tonnes used every year and seizures representing about 20 % of domestic consumption. Although these figures are much lower than those for Spain, they are high compared with Italy, and may point to the use of France as a transit area for Moroccan resin, which most likely enters the country via the Iberian Peninsula. Indeed, the relatively small average size of resin seizures (0.5–1 kilogram) could indicate that France is not a major entry point for Moroccan resin, but that trafficking of resin at wholesale level is common there.

It is interesting to note that these three countries are also major markets for herbal cannabis products, with each consuming an estimated 100–200 tonnes annually. In all three, the amount seized would constitute a very small proportion (under 3 %) of the amount estimated to be consumed. However, closer analysis of the data may point to different strategies at play, whether from traffickers or law enforcement agencies. Seizures of herbal cannabis in Spain contrast with seizures of resin, as they are on average extremely small (under 100 grams), probably indicating that the material is of local origin and that it is trafficked in limited quantities. One may argue, however, that because of their traditional focus on resin, law enforcement agencies may have developed less efficient strategies to counter trafficking in herb and that, as a consequence, large seizures of herb are very rare. At the other extreme lies Italy, where, on average, seizures of herbal cannabis are nearly as large as those of resin, at 2 and 3 kilograms respectively. This might point to law enforcement agencies focusing on middle to upper segments of the cannabis market in general, whatever

([52]) In Ireland in particular, the market share of herb might have become higher than that of resin since 2009 (Arnold, 2011).

the product; it could also indicate importation of herbal material (for instance from the Balkan region) or domestic production on a larger scale than in Spain.

Average seizure sizes greater than 1 kilogram suggest that Portugal and Ireland are also entry points for Moroccan resin into Europe. In these two countries, resin imports appear to supply both the national and other markets, with the two territories being used as transit areas. Although the market for resin in Portugal is probably smaller than that in Spain, Italy and France, it can still be viewed as relatively large, an estimated 30 tonnes per year; this being so, the amount of resin intercepted in Portugal could be equivalent to 1.4 times the local demand for the drug. Resin seizures in Ireland are smaller than those in Portugal, and would represent only 30 % of the estimated national consumption (9 tonnes). Part of the resin entering Portugal is smuggled on to Spain and France, from where it is either distributed locally or smuggled further north and east to other markets. It is likely that a substantial share of the resin entering Ireland eventually ends up on the United Kingdom market, which, although smaller than the market for herb, is still rather large, estimated to be about six times the size of the Irish market for resin.

In contrast to Spain, France and Italy, demand for cannabis herb in Portugal is very limited (estimated at less than 5 tonnes). Seizures of herb, however, would equate to about 40 % of national consumption, the third highest rate across the 30 European countries. The average size of herb seizures points to trafficking at middle and wholesale levels, and possibly to imports, most likely from Africa. The relative importance of interdictions compared with estimated consumption would seem to indicate that the country is used as a transit area to other European markets. Alternatively, the size of the local market for herb might simply be underestimated.

The three Nordic countries in this group have similar profiles, with estimated market sizes for resin similar to that of Ireland, and quantities intercepted representing between 13 % and 16 % of estimated national demand. On average, resin seizures are larger in Denmark (200–500 grams) than in Sweden and Norway (100–200 grams), pointing to its likely role as a transit area to other Nordic countries. Annual resin seizures in these three countries are generally much smaller than those in the other countries reviewed here. This may indicate a more limited bulk trafficking of cannabis resin in these Nordic countries, or the targeting of lower segments of the resin market by law enforcement agencies, or both.

Focus on cannabis herb

Seventeen countries appear to focus mainly on cannabis herb, although in some of them the fight against resin trafficking may still occupy a substantial place in the fight against drug supply in general. Cannabis herb is the most seized illicit drug in 12 countries ([53]), and in five others ([54]) it is more seized than resin. In all of these countries, the national market for herbal cannabis is estimated to be larger than that for resin.

Turkey reports the largest seizures of herbal cannabis in Europe. On average, seizures of herb are very large, over 2 kilograms, as are resin seizures. The country has a large population and is likely to provide a substantial market for both cannabis products, but because of the lack of data no conclusion can be offered as to the relative size of seizures compared with national demand. Data point to trafficking at wholesale level. Although it is likely that herbal material seized originates in the country itself, resin seized in Turkey may have been produced in south-west Asia, the Middle East or locally. For both products, data seem to indicate that either law enforcement agencies do not target lower segments of the market or that amounts intercepted at that level are not systematically reported ([55]).

The United Kingdom and Germany would appear to be the largest European markets for herbal cannabis, with national consumption estimated, respectively, at around 200 and 250 tonnes. In the United Kingdom, the relatively small average size of seizures (100–200 grams) is likely to reflect the large proportion of seizures made at user level due to the increasing use of police warnings for cannabis possession (Mulchandani et al., 2010). In Germany, seizures are generally slightly larger (200–500 grams), possibly pointing to a combination of importation operations from other producing countries (e.g. Netherlands) and domestic production. The amounts of herb intercepted in these countries would be equivalent to 10 % of national demand in the United Kingdom and 3 % in Germany. A possible explanation for the apparently higher level of interception in the United Kingdom is that the major shift towards the domestic cultivation of cannabis herb that took place there a decade

([53]) Czech Republic, Germany, Greece, Cyprus, Hungary, Austria, Poland, Slovenia, Slovakia, United Kingdom, Croatia, Turkey.

([54]) Bulgaria, Latvia, Lithuania, Luxembourg, Romania.

([55]) This needs to be followed up for resin, as the situation may be changing: the average size of resin seizures has dropped from 10 kilograms in 2006–08 to 1 kilogram in 2009.

ago may have increased the awareness of law enforcement agencies of cannabis herb trafficking, and led to a sharper focus on cannabis herb interceptions.

Both countries are also major consumer markets for cannabis resin (estimated at between 50 and 100 tonnes annually). Seizures in the United Kingdom are relatively large (on average, 500–1 000 grams), and represent about 40 % of national demand, which may indicate that the country is targeting imported drug. In Germany, resin seizures do not differ much from herb in terms of average size, and would represent a mere 6 % of the estimated national market; together, these findings may point to Germany having a limited role as a transit area for imported resin.

The Czech Republic and Poland are potentially the next largest markets for herbal cannabis in Europe, estimated at between 50 and 60 tonnes a year each ([56]). However, seizures in these countries are estimated to represent a negligible fraction of national demand (1 % or less), probably indicating that trafficking of herb remains mainly within national borders.

In five countries, including Bulgaria, Greece, Hungary, Austria and Slovakia, national demand for cannabis herb is estimated at between 10 and 20 tonnes. Seizures in Hungary, Austria and Slovakia are on average very small, and would represent less than 5 % of estimated national consumption, pointing to local rather than cross-border trafficking. Bulgaria and Greece present a rather different profile. In Bulgaria, large multi-kilogram seizures would seem to indicate that law enforcement agencies target mainly the upper levels of the herbal cannabis market (including large-scale domestic production). The impact of these actions, however, may be limited, as total amounts recovered would represent only 0.2 % of estimated national consumption. Seizures of herbal cannabis in Greece are also large, 1–2 kilograms, on average, and would represent about 50 % of estimated national consumption — an exceptionally high proportion for cannabis herb. This finding suggests the existence of intense cross-border trafficking of herbal cannabis between Greece and neighbouring countries.

([56]) As a point of comparison, cannabis herb consumption in the Czech Republic was estimated, based on a different set of assumptions, at just under 20 tonnes for the year 2008 (Vopravil J., presentation at the Workshop DPE, Rome, March 2012). Although this result is 2 to 3 times lower that the estimate arrived at in this publication, seizures of herb would still be very marginal in comparison, representing about 1 % of the estimated consumption.

In the other countries in this group (Cyprus, Latvia, Lithuania, Luxembourg, Romania, Slovenia, Croatia), both national consumption estimates of herbal cannabis and quantities intercepted as compared with national demand are low. Local trafficking would seem to be predominant in these countries, although an average seizure size of 500–1000 grams in Cyprus may indicate cross-border trafficking, probably with neighbouring Turkey and Greece.

Mixed profiles

A number of countries are characterised by a more mixed profile in terms of their cannabis markets and interdictions against cannabis supply.

In the Netherlands, although the national market for cannabis herb is estimated to be twice the size of that for resin, law enforcement would seem to play a substantial role in terms of cannabis resin interdictions of cannabis resin, which would represent about 40 % of estimated national consumption compared with 12 % in the case of herb. Together with Belgium, the Netherlands is indeed often portrayed as an entry point for Moroccan resin, which is then further distributed to other markets in Europe, whereas national demand for herb is likely to be met by domestic production. However, great caution is required when attempting to draw conclusions from incomplete and not so recent data on seizures from the Netherlands.

In Belgium, Estonia and Finland, seizures of herb outnumber those of resin, but more resin than herb is intercepted. This is in line with the profile of these countries: in all three cannabis herb is predominant at retail level while they are transit countries for cannabis resin destined for other markets.

Data point to Belgium as a trafficking hub for both cannabis products. Seizures of resin would be three times the estimated national demand, and are usually of very large size (average seizures of several kilograms), as in Spain and Turkey. This suggests that cannabis resin is directly imported into the country, probably mostly from Morocco. The amounts of herbal cannabis intercepted would be equivalent to about 20 % of the national market, which is a high proportion compared with other countries, and seizures are generally of medium size (200–500 grams on average). This might lend support to the blurring of the boundaries between Belgium and the Netherlands that has been reported for domestic cannabis production and the supply of herbal products to both markets; this could be accompanied by an intensification of cross-border movements and therefore interceptions.

In both Estonia and Finland, cannabis herb seizures are very small, clearly taking place at retail level, and would represent only a small fraction (under 1 %) of the estimated national market, which is also very limited, albeit larger than that of resin. Interceptions of cannabis resin in Estonia would seem to take place at a relatively high level in the supply chain, with seizures estimated to represent about 20 % of the national market and being relatively large on average (1–2 kilograms). It is likely that some of the resin intercepted in Estonia is destined for Russia and the Nordic countries.

Reducing the supply of cannabis to European markets

Prioritising cannabis enforcement

Activities aimed at reducing the supply of cannabis products in Europe are often implemented within the existing framework of drug law enforcement and the fight against organised crime (Decorte, 2007; Frank, 2007; Moeller, 2009). This is particularly so in relation to reducing the supply of imported cannabis resin, but also applies to imported and European-grown herb. However, since the early to mid-2000s, several countries have stepped up their efforts to disrupt the cannabis market. Although the intensity of these efforts varies between countries, they may be indicative of the emergence of a general European trend whereby more attention is focused on the cannabis market, especially domestic cannabis production. Several European countries mention the cannabis market as a priority in their drug policy documents, or are developing targeted actions towards sectors of the cannabis market (e.g. Belgium, Denmark, France, Ireland, Netherlands). This increased attention given to cannabis by Member States has been reflected at the European level. Thus, in January 2010, Europol opened a 'cannabis analysis work file' (AWF), which includes subprojects on wholesale cannabis trafficking and indoor cannabis cultivation, and expert components such as the Europol 'logo system on cannabis' (ELSC) and the Europol 'cannabis cultivation site comparison system' (ECCCS) ([57]).

The heightened focus on cannabis is the result of a change in perception among law enforcement agencies and policymakers, whereby the cannabis market has increasingly been seen as a threat. This shift in perception appears to have occurred first in the Netherlands. In Europe, overall, it seems to have coincided with an increase in domestic

([57]) An analysis work file is essentially a secure database containing information provided by participating countries, under strict confidentiality rules. It allows Europol to support national law enforcement forces.

cannabis production, a phenomenon that has become more visible in recent years, especially as a result of intensified media attention. In certain ways, the increased prioritisation of cannabis may be also viewed as a response to the increased 'cultural weight' of the cannabis movement in European society, outlined in Chapter 3.

Whatever the case, four categories of arguments about the types of risk posed by the cannabis market have been offered to explain the need to focus more law enforcement attention on it. The first argument is that it is necessary to curb the violence and criminality associated with the cannabis market, especially with criminal gangs. Therefore, the need to control organised crime involvement in cannabis cultivation is a major argument for intensifying law enforcement activities. The second argument is centred on public health. Concerns about the harmfulness of possibly increasing THC levels, particularly on mental health, have been expressed in several European countries. Although the possible health risks of high-THC cannabis raise concerns among experts and feature prominently in the public debate, the risks are not well understood. The third argument concerns public safety. The setting up of large plantations inside buildings often entails converting the premises, for instance to install watering systems, which may damage the property. Risks are also related to the heavy consumption of electricity that is necessary to provide artificial light for cannabis plants grown indoors. Unsafe methods to bypass electricity meters — to avoid paying large bills or raising suspicion — or ill-adapted wiring systems are reported to have caused fires in indoor plantations. Furthermore, conversion of premises, electricity theft and fires all result in financial losses to private and public home-owners and electricity suppliers. The fourth and final argument is of a more political nature. It relates to the large profits earned by cannabis growers, especially organised crime gangs. The profits reaped in the cannabis business may be used to bankroll other licit and illicit activities, or to fuel corruption, and thereby increase the power of the criminal organisations involved, which is viewed as a threat that must be addressed by law enforcement.

However, it has also been suggested that enhanced law enforcement pressure on the cannabis market may have adverse effects, including increasing some of the risks listed above. Some argue that law enforcement efforts have dissuaded many non-commercially oriented, 'idealistic' players from growing cannabis, with the result that cannabis cultivation is increasingly carried out by organised crime groups, who factor in the risk of being caught as a professional hazard, and whose aim is financial gain (Decorte, 2008; Maalsté and Panhuijsen, 2007; Moeller, 2009; Werb et al., 2011). This has led to increasing levels of violence and criminality in the cannabis market, with events such as theft of harvests, booby-trapping of cultivation sites, theft of or

non-payment for harvests, possession of weapons, threats and intimidation becoming more frequent (Decorte, 2010; Maalsté and Panhuijsen, 2007; Moeller, 2009). Spapens et al. (2007) argue that the violence in the Dutch cannabis market is mostly related to 'business disputes' such as non-payment between the actors involved or violence resulting from thefts of harvests. This scenario is likely to have spiralling effect: the increasing criminal orientation of the market will drive more non-commercially oriented actors to stop growing cannabis, which in turn will lead to more organised crime, more violence, and so on (Decorte, 2008). Other consequences are said to derive from the increased influence of organised crime and other purely profit-oriented players in the cannabis market. These are said to include, for instance, artificially increasing the weight of herbal products, using chemical fertilisers and pesticides, and adding products to improve the appearance of the herbal material. Moreover, commercially oriented growers are thought to be especially interested in growing the stronger varieties of cannabis, as these are more profitable (Decorte, 2008 quoting Kerssemakers, 1997; Maalsté and Panhuijsen, 2007; Szendrei, 1997; Traag et al., 2001). The effect of this would be to increase the potency of herbal materials available on the market.

Law enforcement initiatives

European Union Member States have responded to the developments in the cannabis market with original law enforcement initiatives, some of which are reviewed here.

