

About the problem to regulate by law unavoidable entries of unauthorised substances into organic products – illustrated by chemical-synthetically plant protection products

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Starting Point

The discussion how to deal with findings of unauthorised substances in organic products is all the time present throughout the revision process of the organic regulations within the EU legislation framework. The Council and Parliament of the European Union want to make every "presence" of impermissible substances in products from organic farming into the trigger for measures, which range from intensive research into origins all the way to withdrawal of organic quality. In so doing the concept of the presence of impermissible substances is not being defined any more clearly. The present position statement aims to consider the entry paths, type and amount of impermissible materials and examine the possible effects agriculture utilising chemicals on an industrial scale has on organic farming.

Background

Modern agriculture is distinguished by the high usage of synthetic substances. These materials are distributed upon the area where they should develop their action/effect, however they spread out widely throughout the entire ecosystem through various processes in the soil and the atmosphere. The chemical and biological decomposition of the chemicals can only be traced analytically up to their respective limit of detection (LoD). Equally these materials also remain overall in the long term below the detection threshold. And enormous amounts are added to that year for year through renewed applications.

Organic products are also being produced in this "natural" environment, although organic farming is distinguished exactly by the fact that it is obtained without agrochemicals. The presence of agrochemical materials in the smallest amounts in every natural organism and product is the conclusive consequence of the decades-long and continuing use of these substances.

Scientific Foundation

The concept of presence is closely coupled with the method through which the presence is ascertained. As much in accordance with chemical statistics as according to analytical methods the number of substances present is continually increasing the smaller the concentrations let in for consideration. Finally it is only a question of the capabilities of the analytical methods to confirm by experiment the results of the chemical statistical calculations: in the smallest amounts, nearly every substance is present in every sample. "Presence" is thus conceivably an unsuitable concept.

Possible Consequences

Should the claim of the "absence of impermissible substances" be made for a product from organic agriculture, then one must be clear about this, that already this claim cannot be ascertained even for many plants and animals in the wild, that is in the natural environment not being used for agriculture. The unrealistic and unscientific idea that products from organic farming can be raised, processed and transported without residual pollutants is based on the paradox that the products could be cleaner than the natural environment. This will lead in the end to the result that organic farming of all things, will be impossible in co-existence with chemical-industrial agriculture due to accidental or irreproducible general contamination.

Grounds for Consideration

A. What are impermissible substances in the sense of the regulations governing organic farming?

Impermissible substances are all those which are not generally permitted (such as drinking water and salt) and are not positively listed in the appendixes of the respectively valid European Implementation Regulations for Organic Farming.

In the following the details are restricted to pesticides since these are the most relevant and examined group of materials regarding co-existence.

B. Presence versus Detectability

When is a material present in chemical/physical terms?

It is important here to distinguish clearly between presence and detectability. A material is present in the strictest sense when it is 'at hand'. However, it is first detectable when the amount in the analysed sample is large enough that the chemical and physical methods of detection are responsive. With the examination of residues from pesticides these methods can yield a quantitative proof starting from a content of just a few micrograms of material per kilogram of analysed material ($\mu\text{g}/\text{kg}$). In purely material terms, for many things that corresponds to an amount of approximately 10^{15} molecules, that is a number with 15 zeroes. This is clarified by the example of Glyphosate (molecular mass = 169 g/mol):

A detected concentration of Glyphosate of 0.01 mg (= 10 μg) in 1 kg of analysed material corresponds to approximately 35 thousand million million (35×10^{15}) molecules! Even a thousand times smaller concentration of 10 ng/kg (nanogram/kilogram) means that there are still about 35 trillion molecules of Glyphosate per kilogram of analysed material at hand! Thus presence is a very relative term.

What can analysis achieve today in technical terms?

Drinking water analysis: detection of up to 0.1 microgram/litre = 0.1 ppb (1 black grain among 10 billion other coloured grains); The problem: more and more detections of more and more materials, for example medicines/drugs.

Dioxin analysis: detection of up to 0.1 nanogram/kg = 0.1 ppt (1 black grain among 10 trillion other coloured grains)!

