

Hydroponic Cannabis & Potency: Recent Developments

by Greg Swensen (September 2009)

1. Introduction

Over recent years the mode and degree of sophistication of hydroponic cultivation of cannabis has transformed from what was previously perceived as a benign cottage industry, to being a sophisticated activity conducted and managed by well organised criminal organisations.

It has been specifically noted in recent Canadian research, which is applicable to developments in Australia, there a cannabis cultivation 'industry' has developed which provides specialised services and roles. These include 'crop sitters', people who are hired to protect growing facilities and look after the crop, 'brokers', people who perform the role of negotiating agents between growers and buyers, 'harvesters' (or 'dial a harvest'), people who specifically cut, dry and package a crop and 'exporters' who facilitate shipments to other jurisdictions.¹

Concerns have been raised about the growing popularity of hydroponic cultivation because of concerns it could pose a number of health risks to both end users and operators. These risks arise because of the extensive use of chemicals such as phosphoric acid, nitric acid or potassium hydroxide to adjust pH levels of growing solutions and promote growth of plants and chemicals to eradicate and control diseases and insect pests that flourish in the controlled environments in a hydroponic operation.

There are risks to the operators of hydroponic setups because of their exposure to airborne bacteria which readily grow in the high humidity environment, as well other types of risks, such as electrocution due to the bypassing of mains electricity meters and the wiring of fans and other electrical equipment.² There are also numerous risks to police when they attend and shut down hydroponic crops, such as the use of power bypassing, which often includes unsafe wiring and requires attendance by Synergy staff to ensure safety, the chemicals involved and the heat globes, which can reach 200 degrees Celsius and may explode.

A number of attractions of indoor hydroponic cultivation over outdoors cultivation have been identified:

"While the volume of plants is typically lower for hydroponic cultivation, hydroponic cannabis can be grown all year round and produce a high yield of 'head' or 'buds' in a shorter time period. These factors, and a user perception of greater potency, make hydroponic cannabis more attractive and prices can be double that of bush cannabis. The relatively easy methods of production mean groups involved in cultivation typically show less sophistication than groups involved in other drug production."³

This observation is of importance for another reason as it identifies that as cannabis can be relatively easily cultivated hydroponically and involves a limited outlay, then cultivation of less 10 plants may be an enterprise that appears to be superficially attractive to someone who was not otherwise involved in the organised production and sale of cannabis.⁴

¹ Royal Canadian Mounted Police. *Marihuana cultivation in Canada: evolution and current trends*. November 2002.

² Ibid.

³ Australian Crime Commission. *Illicit drug data report 2003-04*. Canberra, Australian Crime Commission, 2005, 4.

⁴ The cultivation of 10 plants or more is regarded as a serious offence in WA, as cultivation of this number or more is deemed cultivation with intent to sell or supply: *Misuse of Drugs Act 1981* 7(1)(a) and Schedule 6.

The scale of hydroponic cultivation, whilst difficult to estimate, would appear to be quite widespread and efficiently organised. Indeed, it has been suggested that the existence of hydroponic cultivation is now the single most common reason for stealing electricity in Australia, constituting about 20% of all power theft. The chairman of the Electricity Suppliers Association of Australia was quoted in a 2002 article on this issue.⁵

“ESA chairman Keith Orchison says the greatest single use of the stolen electricity is to power hydroponic cultivation of marijuana, a technique that uses large amounts of artificial light and pumping equipment to provide water borne nutrients to the plants. ‘It is the fastest-growing area of electricity theft in Australia,’ he says.”⁶

An article published in the November/December 2003 issue of the newsletter of the Australian Hydroponic and Greenhouse Association shortly after the SA reform had excluded hydroponic cultivation from the CEN scheme, confirms concerns that hydroponic cultivation had become a significant method of cultivation.

“In the early days, store owners focussed on the home garden market, but as the retail industry grew, it became obvious it was also attracting a large cannabis growing market. To a large extent, early SA and ACT legislation decriminalising cannabis for personal use, and rapidly evolving hydroponics technology worldwide, contributed to the explosion of stores. ... (the) new legislation in SA, which makes it a serious offence to grow cannabis hydroponically, and WA where it will soon become an offence to ‘knowingly’ sell equipment that will be used to grow cannabis, is a serious wake up call for all hydroponic retailers to change their business practices if they want to avoid further restriction.”⁷

2. Legislation

2.1 Western Australia

The Cannabis Control Act 2003 (CCA) prohibits a CIN being issued if a cultivated plant is being cultivated hydroponically. The CCA does not contain a definition of hydroponic cultivation. It should be noted that as well as exclusion of hydroponically cultivated plants, that Section 7 will only apply if the plants (ie not more than two) are growing at the time. Whilst there are no thresholds specified under the legislation as the size of any growing plants, additional evidence would probably be considered by police with regards as to whether there was an element of sale or supply in situations involving mature plants.