In August 2002, Spain launched the first phase of the *Sistema integral de vigilancia exterior* (SIVE, integrated system for external surveillance) air and sea detection and interception system, operated by the Guardia Civil (a military force placed under the authority of the interior ministry). The SIVE is an integrated system of radars and powerful cameras, with the ability to detect and identify objects such as small 'go-fast' smuggler's speedboats at a distance of up to 5 kilometres. These sensors are connected to sophisticated voice and data communication equipment and linked to a control centre that coordinates interception operations at sea or on land implemented by the Guardia Civil. The aim of the SIVE is to combat the smuggling of irregular migrants and drugs, often cannabis resin and sometimes cocaine (EMCDDA and Europol, 2010) from the coast of North Africa. In the first phase of the project, SIVE sensors were initially positioned along the western part of the southern Mediterranean coast and the control centre was based in the city of Algeciras and covered the coastal area, Spanish territorial waters and air space in the Strait of Gibraltar region. Subsequently, SIVE was expanded with sensors and control centres installed in coastal regions including Málaga and Fuerteventura (Canary Islands) in 2003, Cadiz and Almería in 2004, Ceuta in 2005, and Almeria in 2006 (Guardia Civil, NDa–d).

The SIVE is to become part of a network of maritime surveillance systems against drug trafficking and irregular migration situated on the coasts of Spain, Greece, France, Italy and Portugal, under the EUR 42-million Perseus project, jointly funded by the European Commission and several institutional and private partners (Perseus, 2011). The 4-year Perseus project launched in January 2011 is implemented in the context of the European Commission's European border surveillance system, which is designed to support EU Member States in their efforts against irregular migration and cross-border crime (European Commission, 2008).

Suppressing commercial cannabis production within Europe has become a law enforcement priority in several Member States, and specific measures have been taken at national and EU level in recent years. For instance, in 2008, tackling for-profit cannabis production was treated as a national priority by law enforcement in at least three countries. While Belgium has made suppressing illegal cannabis production one of the priorities of the National Security Plan 2008–12, the Netherlands and the United Kingdom have implemented multifaceted strategies designed to increase the detection and destruction of commercial cannabis plantations by law enforcement agencies. These strategies usually rest on three pillars.

First, in order to increase detection rates, efforts are made to raise awareness of cannabis cultivation among the general population, key non-law enforcement sectors (e.g. electricity suppliers, DIY stores, cleaning companies, insurance companies) and law enforcement agencies. For instance, police in Scotland have produced an information leaflet for private landlords, and provide letting agents with information to include on their websites. In Delft and Rotterdam, the Netherlands, police put posters on buildings where cannabis plantations had been dismantled, in order to warn residents about the risks implied by such plantations.

Secondly, and also primarily to increase detection rates, partnerships are established between the police and sectors with a stake in preventing the phenomenon, including electricity providers, housing authorities and insurance companies. Many illicit plantation owners illegally tap the electricity required for their functioning, resulting in losses to electricity companies, which therefore have a strong interest in collaborating with police forces, as is the case in the Netherlands, in order to detect illicit cultivation sites (Wouters, 2008). In the United Kingdom, although partnerships with electricity companies are reported to produce relatively little operational intelligence, an estimate of the cost implications of stolen electricity from one plantation encouraged an electricity provider to purchase thermal imaging equipment for the local police force.

Thirdly, to increase detection, destruction and prosecution rates, steps are taken to improve police efficiency. In the United Kingdom, this involves measures such as enhancing coordination among national and regional law enforcement forces, in particular through the Association of Chief Police Officers (ACPO). In the Netherlands, an 'organised cannabis cultivation taskforce' was established in July 2008. It is led by the public prosecutor and has the role of coordinating efforts by law enforcement, local government, magistrates and the tax office. Some police forces are equipped with detection technology more commonly used by the military, including infrared cameras for thermal imaging. Coordinated operations are implemented to destroy plantations. In the Netherlands, such operations are known among law enforcement agencies as 'harvest days'. Police forces in many Dutch regions regularly mount all-day activities in order to destroy several plantations in sequence. According to research published in 2008, each regional force holds on average one 'harvest day' a month, during which an average of five sites are raided. However, police operations are also implemented on an ad-hoc basis (Wouters, 2008).

Other countries do not report multifaceted strategies but may implement some of their components. For example, in Germany, the Bundeskriminalamt (the federal criminal police office) has set up a special unit to report on cannabis offences throughout the country. In addition, some regional police forces, for instance in North-Rhine Westphalia, have launched awareness-raising campaigns for law enforcement officers and the general public, and carry out targeted operations against plantations. In France, several law enforcement organisations recently joined forces to produce a manual on indoor cannabis cultivation, in order to raise awareness of the problem among French forces and to facilitate investigations (MILDT, 2011).

In several European countries, training courses, conferences and seminars are organised to facilitate the exchange of information on these and other investigative and detection techniques. One example is the European Network Drugs Expertise, which organised its first conference in 2007 in order to facilitate the exchange of knowledge and best practice in this field.

Enter the private sector

A notable development, which seems to be restricted to the Netherlands for the time being, is that the dismantlement of illicit cultivation sites may now be subcontracted by law enforcement forces to specialised private firms, several of which are reported to exist in the Netherlands and to compete with one another (Wouters, 2008;

Wouters et al., 2007). This phenomenon, alongside the use of sophisticated technologies such as radars, infrared and thermo-imaging cameras or unmanned detection helicopters developed by private firms, illustrates the emergence of a commercial sector specialising in providing services and equipment targeted at reducing the supply of drugs, including cannabis, in Europe.

Cannabis profiling

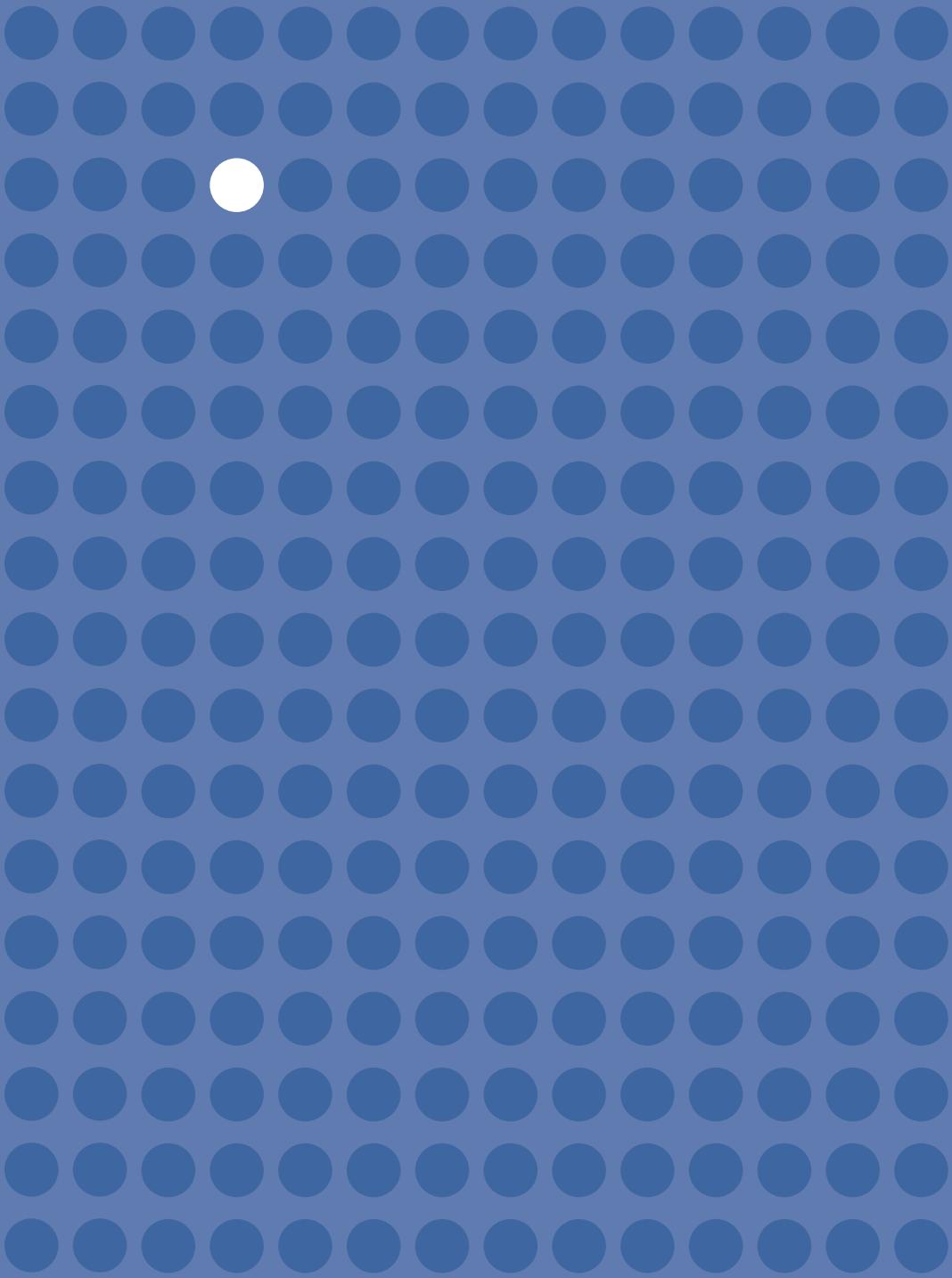
Recent research has shown that profiling techniques of cannabis products could be used to identify the origin and the mode of production of material seized by law enforcement agencies. They may be used for back-tracking a given sample from users to traffickers, and on to producers, with a possibility of identifying links between them.

Chemical profiling focuses on the various compounds that cannabis plants contain (see Chapters 1 and 4). There is indeed a large variation in the biochemical composition of the cannabis material circulated on the market, resulting from variations in the plants' genetics and growing conditions.

The principle of developing a chemical profile, or chemical fingerprint, of cannabis samples and using it to identify their geographic origin was demonstrated by Elsohly et al. (2006). Several techniques have been tested since then, including two-dimensional gas chromatography combined with a pixel-based chemometric processing (Gröger et al., 2008), and isotope ratio mass spectrometry through the measurement of the stable isotope ratios of carbon and nitrogen (Benson et al., 2006; West et al., 2009a) and of strontium (West et al., 2009b).

Genetic profiling allows products to be linked based on their genetic profiles, although, unlike human DNA, genetic fingerprints are not necessarily unique as cloning of cannabis strains is now quite common. This may limit the ability to prove that samples with matching DNA profiles come from the same plant, let alone the same grower (UNODC, 2009a).

A review of the DNA-based methods developed to identify and individualise cannabis herb can be found in the work published by Miller Coyle et al. in 2003. More recently, Mendoza et al. (2009) documented the use of a new DNA-based technique, with which they were able to differentiate between samples of herb from the USA, while in Australia, Howard et al. (2009) have set up a database to record both the allelic and genetic diversity of *Cannabis sativa* in the country for use in future forensic investigations.



Concluding remarks: what we know and what we don't know about the market for Europe's most commonly consumed illicit psychoactive substance

The product

In a discussion on information gaps, it is perhaps worth starting from the perspective that it should be accepted that we cannot know all that we would wish to know. It would be nice to have a robust estimate of overall cannabis production, but the ubiquitous nature of this substance makes such an objective difficult to achieve in practice. *Cannabis sativa* L. is a cosmopolitan species that has adapted to grow in all parts of the world, from the equator to latitude 66°N in Russia. It is now found in all continents apart from Antarctica. In Europe, cannabis cultivation can take place practically anywhere, with the development of specific varieties to be grown outdoors in northern latitudes, and the spread of indoor cultivation, which is limited only by access to electricity and water. This means that in reality we need to treat any overall production figures with considerable caution, as best guesses — and even here be aware that they may be misleading. That said, information sources may, when critically reviewed, be sufficient to point us in the direction of overall trends. Here, the picture for Europe, and globally, is one of a diversification of product types, and probably an increase in overall production.

Two categories of products are derived from the vast majority of the cannabis cultivated outdoors and indoors worldwide: cannabis herb ('marijuana'), which is usually made up of the flowering tops of the cannabis plant together with some amount of leaves; and cannabis resin ('hashish'). These are also the two products most widely available in Europe and the most consumed cannabis products worldwide. However, there are various types of cannabis resin and even more types of cannabis herb, and they may be distinguished in several ways, including the content of delta-9-tetrahydrocannabinol (THC), the main psychoactive substance found in cannabis, and whether the type of cannabis plant grown is or is not sinsemilla, i.e. seedless. We have in this report summarised the available information on the relative availability of different cannabis products. However, clearly the current picture is a partial one, and more information on the kinds of cannabis products available within the market would be useful. In this respect, the development and implementation of a common taxonomy and nomenclature would be useful, as understanding is currently handicapped by the fact that terminology is not standardised in this area.

Cannabinoid content, including THC, in cannabis varies widely depending on a number of factors including genetic varieties, growing environments, cultivation techniques, processing methods, freshness of the products, packaging, transportation and storage. As a result, potency varies widely, not just between products, but also within products between the different varieties available on the market. Data on potency are therefore difficult to interpret, and sampling and methodological issues are important. However, routine testing for cannabinoids in cannabis products is rarely implemented outside a limited number of countries in Europe, as it requires performing fairly sophisticated and expensive laboratory tests. In addition to a number of sampling and analytical issues, it is often found that, where analysis takes place, only THC is analysed, while contents of other cannabinoids such as cannabidiol (CBD) and cannabinol (CBN) are rarely systematically researched. This is a problem because differences in potency and chemical composition may have implications for public health and may impact on consumer preferences. However, it is also not known to what extent high-potency cannabis results in greater exposure to the drug, as it is possible that users, when consuming high-potency products, simply adjust their consumption patterns, thus titrating the amount of THC they receive.

High-potency sinsemilla material raises another important health-related issue, as it has been shown that cannabis grown intensively under artificial conditions generally contains lower levels of CBD in comparison with other herbal cannabis material or resin. This substance has been found to have antipsychotic properties, and it has been suggested that it may to some extent mitigate some of the more troublesome psychoactive effects associated with THC consumption. Any variation in the relative proportions of THC and CBD in illicit cannabis therefore has possible implications for the overall negative health consequences associated with consumption of the drug. Given current concerns on the potential association between some forms of mental illness and cannabis use, this issue is not a trivial one. Although the science in this area is still developing, it would appear important to also improve the monitoring of the chemical content of cannabis products available in Europe and to link this information with other epidemiological data.

The supply

As noted already, uncertainties in estimates of global cannabis production published since the mid-2000s, together with the reliability issues affecting the data used to calculate them, make it difficult to use them for monitoring purposes, especially in order to evaluate the impact of supply reduction activities. In the present

conditions, it is indeed probably impossible to estimate the global production of such a widespread drug as cannabis with the degree of accuracy and reliability needed for practical purposes.

The ubiquity of cannabis production in the world is reflected in the variety of sources for imported cannabis herb and resin present on European markets, with cannabis products being imported from all continents but Australasia and Antarctica. Nevertheless, five regions, and one country within each, obtain the largest total of mentions in the 90 Reitox reports analysed for this Insight and may be viewed as the main sources of the imported cannabis products available on European markets. These regions and countries are North Africa (Morocco), south-west Asia (Afghanistan), the Balkans (Albania), the Middle East (Lebanon) and sub-Saharan Africa (South Africa). In this respect, the current report suggests that a more diverse situation exists than was perhaps expected and points to a longer-term need to better monitor changes in supply patterns. It also suggests that the market may be relatively resilient to interdiction efforts that target single source countries.

