A More Reliable Evaluation of Hemp THC Levels is Necessary and Possible

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ABSTRACT. Most industrial crops that are cultivated within the 27 member states of the European Union (EU) are supported by agricultural subsidies. An official list of the hemp varieties that receive an agricultural subsidy in the EU is maintained by the EU Commission, and EU member states are expected to sample, analyze, and report *delta*-9-tetrahydrocannabinol (THC) values for eligible crops of each cultivated variety by the end of each year, according to EU Regulation No. 796/2004. Based on this information, additions to and deletions from this list are made early in the following year. The main criteria for being included on the EU list of subsidized hemp varieties seems to depend on two important factors: the variety be included in the EU Common Catalogue of recognized plant cultivars, and the variety, on average, must have less than 0.2% THC, according to the sampling and testing methodologies described in Annex I of EU Regulation No. 796/2004. By comparison, values for common drug-Cannabis typically range from 5–10% THC. The purpose of this article is to point out important features in the EU sampling protocols that favor monoecious fiber varieties from western Europe and disfavor dioecious oilseed varieties from eastern and northern Europe, in addition to other peculiar features. Also, potential systematic problems that exist within the current analytical protocol for analyzing THC are identified and discussed. Direct criticism is leveled at the ignorance and incompetence demonstrated by civil servants who are responsible for correctly understanding and implementing EU

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Regulation No. 796/2004. Suggestions for improvements in various aspects of reporting, sampling, and analytical methodologies are presented.

KEYWORDS. Hemp, THC content, sampling procedures, analytical protocols, European Union (EU)

"When you believe in things that you don't understand, then we suffer; superstition ain't the way."

Stevie Wonder, 1972

INTRODUCTION

There is always some amount of mystery and uncertainty in any measure. Ideally, analytical protocols are designed, established, periodically verified, and hopefully implemented, in such a way that insures both accuracy and precision in the resulting measure(s). Eurachem, for example, is a network of professional organizations that provides a focus for analytical chemistry and quality-related issues in Europe, with the objective of establishing a system for the international traceability of chemical measurements and the promotion of good quality practices (Eurachem, 2008). Such a structure allows analytical laboratories throughout the European Union (EU) to cooperate and provide a sufficient level of confidence in analytical results. Therefore, a sufficient level of ability and know-how already exists within this structure to assist in the compliance of EU member state agencies with EU regulations on hemp field sampling and subsequent quantitative analysis of *delta*-9-tetrahydrocannabinol (THC). Surprisingly, there are currently no systematic controls for the quantitative evaluation of THC in hemp within or between member states in the EU.

Moreover, member states often rely on unskilled people to collect field samples, and then pass these samples on to forensic laboratories that may or may not have any experience or interest in the quantitative analysis of low THC values in samples which are not of forensic interest. The reason for this is quite simple—typically, only the qualitative presence of THC is necessary for forensic purposes, rather than a precise or even accurate measure of the analytical value. Subsequently, EU member state agricultural ministries receive these results and apparently accept them without any further question or critical analysis. These results are then passed on to the EU Commission for further consideration. Unfortunately, it seems,

there is no possible recourse or procedure to discuss or even to question the validity of these results after this point.

From a scientific point-of-view, analytical results that cannot be demonstrated to be supported by fact and objectivity lack inherent meaning, and the intrinsic value of such data is lost. In this way, people who use this information as fact for evidence-based decisions, such as civil servants or political officials, may come to believe in things that are, in fact, not really true in a scientific sense of the word. Even worse is the situation where such decisions are in the hands of only a few individuals who may be unable, unwilling, or even uninterested in knowing if the information they have is scientifically valid or not. In such cases, we all suffer and become unwittingly deceived through such ignorance, and valuable opportunities may be lost.

Estimating a valid THC level in a hemp sample offers a unique example to illustrate this point of collective incompetence. For many reasons, it is difficult to obtain reliable scientific data on THC levels for hemp in the EU. In general, 1) THC is not especially stable in the standard stock solutions that are purchased from chemical supply companies (Poortman-van der Meer and Huizer, 1999); 2) there has not been either the political or technical will to require the necessary extra steps in laboratory analysis to determine and verify the true value of the standard THC stock solution that is used to eventually determine the THC level in a field sample; and 3) there is currently not a uniform understanding of the hemp sampling protocol that is described in Article 33 of EU Regulation No. 796/2004, Annex I.

Perhaps this was not such a critical issue in the recent past, when Article 3(1) of Council Regulation (EEC) No. 619/71 of 22 March 1971 was initiated to provide general rules for granting financial aid for growing hemp in Europe, when the average value of the allowable THC level was 0.3%. However, as subsequently amended by Regulation (EC) No. 2702/1999 for the production of hemp in the 1998/1999, 1999/2000, and 2000/2001 marketing years, the EU Council specified that only varieties found to have a THC content not exceeding 0.3 % and, for subsequent marketing years, not exceeding 0.2 % would be allowed on that list of subsidized hemp varieties in the future. Peculiar changes were also made to the field sampling procedures as well. Measuring such low levels of THC with both accuracy and precision is well within the domain of modern analytical technology, but without a corresponding shift in policy to update the analytical procedure in the current EU regulation, neither accuracy nor precision can be assured. This problem is discussed in detail in the following sections of this article.

Although there was no health crisis, no diversion of hemp to the black market, no public outcry, or even any scientific evidence presented to encourage this dramatic change, the primary impact of lowering the THC cutoff value for hemp from 0.3% to 0.2% has effectively prevented eastern and northern European hemp varieties from competing with the established monoecious cultivars from western Europe in the modern EU market. It is probably no surprise that French interests have been so heavily promoted, preserved, and intimately linked to the crafting of these regulations, which have positioned their precious monoecious fiber hemp varieties to be favorably influenced by the current regulations. This situation stems from a long and productive legacy regarding French hemp production, which was in place well before the Second World War, and particularly for hemp fiber as a strategic commodity in the production of specialty papers for bank notes, thin pages for bibles, teabags, and rolling papers for cigarettes.

Hemp fiber still has value in the modern world, and now hempseed has become recognized as a rich nutritional resource for essential fatty acids and high quality vegetable protein (Callaway, 2004). Unfortunately, EU protocols for sampling hemp seed food crops and analyzing those samples for THC have not advanced to keep pace with this relatively new application and the requirement to measure even lower THC levels with both accuracy and precision for this particular end use. Also, there seems to be a critical lack of experience in understanding these regulations in member states, especially from northern Europe, where a detailed familiarity of hemp morphology is either lost or was not ever extant in the first place. Moreover, the long days at the higher latitudes of northern Europe will inhibit flowering for most hemp varieties (Callaway and Hemmilä, 1996), which makes the correct sampling time described in the regulation botanically impossible. In other words, a situation currently exists in the Nordic countries where sampling authorities and agricultural policymakers have failed to understand both the meaning and subsequent implications of these regulations and protocols. Thus, it is not surprising that these regulations have not been implemented in a fair and uniform way throughout the EU. Moreover, the precise time of hemp's end of flowering may not be determined without carefully controlled observations over time, and preferably with several planting dates (Amaducci et al. 2008).