The Cannabis Control Act 2003 (CCA) extends the ambit of the law in WA in relation to hydroponically cultivated cannabis as it created a new offence in the MDA of selling or supplying or offering to sell or supply *“any thing that the person knows will be used to cultivate a prohibited plant ... by hydroponic means”*.⁸

The rationale for regulating those who sell and supply hydroponic equipment was outlined in a paper prepared for the 2002 South Australian drug summit.

“Police claim that South Australia has a significant number of hydroponic shops compared with other jurisdictions, there are linkages between organised crime groups, cannabis producers and a

⁵ This article also refers to other indicators which substantiate the growth in hydroponic cultivation and the growing use of cannabis, such as large listings of hydroponic equipment suppliers listed in the Yellow Page telephone directories and an increase in the sale of roll your own cigarette papers.

⁶ Treadgold T. ‘Agribusiness: joint interest in an economy gone to pot.’ *Business Review Weekly* 23 June 2000.

⁷ Paul C. ‘Retail industry reforms.’ *Practical Hydroponics & Greenhouses*, Issue 73, November/December 2003.

⁸ Misuse of Drugs Act 1981 s. 7A.

significant number of hydroponic shops and that a proportion of the hydroponic retail industry is supported by illegal cannabis cultivation."⁹

When the Cannabis Control Bill 2003 was first introduced on 20 March 2003 it contained an offence of someone selling or supplying or offering to sell or supply any thing if that person "*knows or reasonably ought to know*" that such a thing would be used to hydroponically cultivate cannabis (Clause 28).

However, this provision was amended by the Legislative Council in early September 2003 by the Greens and Liberals by removing the requirement for reasonable knowledge. It was noted that this amendment meant that it would "*raise the evidentiary requirement for the offence such that knowledge of the intended uses of hydroponic equipment would have to be proven in any prosecution ... (which) is likely to lessen the specific deterrent effect of the offence.*"¹⁰

Furthermore, the MDA provides that either the police or the Director of Public Prosecutions, upon conviction of someone for this offence may obtain an order prohibiting them for up to two years from selling or supplying or offering to sell or supply any thing that could be used to hydroponically cultivate cannabis.¹¹ At 31 March 2007 it is believed there had been no charges laid in WA concerning Section 7(A) of the MDA.

The purpose of Section 7A of the MDA is to enable police to target the activities of those involved in selling equipment that could be used for the hydroponic cultivation of cannabis.¹²

7. CIN for offence under Misuse of Drugs Act 1981 s. 7(2)

....

(2) A CIN may be issued under subsection (1) if, and only if—

(a) *the alleged offence involves cannabis plants under cultivation, other than cannabis plants under hydroponic cultivation;*

...

7A. Selling or supplying a thing knowing it will be used in the hydroponic cultivation of a prohibited plant

(1) *A person who sells or supplies, or offers to sell or supply, to another, any thing that the person knows will be used to cultivate a prohibited plant contrary to section 7(1)(a) or (2) by hydroponic means commits an indictable offence.*

(2) *A court convicting a person of the offence under subsection (1) may, on the application of the Director of Public Prosecutions or a police prosecutor, in addition order that the person be prohibited for a period set by the court (but not exceeding 2 years) from selling or supplying, or offering for sale or supply, to another, any thing that may be used to cultivate plants by hydroponic means.*

(3) *A person who contravenes an order under subsection (2) is guilty of a simple offence.*

⁹ South Australia, Drugs Summit. *Law enforcement in the illicit drug market*. Issues paper prepared for South Australian drugs summit 2002.

¹⁰ Hon J McGinty. Western Australian Parliament, Legislative Assembly. *Hansard* 23 September 2003, 11664.

¹¹ *Misuse of Drugs Act 1981 s. 7A (2)*.

¹² No charges had been laid under section 7A up to 31 March 2007.