Most of the cannabis resin available on European markets appears to be supplied from Morocco. This raises an interesting issue, however, as the latest estimates of Moroccan resin production appear to conflict with other data sources. Tentative estimates of annual resin consumption in the EU Member States and Norway amount to around 1 300 tonnes, which is 10 times higher than the amount of resin estimated to be left from Moroccan production after deducting seizures made by Spain (the country reporting the largest resin seizures in Europe and the world) and Morocco. Taking into account the fairly substantial amounts of resin seized in countries such as Algeria, Belgium, France, Italy and Portugal (much of which is also likely to originate from Morocco) would make this discrepancy greater still and leave practically nothing for consumption in Europe. This apparent gap in the European market for resin is unlikely to be met by domestic production in Europe, since cannabis resin is not produced on a large scale in the European Union or Norway (European cannabis production is overwhelmingly of herbal material). Intelligence reports and comparison of the physical and chemical characteristics of resin seized in Europe would also suggest that Morocco is the most likely source for a large proportion of resin entering the European Union. Thus, it is hard to reconcile current production estimates with other data sources; this suggests the possibility that current production estimates are unrealistically low.

Another interesting recent development is that Afghanistan is now estimated to have surpassed Morocco to become the world's largest producer of cannabis resin.

Despite this, to date there is very little evidence to suggest that Afghan-produced resin is widely available on the European market. In fact, the geographical spread of Afghanistan resin currently remains unclear, and direct comparisons with Morocco may be unsafe. It would seem that resins made in Afghanistan and Morocco are substantially different products that cannot easily be compared. Some reports suggest that much of the current resin production in Afghanistan consists of extremely low-grade product. Thus, a volume-for-volume comparison with Moroccan production may not be appropriate. A caveat to this discussion is that investments in forensic profiling would be useful in this area, in order to improve understanding of the nature, origin and trafficking routes of the different cannabis resins available on European markets. Currently, our ability to track different products back to their source countries is limited. A small investment in profiling and the establishment of a central database for compiling information from different countries could prove extremely valuable in this respect.

Resin from other countries may not be a major issue, but it is worth monitoring. In recent years, large seizures of cannabis resin have been reported in Turkey. However, the information available makes it difficult to ascertain whether these seizures reflect transit of resins made in Afghanistan or Lebanon, or resin production in Turkey itself, or all three origins at the same time. Considerable amounts of cannabis plants (over 20 million) were reported seized in Turkey at the beginning of the new millennium, which would suggest that domestic cultivation was substantial at that time at least. Whether this remains the case today is less clear, but it is an important issue for further research. The intended destination of the cannabis products seized in Turkey is also not fully understood, and it is not known whether the drugs confiscated there were intended for the domestic market, for other European markets or for both. It does appear, though, that most cannabis users in Turkey are using herbal preparations, except in east and south-east Anatolia, where resin products predominate. However, there is no good information available on the relative size of these markets, and data on cannabis prevalence in general are also weak. Those data that do exist are on cannabis consumption in 2003 among 15-year-old school students. Should this information reflect the current situation, Turkey would be among the countries with the lowest prevalence levels reported in Europe. However, this contention must be regarded as highly speculative and, given the importance of Turkey in respect to seizures, the only strong conclusion that can be drawn is that further studies would be helpful. It is also worth noting that Turkey is a relatively large country, with the biggest population after Germany of

the 30 European countries reporting to the EMCDDA. It also has a relatively young population by European standards, and therefore potentially represents a large market for cannabis, even if prevalence rates have remained relatively low.

The Balkan region, and especially Albania, seems to be a significant but often overlooked source of cannabis products used on some European markets. Cannabis from this area is more likely to be herbal rather than resin, although again the paucity of data from this area makes this conclusion necessarily tentative.

Historically, Lebanon was an important player in the European market, and was a major resin producer in the 1980s. However, in the early 1990s, after a major campaign to eradicate cannabis crops and develop alternative farming, Lebanon ceased to be a major source country for the European Union. Some signs of a revival were noted in recent times, but again eradication efforts in 2009 were reported to have left the country entirely free of cannabis production. Though, as noted previously, the cannabis market is a dynamic one and the situation can change rapidly, underlining once more the need to improve monitoring and surveillance capacity.

While noting that global cannabis estimates are problematic, it is also clear that there is currently no robust method to estimate the extent of domestic cannabis cultivation and subsequent production of cannabis material on European soil. We do know that cultivation is taking place in most countries, even if the scale of production is unclear. There is evidence of cannabis cultivation in 29 out of the 30 countries covered in this publication, with no information provided for Malta. It would seem that indoor cultivation is taking place in 26 countries, of which 12 have specifically mentioned the existence of hydroponic methods, while outdoor growing is reported in 25 countries in Europe.

A clear assessment of trends in the use of different cannabis products is also currently difficult, although some information does exist. Data would suggest that there has been a partial *import substitution* of resin by domestically grown cannabis herb in both Belgium and the Netherlands. A variant of this trend is also reported in the United Kingdom, where an initial partial replacement of imported resin by imported herb was then followed by a partial substitution of imported herb by domestic production of herbal cannabis. It is possible that other countries have also witnessed this kind of shift, but conclusions here must be made with caution as the evidence available is weak and does not point in any clear direction. However, taken as a whole the available information would suggest that overall the shift towards *import substitution* has resulted in changes in the relative market shares of resin and herb in

the cannabis material predominantly consumed in Europe over the last two decades, and it is likely that contemporary increases of the demand for and the supply of domestic herbal cannabis have mutually fuelled each other. Two-thirds of Europe would now seem to be consuming mainly herbal products and one-third mainly resin, which compares with the situation in the 1980s, when all western European cannabis consumption was dominated by resin, and cannabis use in eastern and central Europe was reported to be extremely low. There has indeed been a shift towards herbal cannabis among consumers in Belgium, Germany, the Netherlands, Finland and the United Kingdom, while the share of herb in resin-dominated countries such as Ireland, Spain, France and Norway seems to be increasing.

Spain has traditionally been seen as dominated by resin in terms of consumption, mainly because of its proximity to the main resin producer for Europe, Morocco, and because the country is a major entry point for Moroccan resin imported into Europe. However, Spanish law enforcement is also experienced and relatively proactive and has implemented a number of specific tactics and tools to intercept Moroccan resin. This has resulted in giving the country a high profile as a major actor, both in terms of being on the cannabis resin trafficking route and in terms of law enforcement responses. Perhaps part of the reason for the focus on resin from law enforcement originates in the pressure of the international community on a country portrayed as a recognised door to Europe for Moroccan produce. Less discussed is the suggestion that herbal cannabis is also now grown in Spain, and this production may not be trivial. Active domestic production of cannabis herb is suggested, for example, by the spread of cannabis social clubs, although again conclusions in this area must be accompanied by a warning that information on the topic is sparse. Nonetheless, it is possible that significant domestic cultivation is taking place in Spain although, because of the enforcement focus on resin importation and transit in Spain, the visibility of domestic production (which, in the absence of studies, is based on law enforcement statistics) remains relatively low.

In both France and Italy, evidence seems to point to non-negligible levels of domestic cannabis cultivation, but extent and trends are difficult to analyse from the data available. However, it is likely that, as for Spain, the visibility of domestic production is hindered by the fact that the interdiction measures against cannabis supply remain centred on importation of cannabis resin and that, in spite of increasing awareness among law enforcement agencies about the need to address domestic herbal production, activities in this area are limited in comparison with those directed

against imported resin. We must therefore conclude that it is at least possible that the consumption of cannabis herb in Spain, France and Italy accounts for a larger market share than the 20–40 % estimated in this volume. The problem is simply that the data available do not allow us to judge accurately. Additional and more robust data are clearly needed to document cannabis domestic production and consumption of herbal products in these countries.

Any discussion of production and distribution in Europe needs to be informed by the fact that the scale and motivation of those growing cannabis are heterogeneous. Importantly, cannabis growers (and distributors) can be divided into two broad categories: *commercial* and *non-commercial*. The main element driving this separation is motivation. Whereas the first group is mainly driven by the prospect of financial gain, the second group is driven by a number of other factors, which include a diversity of motivations ranging from ideological reasons, through catering for personal supply, or for friends, to ensuring the quality and integrity of the product and avoiding exposure to the criminal element of the market. Overall, this group tends be in smaller-scale production — although this is not always the case.

A worrying development from a law enforcement perspective is that a number of countries have noted an increase in the professionalisation and organisation of cannabis cultivation on their territory, with a clear stratification of roles within the industry. It would appear that many commercial cannabis-growing operations across Europe are now run by criminal organisations, although explicit reference to this is made only by a few countries. Crime organisations rarely restrict their activities to one criminal area, and their involvement in the cannabis trade increases the likelihood of an association developing between cannabis production and other criminal activities. This has been noted to some extent. Belgium, Denmark and the Netherlands all report increases in criminal activities, including violence and intimidation, linked to cannabis production. This can be understood in the context of the need for criminal organisations to secure dominance of the market and avoid detection. It has also been linked to an increase in competition in the commercial sector of cannabis production. Cannabis producers can also be the victims of crime, with some countries noting that small-scale growers are sometimes 'coerced' into growing cannabis for larger criminal groups that are running multiple growing sites. The strategy of running multiple sites itself may also be becoming more common. This type of approach may be viewed as a way to ensure business continuity and minimise the impact of detection since, in the event that one of the small-scale

cultivation sites is dismantled by law enforcement, only one branch of an operation is taken down. The extent and spread of this phenomenon is, not surprisingly, difficult to document, but it does appear to be becoming more common in both the Netherlands and the United Kingdom. A worrying conclusion must be, however, that cannabis production is increasingly viewed by criminal organisations as a relatively easy way to generate income. Moreover, cannabis plantations themselves may be targeted by other criminal organisations. Taken together, the location of production sites within communities increases the possibilities that the crime and violence that are becoming increasingly associated with this activity may impact on the well-being of the public at large.

It is interesting to note that, in opposition to trends reported for other illicit drugs, prices of cannabis products have not been decreasing in recent years. For both cannabis products, a change in the trend was observed in the middle of the first decade of the twenty-first century, from a decrease since the end of the 1990s to a stabilisation in most countries for resin, and from a stable trend to an increase for herb. The fact that cannabis herb seems to have become more expensive in many countries in the last few years needs to be investigated further in terms of the potential links this change may have with the increasing domestic cultivation of cannabis within Europe. The development of new strains and cultivation techniques with a view to increasing the potency of the herbal material produced in Europe may have had an impact on the price paid at retail level, although data on potency are not conclusive at this stage (see Chapter 4).

The responses

Despite a policy debate that tends to focus on the need to target trafficking and major players in the market, the data available suggest that drug law enforcement activities in Europe are still, to a large extent, directed at cannabis consumption. This result is not surprising, given that cannabis is the most widely available illicit drug in Europe, both geographically and socially, and its use remains a policy concern. This situation might also result, in some countries at least, from the increasing use of annual statistical measurement of objectives to manage performance. This approach, when poorly implemented, can have the unintended consequence of providing an incentive for law enforcement to focus their efforts on offences that can generate multiple arrests for relatively low costs. Offences related to use and possession clearly fall into this category.

A discrepancy also exists in respect to what cannabis products appear to be targeted by interdiction measures. In two-thirds of Europe, consumption of cannabis is dominated by herbal products, and in the other third by resin, and tentative consumption estimates point to resin accounting for about half of the cannabis quantities consumed in the European Union. However, resin seizures by volume are around 10 times larger than those of herb. This is probably explained in part by the difficulties of detecting domestic production, especially when it takes place indoors. In addition, the trafficking of domestically produced cannabis is usually intra-regional, on a relatively small scale, and requires little crossing of borders. It is therefore less exposed to controls and risk of interception. This is clearly evidenced in the tentative interception rates that may be derived from the total cannabis consumption estimates for the European Union and Norway, at around 40 % for resin and just under 10 % for herbal cannabis. This raises an interesting question. The costs of lost product through interception are usually assumed to be reflected in illicit drug market prices. It would seem that in Europe there is, in general, less pressure from law enforcement on the market for domestically grown herb than resin. Yet prices of herbal preparations appear to be increasing and resin prices are relatively stable.

A theme running through this report has been the dynamic nature of the European cannabis market. This can also be seen in the relationship between interdiction activities and market developments. Evidence suggests an interaction in Europe between the cannabis market and the policies and strategies that are developed to respond to it. A 'push and pull' effect appears to occur whereby the cannabis market, the players within it and responses to it are in a continual state of evolution and adaptation against each other, continually reshaping and redefining how the market operates. This represents an important challenge for developing interventions, as successful strategies need to be constantly reviewed and adapted if they are to remain fit for purpose. It also once more suggests the importance of good intelligence, the need for strategic planning and ongoing monitoring and surveillance.

Of particular note is the possible impact of a variety of policy changes in the Netherlands and, although country specific, it may serve to exemplify the impact that policy may have upon the market in a broader sense. Some commentators have argued that increased law enforcement focus upon cannabis cultivation, initially set in response to the increasing presence of large-scale (organised) cultivation, may

have had unintended results: some have argued that it impacted upon the categories of cultivators (*commercial* versus *non-commercial*) and the proportions of the market that they occupy, resulting in an increased pressure on small-scale production, and leading to a situation in which cannabis supply is more likely to be in the hands of larger and commercial operations. This in turn may have led to alterations in the quality of the product. In addition, increases in the proportion of commercial cultivators have been linked to increases in crime and violence associated with competition for market dominance. The domination of the market by commercial producers may eventually have a knock-on effect, whereby consumer dissatisfaction with the quality of the product would lead to increases in small-scale cultivation. The extent to which this happens in practice is unclear, but it does illustrate the value of analysing the medium and long-term impacts of different intervention approaches. It also reminds us that actions can have unintended consequences and thus evaluation should be an important element of any strategic approach.