This article describes the implication of the unprecedented reduction of allowable THC levels by one-third, from 0.3% to 0.2%, for no apparent reason other than for those in western Europe to maintain control over a lucrative agricultural market. In combination with this arbitrary reduction, a special sort of ignorance has been clearly demonstrated by EU agricultural ministries, particularly in Sweden and Finland, where civil servants have been either

unable or unwilling to understand regulatory protocols and the intrinsic meaning of the scientific information that has resulted from these protocols.

EU REGULATIONS FOR HEMP FIELD SAMPLING FOR THC

Measuring a physical phenomenon is not necessarily very difficult; however, the decision of how to collect and prepare a bulk sample may depend on what it is that one wants to demonstrate. Ideally, most of the effort invested in making a measurement is made in collecting the samples to be analyzed and assuring that the method of measurement is correct, and within a certain degree of accuracy and precision. European Union field sampling protocols for hemp are somewhat complex, especially for anyone who may not be familiar with even the basics of hemp morphology. The field sampling protocol consists of separate procedures for monoecious (Procedure A) and dioecious (Procedure B) varieties of hemp, which are found in Section 2, Appendix I of EU Regulation No. 796/2004. The major features and differences between these procedures are presented in Table 1.

An especially quirky addition to the EU sampling protocol for hemp crops concerns a fine distinction between monoecious and dioecious hemp cultivars. Hemp, by nature, is a dioecious plant, i.e., presenting separate male and female plants, approximately 50/50 within a given crop. However, with careful selection and a few botanical tricks, one can have both male and female flowers appear on the same plant, i.e., monecious. This is an artificial state that requires an intensive effort to maintain. For no apparent reason, the current EU sampling protocol for hemp requires that only female samples be

TABLE 1. EU Regulation EC No. 796/2004 Annex 1 Section 2

Field Sampling Methodologies	
Procedure A	Procedure B
Monoecious 50 plants/field	Dioecious 200 plants/field
. . . 30 cm part containing at least one inflorescent. . . .	. . . upper third of each plant selected. . .
. . . 20 days after the start of flowering to 10 days after the end of flowering . . .	. . . only females shall be taken . . . during the 10 days following the end of flowering . . .
(another option) . . . from the start of flowering to 20 days after the start of flowering . . .	(no other options)

taken from a dioecious crop (procedure B), while any stem of 30 cm in length with at least one inflorescence of either gender will do from the monoecious crop (procedure A). As THC levels tend to be higher in female inflorescences, and also lower in stem portions of the plant, one can easily see that such a sampling protocol already skews the results towards lower THC values for the monoecious crops and higher THC values for the dioecious crops. If the regulations for sample preparation are followed carefully in procedure B, and the stem is removed before analysis, this still means that the analytical sample for monoecious hemp may contain other vegetative material, such as the remnants of male flowers, which have lower levels of THC than female inflorescences, and will contribute to overall lower THC levels for this sample in the final analysis.

This peculiar situation, of having two sampling protocols for a single plant species, not only deters from a uniform understanding and application of the field sampling protocol throughout the EU, but also favors monoecious varieties by offering opportunities for significantly earlier sampling times within Procedure A (Table 1). In other words, because THC levels naturally increase as the hemp plant matures (Höppner and Menge-Hartmann, 1995), a later field sampling of hemp often results in higher THC values. For this reason, an early-maturing dioecious variety of hemp that is grown for seed, such as Finola, is at a particular disadvantage; first, because it generally is the earliest variety to reach end of flowering (Callaway and Laakkonen, 1996), and secondly, because seed crops are left in the field for longer periods of time than fiber crops, thus allowing more opportunity for late sampling. Moreover, with each member state operating under its own interpretation of EU Regulation No. 796/2004, either by design or simply by ignorance, anywhere between one to 27 different implementations of these protocols may apply for a given variety in any year. One implication of this situation is that Finola was removed from the EU list of subsidized hemp cultivates in 2007, supposedly for THC values that were just above the 0.2% level in 2006 (Tables 2–4).

TABLE 2. Worldwide reported Finola THC values for 2006

	Number of Countries	Number of Samples	Days After Sowing	THC Average % +/– sd	% THC Range
EU	5	24	74–128	0.24% +/–0.16%	0.05–0.58
Canada	1	170	80+	0.14% +/–0.06%	0.01–0.73
New Zealand	1	7	65	0.04% +/–0.02%	0.03–0.08

TABLE 3. Finola EU THC results for 2006

Country	Sampling Date	Days After Sowing	THC Average %	Number of Samples
Finland	29.9	93	0.32	1
Sweden	20.7–20.9	74–128	0.40	15
UK	31.7	80–85	0.36	6
Estonia	14.8	70	0.09	1
France	?	?	0.05	1

TABLE 4. Finola THC results from Sweden 2006

Sampling Procedure	Sampling Date	Days After Sowing	THC%
B	20.7.2006	74	0.19
B	24.8.2006	101	0.32
B	**1.9.2006**	**109**	**0.29**
A	**1.9.2006**	**109**	**0.09**
B	5.9.2006	113	0.40
B	5.9.2006	113	0.50
B	6.9.2006	114	0.36
B	6.9.2006	114	0.37
B	7.9.2006	115	0.42
B	11.9.2006	119	0.41
B	12.9.2006	120	0.58
B	12.9.2006	120	0.50
B	14.9.2006	122	0.54
B	14.9.2006	122	0.38
B	20.9.2006	128	0.58

This does not mean that it is illegal to cultivate Finola in the EU, and in fact this cultivar remains in the Common Catalogues of both Finland and the EU as a recognized crop variety, but in effect it means that an unsubsidized hemp cultivar is at a particular economic disadvantage when hempseed producers are deciding which cultivar to grow.

Thus, to have a fair sampling procedure that covers all varieties over a large geographic region, a specific stage in the plants life cycle must be consistently identified with reliability and uniformity from year to year. In effect, this means that each variety may have a different day, or span of days, after sowing at which the crop is ready for sampling. In the EU, this

period of time is described as 10 days following the end of flowering for dioecious hemp varieties, and either 20 days after the start of flowering to 10 days after the end of flowering for monoecious varieties, with the additional option of sampling at the start of flowering to 20 days after the start of flowering for monoecious varieties (note the early sampling bias that is only allowed for monoecious varieties, especially in the second option). These peculiar sampling parameters are summarized in Table 1.

