

Sanctioning Large-Scale Domestic Cannabis Production - Potency, Yield, and Professionalism

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ABSTRACT

Domestically cultivated cannabis, referred to as sinsemilla, constitutes a growing share of the illicit drug markets in the Scandinavian countries. In this study we present forensic evidence of THC content in sinsemilla and resin confiscated by the Danish police from 2008 to 2012. The purpose is to establish a mean potency, a yield estimate for professionally grown plants, and an assessment of how „professionalism“ applies to domestic cultivation. We find a mean THC content in our sample normally distributed around 12% for sinsemilla (n=35) and 11.7% for resin (n=99). This is markedly higher than the assumption of THC content in sinsemilla between 6-8% as is currently applied in Norway and Sweden. It is also higher than the previous estimate of resin potency. The yield in sinsemilla plants is found to be 46 grams per plant. This is much lower than the estimate applied in criminal cases, which indicates that courts do not apply a yield-percentage estimate. The specificities of domestic cannabis cultivation also relate to the sanction criteria „professionalism“. Firstly, the number of plants found can provide for calculation of an aggregate quantum. Secondly, this can be related to the formal quantum thresholds between the (various) grades of illicit drug crimes in the national legal systems. Finally, we introduce the nationality of the gardener as an indication of professionalism in combination with the equipment found on site. We conclude that proportionality in criminal sanctioning of large-scale cannabis cases would improve by applying a 1:1 potency level between sinsemilla and resin.

Keywords:

Cannabis, sinsemilla, potency, yield, THC

1. INTRODUCTION

Cannabis is the most widely used illicit drug in the world. In the Scandinavian countries between 5-8% of young adults will use the drug over the course of a year. Each such „annual“ user will on average consume an estimated 100 grams [1]. Traditionally the cannabis markets in Scandinavia have been supplied with cannabis resin¹ trafficked from Morocco, over Amsterdam, via Copenhagen to Sweden and Norway. This distribution pattern is believed to have evolved in recent years. It is now held that the Scandinavian cannabis markets increasingly consist of domestically produced sinsemilla („without seeds“). This domestic production presents a series of questions to prosecutors and courts as regards the proportional severity of criminal sanctioning compared to resin and marijuana. The available legal practice from Scandinavia is limited but demonstrates that courts in Norway, Sweden, and Denmark compare the potency of sinsemilla with the potency of resin. This ratio is then multiplied by the amount of sinsemilla involved in the case. The result expresses the amount of sinsemilla involved in the case as a comparable amount of resin, for which there is an established sentencing practice.

In this study we wish to draw attention to the fact that this procedure holds the risk of disproportionate sanctioning. The problem is that both

sinsemilla and resin are dynamic products. Their chemical properties vary over time, between regions, and with levels of professionalism in the production process. The assessments currently applied in Scandinavian courts rely on an understanding of cannabis products that may be outdated. In order to ensure proportionality, sanctioning practice needs to be based on thorough forensic analysis of both products. In this study we present forensic evidence of THC content in sinsemilla and resin confiscated by Danish police from 2008 to 2012. The purpose is to provide a basis on which to discuss criminal sanctioning in cases involving large amounts of domestically produced sinsemilla in Scandinavia.

Indoor cultivation of sinsemilla was first introduced in the Netherlands in the 1980's. The dense population and limited farming areas meant that knowledge about artificial lightning, hydroponics, watering techniques, and climate control was available. This technical knowledge was easily adapted to cannabis cultivation. Eventually the effectiveness of this production method provided the foundation for a „green avalanche“ [2] where Australia, New Zealand, and Canada are now largely self-sufficient with domestically produced sinsemilla [3,4]. A similar development is underway in Europe [5]. Jansen [2] estimates that three-quarters of the cannabis that is used in Switzerland and the Netherlands is domestically produced and this trend has also been documented in England [6], and Norway [7].

Generally, for Scandinavia, domestic sinsemilla production is still a quite new phenomenon. Until 2005 Danish National Police stated that no domestic production of illicit drugs takes place. This assessment changed only a few years later when a large number of cannabis plants were found in the remains of a burnt down farm in 2008. Police also discovered a notebook with information on even larger clandestine greenhouses. Two years later

¹The three most common preparations of the Cannabis sativa L. pistillate inflorescence plant are referred to as marijuana, resin, and sinsemilla („without seeds“). Marijuana is the leaves and flowering buds. Resin, is a compacted mix of the flowering tops and plant material. Sinsemilla is the term used for the intensively cultivated plants, sometimes also referred to as Skunk.

police found the dead body of a Vietnamese national in a septic tank and the criminal investigation revealed that he had been the gardener in a nearby cannabis production facility [8]. Since then, Danish police have found many other similar arrangements.