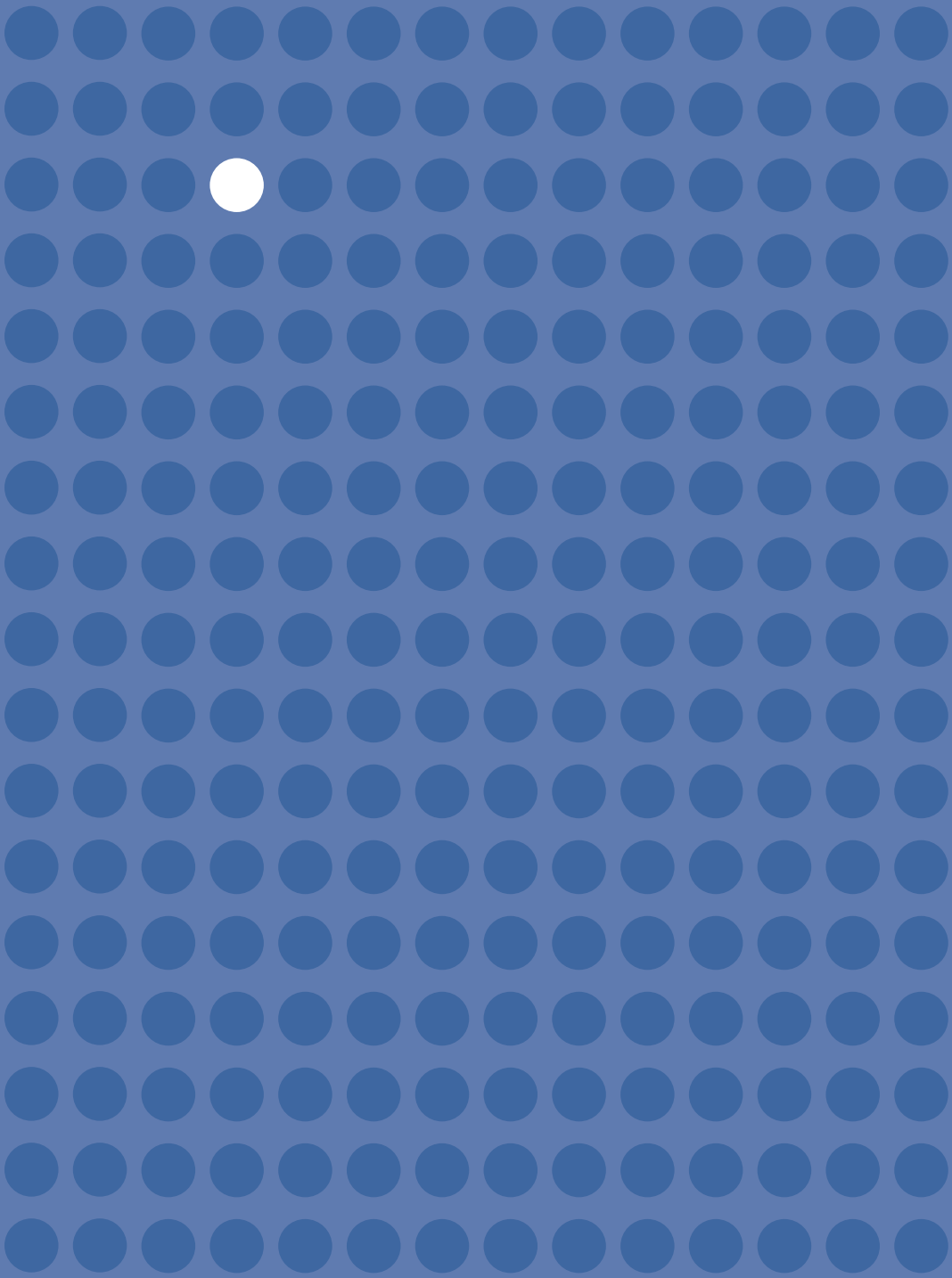
Another example of the possible effects of geographically restricted policy initiatives is the risk of displacement. A possible example of this can be seen in respect to Dutch efforts to dismantle cannabis cultivation sites in the Netherlands, which may have, in part, contributed to the rise in cannabis production reported in neighbouring countries, although changes in the Belgian policy related to the prosecution of cannabis cultivation may also have played a role here. This underlines the value of coordinated and concerted actions by European countries. Such actions reduce the risk of displacement of illicit production to areas where responses are perceived by criminal players as more lenient or less proactive.

And, finally, extrapolation issues

This report has brought together in one place a wealth of information on the European cannabis market. To understand today's situation we have had to journey through time and geography, and address issues as broad as plant genetics, legal frameworks and the organisation of criminal activities. The picture that emerges is of a dynamic, sophisticated and complex market. It is also one of considerable heterogeneity in respect to both time and place.

A strong message has emerged that underlines the value of monitoring and analysis if this market is to be understood, if future developments are to be observed and if interventions are to be effective and not produce negative unintended consequences. However, another conclusion is also evident. Many of the conclusions we draw here

are based on data from a restricted number of countries. In many areas, our current data sources are poorly developed or simply non-existent. Moreover, some of the information we do have, when viewed with a critical eye, is clearly suspect and may even be misleading. A clear need exists to improve data sources and to extend them to more countries. Data collection on the supply side of drug markets in general, and on drug production in particular, is unequally developed and poorly routinised across Europe. Focused studies, where they exist, reflect only the situation in a handful of countries. This is an obvious limit to the generalisation of the results and trends reviewed here, and the reader should be especially cautious in this respect. In bringing together all the available information in this area, this report has also highlighted the considerable knowledge gaps that exist. However, we regard this as a valuable exercise in itself, as it provides a necessary starting point for future efforts to improve our understanding of the diversity that is also a defining characteristic of the European cannabis market.



Appendix

Table A1: Estimated market shares of cannabis products consumed in Europe by country, 2008/09

Country	Cannabis resin (%)	Cannabis herb (%)
Belgium	20	80
Bulgaria	5–15	85–95
Czech Republic	5–10	90–95
Denmark	90–95	5–10
Germany	30	70
Estonia	5–20	80–95
Ireland	50–60	40–50
Greece	1–5	95–99
Spain	70–80	20–30
France	60–85	15–40
Italy	65–75	25–35
Cyprus	10–15	85–90
Latvia	10–20	80–90
Lithuania	10	90
Luxembourg	10	90
Hungary	5–10	90–95
Malta	80	20
Netherlands	30–40	60–70
Austria	20–25	75–80
Poland	2–10	90–98
Portugal	85–90	10–15
Romania	15–40	60–85
Slovenia	1–5	95–99
Slovakia	2–3	96–97
Finland	35	65
Sweden	70–80	20–30
United Kingdom	15–30	70–85
Croatia	5–15	85–95
Turkey	15–25	75–85
Norway	85–90	10–15

Source: EMCDDA and Reitox national focal points (for additional sources see Chapter 5).

Table A2: Potency (% THC content) of cannabis resin in Europe, 2000–09

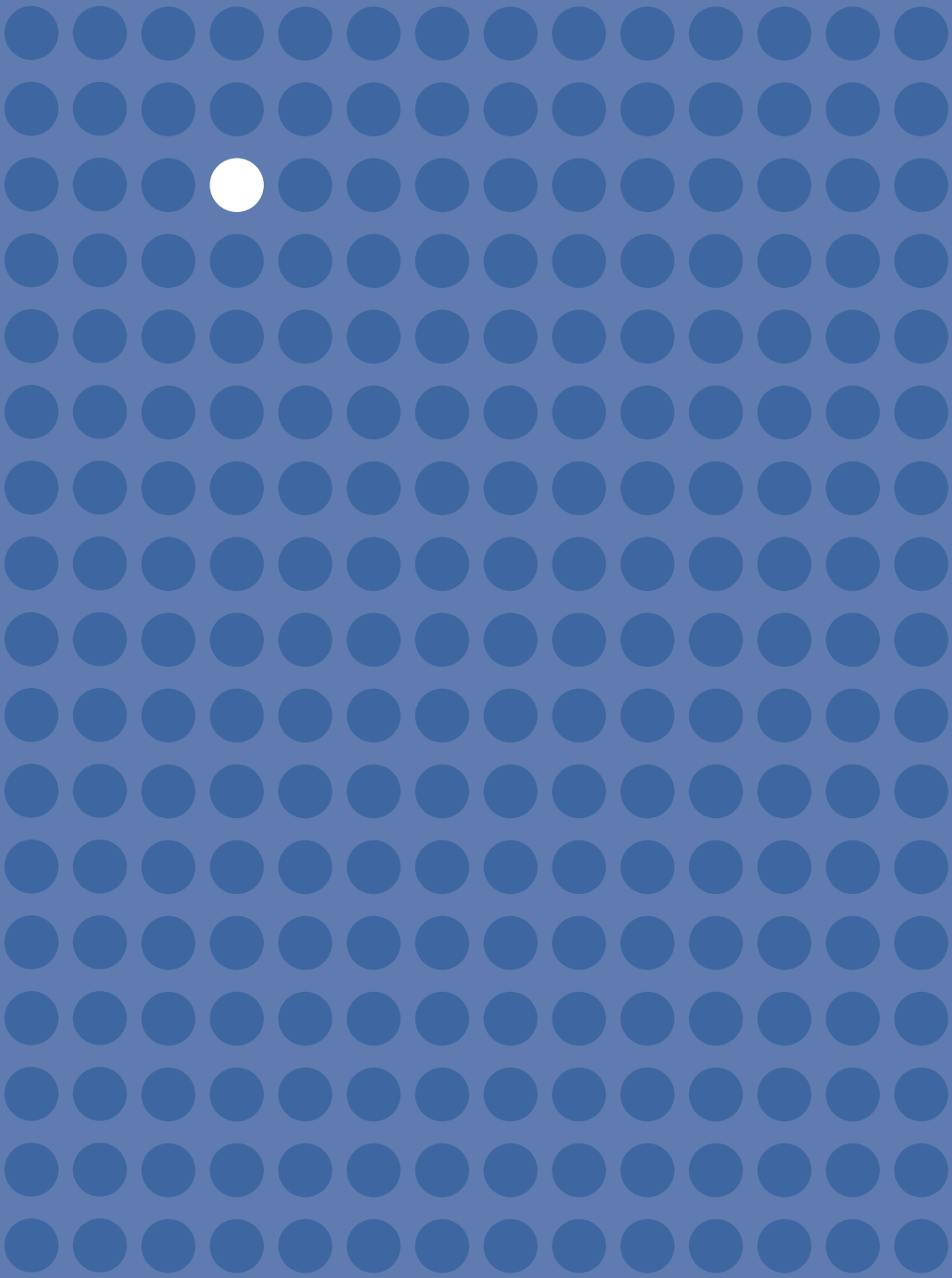
Country	Measure	Market level	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	Mean	Retail	7.1	13.6	9.38	15.4	14.58	16.17	10.75	9.72	10.31	10.62
Belgium	Median	Retail	–	–	9.5	15.45	14.4	16	9.3	10.8	9.9	10.2
Bulgaria	Mean	Undefined	–	–	–	1.5	–	2.2	5	3.4	4.1	2.9
Bulgaria	Mode	Undefined	–	–	–	–	–	1	5	5	3.5	1.5
Czech Republic	Mode	Undefined	–	–	–	–	10	7.4	11	8.1	5.23	15.9
Germany	Median	Undefined	10.5	8.6	7.9	–	8.4	8.6	6.7	7	7.2	7.4
Estonia	Mean	Undefined	–	–	–	–	–	4.38	3.7	–	4.9	4
Spain	Mean	Undefined	–	–	–	–	13.1	11.8	9.8	11.3	11.1	12.8
France	Mean	Undefined	–	–	8	9	9.3	8.8	8.8	10	10.1	10.5
France	Mode	Undefined	–	–	–	8	10	10	8	7	10	9
Italy	Mean	Retail	–	–	8.29	7.61	8.22	–	6	5.3	5.8	4.6
Italy	Mode	Retail	–	–	–	–	–	–	–	6.4	7.3	3.8
Luxembourg	Mean	Undefined	8.03	7.12	–	7.8	6.94	10.92	7.36	8.52	10.3	12.39
Luxembourg	Mode	Undefined	–	–	–	–	–	9	–	2.2	2.25	–
Hungary	Mean	Undefined	–	4	–	–	4	3.5	1.8	2.9	3.2	4
Hungary	Mode	Undefined	–	–	–	–	–	3.5	2.3	2	2	–
Malta	Mean	Retail	–	–	–	10	10	10.3	9.2	–	7.5	8.5
Malta	Mode	Retail	–	–	–	–	–	11	8.3	–	8	9.1
Netherlands	Mean	Retail	12.6	12.8	17.8	16.6	18.2	16.9	18.7	13.3	16.2	17.3
Austria	Mean	Retail	–	9	2	8	10	7.6	5.7	10	10.9	9.8
Austria	Median	Retail	–	–	–	–	–	7.4	4.9	6	7.5	9.5
Portugal	Mean	Retail	2.2	5.5	2.6	6	6.9	5.4	5.8	6.6	7	7.2
Portugal	Mode	Retail	–	–	–	4.4	5.2	4	2.9	5.8	4.8	6.4
Romania	Mean	Undefined	–	–	–	–	–	–	–	–	8.3	3.75
Slovenia	Mean	Undefined	–	–	–	–	–	–	13.6	–	9.4	6.7
Slovakia	Weighted mean	Undefined	–	8.2	14.9	24.6	15.5	13.2	9.8	8.2	13.4	8.2
Slovakia	Median	Undefined	–	11.5	11.5	12.1	13.1	12.8	10.2	9.1	10.1	10.2
Sweden	Mean	Undefined	–	–	–	–	–	–	–	–	9.3	11
Sweden	Median	Undefined	–	–	–	–	–	–	–	–	9	10
Sweden	Mode	Undefined	–	–	–	–	–	–	–	–	8	9
United Kingdom	Mean	Retail	18.1	7.4	2	9.8	3.4	5.25	3.3	–	–	–
Turkey	Mean	Undefined	–	–	3.08	2.13	2.45	–	–	5.47	6.52	10.03
Norway	Mean	Undefined	8	8	5	7	–	7	–	7	10	14

Notes: Data are reproduced in the table as submitted to the EMCDDA (not rounded). Variation in data collection methods, including in sampling strategies and sample size, calls for caution when making comparisons between (and within) countries. No data are available for the following: Denmark, Ireland, Greece, Cyprus, Latvia, Lithuania, Poland, Finland, Croatia.
Source: EMCDDA and Reitox national focal points.

Table A3: Potency (% THC content) of cannabis herb in Europe, 2000–09

Country	Measure	Market level	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	Mean	retail	10.4	6	8.85	13.82	13.27	14.25	7.78	8.91	9.11	9.92
Bulgaria	Mean	Undefined	–	–	–	2	–	2.4	2	1.5	1.6	2.4
Bulgaria	Mode	Undefined	–	–	–	–	–	2	1.5	1	1	1
Czech Republic	Mean	Undefined	–	–	–	–	3	3.8	4.5	4.7	5.5	4.2
Czech Republic	Mode	Undefined	–	–	–	–	–	1.6	1	1.5	1.5	1.7
Germany	Median	Undefined	6.4	8.6	8.4	–	10.8	9	7.8	7.4	7.4	8.3
Germany (1)	Median	Undefined	–	–	–	–	–	12.3	10.6	10	10.5	11.2
Germany (2)	Median	Undefined	–	–	–	–	–	4.1	2.2	2.4	2	2.1
Estonia	Mean	Undefined	–	–	–	–	–	3.31	2	–	6.6	8
Estonia	Mode	Undefined	–	–	–	–	–	0.35	1.1	–	1.1	12
Spain	Mean	Undefined	–	–	–	–	7.9	7.3	7.9	7.9	7.8	7.7
France	Mean	Undefined	–	–	8	8.5	8	6.1	7.8	7.5	5.8	8.5
France	Mode	Undefined	–	–	–	5	14	6	2	4	2	4
Italy	Mean	Retail	–	–	4.89	7.85	5.78	–	5.4	2.2	4.7	5.9
Italy	Mode	Retail	–	–	–	–	–	–	2	0.05	1.8	6.6
Luxembourg	Mean	Undefined	–	–	7.96	–	–	–	–	10.21	9.75	11.18
Luxembourg	Mode	Undefined	–	–	–	–	–	–	–	9.75	7.15	–
Hungary	Mean	Undefined	–	–	0.5	1.2	1.7	1.7	1.8	1.2	1.4	1.34
Hungary	Mode	Undefined	–	–	–	–	1	1.5	0.6	0.4	1	–
Malta	Mean	Retail	–	17	–	7	4.7	8.5	5.5	–	4.5	6.25
Malta	Mode	Retail	–	–	–	–	–	10	5.7	–	4	7.6
Netherlands (3)	Mean	Retail	5	5.1	6.6	6.2	7	6.7	5.5	6	8.4	9.9
Netherlands (4)	Mean	Retail	8.6	11.3	15.2	18	20.3	17.7	17.5	16	16.4	15.1
Austria	Mean	Retail	–	5	9	4	4.8	5.6	7.2	6.7	7.2	5.9
Austria	Median	Retail	–	–	–	–	–	6.3	6.2	5.9	6.6	4.9
Poland	Mean	Retail	–	–	–	–	0.6	1.01	1.34	5.22	6.85	7.7
Poland	Mode	Retail	–	–	–	–	–	0.75	0.9	5	4.35	6
Portugal	Mean	Retail	0.2	5.2	3.1	1.4	3.5	3	6.3	3.9	4.8	3.8
Portugal	Mode	Retail	–	–	–	1.3	1.5	3	2.2	0.7	9.4	0.1
Romania	Mean	Undefined	–	–	–	–	–	–	–	–	–	2.27
Slovenia	Mean	Undefined	–	–	–	–	–	–	–	5.3	8.7	7
Slovenia	Median	Undefined	–	–	–	–	–	–	–	4.5	7.7	4.8
Slovenia	Mode	Undefined	–	–	–	–	–	–	–	8.2	8.4	8.9
Slovakia	Weighted mean	Undefined	–	1.6	3.1	3.8	2.6	6.1	6.4	4.9	7.6	12.4
Slovakia	Median	Undefined	–	–	3	5.2	6.2	7.8	7.4	8.3	9.6	11.2
Finland	Mean	Retail	–	–	2	1	–	–	3.4	4.3	4. 9	4.6
Finland	Median	Retail	–	–	–	–	–	–	2.5	2.9	2.4	3.9
Sweden	Mean	Undefined	–	–	–	–	–	–	–	–	4.2	–
Sweden (1)	Mean	Undefined	–	–	–	–	–	–	–	–	7.5	–
Sweden (2)	Mean	Undefined	–	–	–	–	–	–	–	–	1.5	–
United Kingdom	Mean	Retail	12	9.5	10.8	10.7	12.7	13.48	11.3	–	–	–
Turkey	Mean	Undefined	–	–	0.35	0.34	0.41	0.37	–	2.94	3.45	4.72
Norway	Mean	Undefined	–	–	8	4	–	–	–	3	4.5	3.8

Notes: Data are reproduced in the table as submitted to the EMCDDA (not rounded). Variation in data collection methods, including in sampling strategies and sample size, calls for caution when making comparisons between (and within) countries. No data are available for the following: Denmark, Ireland, Greece, Cyprus, Latvia, Lithuania, Croatia.
(1) Sinsemilla; (2) other herbal cannabis; (3) imported; (4) domestic (nederwiet).
Source: EMCDDA and Reitox national focal points.