The resulting variations in THC values are evident in the reported results for Finola and other hemp varieties in the EU (Tables 2–6). Especially telling are the wide variety of reported results for Finola in 2006 from different countries. In Table 2 are presented the available worldwide THC results for Finola in 2006. If we use the calculation method that is used by the EU, which combines all data from each country as one single value and then averages all singular values to achieve a common average, then the worldwide THC value for Finola in 2006 would be 0.14%. By coincidence, this happens to be the exact same value for the average Finola THC result from Canada in 2006, which was obtained from 170 different field samples (Table 2). This data set from Canada in Table 2 is also the most reliable for Finola because the number of analyzed samples

TABLE 5. EU THC results for the monoecious French variety Fedora 17 in 2006

Country	Samples	THC max (%)	THC min (%)	THC avg (%)
France	147	0.17	0.04	0.08
Denmark	24	0.16	0.04	0.06
Austria	85	0.16	0.06	0.11
Sweden	18	0.26	0.06	0.14
UK	1	0.07	0.07	0.07
EU avg	**275**	**0.26**	**0.04**	**0.09**

TABLE 6. EU THC results for the monoecious Hungarian variety Tiborszállási in 2007

Country	Samples	Sampling Date	%THC
Hungary	1	July 24	0.09
Sweden	1	September 19	0.42
Finland	6	September 18–19	0.20

is large (N = 170) and also because Canada has a comprehensive system for certifying laboratories for their ability to provide competent analyses of THC for hemp samples. Moreover, the sampling procedure in Canada is more uniform and easier to understand than the one used in the EU. In Canada, the time of sampling is determined when a certain percentage of mature seed can resist compression between the thumb and index finger (Health Canada, 2007). Although there is the occasional outlying values in this data set (Table 2), i.e., the rare high (0.73%) and occasional low (0.01%) values that are represented as the range, such variation can be expected from such a large sample. Finally, the standard deviation for the data from Canada is considerably low (+/– 0.06%), which is a good indication of reliability for the average value of 0.14% THC.

By contrast, the total EU sample size for Finola in 2006 was relatively small (N = 24) the standard deviation of the average value is high (+/– 0.16%) and there is no comprehensive system in the EU to certify laboratories for their ability to analyze THC in hemp samples. Moreover, the EU range in Table 2 is slightly smaller than the range from Canada (+/– 0.05 to 0.58% THC), yet still rather large for such a small data set, which again indicates a certain amount of unreliability in these collective measures from various countries in the EU. This may also be due to the poor understanding of how to determine the correct sampling time for this crop in the EU. Compared to Canada, the sampling time for hemp in the EU is earlier, because in Canada the time is determined by seed formation, which naturally follows the end of flowering. In consideration of this fact, the Canadian THC limit for hemp is also higher (0.3%) than in the EU (0.2%), and not actually more liberal.

Furthermore, the field samples for Finola from the EU in 2006 were taken over a much wider time window (74–128 days), which certainly has influenced these results (Table 2). The data from New Zealand, for example, is interesting in that all seven samples were taken on the same day, and at the end of flowering for this variety. Notice that both the range (0.03 to 0.08% THC) and the standard deviation (+/– 0.02%) are considerably low, which is consistent with uniform sampling and analytical methodologies.

Table 3 presents a closer look at the EU THC for Finola in 2006, according to each country. Again, one can clearly see a natural correlation between sampling time, in terms of days after sowing, and THC levels. In other words, samples taken at later dates in the summer, from older plants, exhibit higher THC values. It was not possible to ever recover precise information for Finola THC sampling times in France, because the EU system does not allow for such information to be recorded and made available for later consideration, and in this case the actual farmers could

not be located or contacted. However, it seems that hemp sampling agents in France, where hemp has been consistently cultivated for many decades, are already familiar with both hemp morphology and EU regulations for determining the correct sampling time, and so it follows that a low (0.05%) THC value was reported for Finola in 2006 from France, because it was both sampled and analyzed correctly. Perhaps it is no coincidence that this value is so similar to the value from New Zealand (0.04%), where a uniform sampling and analysis were also applied. A similar rationale may apply to the results from Estonia, where the THC level was estimated from a single Finola crop to be 0.09%.

Sweden reported the highest values for Finola THC in the EU (0.4%) in 2006, and from the largest number of samples (N = 15). The individual results from these samples are presented in Table 4. Although the EU regulations clearly state that the sampling window should be only 10 days, in addition to sampling at the correct time, Swedish sampling authorities sampled and reported data over a 54-day interval for Finola in 2006, which is in clear violation of the sampling window that is described in Annex I of EU Regulation No. 796/2004. Moreover, the first of these 15 samples (on 20 July, at day 74 after cultivation) was already late and past the end of flowering for Finola, which should normally be sampled somewhere between days 65 and 70 after sowing. Also, it is interesting to note the difference in sampling methods, which was done by the curious Swedish authorities, from the same crop on 1 September at day 109 after sowing (Table 4). It is quite surprising to see a three-fold difference in THC results from sampling procedures A (0.09% THC) and B (0.29% THC). Aside from this single example, all other samples in this data set were collected according to procedure B, of course. This is a special misapplication of the EU sampling regulation, which illustrates two problems; late initial sampling, combined with additional sampling over a much longer period of time.

Field Sampling Methodologies

Sampling an industrial hemp crop for THC analysis can be complicated and variable. For example, someone with or without much training will be asked to go into a hemp field and cut certain portions of plants and prepare these as a uniform sample for analysis. The key phrase that is used to describe the correct sampling time for a dioecious crop in EU Regulation No. 796/2004 is simply offered as 10 days following the ". . . end of flowering . . . ," and then sampling within a 10-day period after that time, in Annex I Section 2 (Samples), with no further elaboration, and

there is no definition of this quoted phrase at any point in the regulation. It is not even stated if the end of flowering should be observed in male plants, which is quite obvious, or female plants, which is practically impossible. In fact, when asked for clarification on this point, Hermanus Versteijlen of the EU Commission responded with the following:

> . . . this is the responsibility of Member States to implement properly analytical procedures including sampling during the relevant period of vegetation. (Versteijlen, 2007).