2.2 South Australia

45A. Expiation of simple cannabis offences

....

(8) For the purposes of this section

artificially enhanced cultivation means—

- (a) *cultivation in a solution comprised wholly or principally of water enriched with nutrients;*
or
- (b) *cultivation involving the application of an artificial source of light or heat;*
child, in relation to a simple cannabis offence, means a person who was, on the date of the alleged commission of the offence, under the age of 18 years;

2.3 Australian Capital Territory

162. Cultivation of 1 or 2 cannabis plants

(1) A person commits an offence if the person cultivates 1 or 2 cannabis plants.

Maximum penalty: 1 penalty unit.

(2) In this section:

artificially cultivate means—

- (a) *hydroponically cultivate; or*
- (b) *cultivate with the application of an artificial source of light or heat.*

cultivates has the meaning given in the Criminal Code, section 615 but does not include artificially cultivate.

2.4 New South Wales

An amendment in February 2006 to the *NSW Drug Misuse and Trafficking Act 1985* inserted a definition of “*cultivation by enhanced indoor means*” and established thresholds specifically concerned with hydroponic cultivation. The definition is set out in Section 3 as follows:

Definitions

“*cultivation by enhanced indoor means*”, in relation to a prohibited plant, means cultivation of the plant:

- (a) *that occurs inside a building or structure, and*
- (b) *that involves any one or more of the following:*
 - (i) *the nurture of the plant in nutrient-enriched water (with or without mechanical support),*
 - (ii) *the application of an artificial source of light or heat,*
 - (iii) *suspending the plant's roots and spraying them with nutrient solution.*

This means that in NSW that hydroponic cultivation of a “small quantity” ie less than five plants, is treated the same as outdoor cultivation (ie if dealt with summarily the maximum penalty is \$5,500 and/or up to two year imprisonment or both).

The amendment also means hydroponic cultivation from five up to 49 plants (“indictable quantity”) or between 50 to 199 plants (“commercial quantity”) attracts a maximum penalty of \$385,000 and/or imprisonment up to 15 years or both.

The hydroponic cultivation of more than 200 plants (“large commercial quantity”) attracts a maximum penalty of \$550,000 and/or 20 years imprisonment or both. The NSW reforms also established aggravating circumstances when children are present in a building where there is a hydroponic setup.

3. Potency

Victorian research has suggested higher levels of THC in hydroponic plants could not be attributed to the conditions of cultivation, but rather from the use of higher yielding plants from cloned stock.¹³ This means it would be feasible for those growers who wanted access to higher potency cannabis to use cloned stock and cultivate plants in soil and not under artificial conditions. The rationale for prohibition of hydroponic cultivation on the grounds of higher potency may therefore not be a credible argument because high yields could also be obtained by non-hydroponic growing methods.

The justification as to why hydroponic cultivation may attract higher penalties compared to non-hydroponic cultivation may not primarily be because of the higher potency levels, but because this form of cultivation provides higher yields based on short growing cycles, with perhaps three or more growing cycles per year. There must be a real possibility that someone who cultivates cannabis by hydroponic means ostensibly for self supply will become involved in commercial supply because of the relatively large quantities of cannabis that can be produced on a regular basis.

It has been asserted that as hydroponic cannabis may have contributed to an apparent increased incidence of mental health problems as it facilitates the production of higher potency forms, a specific offence of hydroponic cultivation of cannabis should be introduced. Concern about this issue is demonstrated with an amendment in 2006 in NSW which now targets hydroponic growers. The following observation was made the NSW Government when it first flagged that it would introduce this reform.

“NSW Premier Morris Iemma linked the growing popularity of hydroponic cannabis to the prevalence of mental illnesses including depression and schizophrenia. ‘It is not a harmless drug,’ he said. ‘If we are to improve mental health in our community it is essential that we shut down these indoor cannabis factories and punish severely the criminals behind them.’”¹⁴

As it has been asserted that the potency of cannabis has increased over recent years by “between 10 and 30 times” compared to the potency of cannabis available twenty years ago,¹⁵ this requires an examination of the evidence that might exist to support this proposition.

It should be noted there is some difficulty in determining whether potency has increased because of limited time series data and concerns about representative sampling of cannabis used by cannabis smokers.