References

Advisory Council on the Misuse of Drugs (2008), *Cannabis: classification and public health*, available online at: http://www.homeoffice.gov.uk/publications/drugs/acmd1/acmd-cannabis-report-2008?view=Binary (accessed 2 August 2010).

Afsahi, K. (2011), 'Cannabis cultivation practices in the Moroccan Rif', in Decorte, T., Potter, G. and Bouchard, M. (eds), *World wide weed. Global trends in cannabis cultivation and its control*, Ashgate, Farnham, pp. 39–54.

ACPO (Association of Chief Police Officers, National Policing Improvement Agency) (2009), *Practical advice on tackling commercial cannabis cultivation and headshop*s. 2. *Cannabis farms*, available online at: http://www.npia.police.uk/en/docs/Cannabis_Cultivation_R.pdf (accessed 2 August 2010).

ACPO (2012), *UK national problem profile: commercial cultivation of cannabis 2012*, available online at: http://www.acpo.police.uk/documents/crime/2012/20120430CBACCofCPP.pdf (accessed 24 May 2012).

Arana, X. and Montañés Sánchez, V. (2011), 'Cannabis cultivation in Spain: the case of cannabis social clubs', in Decorte, T., Potter, G. and Bouchard, M. (eds), *World wide weed: Global trends in cannabis cultivation and its control*, Ashgate, Farnham, pp. 163–180.

Arnold, C. (2011), *The potency of THC in cannabis products: Paper No 1*, NACD Research Working Paper Series, National Advisory Committee on Drugs, Dublin.

Barriuso, A. M. (2011), 'Cannabis social clubs in Spain: a normalizing alternative underway', *Transnational Institute Series on legislative reform of drug policies No 9*, January 2011, available online at: http://www.tni.org/sites/www.tni.org/files/download/dlr9.pdf (accessed 9 August 2011).

Beck, F. and Legleye, S. (2003), *Drogues et adolescents. Usages de drogues et contextes d'usage entre 17 et 19 ans, evolutions recentes, ESCAPAD (2002)*, OFDT, Paris.

Benabud, A. (1957), 'Psycho-pathological aspects of the cannabis situation in Morocco: Statistical data for 1956', *Bulletin on Narcotics* 4, available online at: http://www.unodc.org/unodc/en/data-and-analysis/bulletin/bulletin_1957-01-01_4_page002.html#s000

Ben Lakhdar, C. (2007), *Le trafic de cannabis En France: estimation des gains des dealers afin d´apprécier le potentiel de blanchiment*, OFDT, Paris.

Benson, S., Lennard, C., Maynard, P. and Roux C. (2006), 'Forensic applications of isotope ratio mass spectrometry: a review', *Forensic Science International* 157(1), pp. 1–22.

Bieleman, B. and Nijkamp, R. (2010), *Aantallen coffeeshops en gemeentelijk beleid 1999–2009 [Coffeeshops in the Netherlands 2009]*, Bureau Voor Onderzoeak & advies, Intraval.

Bieleman, B. and Snippe, J. (2006), 'Coffeeshops en criminaliteit (Coffee shops and criminality)', Justitiële verkenningen 1, pp. 46–60.

Bieleman, B., Beelan, A., Nijkamp, R. and de Bie, E. (2008), *Aantallen coffeeshops En Gemeentelijk Beleid 1999–2007 [*Coffeeshops in Nederland 2007], Bureau Voor Onderzoeak & advies, Intraval.

Bloomer, J. (2008), *A political ecology approach to extra-legal rural livelihoods: a Lesotho-based case study of cultivation of and trade in cannabis,* PhD thesis, Department of Geography, University of Dublin, Trinity College, Dublin.

Bócsa, I. and Karus, M. (1998), *The cultivation of hemp. Botany, varieties, cultivation and harvesting*, Sebastopol, CA, Hemptech, p. 44.

Bouchard, M. (2007), 'A capture–recapture model to estimate the size of criminal populations and the risks of detection in a marijuana cultivation industry', *Journal of Quantitative Criminology* 23, pp. 221–241.

Bouchard, M. (2008), 'Towards a realistic method to estimate cannabis production in industrialized countries', *Contemporary Drug Problems* 35, 291–320.

Bouchard, M. and Dion, C. (2009), 'Growers and facilitators: probing the role of entrepreneurs in the development of the cannabis cultivation industry', *Journal of Small Business and Entrepreneurship* 22(1), pp. 25–38.

Bouchard, M. and Nguyen, H. (2011), 'Professionals or amateurs? Revisiting the notion of professional crime in the context of cannabis cultivation', in Decorte, T., Potter, G. and Bouchard, M. (eds), *World wide weed: global trends in cannabis cultivation and its control*, Ashgate, Farnham, pp. 109–126.

Bouquet, R. (1950), 'Cannabis', *Bulletin on Narcotics*, Issue 4, available online at: http://www.unodc.org/unodc/en/data-and-analysis/bulletin/bulletin_1950-01-01_4_page003.html

Bouquet, R. (1951), 'Cannabis (concluded)', *Bulletin on Narcotics*, Issue 1, available online at: http://www.unodc.org/unodc/en/data-and-analysis/bulletin/bulletin_1951-01-01_1_page005.html

Bovenkerk, F. and Hogewind, W. I. M. (2002), *Hennepelt in Nederland: Het probleem van de criminalitiet en haar bestrijding* [*Cannabis cultivation in the Netherlands: The problem of criminality and law enforcement*], William Pompe Instuut voor Strafwetenschappen, Utrecht.

Bruining, W. (2003), 'How to avoid criminalisation of Euro Cannabis, learning from the Dutch Experience. A plea for depenalizing, yet controlling production of Cannabis for private use in Europe', paper presented at the CEDRO Drug Policy Seminar, 12 September 2003, Amsterdam, available online at: http://www.cedro-uva.org/lib/bruining.how.html (accessed 11 July 2011).

Bureau for International Narcotics and Law Enforcement Affairs (2009), *International Narcotics Control Strategy Report*, United States Department of State, Washington, DC, March, available online at: http://www.state.gov/documents/organization/120054.pdf

Calafat, A., Juan, M., Becoña, E., et al. (2000), 'Estrategias y organización de la cultura pro-cannabis', *Addiciones* 12(2), pp. 231–274.

Camp, J. (1936), 'Antiquity of hemp as an economic plant', *Journal of the New York Botanical Garden* 37, p. 110.

Carpo Regional Project (2007), 'Update of the 2006 situation report on organised and economic crime in South-eastern Europe', *Trends in Organized Crime* 10, pp. 102–112.

Casey, J. and Hay, G. (2009), *Assessing the scale and impact of illicit drug markets in Scotland*, Edinburgh, Scottish Government Social Research.

Caulkins, J. P. and Pacula, R. L. (2006), 'Marijuana markets: inferences from reports by the household population', *Journal of Drug Issues* 36(1), pp. 173–200.

Chandra, S., Lata, H., Khan, I. A. and ElSohly, M. A. (2008), 'Photosynthetic response of *Cannabis sativa* L. to variations in photosynthetic photon flux densities, temperature and CO_2 conditions', *Physiology and Molecular Biology of Plants* 14, pp. 299–306.

Chatwin, C. (2007), 'Multi-level governance: the way forward for European illicit drug policy?', *International Journal of Drug Policy* 18, pp. 494–502.

Chatwin, C. (2010), 'User involvement in the illegal drugs field: what can Britain learn from European experiences?', *Safer Communities* 9(4), pp. 51–60.

Chin, V., Dandurand, Y., Plecas, D. and Segger, T. (2000), *The criminal justice response to marihuana growing operations in BC*, Department of Criminology and Criminal Justice, University College of the Fraser Valley, Abbotsford, British Columbia.

Chouvy, P.-A. (2005a), 'Morocco said to produce nearly half of the world's hashish supply', *Jane's Intelligence Review* 17(11), available online at: http://www.geopium.org/Chouvy-JIR-NOV2005-Morocco_said_to_produce_nearly_half_of_the_worlds_hashish_supply.html

Chouvy, P.-A. (2005b), 'Morocco's smuggling rackets: hashish, people and contraband', *Jane's Intelligence Review* 17(12), available online at: http://www.geopium.org/Chouvy-JIR-DEC2005-Moroccos_smuggling_rackets_hashish_people_and_contraband.html

Chouvy, P.-A. (2008), 'Production de cannabis et de haschisch au Maroc: contexte et enjeux', *L'espace politique*, No 4, available online at: http://www.geopium.org/chouvy_Espace_politique-Production_cannabis_haschich_Maroc_contexte_enjeux.htm

Chouvy, P.-A. and Laniel, L. (2006), 'Production agricole de drogues illicites et conflictualités intra-étatiques: dimensions économiques et stratégiques', *Les Cahiers de la sécurité*, No 62, available online at: http://laniel.free.fr/INDEXES/PapersIndex/AGRO-DROGUES/Agro_Drogues_Laniel_Chouvy.htm

Clarke, R. C. (1998), *Hashish!*, Red Eye Press, Los Angeles.

Clarke, R. C. (2001), 'Sinsemilla heritage: what's in a name?', in King, J. (ed.), *The cannabible*, Ten Speed Press, Berkeley, CA, pp. 1–24.

Clarke, R. C. and Watson, D. P. (2007), 'Cannabis and natural cannabis medicines', in ElSohly, M. A. (ed.), *Marijuana and the cannabinoids,* Humana Press, Totowa, NJ, pp. 1–16.

Conrad, C. (1994), *Hemp, lifeline to the future*, 2nd edn, Creative Expressions Publications, Los Angeles, pp. 8–9.

Costes, J.-M., Ben Lakhdar, C., Dujourdy, L., et al. (2009), *Cannabis markets in Europe: production, market shares of different products and potency issues*, Final report to the EMCDDA, OFDT, Saint-Denis.

Cour des comptes (2011), *L'organisation et la gestion des forces de sécurité publique, Rapport public thématique*, Cour des comptes, Paris.

CSD (Centre for the Study of Democracy) (2007), *Organized crime in Bulgaria: markets and trends*, available online at: http://pdc.ceu.hu/archive/00003706/01/organized_crime_markets_and_trends.pdf

Dahl, V. H. and Frank, V. A. (2011), 'Medical marijuana: exploring the concept in relation to small scale cannabis growers in Denmark', in Decorte, T., Potter, G. and Bouchard, M. (eds), *World wide weed: global trends in cannabis cultivation control*, Ashgate, Farnham, pp. 51–74.

Decorte, T. (2007), 'Characteristics of the cannabis market in Belgium', in Fountain, J. and Korf, D. J. (eds), *Drugs in society: European perspectives*, Radcliffe Publishing, Oxford.

Decorte, T. (2008), 'Domestic marijuana cultivation in Belgium: on (un)intended effects of drugs policy on the cannabis market', in Korf, D. (ed.), *Cannabis in Europe: dynamics in perception, policy and markets,* Pabst Science Publishers, Lengerich.

Decorte, T. (2010a), 'The case for small-scale domestic cannabis cultivation', *International Journal of Drug Policy* 21, pp. 271–275.

Decorte, T. (2010b), 'Small scale domestic cannabis cultivation: an anonymous Web survey among 659 cannabis cultivators in Belgium', *Contemporary Drug Problems* 37 (Summer), pp. 341–370.

Decorte, T. (2011), ' "Stories", "Facts" and "Myths". Perceptions of Domestic Cultivators on Potency and Quality of Cannabis', in Decorte, T., Potter, G., Bouchard, M. (eds), *World wide weed: global trends in cannabis cultivation control*, Ashgate, Farnham, pp. 91–108.

De Meijer, E. P. M. (1994), 'Cannabis germplasm resources', in Ranalli, P. (ed.), *Advances in hemp research*, Haworth Press, New York, pp. 133–151.

De Meijer, E. P. M., Bagatta, M., Carboni, A., et al. (2003), 'The inheritance of chemical phenotype in *Cannabis sativa* L.', *Genetics* 163, pp. 335–346.

De Meijer, E. P. M., Hammond, K. M. and Micheler, M. (2009), 'The inheritance of chemical phenotype in *Cannabis sativa* L. (III): variation in cannabichromene proportion', *Euphytica* 165, pp. 293–311.

Demetrovics, Z. (2009), 'Hungary: a review', in Hadfield, P. (ed.), *Nightlife and Crime*, Oxford University Press, Oxford, pp. 169–182.

De Ruyver, B. (2006), 'Drugs in de Lage Landen; de Belgische kant van het verhaal', *Justitiële verkenningen* 1, pp. 135–145.

De Ruyver, B. (2011) *Tackling professional (criminal) cannabis cultivation*, European Seminar on organised Crime and Cannabis, Institute for International Research on Criminal Policy, Ghent University, Amsterdam, June 8th, 2011.

De Ruyver, B. and Surmont, T. (2007), *Grensoverschrijdend drugtoerisme. Nieuwe uitdagingen voor de Euregio's* (*Cross-border drug tourism. New challenges for the Euregio*).

Doekhie, J., Nabben, T. and Korf, D. J. (2010), *NL Trendwatch: gebruikersmarkt uitgaansdrugs in Nederland, 2008–2009*, Rozenberg Publishers, Amsterdam.