Thus, each member state is left to determine the "end of flowering" for a sampled hemp variety, with or without the help of people who may or may not know anything at all about hemp morphology. For example, a self-styled hemp expert committee from the Finnish Ministry of Agriculture has simplified the matter by unilaterally declaring that the actual time of sampling is not actually important, because the members of this select group have decided for themselves that THC levels do not actually increase during the hemp plant's life (Palonen, 2008). This declaration of policy in Finland seems to run contrary to the efforts of detailed wording on sampling time in Annex I of EU Regulation No. 796/2004, yet Palonen went so far as to include a literature reference to shore up their opinion-based decision (Höppner and Menge-Hartmann, 1995). On behalf of this group, Palonen states that, ". . . THC-content will not necessary rise after the correct sampling time." Unfortunately, it seems that no one in Palonen's expert group had actually bothered to even read the referenced article, as the following sentence from the abstract clearly states, "The contents of THC increased during plant development.." It is not only difficult, but especially frustrating and perhaps even impossible to have a rational, evidence-based discussion with a group having a mentality like this. In reality, these representatives of Finnish Ministry of Agriculture have never understood the regulation that requires the need to sample hemp at a particular time, and has now simply decided to ignore this aspect of the regulation. The alternative would be for this institution to admit that it has failed to correctly understand and apply the regulation, which does not yet seem to be an option in its presently limited constellation of choices.

However, this example serves to illustrate an unfortunate situation resulting from the absence of accreditation or any sort of check to see if a member state is capable of understanding or applying the sampling regulation in a uniform way. In at least some cases, the time of sampling has been determined by individuals who have had little or no training for this job, or even a familiarity with hemp or hemp morphology. Moreover, analytical procedures

have been used that are radically different from the procedure described in the EU protocol, which further complicates the problem of reliability and obtaining meaningful results. In any case, without a precise definition and uniform understanding of the phrase "end of flowering," careful observations over time (Amaducci et al. 2008), or a simplified sampling procedure, it is difficult to imagine how the current regulation can ever be interpreted and applied in a uniform way by those who are supposedly trained and responsible for sampling and analyzing hemp THC values in the EU.

Timing of Field Sampling

As already demonstrated, the time of sampling a hemp crop for THC analysis *is* critical, and the results are strongly influenced by dynamic changes in plant morphology, which occur throughout the plant's life. In Finland, for example, two responses are common when official sampling agents have been asked how they determined the correct sampling time for Finola: 1) either the agent was not aware that a particular time of sampling was important, and they hastily completed the task just days before the crop was harvested; or 2) the time of sampling was simply decided to occur at some point after one's summer holiday, which is typically some point in time after the end of July. This may not be so critical for hemp varieties that develop late in the summer, but it is especially critical for varieties that mature early in the summer, such as Finola. The purpose of having established protocols, which supposedly enjoy a universal understanding and application, is to take into account the fact that different varieties of hemp do mature at different rates under different growing conditions, and that THC values gradually increase during the life of a hemp plant.

Unfortunately, if the sampling agent is not well acquainted with hemp morphology, or without even a good idea of when this point occurs in terms of days after sowing, then the actual sampling time becomes completely arbitrary. Sampling time is also not so critical for monoecious hemp varieties, which are primarily grown for fiber and are often harvested before the end of flowering, which is also before seed production has begun. However, a problem now occurs when these traditional fiber varieties are grown for seed production, typically outside of their country of origin, and thus sampled later than ever intended. In such cases, some fiber varieties have already demonstrated THC values slightly over the 0.2% limit because: 1) they are sampled later, and 2) they are being analyzed by member states that have little or no prior experience in the precise and accurate analysis of low THC levels in hemp.

Fedora 17, a monoecious variety from France is presented as an example of this situation in Table 5. This variety will not reach a point that can be described as end of flowering at high latitudes, as the long days in Sweden will effectively inhibit flowering. A similar situation was also observed in Sweden for Felina 32 in 2006 (data not shown), where a high value of 0.23% THC was observed. On average, both varieties gave ultimate values in Sweden that were below the 0.20% limit; 0.14% for Fedora and 0.15% for Felina, so these are not yet in any real danger of being removed from the list of subsidized hemp varieties. However, one can see that even these varieties from France are in danger of losing their status when they are left to grow for unusually long periods of time, ostensibly while a Nordic sampling agent waits indefinitely for the end of flowering to occur.

BASIC PRINCIPLES BEHIND SAMPLING AND QUANTITATIVE ANALYSES

It is important to have some understanding of the process that gives rise to these numbers. Analytical chemistry is the field of science that is devoted to answering the following two questions, "What is in this?" and "How much is there?" (for a more thorough overview, see Seely (2008)). Unfortunately, there is no magic that automatically comes with the process of analysis, and such information is useless in the absence of reliability. Thus, both accuracy and precision are required in both the sampling and the analysis of any sample. To understand the importance of these two concepts—accuracy and precision—imagine throwing darts at a round target on a wall. If most of the darts hit close to the center of the target, then the dart throwing can be considered to be both accurate and precise. If most of the darts cluster near some other point on the target, or even the wall, then the throwing can be said to have precision, but not accuracy. In this case, a simple adjustment of the throwing technique towards the bull's-eye, and some practice, can significantly improve the accuracy. If the darts show no particular pattern at all, and few if any are near the center of the target, then the throwing lacks in both accuracy and precision. For important matters, both accuracy and precision should be known to a high degree of confidence, which is also expressed in numbers.

Accuracy and Precision in Measuring THC

To achieve both accuracy and precision in the analysis of THC in a hemp sample, uniform sampling and quantitative analysis are required to deliver

reliable results that can be used to make rational, evidence-based decisions. European Union Regulation No. 796/2004 describes the sampling methods that are to be used for collecting hemp field samples, which are subsequently analyzed for THC. Each of the 27 member states is responsible for interpreting these regulations, coordinating both the sampling and analysis, and finally reporting these results to the Commission. These tasks are typically organized through the disparate Ministries of Agriculture, and THC analyses are typically made by state forensic laboratories. As far as THC values are concerned, and as already discussed, a critical feature is to determine a correct and uniform time of sampling the hemp crop. Ideally, such a procedure provides for a consistent sampling methodology for all hemp varieties, no matter where they are grown. A consistent procedure for eliminating, or at least significantly reducing the possibility of unreliable data is essential. Otherwise the presentation of a single analytical number from a sample, taken as fact, may or may not reflect a more essential truth for that sample. In other words, the number may be in error and have no intrinsic value for making important decisions. Gross errors in calculation, either in sampling or analysis, may also give false information, and without any indication that such information is false.

The latter example provides an especially dangerous situation when investigators (and particularly policymakers) accept analytical data at face value and do not really know if the information is actually true or false. At this point, the data becomes useless, but may still be used to make and implement important decisions. Lacking an awareness of this ignorance results in a misapplication of the information, and unintended consequences from subsequent decision(s) made.