The most complete set of time series data on trends in potency is from the Potency Monitoring Project which has analysed samples of cannabis seized obtained by DLE activities in the US since the mid 1970s. It has been noted, based on analysis of more than 34,000 samples, that there was a small increase in THC content in US from 1980 to 1998 (from 3.3% to 4.4%) and that “between 1989 and

¹³ Fiddian S & Quin C. *Determination of the THC levels and variation in the physical appearance of cannabis*. NDLERF Monograph Series No. 8. Canberra, National Drug Law Enforcement Research Fund, 2004.

¹⁴ Salusinszky I & Richardson T. ‘10 years jail for growers of hydroponic marijuana.’ *Weekend Australian* 4-5 February 2006.

¹⁵ Hall W & Swift W. *The THC content of cannabis in Australia: evidence and implications*. Sydney, National Drug & Alcohol Research Centre, University of New South Wales, 1999, 1; Copeland J, Gerber S & Swift W. *Evidence-based answers to cannabis questions: a review of the literature*. ANCD Research Paper 11. Canberra, Australian National Council on Drugs, 2006, 10; Mikuriya TH & Aldrich MR. “Old drug, new dangers: the potency debate.” (1988) 20 *Journal of Psychoactive Drugs* 47-55.

1998, at least two thirds of all seizures had a THC content of 5% or less, with an average of only 3.9% of seizures containing more than 9% THC.”¹⁶

A European review concluded that potency levels throughout Europe have been stable for many years, with levels of between 6 and 8%, with the exception of the Netherlands, where rates as high as 16% had been detected in 2000-2001.¹⁷ This review also considered that “(s)tatements in the popular media that the potency of cannabis has increased by ten times or more in recent decades are not supported by the limited data that are available from either the USA or Europe.”¹⁸

The proposition that there has been a large increase in potency levels over the past two decades has been relied upon to ‘explain’ a perceived increase in cannabis related adverse effects, especially in young people and an increased incidence of cannabis related mental health problems.¹⁹ There has also been attempts to link this issue to growing attendances for treatment for cannabis dependence at specialist service providers throughout Australia.²⁰

The complexity of determining the harms from higher potency forms of cannabis involves understanding a number of issues, such as the half life of cannabinoids in humans and identification of active ingredients that have effects on humans. For instance, in addition to the well known active ingredient tetrahydrocannabinol (THC), there has also been research about the effects of another active ingredient, cannabidiol (CBD) and its usefulness as anti-convulsant, as a treatment for opiate withdrawal and an anti psychotic drug.

It has been noted that selective breeding may mean that cannabis with higher levels of THC will become preferred with possible attendant increased risks of harm.

“The market place for home grown varieties of cannabis seed does point to a worrying trend. A company selling cannabis seeds has published the relative rates of THC and CBD in their products.²¹ They showed the claimed THC contents of between 5.7% and 19.5% of plant weight (mean – 11.6%), with CBD rates of between <0.01% and 0.6%. CBD rates are rarely published in research reports, despite the anxiolytic and antipsychotic effects. Earlier studies into cannabis did attempt to analyse CBD rates; these found wide variations but the most potent breed found was 3% THC and 0.5% CBD. This picture suggests that while THC rates are rising, CBD rates are remaining the same. If this is the case not only will high potency products be stronger they may have the potential to be more harmful.”²²

A 1999 Australian review considered data from NZ which showed that hydroponically cultivated cannabis typically had THC levels of about 6% to 8%, with an occasional sample producing a higher result. With respect to Australian data it was not possible to determine if there had been a change in

¹⁶ Hall W & Swift W. *The THC content of cannabis in Australia: evidence and implications*. Sydney, National Drug & Alcohol Research Centre, University of New South Wales, 1999, 2.

¹⁷ King LA, Carpentier C & Griffiths P. ‘Cannabis potency in Europe.’ (2005) 100 *Addiction* 884-886.

¹⁸ King LA, Carpentier C & Griffiths P. *An overview of cannabis potency in Europe*. Lisbon, Portugal, European Monitoring Centre for Drugs and Drug Addiction, 2004.

¹⁹ Compton WM, Grant BF, Colliver JD, Glantz MD & Stinson FS. ‘Prevalence of marijuana use disorders in the United States, 1991-1992 and 2001-2002.’ (2004) 291 *Journal of American Medical Association* 2114-2121.