Domestic cultivation of sinsemilla has many advantages for criminal entrepreneurs: Firstly it serves as import substitution; instead of smuggling resin across several national borders, domestic production reduces the risks by bringing the product closer to the end users. Secondly, indoor grown plants can be harvested four to six times a year, as compared to only one annual harvest from outdoor grown cannabis. Finally, the product is potent, and even a single plant produces a large amount of cannabis, that does not require further processing; as opposed to resin that requires preparation and packaging to make it suitable for transportation. In sum, domestic cultivation can quickly become profitable for even small-scale growers. On a large-scale, cultivation is associated with organized criminal groups [9].

1.1 Purpose

The purpose of this study is to examine the issues that surround criminal sanction claims in cases of large-scale sinsemilla production. Sanction severity in illicit drug cases depends on the type of drug, the quantum involved, and the degree of professionalism in the commission of the crime. There is not yet an established legal practice for sentencing domestic sinsemilla production in Scandinavia. Determining sentence severity in cases with large amounts of sinsemilla raises a series of legal questions. These questions warrant public discussion as well as academic scrutiny.

The purpose of this study is to provide the forensic analysis of domestically produced sinsemilla as well as resin. Finally, we discuss what qualitative aspects of the production indicate professionalism and suggest an implication for a quantity threshold that denotes professionalism in the letter of the law. With this we aim to provide a foundation for sanction claims that ensures proportionality between large-scale sinsemilla production and other cannabis-related crimes.

We pose the research questions as follows: What is the mean THC-content in resin and domestically produced sinsemilla in Denmark for the period 2008-2012? What is the yield from a sinsemilla plant?

Below, we review the literature on potency, yield, sanctioning procedures and professionalism in sinsemilla production. After this we introduce the data and methods applied in the present study. Finally, we present findings on potency, yield and professionalism, and discuss how these relate to current legal practices in Scandinavia.

2. REVIEW

2.1 Potency

The most important chemical constituent in cannabis in terms of intoxication is Δ^9 -tetrahydrocannabinol (THC). In plant material the majority of the total THC content is comprised by THC acid which is converted to THC by heating. There are many other cannabinoids present in the plant, some of which are also important for the associated harms, notably cannabidiol (CBD) [10]. Research has found that the contents of THC and CBD are "heterogeneous", i.e. a high content of THC is correlated with a low level of CBD and vice versa

[11]. THC content (THC-acid and THC) is therefore the single-most relevant indicator of potency for criminal law.

The most extensive and detailed forensic analysis of sinsemilla are performed at the University of Mississippi on behalf of the National Institute on Drug Abuse (NIDA) [12-15]. These analyses find that THC-concentration in the flowering tops increased markedly in the USA in the 1990's, and has since stabilized with an average of about 11%. In Europe forensic analyses of sinsemilla are conducted in a handful of countries, but most consistently in the United Kingdom and the Netherlands. Both countries have observed an increase in THC-content over time, but to an even higher level than found in the USA. Bone and Waldron [16] found the average THC-level in the United Kingdom to be 9.4% in 1997, with a maximum of 19% [17]. In the mid- to late 2000s it was found to be 16.2% with a range from 4.1% to 46% [18]. In the Netherlands mean concentration of THC in sinsemilla increased from 9% in 1999/2000, to 15% in 2001/2002 [19], and finally to a mean of 20.4% in 2004 [20]. King [5, p. 251] sums up that the overall rise in sinsemilla potency in Europe from late 1990's to late 2000's is "appreciable" and that the current level is approximately twice that which is found in resin. His assessment is that the Moroccan resin is still produced with traditional methods and at the time of her writing, there was no observable increase in average resin potency.

2.2 Yield

There is considerable variation in THC content in the different parts of the plant. The flowering tops contain the most THC, and the leaves contain the second-most. The weight of the dried leaves and flowering tops, divided by the weight of the fresh plant minus the root is referred to as the yield percentage. Yield percentage multiplied by the weight of the plant. In legal terms the plant is the parts that are above ground, i.e. not the roots.