Proportionality of expenditure/benefit and validity

The detection sensitivity cited in the drinking water and dioxin analyses cannot be achieved in the pesticide residues analysis nor in the contamination analysis of foodstuffs. There are two reasons for this:

Drinking water is in analytical terms the "simplest" examination material of all. It contains no disturbing constituents, which could impede the analysis. (If that were the case, then by definition it would not be drinking water). Without any disturbing material the analysis is consequently optimally sensitive.

The dioxin analysis restricts itself to a total of 17 exactly defined compounds from the group of Polychlorinated dibenzo-p-dioxins (PCDD) and the polychloride dibenzofurans (PCDF) and for which the so-called 'isotopically labelled' reference material can be manufactured. Through their utilisation and the application of what are termed high-resolution mass spectrometers it is possible to detect extremely small concentrations.

Neither condition is fulfilled with the analysis of pesticides and contaminants. On the one hand there are many hundreds of compounds (more than 1300 known pesticides¹ and several hundred potential contaminants) for which - with very few exceptions - there are no "isotopically labelled" reference materials available. On the other hand the diversity of the foodstuffs and agricultural products to be examined is enormous with uncountable numbers of constituents, which are "disruptive" to analysis (fats, proteins, sugar, natural colourings, antioxidants and many more).

Under optimal conditions in many cases a concentration of a pesticide or a contaminant of 0.01 mg per kg of analysed material can be detected with certainty. In a few cases and when the boundary conditions are exceptionally favourable even a concentration of up to 0.001 mg/kg (1 µg/kg) can be measured with certainty. Frequently however the opposite is the case and the material to be examined contains lots of "disruptive substances" which cannot be appropriately separated. That results in reporting limits of 0.05 mg/kg or in a few cases also of 0.1 mg/kg.

The limit of detection is method-dependent and specific to a single active ingredient in a specific analysed material. Along with that there is a deviation range from laboratory to laboratory. It is therefore not meaningful to replace the term "presence" with the term "limit of detection", particularly since this in operation approaches very near to the limiting value.

¹ The Pesticide Manual© BCPC (British Crop Production Council), 2014

Conclusion: Even with the use of the most optimal analytic technology in many cases the detection/quantification of contents of pesticides and contaminant less than 0.01 mg/kg is not possible with certainty. Whether this corresponds to a limit of detection, the reporting limit or a limit of quantification (LoQ) is an academic discussion and in practice neither solvable nor relevant. What is decisive is whether the analyte is "detected" and can be provided with data regarding the "quantity". Only then is an analysis result meaningful to use.

In the case of contaminants (that can also be a pesticide contamination) there is in addition another difficulty. A contamination is always "accidental", because it is not intended (at least not deliberately). Because of that, as a rule, the boundary conditions of the contamination are also not able to be described: duration, intensity, method of transmission (air, water, soil), isolated or (wide)spread influence, direct influencing (drifting across during application onto the neighbouring field) or large area influence (long-distance transport of harmful substances, e.g. bonded to dust particles), weather conditions (wind, rain, storms, dry spells and dust) and other parameters besides, result in a contamination not being evenly distributed across a specimen material. In unfavourable cases there are even so-called 'hot spots', which simulate pollution, but are also not evenly distributed across the entire region of a specimen material. In such cases it is not possible to draw a conclusion from a sample, even if it is considered to be "representative" in accordance with the current guidelines. In this connection let us recall the official sampling procedure for import control of dried fruit and nut products, in order to detect a possible contamination of these goods with mould toxins (mycotoxins) and if necessary to take them off the market. Even here the mycotoxins form clusters, which as a rule are not detected by an otherwise normal, representative sampling. For this, according to the EC Regulation No. 401/2006², for example for dried figs, a bulk sample of 30 kg is to be used, which is divided into 3 individual samples each of 10 kg which must be prepared accordingly for the final analysis. For nuts, other oilseeds and some other product groups 'aggregate samples' of 20 kg weight are to be employed. This shows what an enormous effort is necessary with such arbitrarily distributed contaminations in order to obtain a reliable statement regarding a corresponding batch of goods. In any case, even with these methods the basic problem is not solved, since an amount, which would be harmful in isolation can be diluted across the entire sample to a level below the limit of detection.