²⁰ However, the growing attendances at treatment programs of persons with cannabis as the principal drug of concern may be closely related to the growing number of cannabis related cautions linked to conditional attendance at an educational and/or brief intervention session. Cf: Australian Institute of Health and Welfare. *Alcohol and other drug treatment services in Australia 2003-04. Report on the National Minimum Data Set*. AIHW Cat. No. HSE 100. Canberra, Australian Institute of Health and Welfare, 2005.

²¹ Pukka Seed Company - <http://www.ganja.co.uk/>.

²² Smith N. ‘Letter to editor. High potency cannabis: the forgotten variable.’ (2005) 100 *Addiction* 1559.

potency levels as this had not been tested systematically over a sufficient length of time by any of the Australian police services.

“Over the past two decades a large scale illicit cannabis industry has developed in Australia to meet the demand for cannabis products among a growing number of cannabis users. It has been estimated that daily and weekly cannabis users, who prefer the more potent forms of cannabis, account for 80% of cannabis consumed. Any increase in the number of regular cannabis users that may have occurred in recent decades may have increased the demand for and availability of more potent forms of cannabis. Any such increase in the availability of more potent forms of cannabis would have increased the amount of THC consumed by heavier cannabis users without there having been any increase in the average THC content of cannabis plants.”²³

The researchers concluded that although Australian data was absent, it was plausible to believe that THC content of the most widely used cannabis in Australia had increased modestly, in line with reliable evidence from the USA and NZ of similar increases in potency.²⁴ However, it was observed whilst there may have been a modest increase of THC content, it was believed there were two more important factors concerning the cannabis market and cannabis related harms,

“an increase in the availability of more potent forms of cannabis and the increased use of these more potent forms by regular cannabis users. These trends have been encouraged by a rising prevalence of cannabis use among young people, earlier initiation of use and higher rates of regular use by adolescents and young adults. Law enforcement efforts to reduce large scale cannabis plantations may have also played a contributory role, although this is less certain.”²⁵

As a low priority is placed on regularly collecting this type of indicator data, information is largely gathered through occasional *ad hoc* surveys in Australian jurisdictions rather than collected and managed in a systematic and reliable fashion at both national and jurisdictional levels.

An example of an occasional survey was a brief project that analysed the THC content of cannabis seized by police in WA between March and May 1996 (Figure 8-11). This research yielded a mean THC level of 3.8% from a total of 168 samples of cannabis and also confirmed, like surveys elsewhere, that relatively higher THC levels were obtained from the flowering tops of cannabis plants (mean 6.4% THC) compared to leaf (mean 2.2% THC).

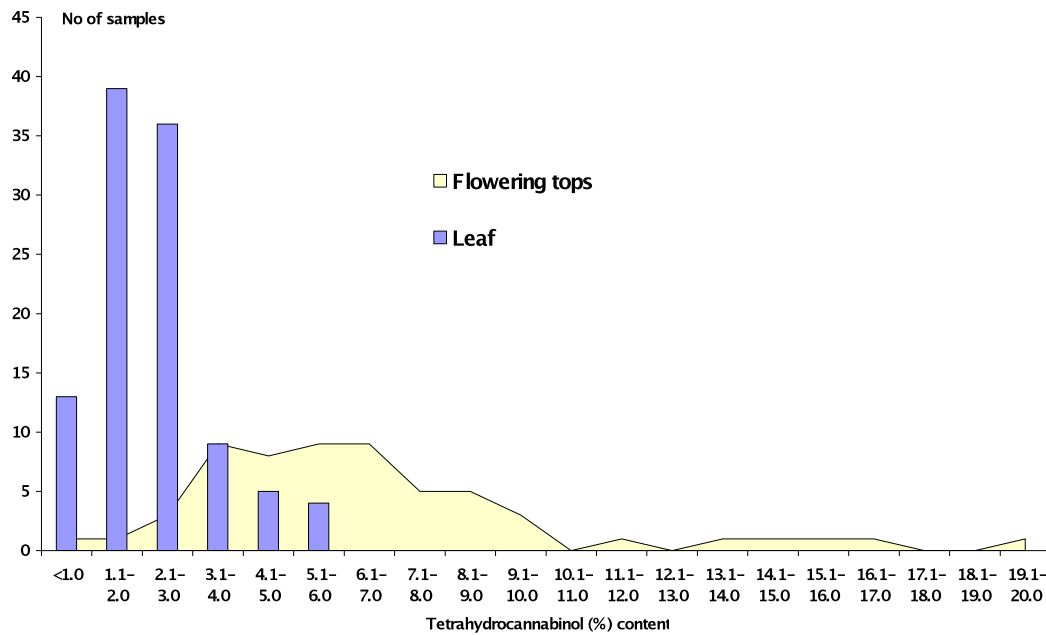
This WA data from 1996 shows there was a lower range of THC levels obtained from leaf material (from <1.0% to 6.0%) compared to the levels in flowering tops (from <1.0% to 20.0%). (See Table A4-14 in Appendix 4.)