The flowering tops of the plant take time to develop. This is important for estimating the quantum of sinsemilla produced per plant. A plant differs from a cutting. This is not trivial. With four to six harvests per year there will inevitably be an element of arbitrariness in when police discover the cultivation site. Some of the plants will be very small, some will be cuttings, and some will be fully grown. Should the sanction claim be based on actual found yield, or the potential yield that the plants could produce, if they were allowed to grow? Usually you would expect sanctioning to be based on the actual find but even the smallest plants will be ready for harvest in a few months' time. This is a question of the understanding and reach of the intent to commit a crime. Criminal intent is interpreted differently in various national legal traditions. In the Scandinavian countries, Denmark sanctions intent at an earlier stage in the commission of crime than Norway and Sweden [21].

2.3 Sanctioning sinsemilla in Scandinavian criminal law

Sanction severity in illicit drug cases primarily depends on the type of drug and the quantum. For sinsemilla this means establishing an aggregate amount of THC by multiplying the found yield with the relative potency. This amount of THC is then compared to a similar assessment of the amount of THC in various amounts of resin. However, as demonstrated above, the forensic literature on cannabis potency suggests that sinsemilla displays large variations in potency over time and between regions. Currently the

Scandinavian countries vary in their assessments of sinsemilla, but they all depart from the observation that resin is "normal" potency, and marijuana is "low" potency.

In Sweden normal resin potency is defined as 4-6% THC, and low marijuana potency is 2-3%. Sanctioning in cases involving sinsemilla departs from the assumption that the sinsemilla is of "normal" potency, i.e. a 1:1 ratio with resin [22-24].

In Norway, normal potency is defined as 7% THC. Marijuana is defined as "less potent" than resin in a verdict from 1998 and is therefore sanctioned less severely [25]. The legal status of sinsemilla is not yet determined. Norway's criminal police, Kripos [26], conducted forensic analysis in 2008 (n=59) and 2009 (n=150) and found sinsemilla plants to have between 3-7% THC. These samples included both plants that were ready to harvest and plants at an earlier developmental stage and measured THC as an average for the whole plant. After isolating the flowering tops, these were found to contain between 11-22% THC, with a maximum of 28-35%. A verdict from 2011 [27] refers to the 1998 verdict in support of sanctioning sinsemilla like marijuana, i.e. less severely than resin. In the comments to the verdict the court acknowledges the Kripos studies, but argues that the large variation in potency found in these studies and the lack of an established uniform mean potency must come to the benefit of the defendant.

In Denmark until May 2013, sinsemilla was sanctioned on the basis of forensic analysis that found a mean THC level of 12% in sinsemilla and 8% in resin, i.e. a 1.5:1 ratio. The THC level in resin of 8% refers to a local study from 1993 where 516 resin samples were analysed [28]. However, there is no written legal practice that documents this assessment authoritatively. The practical procedure is to have expert evidence on potency and yield from the Institute of Forensic Medicine in each individual case concerning large-scale production. The present study introduces newer forensic evidence than what has been applied in recent legal practice.

2.4 Professionalism

The first indicator of professionalism in drug cases is the amount involved. Scandinavian drug laws demarcate minor from serious offenses in different ways and at different quantity thresholds. Courts in all three countries consider the type of drug, the quantum and the "character" of the crime; was it professional in nature? The differences in quantity thresholds reflect overall drug policy evaluation of the harmfulness of cannabis. Sweden has three categories, minor, normal and major. The quantity threshold to major drug crime is 2.5 kg of resin. Norwegian criminal law distinguishes between four severity categories. The quantity threshold to major drug crime is 1 kilo of resin, and 80 kilos of resin demarcates an "especially large quantum" which is the most severe category. Denmark only has two categories of drug crimes and the threshold to serious drug crime is 10 kg of resin, and 10-15 kg of marijuana.

What else constitutes professionalism in sinsemilla production? There are various typologies of cannabis cultivators [6] that all identify technical equipment as a trait of professionalism. The courts in all three countries look for evidence of advanced technical equipment, like adjustable heating lamps, fans, tables for flower pots, fertilizers, and automatic watering systems [16]. In a Swedish case 3000 grams of sinsemilla and presence of technical equipment was sanctioned as professional production [29]. In Norway the court applied the aggravating "professional characteristics" to a case with 20 plants, and an estimated production capacity at 1.6 kg, i.e. a yield of 80-120

grams per fully grown plant [27]. Few plants can still be seen as professional production when there is expensive equipment present. The investment in equipment is interpreted as intent to produce more cannabis in the future.