DRCN (Drug Reform Coordination Network) (2001a), 'Lebanese government looks the other way as farmers harvest hash crop, poppies now being planted', *Drug War Chronicle* 213, 30 November, available online at: http://stopthedrugwar.org/chronicle-old/213/lebanon.shtml

DRCN (2001b), 'Return of the repressed: hash production revives in Lebanon's Bekaa Valley, farmers vow to fight eradication', *Drug War Chronicle* 191, 22 June, available online at: http://stopthedrugwar.org/chronicle-old/191/bekaavalley.shtml

Duffy, M., Schaeffer, N., Coomber, R., O'Connell, L. and Turnbull, P. (2008), *Cannabis supply and young people: 'it's a social thing'*, Joseph Rowntree Foundation, York.

Du Toît, B. (1975), 'Dagga: the history and ethnographic setting of Cannabis sativa in Southern Africa', in Rubin, V. (ed.), *Cannabis and culture*, Mouton Publishers, The Hague.

Eisenbach-Stangl, I., Moskalewicz, J. and Thom, B. (eds) (2009), *Two worlds of drug consumption in late modern societies*, Public Policy and Social Welfare Vol. 34, Ashgate, Farnham.

ElSohly, M. A. and Slade, D. (2005), 'Chemical constituents of marijuana: the complex mixture of natural cannabinoids', *Life Sciences* 78, pp. 539–548.

ElSohly, M. A., Standford, D. F. and Murphy, T. P. (2006), 'Chemical fingerprinting of cannabis as a means of source identification', in ElSohly, M. A. (ed.), *Forensic science and medicine: marijuana and the cannabinoids*, Humana Press Inc. Totowa, NJ, pp. 51–64.

EMCDDA (European Monitoring Centre for Drugs and Drug Addiction) (2004), *An overview of cannabis potency in Europe*, EMCDDA Insights, No 6, Office for Official Publications of the European Communities, Luxembourg.

EMCDDA (2007), *Drugs and crime: a complex relationship*, Drugs in Focus, No 16, Office for Official Publications of the European Communities, Luxembourg.

EMCDDA (2008a), *A cannabis reader: global issues and local experiences*, EMCDDA Monographs No 8, Vols 1 and 2, Office for Official Publications of the European Communities, Luxembourg.

EMCDDA (2008b), *Monitoring the supply of heroin to Europe*, EMCDDA, Lisbon, available online at: http://www.emcdda.europa.eu/publications/technical-datasheets/heroin-trafficking

EMCDDA (2009), *Annual report*, Publications Office of the European Union, Luxembourg.

EMCDDA (2011a), *Annual report 2011: the state of the drugs problems in Europe*, Publications Office of the European Union, Luxembourg.

EMCDDA (2011b), *Statistical bulletin*, EMCDDA, Lisbon, available online at: http://www.emcdda.europa.eu/stats11/szrtab2

EMCDDA (2011c), *ELDD topic overview: threshold quantities for drug offences*, available online at: http://www.emcdda.europa.eu/html.cfm/index99321EN.html

EMCDDA and Europol (2010), *Cocaine: a European Union perspective in the global context*, EMCDDA–Europol joint publication, Publications Office of the European Union, Luxembourg.

ENCOD (European Coalition for Just and Effective Drug Policies) (2009), *Use of drugs and advocacy*, Servicio Central de Publicaciones des Gobierno Vasco, Vitoria-Gasteiz.

ENFSI (European Network of Forensic Science Institutes) (2003), *Guidelines on representative drug sampling*, Drug Working Group.

Eurobarometer (2011), *Youth attitudes on drugs: analytical report*, Flash Eurobarometer 330, The Gallup Organization.

European Commission (2008), *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions examining the creation of a European Border Surveillance System (EUROSUR)*, COM(2008) 68 final, {SEC(2008) 151} {SEC(2008) 152}, Brussels, 13 February, available online at: http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=COMfinal&an_doc=2008&nu_doc=68

Fisher, J. (1975), 'Cannabis in Nepal. An overview', in Rubin, V. (ed.), *Cannabis and Culture*, Mouton Publishers, The Hague, pp. 247–256.

Fijnaut, C. and De Ruyver, B. (2008), Voor een gezamelijke beheersing van de druggerelateerde criminaliteit in de Euregio Maas-Rijn [*To an integrated control of the drug related crime in the Euregion Meuse-Rhine*].

Frank, V. A. (2007), 'Danish cannabis policy in practice: the closing of 'Pusher Street' and the cannabis market in Copenhagen', in Fountain, J. and Korf, D. J. (eds), *Drugs in society: European perspectives*, Radcliffe Publishing, London.

Frank, V. A. (2008), 'Danish drug policy: shifting from liberalism to repression', *Drugs and Alcohol Today* 8(2), pp. 26–33.

Frank, V. A. (2009), 'Domestic cannabis cultivation in Denmark: a matter of identity and sociality?', paper presented at the 3rd ISSDP conference in Vienna, available online at: http://www.issdp.org/conferences/2009/papers/Vibeke%20Frank%20ISSDP%202009.pdf

Fritschi, G., Klein, B. and Szilluweit, W. (2006), 'Verteilung der THC-Gehalte in Marihuanapflanzen: Bestimmung der Gehalte in Wurzeln, Stängeln, Blättern und Blüten', *Toxichem+Krimtech* 73(2), pp. 54–56.

Fuchs, L. (2003 [1542]), *De historia stirpium commtarii insignes*, CD-ROM edition, Octavo, Oakland, CA.

Gamella, J. F. and Jimenez-Rodrigo, M. L. (2004), 'A brief history of cannabis policies in Spain (1968–2003)', *Journal of Drug Issues* 3, pp. 623–660.

Gershenzon, J. (1994), 'Metabolic costs of terpenoid accumulation in higher plants', *Journal of Chemical Ecology* 20, pp. 1281–1328.

Gill, E. W., Paton, W. D. and Pertwee, R. G. (1970), 'Preliminary experiments on the chemistry and pharmacology of cannabis', *Nature* 228, pp. 134–136.

Grigoryev, S. (1998), *Hemp (Cannabis sativa L.) genetic resources at the VIR: from the collection of seeds, through to the collection of sources, towards the collection of donors of traits. The history of cultivation of hemp in Russia*, Online publications, N.I. Vavilov Research Institute of Plant Industry, available at http://www.vir.nw.ru/hemp/hemp1.htm (accessed 19 August 2011).

Gröger T., Schäffer M., Pütz M., et al. (2008), 'Application of two-dimensional gas chromatography combined with pixel-based chemometric processing for the chemical profiling of illicit drug samples', *Journal of Chromatography A* 1200, pp. 8–16.

Guardia Civil (NDa), 'Sistema integrado de vigilancia exterior (SIVE). Introducción', available online at: http://www.guardiacivil.es/prensa/actividades/sive03/intro.jsp

Guardia Civil (NDb), 'Sistema integrado de vigilancia exterior (SIVE). Localización e implantación', available online at: http://www.guardiacivil.es/prensa/actividades/sive03/localizacion.jsp

Guardia Civil (NDc), 'Sistema integrado de vigilancia exterior (SIVE). Funciones y capacidades técnicas', available online at: http://www.guardiacivil.es/prensa/actividades/sive03/funciones.jsp

Guardia Civil (NDd), 'Sistema integrado de vigilancia exterior (SIVE). Funciones y capacidades técnicas', available online at: http://www.guardiacivil.es/prensa/actividades/sive03/otras.jsp

Gupta, P. C. and Ray, C. S. (2004), 'Epidemiology of betel quid usage', *Annals of the Academy of Medicine Singapore* 33, pp. 31–36.

Gutierrez, I. M. (2010), *La cultura cannábica en España (1991–2007),* Universidad de Granada, Granada.

Hakkarainen, P. and Perälä, J. (2011), 'With a little help from my friends: justifications of small-scale cannabis growers', in Decorte, T., Potter, G. and Bouchard, M. (eds), *World wide weed: global trends in cannabis cultivation control*, Ashgate, Farnham, pp. 79–89.

Hakkarainen, P., Kainulainen, H. and Perälä, J. (2008), 'Measuring the cannabis market in Finland: a consumption-based estimate', *Contemporary Drug Problems,* 35 (Summer–Fall), pp. 321–345.

Hakkarainen, P., Frank, V. A., Perälä, J. and Dahl, H. V. (2011a), 'Small-scale cannabis growers in Denmark and Finland', *European Addiction Research,* 17, pp. 119–128.

Hakkarainen, P., Perälä, J. and Metso, L. (2011b), 'Kukkaa pukkaa: Kannabiksen kotikasvatus Suomessa', *Yhteiskuntapolitiikka* 76(2), pp. 148–168.

Hammer, J. (2001), 'Lebanon: hash makes a comeback. The Bekaa Valley regains its outlaw reputation', *Newsweek* (International, Atlantic edition), 17 September, available online at: http://www.thedailybeast.com/newsweek/2001/09/16/lebanon-hash-makes-a-comeback.html

Hardwick, S. and King, L. A. (2008), *Home Office cannabis potency study 2008*, Home Office Scientific Development Branch, Sandridge/St Albans, UK.

Harlan, J. R. and de Wet, J. M. J. (1971), 'Towards a rational classification of cultivated plants', *Taxon* 20, pp. 509–517.

Hasan, K. (1975), 'Social aspects of the use of cannabis in India', in Rubin, V. (ed.), *Cannabis and culture*, Mouton Publishers, The Hague, pp. 235–245.

Hibell, B., Guttormsson, U., Ahlström, S., et al. (2009), *The ESPAD report 2007: alcohol and other drug use among students in 35 European countries*, Swedish Council for Information on Alcohol and Other Drugs (CAN), Stockholm.

Hibou, B. (1996), 'Les enjeux de l'ouverture au Maroc. Dissidences économique et contrôle politique', *Les Etudes du CERI*, No 15, April, available online at: http://www.ceri-sciencespo.com/publica/etude/etude15.pdf

Hillig, K. W. and Mahlberg, P. G. (2004), 'A chemotaxonomic analysis of cannabinoid variation in cannabis (Cannabaceae)', *American Journal of Botany* 91, pp. 966–975.

HLSCST (House of Lords Select Committee on Science and Technology) (1998), *Cannabis: the scientific and medical evidence*, HL Paper 151-I, The Stationery Office, London.

Hoare, J. and Moon, D. (eds) (2010), 'Drug misuse declared: findings from the 2009/10 British Crime Survey', *Home Office Statistical bulletin 13/10*, available online at: http://www.cjp.org.uk/publications/archive/drug-misuse-declared-findings-from-the-2009-10-british-crime-survey-22-07-2010/

Hollister, L. E. (1974), 'Structure–activity relationships in man of cannabis constituents and homologs and metabolites of Δ^9-tetrahydrocannabinol', *Pharmacology* 11, pp. 3–11.

Hough, M., Warburton, H., Few, B., et al. (2003), *A growing market: the domestic cultivation of cannabis* (Drugs and Alcohol Research Programme), Joseph Rowntree Foundation, York.

Howard, C., Gilmore, S., Robertson, J. and Peakall, R. (2009), 'A *Cannabis sativa* STR genotype database for Australian seizures: forensic applications and limitations', *Journal of Forensic Sciences* 54, pp. 556–563.

INYPSA (1995), *Programme d'action intégré pour le développement et l'aménagement de la région méditerranéenne marocaine. Prédiagnostic*, INYPSA, Rabat.

Jansen, A. C. M. (2002), 'The economics of cannabis-cultivation in Europe', paper presented at the 2nd European Conference on Drug Trafficking and Law Enforcement, Paris, 26–27 September 2002, available online at: http://www.cedro-uva.org/lib/jansen.economics.html 9th July 2011 (accessed 28 August 2011).

Jansen, M. and Terris, R. (2002), 'One woman's work in the use of hashish in a medical context', in Russo, E., Dreher, M. and Mathre, M. L. (eds), *Women and Cannabis, Medicine, Science and Technology*, Haworth Press, New York, pp. 135–143.

Joffe, A. (2000), 'Drug production and the environment in Lebanon', *Middle East Intelligence Bulletin* 2(9).

Johnston, L. D., O'Malley, P. M., Bachman, J. G. and Schulenberg, J. E. (2010), *Marijuana use is rising; ecstasy use is beginning to rise; and alcohol use is declining among U.S. teens*, University of Michigan News Service, Ann Arbor, MI, available online at: http://www.monitoringthefuture.org/data/10data.html - 2010data-cigs

Joseph, R. (1973), 'The economic significance of *Cannabis sativa* in the Moroccan Rif', *Economic Botany* 27, pp. 235–240.

Kan, M. (1975), 'Cannabis usage in Pakistan. A pilot study of long term effects on social status and physical health', in Rubin, V. (ed.), *Cannabis and culture*, Mouton Publishers, The Hague.

Kandel, D. and Faust, R. (1975), 'Sequence and stages in patterns of adolescent drug use', *Archives of General Psychiatry* 32, pp. 923–932.

Kandel, D., Yamaguchi, K. and Klein, L. (2006), 'Testing the gateway hypothesis', *Addiction* 101, pp. 470–472.

Khalaf, R. (1997), 'Hashish to hardship: Roula Khalaf on the nostalgia poor Lebanese farmers feel for the illicit crop', *The Financial times* (London edition), 26 July.

Kilmer, B. and Pacula, R. (2009), 'Estimating the size of the illicit drug markets: a demand-side approach', in Reuter, P. and Trautmann, F. (eds), *A report on global illicit drug markets 1998–2007*, European Communities, Brussels.

King, L. A., Carpentier, C. and Griffiths, P. (2005), 'Cannabis potency in Europe', *Addiction* 100, pp. 884–886.

Korf, D. (2002), 'Dutch coffee shops and trends in cannabis use', *Addictive Behaviours* 27, pp. 851–866.

Korf, D. J. (2003), 'De economie van de wietkwekerij: een verkenning', in Bovenkerk. F. and Hogewind, W. I. M. (eds), *Hennepteelt in Nederland: het probleem van de criminaliteit en haar bestrijding*, Politie en Wetenschap Series No 8, Uitgeverij Kerckebosch, Zeist.

Korf, D. (2008), *Cannabis retail markets in Amsterdam*, available online at: http://www.drugtext.org/Cannabis-marijuana-hashisch/cannabis-retail-markets-in-amsterdam.html

Korf, D. (2011), 'Marihuana behind and beyond coffeeshops', in Decorte, T., Potter, G. and Bouchard, M. (eds), *World wide weed: global trends in cannabis cultivation control*, Ashgate, Farnham, pp. 181–196.

Korf, D. J., Biemond, R. and Jellema, R. (1994), 'Cannabis-Monsters UvA', in Korf, D. J., Biemond, R. and Jellema, R. (eds), *Prijs en kwaliteit van illegale drugs in Amsterdam*, Criminologisch Instituut Bonger, Amsterdam, pp. 9–16.

Korf, D., Wouters, M. and Benschop, A. (2011), 'The return of the underground retail cannabis market? Attitudes of Dutch coffeeshop owners and cannabis users to the proposed "cannabis ID" and the consequences they expect', *Bonger International Bulletin* 1(1).

Labrousse, A. (1998), 'L'approvisionnement des marchés des drogues dans l'espace Schengen', *Les Cahiers de la sécurité intérieure*, No 32.

Labrousse, A. and Romero, L. (2001), *Rapport sur la situation du cannabis dans le Rif marocain*, OFDT, Paris.