²³ Hall W & Swift W. *The THC content of cannabis in Australia: evidence and implications*. Sydney, National Drug & Alcohol Research Centre, University of New South Wales, 1999, ii.

²⁴ Wayne Hall and Wendy Swift make the observation that there needs to be an investment in establishing and maintaining good data systems to measure changes in operation of the cannabis market, including potency, for without reliable data it is not possible to determine or monitor the impact of law reforms from measures such as the CIN scheme.

²⁵ Hall W & Swift W. *The THC content of cannabis in Australia: evidence and implications*. Sydney, National Drug & Alcohol Research Centre, University of New South Wales, 1999, 11.

Figure 1: Number of seizures by type of cannabis and THC (%) content, WA, 1996



Data from a two year project in Victoria that commenced in December 2000 involved the analysis of over 550 samples of cannabis material and confirmed there was considerable variation in the range of THC levels, with female flowering heads from hydroponically cultivated plants having levels in the range from 5% to 25% and those from plants cultivated in soil having a range from 2% to 25%. Overall:

“69% of the hydroponic samples tested had THC levels in the range of 11-20% whereas 79% of soil grown samples had THC levels in the range 6-15%. The average THC content also differed between the two groups, with the hydroponic group having an average of 15% THC and the soil group averaging 11% THC.”²⁶

A more extended project was undertaken by the Criminal Intelligence Directorate of the Royal Canadian Mounted Police (RCMP) under the auspices of Health Canada, which involved analysis of a total of 3,160 cannabis samples collected by provincial police forces throughout Canada between 1996 and 1999. It was found that whilst there was some variability in potency, yearly national averages were relatively low, with annual means of 6% for 1996/1997, 5.5% for 1997/1998 and 5.7% for 1998/1999 and that nearly a third of all samples were under 3%. This research has been interpreted as indicating the potency of cannabis has gradually increased in Canada in recent years.

“Before the early 1980s, the average THC content of the marihuana seized in Canada seldom reached one percent. Since it now hovers around 6 percent, the increase in potency cannot be denied. The interest here is merely to underscore the reality that not all growers have the expertise, the technological means and the will necessary to produce marihuana with a very high THC content.”²⁷

²⁶ Fiddian S & Quin C. *Determination of the THC levels and variation in the physical appearance of cannabis*. NDLERF Monograph Series No. 8. Canberra, National Drug Law Enforcement Research Fund, 2004, iii.

²⁷ Royal Canadian Mounted Police. *Marihuana cultivation in Canada: evolution and current trends*. November 2002, 18.

A study in 2001 by the Surete du Quebec confirmed a similar pattern of THC levels from qualitative analysis by Health Canada of 503 samples over the five year period 1996 to 2000, with an overall average THC level of about 7%, with annual averages ranging from 3.5% in 1996 to 8.8% in 1999.²⁸

An important outcome from this research that is that it is not possible to conclusively demonstrate that hydroponic cultivation produces female flowering heads with higher THC levels compared to other methods of cultivation. To be able to resolve this issue it would be necessary to generate data from cloned (that is genetically identical) plants grown under different conditions. A recent Australian review has concluded that:

“source of plant stock could have been a major contributing factor, as it appears ... that hydroponic growers commonly grow their crops from clones raised from mother plants derived from imported seed, whereas soil grown plants are commonly grown from seed, often collected from an earlier crop.”²⁹

If there has been an increase in higher potency cannabis over recent years, it is most likely from the use of clones from plants grown from imported seed. If there had been increase availability of higher potency cannabis, then, as this is likely to have been largely consumed by regular users, average THC levels may not have risen.

Whilst there may have been an apparent increase in the number of cannabis users with problems which could be explained by an increase in average THC, it has been suggested there are two more plausible explanations. One explanation is that the cannabis market has changed to produce more potent forms of cannabis and the other is that more harmful forms of cannabis use has become more prevalent among cannabis users.