Producing sinsemilla on a larger scale also involves a minimum of organizational capacity. Firstly, because cooperation is necessary in order to maintain the plants and equipment [7]. Secondly, because large scale production also requires access to distributors, that can and will buy the product consistently, so as not to have inventory of drugs. Internationally the large-scale production of cannabis has been found to be connected to organized criminal groups [30,31]. One particularly intriguing aspect of this association is that the gardeners in professional facilities are commonly Vietnamese nationals. Silverstone and Savage [32] found that most of these gardeners are transported using commercial networks of human traffickers with the promise of work and education in the destination country. In practice this work often involves living in a cannabis cultivation facility. This association between sinsemilla production and organized criminal groups may also exist in Scandinavia. The data for the present study was gathered in Denmark which is a particularly attractive country for organized criminal groups [33-35]. In Paoli and Reuter's [36, p.15] conceptualization, Denmark has the "pull factors" of mass domestic demand for illicit drugs; lenient statutory penalties compared to neighboring Sweden and Norway; and a good geographic location that connects mainland Europe with Scandinavia. Denmark is already perceived as the regional distribution hub for Moroccan resin and can potentially develop a similar status for sinsemilla.

Together, the research reviewed above indicates that sinsemilla is a dynamic product where potency varies over time and between regions. Technological innovations and diffusion of expertise leads to a practical problem of ensuring proportionality when determining criminal sanctioning claims for various cannabis products.

3. DATA AND METHODS

Danish police routinely deliver cannabis plant material to the Departments of Forensic Medicine in Denmark when they have made seizures or found clandestine sinsemilla greenhouses. This material comprises a wide variety of cannabis products ranging from resin and marihuana (dry leaves and flowers) to fresh plant material and whole plants. The purpose of this procedure is to determine potency and yield in individual cases that are to be used to determine criminal sanctions. This study is based on a selection of 300 cannabis cases that have been delivered to the Department of Forensic Medicine during the period from the 1st of January 2008 to the 1st of November 2012. Half of the cases were sinsemilla plants and the other half was resin.

The selection of cases in this study is based on the scale of the greenhouses from which the plants have been seized. Only sinsemilla grown in large-scale greenhouses was selected. The definition of large-scale is based on the presence of technical equipment. All of the greenhouses in our sample use time-controlled artificial lightning, temperature control, fertilizers and semi-automatic or manual watering in the production. With the exception of three cases with only, 10, 11 and 19 plants, all of the cases were for a large number of plants.

A second criterion of selection is that only cases where whole ripe cannabis plants could be recovered were selected. The degree of ripeness was evaluated by competent personal, based on the appearance of the flowers (i.e. relative size and color of flower tops). In some of the cases,

harvested plants or information concerning expected time of harvest such as calendar information or testimony from the gardener could be recovered. This information was used to further support the assessment of ripeness.

A total of 35 cases fulfilling these inclusion criteria were obtained. For practical reasons a protocol for subsampling of plants was developed. Initially the plants in a greenhouse were counted and divided into groups based on their developmental stage. From each group a subsample of ten plants were randomly selected regardless of the total number of plants in the group. In most greenhouses only one group of plants was considered ripe and therefore included in the study. If more groups were considered ripe an average value from that greenhouse was calculated.

3.1 Analysis of THC-content

The total THC content (THC and THC acid) in the dry sinsemilla was analysed using a validated and ISO 17025 accredited analytical method. The expanded measurement uncertainty (method and laboratory uncertainty) was 112% whereas the method accuracy (recovery) was 99-107% of the total THC content. The dry sinsemilla was grinded in a household blender to a fine grained homogenous mixture. Two 1000 mg samples were extracted in 20 ml of methanol for two hours on a laboratory shaker. Subsequent to centrifugation a 1 ml sample of the supernatant was transferred into GC vials and analysed using a GC-FID instrument. THC was quantified using an internal calibration curve with testosterone as an internal standard. Results were calculated as percentage THC w/w. All analysis was conducted in double.

3.2 Estimation of yield

The whole plants excluding the root were brought to the laboratory where the mean fresh weight and height (min – max) of the subsampled plants

was estimated. Subsequently all leaves and flower tops were removed from the stem, pooled into one sample and left to dry in special drying cabinets supplied with a constant air flow. After a few days the dry plant material, was weighed and the yield (gram per plant) could be calculated.