This is why protocols, such as EU Regulation No. 796/2004 were designed, i.e., to reduce the inherent errors in both sampling and measuring. This is also why analytical results are normally reported as averages, typically with values for standard deviation and a range of the values observed. Of course, the date of sowing, and the date of (and method of) sampling is important physical information that should always be recorded and easily available for future evaluation, which is also not possible under the current system in the EU. Only in this way can one begin to make critical evaluations of the data and move forward towards rational, evidence-based decisions. Anything less is opinion-based subjectivity.

Outliers

There are a wide range of opinions about the acceptance and rejection of experimental data, and the criteria for making these decisions. In the

case of unusual analytical results, which may or may not reflect the true value of a measure, the standard objective criterion is referred to as a confidence level, or confidence interval. A conservative confidence level of 99% means that of all values that exist within a Gaussian distribution (i.e., the bell-shaped curve), only 1% of all legitimate values would be expected to fall outside of this level of confidence. In practice, a confidence interval of 95% is often used, which is less strict and means that 5% of all legitimate values would be expected to fall outside of the confidence interval. Going back to the example of throwing darts, if a person were to throw 100 darts at a target, then only 95 of the throws would be considered in the final accumulation of total points with a 95% confidence limit in place. In theory, this means that only the most reliable results are retained for further consideration and, of course, there is the real possibility of always rejecting some good data with a higher confidence limit. However, the idea here is to reject bad data, even at the expense of some small amount of good data, and not the other way around.

ANALYTICAL PROTOCOL: RANDOM VS. SYSTEMATIC ERRORS

In the previous section, the value of following a standardized sampling procedure was described and discussed in detail. An inability to understand and correctly follow this procedure results in random errors. After sampling, and typically after some initial stages of sample preparation, an analytical procedure is followed to obtain a final value, such as % THC. Several important steps must be carefully followed in the laboratory analysis to insure reliability of the results, and even some rational assumptions must be made along the way. To reduce or eliminate random errors, one of the main assumptions is that the analytical instrumentation is working properly, including its maintenance and operation by a skilled professional. A key assumption that is made to reduce systematic errors is that a sufficient number of critical variables for the analysis are under control. The analytical THC standards, for example, must be known to have a specific physical value in order to compare these results with that of an unknown field sample.

Typically, a commercial THC standard is purchased from a chemical supplier, which will advertise that the product they sell contains a certain amount of THC, such as 1 milligram of THC in 1 milliliter of ethyl alcohol (1 mg/ml), and often includes a certificate of analysis as verification of this value with an estimation of error, such as +/– 5%. Unfortunately,

this stated value may not be the true value of the commercial standard, and there is no procedure described in the EU protocol to verify the standardized solution. Thus, the average lab technician who uses this "known" solution value to measure the amount of THC in an unknown hemp sample must assume that the total amount of THC stated on the label of the vial is absolutely true. In many cases, however, this is unfortunately not true (Poortman-van der Meer and Huizer, 1999).

Due to the labile nature of THC in solution, the actual concentration of THC is typically some unknown number that is less than 1 mg/ml, and without knowledge of the true concentration, subsequent THC result from the hemp samples will be artificially high through a systematic error in the calculations that are based on an assumption that the stock standard is actually 1 mg/ml. Moreover, because the rate and degree of degradation in the THC in solution is unknown, the working THC standard must be verified on a periodic basis, i.e., preferably each day that low level THC analyses are being made. In practice, this is not done because: 1) there is no provision for this in the regulation, and 2) because there is not an accreditation process for the accurate and precise measure for low levels of THC in hemp samples in the EU. A deeper rationale for this situation is also understandable, but not obvious; i.e., forensic labs in EU member states are not normally required to routinely measure such small amounts of THC in criminal drug samples with such quantitative precision and accuracy. In other words, it is normally only sufficient for a forensic lab to demonstrate that a crime sample has THC, and it is not important to know the actual percentage of THC in the sample with the precision and accuracy that is called for in the EU analytical protocol for hemp. Again, it is also important to keep in mind that the EU THC limit for hemp is only 0.2%, and by comparison the THC values for common drug-Cannabis typically range from 5–10% THC. It is absurd to believe that anything below 1% THC would be used as drug-Cannabis (Grotenhermen and Karus, 1998), especially when higher levels are readily available to consumers of drug-Cannabis. So who actually benefits from these arbitrarily low levels of THC to define subsidized hemp in the EU?

Degradation of THC in Solution, a Systematic Source of Error

THC is a potent antioxidant, or reducing agent, which means that the actual amount of THC will begin to decline over time, once it is dissolved into a dilute solution of ethyl alcohol (Poortman-van der Meer and Huizer, 1999). The rate of degradation depends on many factors, which are not

described in standard protocols for the analysis of THC and, thus, are not accounted for by most laboratory technicians. There are both elaborate and simple procedures that have been described to verify the purchased THC sample, but these are seldom employed in the quantitative analysis of THC. Normally, a laboratory will make up their own standards, by directly weighing and diluting the chemical of interest. However, pure THC is a thick and sticky oil that can be difficult to manipulate for analytical purposes. Moreover, THC is a controlled substance, and very few labs have the permission or even the desire to keep relatively large amounts of this chemical around for the preparation of analytical standards. Instead, it is simply easier and more convenient to just purchase the dilute solution from an established supplier, and take small amounts from this commercial stock solution whenever a serial dilution of analytical standards are required for the analysis of an unknown hemp sample from the field. At best, this is a tedious process that requires a considerable amount of skill and preparation.

It is not immediately obvious, but if a standard sample is less than the stated amount on the label, the subsequent measurements that are based on that false value will be artificially high. For example, if the standard stock THC sample is 0.75 mg/ml instead of 1.0 mg/ml, or 75% of the stated value, the calculated result of an unknown hemp sample that is based on this particular benchmark will be no less than 25% higher than the true value of the unknown sample. In fact, as the standard sample is diluted, the error is compounded. As most hemp samples are already quite low in THC, the THC standard must be diluted to a considerable degree in order to achieve the same analytical level of the unknown hemp sample.

To simplify this concept, consider buying apples from the market at €1/kg. The customer makes a selection, but the final apple price is unknown until the apples are weighed, and then the weight is multiplied by €1/kg to determine the price. What if the weighing scale has not been properly calibrated, and there is no independent way to check before purchase? If the measurement is not accurate and precise, either the customer or the vendor will not be getting a fair deal in the commercial transaction. For example, if the reading on the scale is one kilogram, when in fact the true weight is something less, say 750 grams, then the customer will be cheated (perhaps unintentionally) by paying the full kg price for only 750 grams of apples. In this example, the customers price will be €1 for 750 grams rather than €1 for one kilogram (1000 grams). In effect, the customer will pay €1.33 for a kilogram of apples rather than the advertised €1/kg, which is about 25% more in cost than if the scale had been properly calibrated to give the correct weight.