It can be difficult to disentangle some of the interactions between DLE strategies and shifts in the cannabis market. For instance, it could be suggested that cultivation of higher potency forms of cannabis was a predictable response by the cannabis market to consumer preferences or that growers adapted their methods of cultivation in response to effective DLE activities. There has been some support for the latter proposition.

“It is also a plausible hypothesis that the supply of more potent cannabis products has been encouraged by the success of domestic law enforcement in detecting and destroying large scale cannabis plantations by operations from the air and satellite surveillance. This success may have created an incentive for illicit suppliers of cannabis to grow small numbers of cannabis plants capable of supplying high THC products.”³⁰

The preference for higher potency cannabis is indicated by the existence of higher prices for hydroponic (or ‘skunk’) cannabis as shown from data compiled by the Australian Crime Commission (ACC). This data which is provided to the ACC by each jurisdiction’s police service and published each year as the Australian Illicit Drug Data Report, shows that at the deal (1 gram) and the ounce (28 grams) retail level can be up to twice as expensive as non-hydroponic cannabis leaf. This indicates that the market places a premium on this form of cannabis for its purported higher potency levels compared to lower yield cannabis not grown under controlled conditions.

²⁸ Ibid.

²⁹ Fiddian S & Quin C. *Determination of the THC levels and variation in the physical appearance of cannabis*. NDLERF Monograph Series No. 8. Canberra, National Drug Law Enforcement Research Fund, 2004 iii.

³⁰ Hall W & Swift W. *The THC content of cannabis in Australia: evidence and implications*. Sydney, National Drug & Alcohol Research Centre, University of New South Wales, 1999, 6.

It has been suggested there are also close parallels in consumer behaviour in relation to both alcohol and cannabis users in response to price.³¹ This is a reminder that cannabis use will also be determined by factors beyond those that may usually be considered as relevant in determining demand and supply through DLE approaches alone.

“The alcohol and public health literature points to the crucial importance of price in determining population consumption. In respect to cannabis, robust data in this area are lacking. However, what we know is that different cannabis products are priced differentially and that prices reflect both potency and variety. In the Netherlands a close correlation between the mean THC content of different products price has been documented. In the United Kingdom the price differential between good quality sinsemilla³² and imported resin (a factor of around 1.5) is consistent with their relative THC concentrations.”³³

While there is evidence of some increase in potency levels, this does not necessarily mean that cannabis users are smoking more cannabis. Indeed it is possible the increased availability of higher potency cannabis has resulted in less cannabis being smoked to obtain the desired effect, which previously would have required the consumption of a larger quantity of cannabis.³⁴ Canadian research on this issue drew the following observations.

“Much has been made of the increase in THC levels in cannabis of the 1990s; critics of decriminalisation point to an elevation in THC content as a reason for alarm, suggesting that the marijuana of the 1960s bears no relationship to the marijuana currently circulating on Canadian streets. ... many marijuana smokers suggest that with higher quality cannabis they tend to smoke much less of the drug. ... Accordingly, it may well be that higher THC levels are consistent with a diminished intake of marijuana smoke, thereby reducing rather than raising the health risks associated with cannabis consumption.”³⁵

³¹ Clements KW & Daryal M. *The economics of marijuana consumption*. Perth, Economic Research Centre, Department of Economics, University of WA, 1999.

³² Sinsemilla is derived from the Spanish word ‘sinsemilla’, meaning without seeds. It is also known by other terms such as ‘skunk’ or ‘buds’ and is cultivated hydroponically through a combination of artificial control of the duration of light, the selective propagation of female cuttings and the prevention of fertilisation.

³³ King LA, Carpenter C & Griffiths P. ‘Cannabis potency in Europe.’ (2005) 100 *Addiction* 885.

³⁴ The issue of cannabis users being able to titrate their dose of THC, in a similar manner as has been found with tobacco smokers, would mean that use of more potent forms of cannabis could result in less cannabis material being smoked. If this outcome did occur, then it “*would marginally reduce the risks of developing respiratory diseases, the most likely adverse health effect of regular cannabis smoking.*”: Hall W & Swift W. *The THC content of cannabis in Australia: evidence and implications*. Sydney, National Drug & Alcohol Research Centre, University of New South Wales, 1999, 10.

³⁵ Boyd N. ‘Rethinking our policy on cannabis.’ *Policy Options*, October 1998, 32.