4. RESULTS

4.1 Potency

Figure 1 above, shows the distribution of potency in frequency intervals. The maximum potency found is 21% and the minimum potency at 6%. This is consistent with the international forensic literature on sinsemilla potency in the 2000's, but substantially higher than the 6-8% assumption that is applied in Norwegian and Swedish criminal sanctioning. The mean potency in the sampled plants is normally distributed around 12% with a standard deviation of 3.

Table 1 below shows a summary of THC content in Danish resin seizures 2008–2012 (n=99). The mean content at 11.7% is markedly higher than the 8% (n=516) found by Kaa and Bowmann in 1997 [28]. This can suggest that resin in Denmark has increased in average potency, which is surprising considering King's [5] assessment that resin potency in Europe appeared stable.

Table 1. Summary of cases with cannabis resin from Danish seizures 2008–2012 (n=99).

	Average (\pm SD)	min	max
Total THC content (%)	11,7 \pm 7	1	33

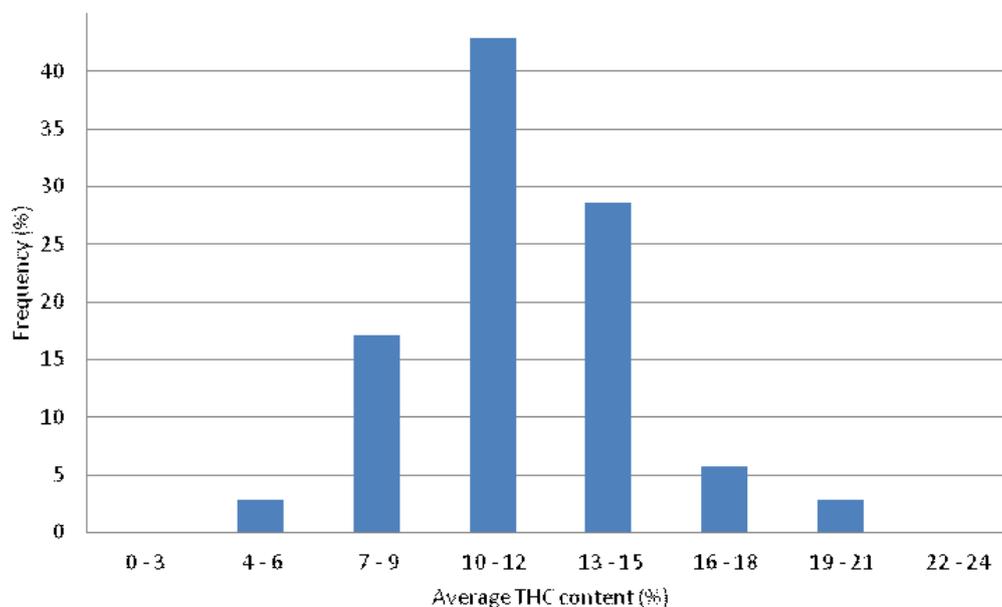


Figure 1. Average THC content (% total THC in frequency intervals) in cases with ripe cannabis plants (n=35)

4.2 Yield

The only written legal practice on yield from sinsemilla in Scandinavian court practice we found is the Norwegian assessment of 80-120 grams per plant. The average yield in the Danish cases is 46 grams per plant, with a standard deviation of 23 grams. Plant yields exhibit normal distribution. Only about 5% of the plants in our sample had a yield of more than 80 grams, and no plant of more than 97 grams. Note that this is markedly less than the Norwegian case. When seen in relation to the total weight of the plant, the mean yield percentage is 19. Table 2 below sums up these results.

4.3 Professionalism

The evaluation of professionalism is contingent upon the presence of technical equipment and the number of plants. Our sample is selected from greenhouses that all used technical equipment like artificial lightning, temperature control, fertilizers and semi-automatic or manual watering. This equipment alone will be taken as an indicator of professional sinsemilla production in a Scandinavian court. In all of the countries there is quantum-threshold that demarcates serious from less serious drug crimes. The thresholds are very different due to the varying degree of punitiveness in

the respective drug policies. In the written practice we found a case from Sweden where 3000 grams, and a case from Norway with 1600 gram production capacity, where both evaluated as professional, due to presence of technical equipment.