Measuring the amount of THC in hemp is a bit more complicated than weighing apples, but the concept is the same. Think about the measured amount of THC as the customer's price for the apples (€1.33/kg), which is higher than the advertised price (€1/kg), and the poorly calibrated scale as a partially decomposed stock solution of the stock THC reference standard, with a true value of 0.75 mg THC/ml instead of the assumed 1.0 mg THC/ml that is stated on the label of the bottle. As with the customer's apple price, the measured amount of THC in the hemp sample, which is calculated from this partially decomposed reference standard, will be an overestimation of the true value for THC that exists within the sample. The converse is also true. However, it is less likely that a stock reference standard will be prepared and delivered with more than its stated value, as the true concentration of THC in solution degrades over time. To take this analogy a bit further, this would be similar to a situation where the calibration for the scale that weighed the apple became progressively worse over time, because of the progressive decomposition of THC in solution, with no external indication that something is wrong.

The true concentration of the stock THC standard must be verified by a standardized method on a periodic basis, due to the inherent instability of THC in solution (Zoller, Rhyn, and Zimmerli, 2000; Poortman-van der Meer and Huizer, 1999). Otherwise, such a systematic bias in the analytical method will give artificially high THC values if the true value of the standard is less than the amount that is claimed on the label.

The current EU regulation does not offer a method to verify the THC reference sample, or even indicate that verification might be needed. The regulation only states that the THC standard must be ". . . pure for chromatographic purposes . . . " (Appendix 1, EC No. 796/2004, L141/54, Section 3.2 Determination of THC Content). This definition may suffice for qualitative determinations but is clearly insufficient to insure the reliability of a quantitative analysis. Such a statement is much like saying that the scale for weighing apples must be clean, which gives absolutely no information to indicate if the scale that is used to weigh the apples is properly calibrated or not.

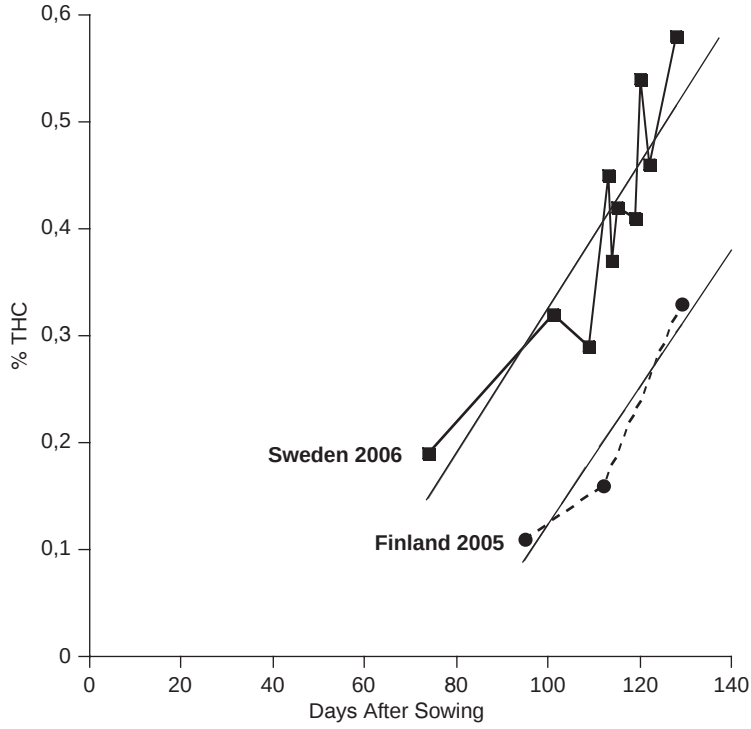
In contrast, Canada has a national accreditation procedure for the labs that do the THC testing of hemp samples, which is typical in most countries for a wide variety of most analyzed chemicals. Surprisingly, the EU has no such system for the validation and accreditation of THC quantitative analysis (although the EU does, of course, have this accreditation for many other chemicals of interest). Without such an accreditation system, there is no incentive for the analytical chemist to even question the validity of the stock THC standard that is ordered from a chemical supply company.

Degradation of the THC Standard in Practice

A slightly high THC value (0.21%) for one of two Finola samples was already included in a report to the EU Commission from the UK in 2004. The other value was 0.17% THC, and when averaged together the reported value from the UK was 0.19%, which is below the 0.2% limit, but was already a cause for some alarm at that time. At this point, the possibility of an unverified THC standard began to be seriously considered as a potential source of artificially high THC values for Finola. This opportunity resulted in a rare and rational discussion of the analytical methodology with the scientist in the UK who had made the laboratory analysis on these samples, and the consensus was that the true value of his commercial THC standard was actually unknown, and that he had assumed the stated value on the label to be the true analytical value. As there was not a requirement or even a suggestion to verify the THC standard before the analysis, according to the EU regulations, this critical step in the analytical procedure was simply omitted, which made the actual work considerably easier. There was also a concluding consensus in this discussion, that this omission was a serious pitfall in the analytical methodology. Unfortunately, it was not possible to have such a rational discussion with the civil servants involved, who are not trained to understand the possible implications of highly technical matters.

A better example of this situation is illustrated in Figure 1, where the Swedish THC results for Finola from Table 4 are plotted over time with THC results from a carefully controlled trial in Finland during 2005. Ideally, these two sets of data would fall on the same straight line of the linear regression. However, in Figure 1 we see two parallel regression lines for these two sets of data—the Swedish regression line (to the left) and the Finnish regression line (to the right). These samples were collected by the same methodology, at similar latitude although in different countries, and analyzed by essentially the same methodology, although by different laboratories and in different years. In 2005, special precautions were taken by the Central Crime Laboratory in Helsinki, Finland to examine the possibility of achieving high THC values for Finola when field samples were taken after the end of flowering. In their analytical investigation, the laboratory took the unprecedented step to upgrade their analytical method for the quantitative analysis of THC by actually verifying their THC stock sample, according to a previously published method (Poortman-van der Meer and Huizer, 1999). In the course of that investigation, it was found that the Finnish THC standard was not 100% accurate, and the necessary correction factor was determined through verification and applied in the

FIGURE 1. 2006 Finola THC data from Sweden with 2005 Finola THC data from Finland.



final analysis. For this reason, it is believed that the Finnish data in Figure 1 is closer to the accurate THC values in these samples than the Swedish data, which may be precise, but are not accurate. It is assumed that Swedish authorities were not even aware of this potential problem, and had not taken the extra steps to verify their THC analytical stock sample. So far, it has been impossible to make direct contact with the Swedish scientist(s) who were responsible for providing these analytical results, in order to determine if this verification was made or not. In all probability, it is reasonable to assume that they were not aware of this potential problem, like the scientist in the UK. More disturbing is that the Swedish scientists are not readily available for comment or question on this matter. In any event, the fact remains that the results presented in Figure 1 are exactly what one would expect from a situation like this, i.e., parallel lines with

the artificially high values (from Sweden) shifted upwards from the data of Finland, which are known to be closer to the true analytical values. Moreover, this conclusion is also consistent with the observation that Sweden continued to report unusually high THC values in 2006 for all hemp varieties tested in that country.