Lalam, N. (2001), *Déterminants et analyse économique de l'offre de drogues illicites en France*, Panthéon-Sorbonne University, Paris.

Lalam, N. and Laniel, L. (2011), 'Knowledge and policies to reduce drug supply in France: some misunderstandings', in Hunt, G., Milhet, M. and Bergeron, H. (eds), *Drugs and culture: knowledge, consumption and policy*, Ashgate, Farnham.

Laniel, L. (1997), 'Violencia y marihuana: usos del 'tabaco del diablo' en el Ghana contemporáneo', in Inchaurraga, S. (comp.), *Drogas y drogadependencias, teoría, clínica e instituciones*, CEAD-SIDA, Universidad Nacional de Rosario, Rosario, available online at: http://laniel.free.fr/INDEXES/PapersIndex/GHANA/GHANAMOTAESP.htm

Laniel, L. (1998), *Cannabis in Lesotho: a preliminary survey*, Management of social transformation connected to the international drug problem, Discussion Paper No 34, Unesco, Paris, available online at: http://www.unesco.org/most/dslaniel.htm#production

Laniel (2000), 'Drogenhandel im südlichen Afrika: Die Hinterlassenschaft von Krieg und Apartheid', in Schönenberg, R. (Hsrg.), *International Drogenhandel und gesellschaftliche Transformation*, Deutscher Universitäts-Verlag, Wiesbaden, available online at: http://laniel.free.fr/INDEXES/PapersIndex/Drogenhandel%20im%20sudlichen%20Afrika/Drogenhandel%20im%20sudlichen%20Afrika.htm

Laniel, L. (2001), 'Drugs in southern Africa: business as usual', *International Social Science Journal*, No 169, September, available online at: http://laniel.free.fr/INDEXES/PapersIndex/issj169ENG.pdf

Laniel, L. (2006), 'Producing cannabis in Africa South of the Sahara: a review of OGD findings in the 1990s', paper delivered at the international workshop, *Drugs and Alcohol in Africa: Production, Distribution, Consumption & Control*, St. Antony's College, University of Oxford, 23 May 2006, available online at: http://laniel.free.fr/INDEXES/PapersIndex/CANNABIS_AFRICA_OXFORD/Cannabis_in_Africa_Oxford.htm

Leggett, T. (2002), *Rainbow vice. The drugs and sex industries in the new South Africa*, Zed Books/David Phillip, London/Cape Town.

Leggett, T. and Pietschmann, T. (2008), 'Global cannabis cultivation and trafficking', in *A cannabis reader: global issues and local experiences*, EMCDDA Monographs No 8, Vol. 1, EMCDDA, Lisbon.

Legleye, S., Ben Lakhdar, C. and Spilka, S. (2008), 'Two ways of estimating the euro value of the illicit market for cannabis in France', *Drug and Alcohol Review* 27, pp. 466-472.

Liebregts, N., Benschop, A., Van der Pol, P., et al. (2011), 'Cannabis dependence and peer selection in social networks of frequent users', *Contemporary Drug Problems* 38(1).

Maalsté, N. and Panhuysen, M. (2007), *Polderwiet,* Uitgeverij De Fontein, Baarn.

Maalsté, N., van den Brink, G., Brouwer, G. and Schilder, A. (2010), *Juridische en praktische haalbaarheid van 'Limburg trekt zijn grens'*, Tilburgse School voor Politiek en Bestuur, Tilburg.

MacCoun, R. (2010), *What can we learn from the Dutch cannabis coffeshop experience?*, RAND Drug Policy Research Centre.

McPartland, J. M. and Russo, E. B. (2001), 'Cannabis and cannabis extracts: greater than the sum of their parts', in *Cannabis therapeutics in HIV/AIDS*, Howarth Press, New York, pp. 103–132.

McPartland, J. M., Clarke, R. C. and Watson, D. P. (2000), *Hemp diseases and pests management and biological control*, CABI Publishing, Oxford, p. 11.

Mahlberg, P. G., Hammond, C. T., Turner, J. C. and Hemphill, J. K. (1984), 'Structure, development and composition of glandular trichomes of *Cannabis sativa* L.', in Rodriguez, E. P., Healey, L. and Mehta. I. (eds), *Biology and chemistry of plant trichomes*, Plenum Press, London, pp. 23–51.

Malingré, T., Herndriks, H., Battermann, S., Bos, R. and Visser, J. (1975), 'The essential oil of *Cannabis sativa* L.', *Planta Medica* 28, pp. 56–61.

Martone, G. and Della Casa, E. (1990), 'Analysis of the ageing processes in hashish samples from different geographic origin', *Forensic Science International* 47, pp. 147–155.

Matelly, J.-H. and Mouhanna, C. (2007), *Police: des chiffres et des doutes*, Editions Michalon, Paris.

Measham, F. and Moore, K. (2009), 'Repertoires of distinction: exploring patterns of weekend polydrug use within local leisure scenes across the English night time economy', *Criminology and Criminal Justice* 9, pp. 437–464.

Mechoulam, R. and Hanuš, L. (2000), 'A historical overview of chemical research on cannabinoids', *Chemistry and Physics of Lipids* 108, pp. 1–13.

Mechtler, K., Bailer, J. and de Hueber, K. (2004), 'Variations of THC content in single plants of hemp varieties', *Industrial Crops and Products* 19, pp. 19–24.

Mehmedic, Z., Chandra, S., Slade, D., et al. (2010), 'Potency trends of Δ⁹-THC and other cannabinoids in confiscated cannabis preparations from 1993 to 2008', *Journal of Forensic Sciences 55*, pp. 1209–1217.

Mendoza, M., Mills, De E., Lata, H., et al. (2009), 'Genetic individualization of Cannabis sativa by a short tandem repeat multiplex system', *Analytical and Bioanalytical Chemistry* 393, pp. 719–726.

Merlin, M. D. (2003), 'Archaeological evidence for the tradition of psychoactive plant use in the old world', *Economic Botany 57*, pp. 295–323.

Mignoni, G. (1997), 'Cannabis as a licit crop: recent development in Europe', *Bulletin on Narcotics* XLIX and L, Nos 1 and 2.

MILDT (Mission interministérielle de lutte contre la drogue et la toxicomanie) (2011), *La culture du cannabis en intérieur. Le guide de l'enquêteur*, MILDT, La documentation française, Paris.

Miller Coyle, H., Palmbach, T., Juliano, N., Ladd, C. and Lee, H. C. (2003), 'An overview of DNA methods for the identification and individualization of marijuana', *Croatian Medical Journal* 44, pp. 315–321.

Moeller, K. K. (2009), 'Police crackdown in Christiania in Copenhagen', *Crime, Law Change* 52, pp. 337–345.

Moffat, A. C, Osselton, M. D. and Widdop, B. (eds) (2004), *Clarke's analysis of drugs and poisons*, 3rd edn, Vol. 2, Royal Pharmaceutical Society, London, p. 743.

Mold, A. and Berridge, V. (2008), 'The rise of the user? Voluntary organizations, the state and illegal drugs in England since the 1960s', *Drugs: Education, Prevention and Policy* 15, pp. 451–461.

Monfreid de, H. (1933), *La croisière du haschisch*, Grasset, Paris.

Moreno, P. (1997), *Estudio del cultivo de cannabis sativa en el Rif marroquí: sus consecuencias socioeconómicas para la región*, doctoral thesis, Universidad politécnica de Valencia, Escuela Técnica Superior de Ingenieros Agrónomos, Valencia.

Mulchandani, R., Hand, T. and Panesar, L. K. (2010), 'Seizures of Drugs in England and Wales 2009/10', *Home Office statistical bulletin 17/10*, Home Office Research, Development and Statistics, London.

Musty, R. E., Karniol, I. G., Shirakawa, I., Takahshi, N. and Knobel, E. 'Interactions of Δ9-THC and cannabinol in man 1976', in Braude, M. C. and Szara, S. (eds), *Pharmacology of marihuana*, Vol. 2, Raven Press, New York, pp. 559–563.

Nabben, T., Benschop, A. and Korf, D. J. (2010), *Antenne 2009: trends in alcohol, tabak en drugs bij jonge Amsterdammers*, Rozenberg Publishers, Amsterdam.

Neve, R. A. (1991), *Hops*, Chapman & Hall, London, p. 4.

Niesink, R., Planije, M., Rigter, S., Hoek, J. and Mostert, L. (2000), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops*, Au151, Trimbos-Instituut, Utrecht.

Niesink, R., Planije, M., Rigter, S., Hoek, J. and Mostert, L. (2001), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2000–2001)*, Au172, Trimbos-Instituut, Utrecht.

Niesink, R., Pijlman, F., Rigter S., Hoek, J. and Mostert, L. (2002), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2001–2002)*, Au0207, Trimbos-Instituut, Utrecht.

Niesink, R., Pijlman F., Rigter, S., Hoek J. and Mostert, L. (2003), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2002–2003)*, Au0243, Trimbos-Instituut, Utrecht.

Niesink, R., Rigter, S. and Hoek, J. (2004), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2003–2004)*, AF 0531, Trimbos-Instituut, Utrecht.

Niesink, R., Rigter, S. and Hoek, J. (2005), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2004–2005)*, AF 0622, Trimbos-Instituut, Utrecht.

Niesink, R., Rigter, S., Hoek, J. and Goldschmidt, H. (2006), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2005–2006)*, AUo299, Trimbos-Instituut, Utrecht.

Niesink, R., Rigter, S., Hoek, J. and Goldschmidt, H. (2007), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2006–2007)*, AF0768, Trimbos-Instituut, Utrecht.

Niesink, R., Rigter, S., Hoek, J. and Goldschmidt, H. (2008), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2007-2008)*, AF0829, Trimbos-Instituut, Utrecht.

ODCCP (United Nations Office for Drug Control and Crime Prevention) (1999a), *The drug nexus in Africa*, ODCCP Studies on Drugs and Crime, ODCCP, Vienna, available online at: http://www.unodc.org/pdf/report_1999-03-01_1.pdf

ODCCP (1999b), *Global illicit drug trends*, ODCCP Studies on Drugs and Crime, Statistics, United Nations Office for Drug Control and Crime Prevention, New York, available online at: http://www.unodc.org/pdf/report_1999-06-01_1.pdf

ODCCP (2000), *World drug report 2000*, Oxford University Press, Oxford, available online at: http://www.unodc.org/pdf/world_drug_report_2000/report_2001-01-22_1.pdf

ODCCP (2001), *Global illicit drug trends 2001*, United Nations Office for Drug Control and Crime Prevention, New York, available online at: http://www.unodc.org/pdf/report_2001-06-26_1/report_2001-06-26_1.pdf

ODCCP (2002), *Global illicit drug trends 2002*, United Nations Office for Drug Control and Crime Prevention, New York, available online at: http://www.unodc.org/pdf/report_2002-06-26_1/report_2002-06-26_1.pdf

OGD (Observatoire géopolitique des drogues) (1994), *Rapport d'enquête sur les enjeux politiques, économiques et sociaux de la production et du trafic des drogues au Maroc*, OGD, Paris.

OGD (1996), *Atlas mondial des drogues*, Observatoire géopolitique des drogues, Presses universitaires de France, Paris.

OGD (1998), *Les drogues en Afrique subsaharienne*, Observatoire géopolitique des drogues, Karthala/Unesco, Paris.

Page, C. P., Curtis, M., Walker, M. G. and Hoffman, B. F. (2006), *Integrated Pharmacology*, 3rd edn, Mosby, St. Louis.

Parker, H. (2000), 'How young Britons obtains their drugs: drugs transactions at the point of consumption', *Crime Prevention Studies* 11, pp. 59–81.

Perez, P. and Laniel, L. (2004), 'Croissance et … croissance de l'économie du cannabis en Afrique subsaharienne (1980–2000)', in *Hérodote, Géopolitique des drogues illicites*, No 112, 1er trimestre, available online at: http://laniel.free.fr/INDEXES/PapersIndex/HERODOTE/Herodote112PAPERS/CANNAFRICAHERODOTE.htm

Perseus (2011), *Protection of European Seas and borders through the intelligent use of surveillance*, Perseus consortium, available online at: http://www.perseus-fp7.eu/wp-content/uploads/2011/06/2011_PERSEUS_Overview_v2.6.pdf

Pertwee, R. G. (2006), 'Cannabinoid pharmacology: the first 66 years', *British Journal of Pharmacology* 147, pp. S163–S171.

Pijlman, F. T. A., Rigter, S. M., Hoek, J., Goldschmidt, H. M. and Niesink, R. J. M. (2005), 'Strong increase in total delta-THC in cannabis preparations sold in Dutch coffee shops', *Addiction Biology* 10, pp. 170–180.

Poortman van der Meer, A. J. and Huizer, H. (1999), 'A contribution to the improvement of accuracy in the quantitation of THC', *Forensic Science International* 101, pp. 1–8.

Potter, D. J. (2004), 'Growth and Morphology of Medicinal Cannabis', in Guy, G. W., Whittle, B. A. and Robson, P. J. (eds), *The Medicinal Uses of Cannabis and Cannabinoids*, Pharmaceutical Press, London, pp. 17–54.

Potter, D. J. (2009a), 'The propagation, characterisation and optimisation of cannabis as a phytopharmaceutical', PhD thesis, Kings College London, available online at : http://www.gwpharm.com/uploads/phd_david_potter_jp.pdf (accessed 5 June 2011).

Potter, D. J. (2009b), 'The increasing potency of street cannabis', presentation to the CINP International Thematic Meeting, Major Psychoses and Substance Abuse, Edinburgh, 25–27 April 2009, available online at: http://cinp.org/fileadmin/documents/congress/edinburgh2009/Presentations/1400_David_Potter_fintry_sun.ppt.pdf (accessed 13 June 2011).

Potter, D. J. and Duncombe, P. (2012), 'The effect of electrical lighting power and irradiance on indoor-grown cannabis potency and yield', *Journal of Forensic Sciences* 57, pp. 618–622.

Potter, D. J., Clark, P. and Brown, M. B. (2008), 'Potency of D9-THC and other cannabinoids in cannabis in England in 2005: implications for psychoactivity and pharmacology', *Journal of Forensic Sciences* 53, pp. 90–94.

Potter, G. (2006), 'Weed, need and greed: domestic marijuana production and the UK cannabis market', PhD thesis, University of Sheffield.

Potter, G. (2008), 'The growth of cannabis cultivation: explanations for import substitution in the UK', in Korf, D. J. (ed.), *Cannabis in Europe: dynamics and perceptions, policy and markets*, Pabst Science Publishers, Lengerich, Germany.

Pudney, S., Badillo, C., Bryan, M., Conti, G. and Iacovou, M. (2006), 'Estimating the size of the UK illicit drug market', in Singleton N., Murray R. and Tinsley L. (eds), *Measuring different aspects of problem drug use: methodological developments*, Home Office Online Report 16/06, London.

Raman, A. R. (1998), 'The cannabis plant: botany, cultivation and processing for use', in Brown D. T. (ed.), *Cannabis: the genus cannabis*, Harwood Academic Publishers, Amsterdam, pp. 29–54.

Reitox national focal points (2009), *National reports 2009*, EMCDDA, Lisbon, available online at: http://www.emcdda.europa.eu/publications/searchresults?action=list&type=PUBLICATIONS&SERIES_PUB=w203 (accessed 17 November 2011).