Denmark is consistently more lenient than the other countries when sanctioning cannabis-related crimes. In Danish criminal law the formal demarcation between less serious and serious drug crimes, i.e. the act on euphoria-inducing substances and the penal code's section 191, is at approximately 10 kg of resin and 10-15 kg of marijuana [37]. The number of sinsemilla plants from our sample that will produce a similar amount of THC as ten kilos of resin is 145 if resin is assessed as 8% THC and 217 if resin is assessed as 12% THC. Figure 3 below shows the number of plants per case in our sample.

Our samples come from police seizures conducted from January 2008 to November 2012. The number of plants per site as shown in Figure 3 is not representative of sinsemilla production in Denmark, but represents the largest clandestine greenhouses that police have discovered over a five year period.

In principle anyone can set up a clandestine greenhouse and start producing sinsemilla, all of the necessary information and equipment is available on the internet. Interestingly in our literature review we found

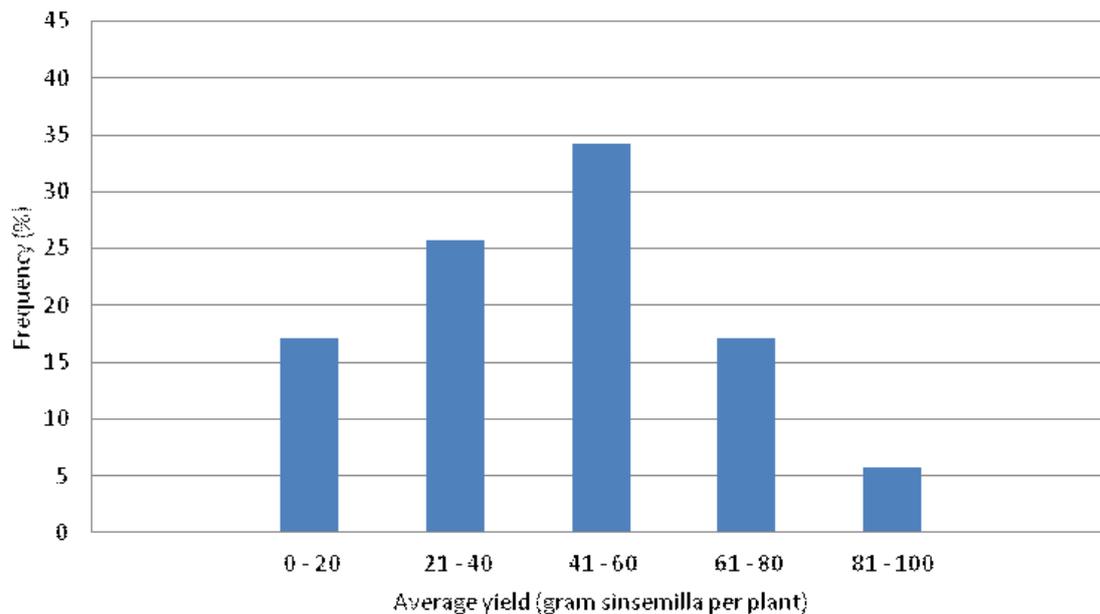


Figure 2. Average yield (gram sinsemilla per plant in frequency intervals) in cases with ripe cannabis plants (n=35)

Table 2. Summary of cases with ripe cannabis plants from Danish clandestine greenhouses 2008 – 2012 (n=35)

	Average (\pm SD)	min	max
Total THC content (%)	12 \pm 3	6	21
Yield (g/plant)	46 \pm 23	8	97
Plant weight, fresh (g)	242 \pm 129	44	567
Plant height (cm)	84 \pm 26	35	170