THE ANALYTICAL METHODOLOGY

Appendix 1, Section 3.0, EC No. 796/2004 describes the analytical methodology for the determination of THC content in the hemp sample. While the analytical method that is described for measuring THC in the hemp sample is clear enough, the required analytical instrumentation that is described (flame ionization detection (FID)) and other aspects of the procedure are presently archaic and lacking in specificity.

FID vs. MS Detection in the 21st Century

Flame ionization detection is a common detection method that was developed for gas chromatography in 1957. Flame ionization detection is still used as a robust detection methodology for many analytical purposes, but has largely been replaced by mass spectrometric detection (MS) during the latter part of the 20th century, because of its high specificity and the wider availability of MS instrumentation. The difference in both detection specificity and sensitivity is roughly similar to comparing people by their shadows (FID) rather than their fingerprints (MS). In fact, MS data is typically referred to as the "molecular fingerprint" of a measured compound. Just like with overlapping shadows of two or more people, FID detection cannot tell the difference between two or more molecules that may not be well separated by gas chromatography, while MS detection can. Thus, with FID, it is possible that a laboratory technician may inadvertently measure THC plus something else by mistake, and never know what or even how much was contributed to the results by that "something else." Of course, this is another way to achieve an artificially high THC value from a hemp sample, particularly when one considers the hundreds of different chemical substances that will occur in any hemp sample. On the other hand, MS detection can provide 100% chemical specificity in a chemical analysis. As this detection is now widely available in the 21st century, it may be time to include it as the analytical procedure of choice

for determining hemp THC values in the EU regulation. It is, in fact, both surprising and a bit embarrassing that the EU must still rely on such an archaic and nonspecific detection method as FID for such an important determination.

Procedure A has Fewer Calibration Data Points for Analysis than Procedure B

To improve both accuracy and precision in the analysis of samples that are assumed to have lower levels of THC (i.e., monoecious varieties), more calibration data points should be included in the standard curve of the analytical method, not fewer points, as indicated for Procedure A in the EU regulations. It is illogical, to the point of embarrassment, that the EU methodology would require less calibration data for the analysis of samples containing less THC collected from Procedure A than the number of samples containing potentially more THC collected from Procedure B. One must ask, "Who benefits from these contorted procedures?" Another feature peculiar to this analytical procedure is the requirement of using squalane as an internal standard at a concentration that is suggested to be almost nine times above the maximum allowable level of THC (0.2%). For higher precision, it would be more logical to have the internal standard closer to the expected THC value to be measures, which would be especially important for values that were of even lower values than 0.2% THC.

TIBORSZÁLLÁSI: ANOTHER EXAMPLE OF FAILED EU POLICY ON THC SAMPLING

The problem of "high" THC values is not specific to Finola, and the examples of high THC values for Fedora and Felina in 2006 have already been mentioned. In addition, the Hungarian monoecious variety Tiborszállási has recently suffered a similar fate, although for slightly different reasons (Table 6). At the lower latitudes of Hungary (ca. 47° N), Tiborszállási will begin to experience 16 hour days in late June, when inflorescence begins. This means that the appropriate sampling time for this variety will be in late July at this latitude. Like Fedora and Felina, whose time of florescence depends on day length, yet unlike Finola whose time of inflorescence is completely independent of day length (Callaway and Laakkonen, 1996), Tiborszállási will not ever reach a point that can be described as "end of flowering" at the high latitudes of Sweden

or Finland, because the 16-hour minimum summer day length that is required stimulate flowering in this variety will not be reached until the middle of August, at which point there is too little time and thermal energy remaining in the season for the inflorescences to sufficiently develop. Perhaps the sampling agents in Finland and Sweden had actually learned something about hemp morphology by 2007, and actually understood the intrinsic meaning of the sampling regulations by then as well. Perhaps by patiently waiting for the correct sampling time, they eventually realized that it would be wise to just take the samples in mid-September, before the snow began to fall (compare sampling dates in Table 6). In this example, even a correct understanding of the regulation has failed to produce a meaningful result in terms of the sampling protocol.

When questioned specifically about such practices, the EU Commission responds by saying that they have received no complaints from member states on these issues, which renders a classic Kafka-like "Catch-22" situation of a bumbling bureaucracy without the ability to understand the very nature of these chronic problems in both the sampling and analytical methodologies for evaluating THC in EU hemp varieties. Clearly, no institution has been too eager to recognize this problem, much less admit that it has made a mistake, and then further take the additional time to embarrass itself by admitting this to the EU Commission.

Another problem in Finland, which has nothing to do with sampling or analytical methodologies, has recently been identified in the reporting of THC values for Finola to the EU Commission. The Finola variety of hemp originates in Finland, where it is naturally maintained. This involves a separate series of bureaucratic procedures, which involves additional expense and special precautions in farming, and fees for testing varietal purity and seed quality, in addition to various registration fees for the certification of the planting seed that is eventually sold to farmers for the cultivation of grain. According to EU regulations, THC levels are to be reported from crops that are eligible for subsidy. Due to the small market for hempseed in Finland, Finola was grown for pedigreed seed and no subsidy was ever paid to farmers in Finland for this production. This means that pedigreed Finola seed crops were sampled for THC, from unsubsidized crops, and that those results were incorrectly reported to the EU Commission. Although this is probably just another example of a consistent inability of civil servants within the Finish Ministry of Agriculture to understand and implement EU hemp regulations, it seems especially punitive for Finola farmers in Finland to be denied a subsidy for a crop that is eligible for a subsidy, while at the same time

this Ministry incorrectly reported THC results from pedigreed seed crops to the EU Commission, which have not received subsidy. The Finnish Ministry of Agriculture initially ignored requests to provide evidence that the reported THC values values for Finola came from crops that were eligible for subsidy, and now inform that such information is "confidential".

POSSIBLE IMPLICATIONS FROM THE MISMANAGEMENT OF HEMP IN THE EU

The EU Charter of Fundamental Rights includes the Right to Good Administration (Article 41), and it is hoped that closer attention will be paid to this particular bit of legislation, while implementing the necessary changes in administrative policies to reduce such neglectful treatment of individuals and small businesses, especially in Finland. In particular, it is hoped that ignoring complaints and refusing to answer specific questions or requests for public information in a timely manner will no longer be acceptable forms of administration.