Reitox national focal points (2010), *National reports 2010*, EMCDDA, Lisbon, available online at: http://emcdda.europa.eu/publications/national-reports

Reuter, P. (2010), *Marijuana Legalization: what can be learned from other countries,* RAND Working Paper Series, RAND Drug Policy Research Centre.

Reuter, P. and Greenfield, V. (2001), 'Measuring global drug markets. How good are the numbers and why should we care about them?', *World Economics* 2, pp. 159–173.

Rhodes, D. F. (1977), 'Integrated antiherbivore, antidesiccant, and ultraviolet screening properties of creosote bush resin', *Biochemical Systematics and Ecology 5*, pp. 281–290.

Rigter, S. and Niesink, R. (2010), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2009–2010)*, AF0994, Trimbos-Instituut, Utrecht.

Rigter, S. and Niesink, R. (2011), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2010–2011)*, AF0994, Trimbos-Instituut, Utrecht.

Rigter, S., Hoek, J. and Niesink, R. (2009), *THC-concentraties in wiet, nederwiet en hasj in Nederlandse coffeeshops (2008–2009)*, AF0894, Trimbos-Instituut, Utrecht.

Roberecht, R. and Caldwell, M. M. (1980), 'Leaf ultraviolet optical properties along a latitudinal gradient in the arctic-alpine life zone', *Ecology* 61, pp. 612–619.

Rosenthal, E. (2001), *The big book of buds*, Vol. 1, Quick American Archives, Oakland, CA, p. 214.

Rosenthal, E. (2004), *The big book of buds*, Vol. 2, Quick American Archives, Oakland, CA, pp. 80–81.

Rosenthal, E. (2007), *The big book of buds,* Vol. 3, Quick American Archives, Oakland, CA.

Ross, S. A. and ElSohly, M. A. (1997), 'CBN and Δ^9-THC concentration ratio as an indicator of the age of stored marijuana samples', Bulletin of Narcotics 1, 008.

Rossington, B. (2011), 'Liverpool drug gangs move in on cannabis trade: special ECHO report', Liver*pool Echo*, 21 July 2011, available online at: http://www.liverpoolecho.co.uk/liverpool-news/local-news/2011/07/21/liverpool-drug-gangs-move-in-on-cannabis-trade-special-echo-report-100252-29092230/ (accessed 9 August, 2011).

Russo, E. (2011), 'Taming THC: potential cannabis synergy and phytocannabinoid-terpenoid entourage effects', *British Journal of Pharmacology* 164, pp. 1344–1364.

Schubart, C. D., Sommer, I. E. C., Van Gastel, W. A. et al. (2011), 'Cannabis with high cannabidiol content is associated with fewer psychotic experiences', *Schizophrenia Research* 130, pp. 216–221.

Schultes, R. E. (1970), 'Random thoughts and queries on the botany of cannabis', in Joyce, C. R. B. and Curry, S. H. (eds), *The botany and chemistry of cannabis*, J and A Churchill, London, p. 11.

Schultes, R. E. and Hoffman, A. (1980), *The botany and chemistry of hallucinogens*, 2nd edn, Charles C. Thomas, Springfield, IL.

Schultes, R. E., Klein W. M., Plowman T. and Lockwood T. E. (1974), 'Cannabis: an example of taxonomic neglect', *Harvard University Botanical Museum Leaflets* 23, pp. 337–367.

Second International Opium Convention, Geneva, 19 February 1925, available at: http://treaties.un.org/doc/Treaties/1925/02/19250219%2006-36%20AM/Ch_VI_6_6a_6bp.pdf

Sentencing Council (2012), 'Drug offences: definitive guideline. Sentencing Council for England and Wales', Sentencing Council, London, available online at: http://sentencingcouncil.judiciary.gov.uk/docs/Drug_Offences_Definitive_Guideline_%28web%29.pdf

Silverstone, D. (2010), 'The policing of Vietnamese organized crime within the UK', *Policing 5*, 41 pp. 41–48.

Small, E. (1976), 'The forensic taxonomic debate on Cannabis: semantic hokum', *Journal of Forensic Science* 21, pp. 239–251.

Small, E. and Cronquist, A. (1976), 'A practical and natural taxonomy for cannabis', *Taxon* 25, pp. 405–435.

Smekens, M. and Verbruggen, M. (2005), *The illegal economy in the Netherlands,* Discussion paper 05005, Statistics Netherlands, Voorburg.

Smith, N. (2005), 'High potency cannabis: the forgotten variable', *Addiction* 100, pp. 1558–1559.

Snoeijer, W. (2002), *A checklist of some Cannabaceae cultivars*, Part a, *Cannabis*, Division of Pharmacognosy, Amsterdam Centre for Drug Research, Leiden, pp. 5–7.

Spanish focal point (2009), *Spain. New development, trends and in-depth information on selected issues*, 2009 national report (2008 data) to the EMCDDA by the Reitox national focal point, Madrid, available online at: http://www.emcdda.europa.eu/attachements.cfm/att_112037_EN_NR_2009_ES.pdf

Spapens, T. (2009), 'The Dutch cannabis market', in Costes, J.-M., Ben Lakhdar, C., Dujourdy, L., et al. (eds), *Cannabis markets in Europe: production, market shares of different products and potency issues*, Final report to the EMCDDA, OFDT, Saint-Denis.

Spapens, T. (2011), *The cannabis market in the Netherlands*, available at: http://ssrn.com/abstract=1856467

Spapens, T. and Van de Bunt, H. (2011), 'Soft drugs regulation and market dynamics in the Netherlands', unpublished paper.

Spapens, T., Van de Bunt, H. and Rastovac, L. (2007), *De wereld achter de wietteelt [The world behind cannabis cultivation]*, Boom Juridische Utigevers, The Hague.

Spooner, C. (2009), 'Social determinants of drug use: barriers to translating research into policy', *Health Promotion Journal of Australia* 20, p. 3.

Surmont, T., Vander Laenen, F. and De Ruyver, B. (2011), 'Finding respondents in local marihuana markets', in Fountain, J., Korf, D. and Frank, V. A. (eds.), *Messages, markets and methods: European perspectives on drugs,* Pabst Science Publishers, Lengerich.

Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) (2007), *Recommendations*, US Department of Justice, Drug Enforcement Administration, Executive Office of the President: Office of National Drug Control Policy 3rd edn, available online at: http://www.swgdrug.org/Archived/SWGDRUG%20Recommendations_100108.pdf

Szendrei, K. (1997), 'Cannabis as an illicit crop: recent developments in cultivation and production quality', *Bulletin of Narcotics* XLIX and L (1/2) pp. 1–21.

Toonen, M., Ribot, S. and Thissen, J. (2006), 'Yield of illicit indoor cannabis cultivation in the Netherlands', *Journal of Forensic Science* 51, pp. 1050–1054.

Traag, W., Gercek, H., Kloet, D., Wychgel, H. and Faasen, I. (2001), *Onderzoek naar residuen van bestrijdingsmiddelen in Nederwiet*, Trimbos-Instituut, Utrecht.

Turner, A. E., Elsohly, M. A. and Boeren, E. G. (1980), 'Constituents of *Cannabis sativa* L. XVII. A review of the natural constituents', *Journal of Natural Products* 43, pp. 169–234.

UNDCP (United Nations International Drug Control Programme) (1997), *Cannabis as an illicit narcotic crop: a review of the global situation of cannabis consumption, trafficking and production*, UNDCP, Research Section, Policy Development and Analysis Branch, Vienna, available online at: http://www.unodc.org/unodc/en/data-and-analysis/bulletin/bulletin_1997-01-01_1_page004.html

United Nations (1973), *Commentary on the Single Convention on Narcotic Drugs, 1961,* United Nations, New York, 1973.

UNODC (United Nations Office on Drugs and Crime) (2003a), *Maroc. Enquête sur le cannabis 2003*, UNODC/Government of Morocco, December, available online at: http://www.unodc.org/pdf/publications/morocco_cannabis_survey_2003_fr.pdf

UNODC (2003b), *Afghanistan opium survey 2003*, UNODC/Government of Afghanistan, October, available online at: http://www.unodc.org/documents/crop-monitoring/Afghanistan/Afghanistan_survey_2003_full_report.pdf

UNODC (2003c), *Global illicit drug trends 2003*, UNODC, New York, available online at: http://www.unodc.org/pdf/trends2003_www_E.pdf

UNODC (2004), *2004 World drug report. Volume 1: Analysis*, UNODC, Vienna, available online at: http://www.unodc.org/pdf/WDR_2004/volume_1.pdf

UNODC (2005a), *Maroc. Enquête sur le cannabis 2004*, UNODC/Government of Morocco, May, available online at: http://www.unodc.org/pdf/research/Morocco_survey_2004.pdf

UNODC (2005b), *Colombia coca cultivation survey*, UNODC/Government of Colombia, June, available online at: http://www.unodc.org/pdf/andean/Part3_Colombia.pdf

UNODC (2005c), *World drug report 2005, Volume 2: Statistics*, UNODC, Vienna, available online at: http://www.unodc.org/pdf/WDR_2005/volume_2_web.pdf

UNODC (2005d), *World drug report 2005, Volume 1: Analysis*, UNODC, Vienna, available online at: http://www.unodc.org/pdf/WDR_2005/volume_1_web.pdf

UNODC (2006a), 'Review of the world cannabis situation', *Bulletin on Narcotics*, Volume LVIII, Nos. 1 and 2, available online at http://www.unodc.org/documents/data-and-analysis/bulletin/2006/Bulletin_on_Narcotics_2006_En.pdf

UNODC (2006b), *World drug report 2006, Volume 1: Analysis*, UNODC, Vienna, available online at: http://www.unodc.org/pdf/WDR_2006/wdr2006_volume1.pdf

UNODC (2007a), *Maroc. Enquête sur le cannabis 2005*, UNODC/Government of Morocco, January, available online at: http://www.unodc.org/pdf/research/Morocco_survey_2005.pdf

UNODC (2007b), *World drug report 2007*, UNODC, Vienna, available online at: http://www.unodc.org/pdf/research/wdr07/WDR_2007.pdf

UNODC (2008), *World drug report 2008*, UNODC, Vienna, available online at: http://www.unodc.org/documents/wdr/WDR_2008/WDR_2008_eng_web.pdf

UNODC (2009a), *Recommended methods for the identification and analysis of cannabis and cannabis products. Manual for use by national drug analysis laboratories*, Laboratory and Scientific Section, UNODC Vienna, United Nations, New York.

UNODC (2009b), *World drug report 2009*, United Nations Publications, New York, available online at: http://www.unodc.org/documents/wdr/WDR_2009/WDR2009_eng_web.pdf

UNODC (2010a), *Afghanistan cannabis survey 2009*, UNODC/Government of Afghanistan, April, available online at: http://www.unodc.org/documents/crop-monitoring/Afghanistan/Afghanistan_Cannabis_Survey_2009.pdf

UNODC (2010b), *World drug report 2010*, UNODC, Vienna, available online at: http://www.unodc.org/documents/wdr/WDR_2010/World_Drug_Report_2010_lo-res.pdf

UNODC (2011a), *World drug report 2011*, UNODC, Vienna, available online at: http://www.unodc.org/documents/data-and-analysis/WDR2011/World_Drug_Report_2011_ebook.pdf

UNODC (2011b), *Drug seizures*, UNODC, Vienna, available online at: http://www.unodc.org/documents/data-and-analysis/WDR2011/Seizures_2011_Final.pdf

UNODC (2011c), *Afghanistan cannabis survey 2010*, UNODC/Government of Afghanistan, June, available online at: http://www.unodc.org/documents/crop-monitoring/Afghanistan/Afghanistan_Cannabis_Survey_Report_2010_smallwcover.pdf

UNODC (2011d), *The global Afghan opium trade. A threat assessment*, UNODC, July, available online at: http://www.unodc.org/documents/data-and-analysis/Studies/Global_Afghan_Opium_Trade_2011-web.pdf

US Department of Justice (2010), *National drug threat assessment 2010*, available online at: http://www.justice.gov/ndic/pubs38/38661/38661p.pdf (accessed 2 August 2010).

Van der Heijden, T. (2007), *Sizing the Dutch cannabis market*, unpublished presentation at the EMCDDA Expert meeting, Towards estimating the size of European drug markets 11–12 December 2007, Lisbon.

Vanhove, W., Van Damme, P. and Meert, N. (2011), 'Factors determining yield and quality of illicit indoor cannabis (*Cannabis* spp.) production', *Forensic Science International* 212, pp. 158–163.

Vanhove, W., Van Damme, P., Surmont, T., Van Puyenbroeck, L. and De Ruyver, B. (2012a), Opbrengstbepaling van een illegale indoor cannabisplantage. Eindrapport voor de Programmatorische Federale Overheidsdienst Wetenschapsbeleid [Yield of an illegal indoor cannabis plantation. Final report for the Federal Science Policy Program], Onderzoeksprogramma ter ondersteuning van de Federale Beleidsnota Drugs, BELSPO, Brussels.

Vanhove, W., Surmont, T., Van Damme, P. and De Ruyver, B. (2012b), 'Yield and turnover of illicit indoor cannabis (*Cannabis* spp.) plantations in Belgium', *Forensic Science International* (in press).

Weisheit, R. A. (1992), *Domestic marijuana. A neglected industry*, New York, Greenwood Press.

West, J. B., Hurley, J. M. and Ehleringer, J. R. (2009a), 'Stable isotope ratios of marijuana. I. Carbon and nitrogen stable isotopes describe growth conditions', *Journal of Forensic Sciences* 54, pp. 84–89.

Werb, D., Rowell, G., Guyatt, G., et al. (2011), 'Effect of drug law enforcement on drug market violence', *International Journal of Drug Policy* 22, pp. 87–94.

West, J. B., Hurley, J. M., Dudás, F. Ö. and Ehleringer, J. R. (2009b), 'The stable isotope ratios of marijuana. II. Strontium isotopes relate to geographic origin', *Journal of Forensic Sciences* 54, pp. 1261–1269.

Wilkins, C., Bhatta, K. and Cassawell, S. (2002), 'The effectiveness of crop eradication in New Zealand', *Drug and Alcohol Review* 21, pp. 369–374.

Wills, S. (1998), '*Cannabis* use and abuse by man: an historical perspective', in Brown, D. T. (ed.), Cannabis: *The genus* Cannabis, Harwood Academic, Amsterdam, pp. 1–27.

Wouters, M. (2008), 'Controlling cannabis cultivation in the Netherlands', in Korf, D. (ed.), *Cannabis in Europe: dynamics in perception, policy and markets*, Pabst Science, Lengerich.

Wouters, M. and Korf, D. (2009), 'Access to licensed cannabis supply and the separation of markets policy in The Netherlands', *Journal of Drug Issues*, Summer, pp. 627–652.

Wouters, M., Korf, D. J. and Kroeske, B. (2007), *Harde aanpak, hete zomer: Een onderzoek naar de ontmanteling van hennepkwekerijen in Nederland*, Rozenberg Publishers, Amsterdam.

Wouters, M., Benschop, A. and Korf, D. (2010), 'Local politics and retail cannabis markets: the case of the Dutch coffeeshops', *International Journal of Drug Policy* 21, pp. 315–320.

Zuardi, A. W., Crippa, J. A. S., Hallak, J. E. C, Moreira, F. A. and Guimarães, F. S. (2006), 'Cannabidiol, a Cannabis sativa constituent, as an antipsychotic drug', *Brazilian Journal of Medical and Biological Research* 39, pp. 421–429.

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