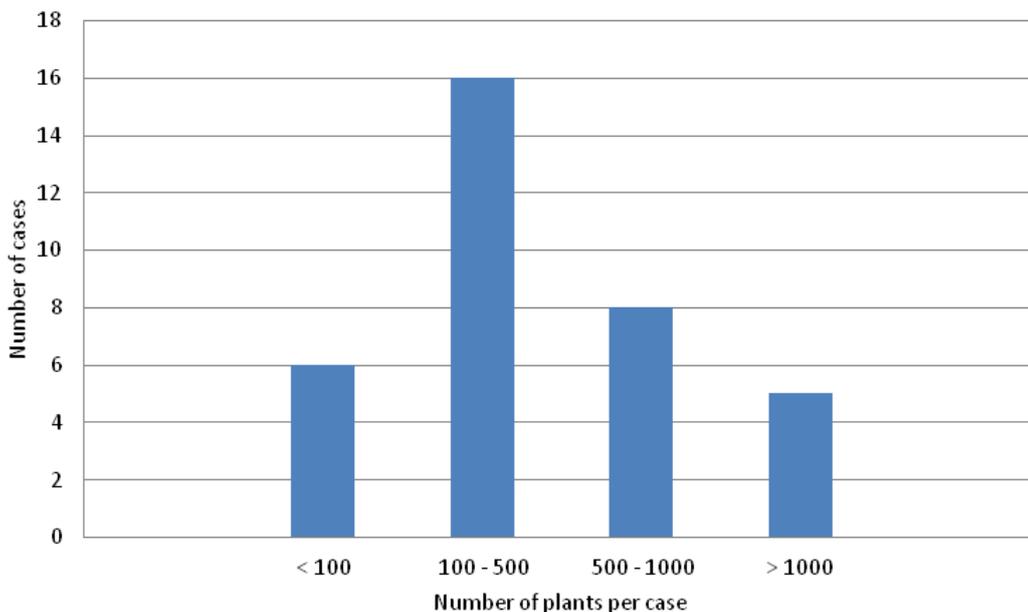


Figure 3. Number of plants per case. Seedlings are not included in the calculation.

that large-scale sinsemilla production is often associated with gardeners of Vietnamese origins. Finding and financing an illegal immigrant gardener requires access to networks that have connections to human trafficking. We take it to be an indicator of professionalism if the gardener is a Vietnamese national. Figure 4 below shows the distribution between Danish and Vietnamese gardeners from the 35 cases that were selected.

More than half of the gardeners in the clandestine greenhouses in our sample were Vietnamese nationals. Two of the cases that are registered as Vietnamese were actually citizens of The Netherlands but of Vietnamese origin. Our sample was selected on the basis of the large scale so this can only be taken an indication, and not definite proof. With this caveat in place, our findings indicate that the most professional sinsemilla production facilities in Denmark are connected with organized criminal groups. This

finding can be implemented in criminal sanctioning practice by using the number of plants present as a threshold.

5. DISCUSSION

5.1 Potency and yield

Forensic analysis of sinsemilla indicates that THC potency levels increase over time. Variations between regions persist, but a temporal trend is discernible within regions. This trend can be explained by increased sophistication of the cultivation process as well as the social diffusion of this knowledge. King [5] identifies genetic, environmental, and freshness, as the central components of this trend. The genetic component consists of using feminized seeds and

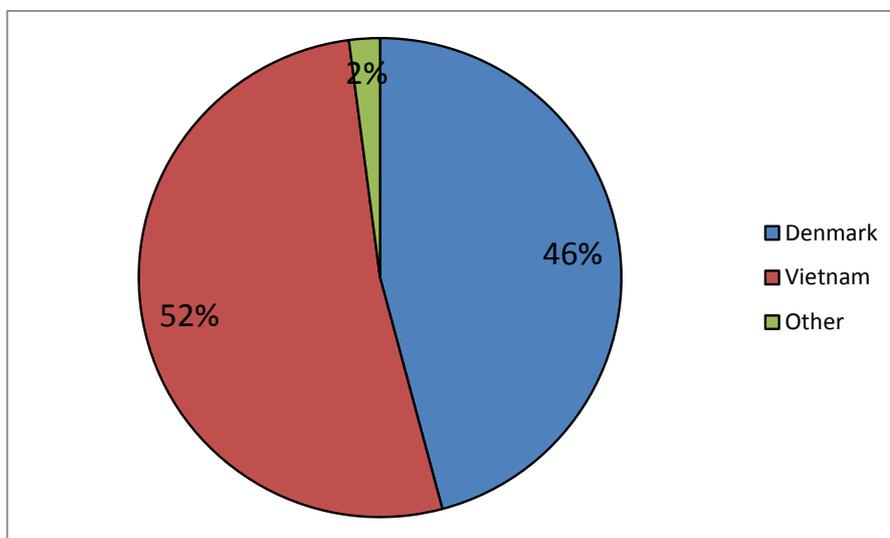


Figure 4. Nationality of the gardener

to select seeds with specific qualities like high potency. The environmental component is the sophistication of the cultivation techniques like 'pruning' during harvest, prevention of fertilization and seed formation. Freshness refers to the degradation of THC that occurs over time which is an issue for resin that is trafficked across great distances. This knowledge is available to anyone on the internet but it appears that a social diffusion is more effective. Toonen, Ribot and Thissen [38] found that the skill of the gardener was an independently attributing factor in achieving high THC potency levels.