The neglect that Finola has experienced with the Finnish Ministry of Agriculture, since 1995, is actually surprising when one considers a working group report from this institution from 2001, entitled Strategy for Finnish Agriculture, which maps a course to 2010 and clearly indicates the importance of crops that are high in both protein and oil. The recent Treaty of Lisbon and other EU Commission documents also contain explicit sentences stating that combating climate change and global warming are now serious policy targets of the EU. This is especially important for the future of hemp, as this crop is an important and needed source of raw material for biofuels and eco-friendly products in the Nordic countries.

> "Never assume malice when stupidity will suffice"
>
> —Heinlein's Razor, 1941

PRACTICAL SUGGESTIONS FOR IMPROVEMENT

Good administration should be the rule rather than the exception, which includes accountability, transparency, open access to information, and responsiveness to feedback. In practice, important details should be

kept and be readily available for the verification and identity of a sampled hemp variety, along with its sowing dates, sampling dates, THC results, and verification that the reported crop sample is even eligible for subsidy.

There must be effective checks in the EU to insure that member state agencies are properly sampling, analyzing, and reporting eligible hemp THC values to the EU Commission, with some way to encourage these agencies to correctly implement these regulations if they have neglected to do so on their own.

The flowering characteristics and approximate window for sampling should be known to some degree of certainty for each variety, at least in its country of origin. This would allow sampling officials to have some general idea of when the crop should be sampled. In any case, some consideration should be made for central and east European varieties when grown at high latitudes, where long day length can inhibit inflorescence.

The sampling procedure should be the same and simplified for all hemp cultivars, monoecious or dioecious, and determined from the time of male flowering, or when the male plants first release pollen, as these are the most obvious morphological features that can be easily recognized with even a minimal amount of training.

An updated analytical methodology is needed for the accurate and precise evaluation of THC in hemp samples. Specifically, revisions should include:

1. The use of FID should be replaced by MS detection, to insure that THC is identified correctly, without the possibility of a contaminating interference.
2. An appropriate method for validating the THC standard stock sample, which can be universally applied and equally evaluated by other laboratories throughout the EU, on a periodic basis, due to the inherent instability of THC in solution. Otherwise such systematic bias will give artificially high THC values with any analytical method.
3. Multiple analyses of test samples by a network of cooperating laboratories for certification, according to Good Laboratory Practice (GLP), where each laboratory establishes a record of technical competence and reliability that is also available for public inspection.

And what about cannabidiol (CBD) in hemp? In addition to low levels of THC, hemp varieties produce more CBD than THC, while drug varieties produce more THC than CBD (Hillig and Mahlberg, 2004; Mechtler et al,

2004). As CBD can effectively attenuate the psychoactive effects of THC, by binding the CB1 receptors in the brain (Pertwee, 2008), it would follow that higher levels of CBD in hemp should also be monitored along with THC in hemp as a precondition, if the general idea is in fact to reduce the unlikely possibility of using this crop as an illegal drug.

Perhaps polymorphisms in the natural genetic variations of hemp could be used to determine, once and for all, if a variety may be considered to be "hemp" or not, which completely eliminates the complicated uncertainties and expense of quantitative analysis in the current situation (Datwyler and Weiblen, 2006). Otherwise, current EU hemp regulations will not keep pace with the variety of uses for hemp crops in the modern world, and more to the point, any hemp variety becomes vulnerable to arbitrary removal from the list of subsidized crops under the current regulations.

CONCLUSION

Hemp is currently grown throughout the EU for a wider variety of purposes than ever before, from ecofiber-based building materials and hurd for animal bedding to functional foods from the seed. However, hempseed crops, in particular, are necessarily in the field for longer periods of time, which allows more opportunity for later sampling, while fiber crops are cut relatively early. This means that a crop's end use seems to be the main difference for hemp, rather than its reproductive status as monoecious or dioecious.

At a time when a world food shortage looms on the horizon, it seems illogical and even irresponsible for governmental authorities to destabilize crops that offer high yields of edible oil, protein, and industrial fiber. This article offers harsh and direct criticism of those who are supposedly responsible for understanding and implementing the regulations that are designed to sample, analyze, and report THC levels in subsidized hemp crops, but it would be unfair to rest blame entirely on a few individuals for these systematic failures, and malice is not assumed. Aside from the acute lack of vision that was used to craft the present regulation, the remaining share of the blame is reserved for a collective inability, ignorance, and certain unwillingness to do anything about this situation. Unfortunately, the *status quo* has remained unmoved, even after several years of attempted dialogue to identify these problems and engage in constructive discussions that could have avoided the current situation of having useful hemp varieties deleted from the EU list of subsidy.

From another perspective, it should be realized that member states with little political power in the EU, such as Finland and Hungary, are typically reluctant to bring up such minor issues for discussion at the EU level, perhaps for fear of getting nothing accomplished. However, such a cowardly attitude is nothing less than shameful and disrespectful to the agricultural community, and especially so in countries such as Finland and Sweden, where the selection of viable industrial crops is extremely limited. In particular, special criticism is directed towards the Finnish Ministry of Agriculture for letting Finland's first and only hemp variety (Finola) become lost in an abyss of bureaucratic rhetoric. It should be emphasized that EU Regulation No. 796/2004 seems to be written to favor monoecious fiber varieties, and especially disfavor grain varieties from Northern and Eastern Europe. It would be hard to believe that the intent and clever wording of this regulation, which favors the production of hemp fiber over hempseed, has been accidental.

Useful varieties of hemp have already been lost through neglect, irrational legislation, and a subsequent lack of interest during the last century. To remove a unique variety of hemp from a subsidy list on the basis of dubious THC values is something like punishing a car manufacture for producing a type of car that has been found to exceed the speed limit, after measuring the car's speed by 27 different methods, where none of these methods are verified by the universal laws of physics. Moreover, it is not as if Finola can now find a niche use in the drug-*Cannabis* trade as an economic alternative.

The future still remains unclear on the eventual status of hemp in the EU, as other varieties remain vulnerable to an arbitrary application of the current regulations. The intent of this article has been to examine some of the more illogical aspects of EU Regulation No. 796/2004 and to encourage policymakers to be more attentive in their roles as civil servants by paying closer attention to their occupational responsibilities.

In this article, the Finola variety from Finland, Tiborszállási from Hungary, and two varieties from France have been mentioned as specific examples of a policy "gone wrong". With the current regulation, all varieties are at risk to suffer from these illogical regulations, as more hemp is grown for grain and other purposes.

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