As regards the question of yield from domestic sinsemilla plants we only found one Norwegian case that estimated the yield from 20 plants to be between 80-120 grams each. The final sentence was based on 80 grams, to let the variation benefit the defendant. This yield estimate is very high compared to our finding of a mean at 46 grams per plant. We suspect that the procedure that was used in determining the yield in the Norwegian case was not sufficiently aware of the variation in potency between the various parts of the plant. Yield is the dried flower tops and leaves, and not the whole plant. Our estimate of 46 grams per plant has a 23 gram standard deviation so there is quite a bit of variety, but still 80 grams appears unreasonable.

As concerns the current legal practice of comparing the sinsemilla with 8% resin we found this to be an outdated practice. The development in the THC-content in resin from 2008 to 2012 indicates that this is a much more potent product than previously recognized. We found the average THC content in resin to be 11.7% for the period 2008-2012, which questions the proportionality of the current sanctioning procedures in cannabis cases. It would be more appropriate to base sentencing on the 1:1 ratio that we found.

This development in the relative potency of these two cannabis products may have further bearing. Recall that King [5] noted that sinsemilla in Europe was approximately twice as potent as resin from the late 1990s to the late 2000s. King [5] suggests that the traditional production method for Moroccan resin is the source of the stability compared to sinsemilla. Our findings on the recent development in the potency of Danish resin questions if this broad assessment is still applicable. Perhaps the marked increase we found is an indication that resin production is also changing towards more effective methods?

5.2 Professionalism

The legal definition of a serious drug crime varies between the Scandinavian countries. The considerations into amount and professionalism are the same, but the exact thresholds vary, notably because Denmark has a much more lenient stance towards cannabis than Norway and Sweden. The formal quantity threshold is 10 kg of resin and 10-15 kg of marijuana in Denmark, similar to 217 plants with the characteristics of our sample. Only 6 of our 35 cases consisted of greenhouses with less than 100 plants. At the opposite end of the spectrum we find 5 cases with more than 1000 plants, 8 of the cases were between 500-1,000 plants. King [5] suggests more research

into the total production capacity of the illicit sinsemilla industry. We can't estimate this number from our sample but we begin to illustrate the scope of the problem. If we arbitrarily chose an example of 1000 plants and multiply this with the mean yield that we found at 46 grams, this comes to a production capacity of 46 kg of sinsemilla with a potency of 12%. With four to six harvests per year this brings the aggregate production capacity to a 230 kg annually, assuming five harvests.

6. CONCLUSION

Domestic production of sinsemilla constitutes a growing problem in Scandinavia. The advantages over trafficking resin from Morocco provide economic incentive for criminal entrepreneurs to establish and run large-scale facilities. Our data show some of facilities contain in excess of a 1000 sinsemilla plants with an average yield of 46 grams. With 4-6 harvests possible in a year this brings the annual production capacity of such a facility to somewhere between 180 to 275 kilos. Criminal sanctioning in these cases need to consider not only the chemical constituent of the product but also the circumstances surrounding the facilities. In our sample about half of the gardeners were Vietnamese nationals. This phenomenon has also been observed in other European countries and we take it to indicate that these facilities are connected to criminal groups that have the required organizational capacity to establish contacts human traffickers.

In the sanctioning procedures that are used in Scandinavian courts sinsemilla is compared to resin on the basis of earlier forensic analysis. Our findings indicate that these forensic analyses have failed to take into consideration the yield from sinsemilla plants and the dynamic nature of the products, both the sinsemilla and the resin. Our findings indicate that there has been an increase in average THC content in resin from 2008 to 2012. Resin has previously been believed to have an average THC-content around 7-8% in Scandinavian criminal courts. The new level of around 12% is markedly higher than what has previously been noted in the forensic literature. We do not know the explanation for the increase but note that it should have consequences for deciding criminal sanctioning severity. These developments all warrant questions as regards the proportionality in current criminal sanctioning of cannabis cases involving large amounts. Ideally a separate sentencing guideline for domestically produced sinsemilla can be developed. Our findings can serve as a starting point for this endeavour. A separate scale would also allow for an independent evaluation of professionalism and societal harm. The current procedure of comparing only the quantum of THC fails to provide a systematic evaluation of the professionalism involved in large-scale cannabis cultivation.

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