In order to be able to assess the marketability of a product then the sampling and analysis must permit an unambiguous conclusion regarding the entire batch.

However, in so far as the residual pollution was caused by an accidental and/or isolated contamination, a representative sampling can mask this origin through the dilution effect. A "suspicion of the first appearances" based exclusively on such a laboratory result is not reasonable in consideration of the discussion presented above. Far-reaching sanctions based only or exclusively upon such an analysis result would be arbitrary and possibly completely disproportionate to the respective situation.

² Regulation (EC) No. 401/2006 last amended by Reg. (EC) No. 519/2014

C. Examples from Agricultural Production

Germany

In the Federal Republic of Germany, with an area of 357,168 km² over 40,000 tons of agrochemicals (active ingredients without accessory agents / co-formulants) are used per year (in 2011: 43,000 tons; in 2012: 45,527 tons)^{3,4}. The area utilised for agriculture worked out in 2013 according to the Federal Bureau of Statistics as 16.663 million hectares, thus 166,630 km².

With that there were in 2011 on average over 258 kg of agrochemicals used per km² of farmland. That means 258 mg agrochemicals per m² surface area. Year for year.

For soft wheat with an area yield of approx. 5.7 tons/hectare that works out to 0.57 kg yield per m². Thus on average, for the production of 0.57 kg of soft wheat (or other agricultural products) 258 mg of crop pesticide was applied, therefore 452 mg for each kilogram. For other agricultural products with different area yields the count is raised or lowered proportionally.

In order to calculate the total pollution on the new plant growth, the total bio-mass yield per area must be added into the equation. This works out for the dry mass yield at 10 to 16 tons per hectare⁵. The calculated application of crop pesticide per kilogram then lies still between 258 and 161 mg. If one considers the top layer of soil with the same mass into the calculation, then the average calculated pollution of topsoil and plant growth per square meter of farmland in Germany is between 80 and 130 mg/kg of dry mass. The actual application on the surface depends greatly upon its use. Organic farming, by definition of the system, doesn't recognise any entries, that is also true for extensively utilised areas for fruit orchards or pasture land. In contrast to that there are high entries for intensive cultivation and horticulture operations.

Why then are there any agricultural products at all in which no residual pollution could be detected? In order to clarify this phenomenon there are various factors, which have to be taken into consideration:

1. The average amount of 80 to 130 mg of agrochemical being applied per kg of topsoil with growth spreads itself across 261 individual active ingredients (2012)⁴. Should these 261 active ingredients be statistically distributed, then the individual amount of residual pollution lies only between 0.3 and 0.5 mg/kg in each farmed crop.
2. Directly following the application of the agrochemicals various processes start to take hold, which spread, dilute, decompose and chemically alter these substances. Physical processes in the atmosphere distribute the matter wide-spread through wind and water across the entire surface area and in the soil. Light and chemical processes decompose the substances or change them chemically. Biogenic processes in the soil and the complete biosphere decompose the substances or bond them chemically into the plant matrix.

³ German Ministry of the Environment: <http://www.umweltbundesamt.de/themen/boden-landwirtschaft/umweltbelastungen-der-landwirtschaft/pflanzenschutzmittel-in-der-landwirtschaft>

⁴ BVL:

http://www.bvl.bund.de/SharedDocs/Downloads/04_Pflanzenschutzmittel/meld_par_19_2012.pdf?__blob=publicationFile&v=3

⁵ Flaig/Mohr(Hrsg.), Energie aus Biomasse, Springer Verlag

Absorptive processes can make reversible or irreversible compounds in the substances by means of micro-organisms.

3. All of the above named processes lead directly to a measurably great reduction in the pollution, in particular during the initial time period. However, at a linear reduction of 90% per time unit and a starting amount of 10^{18} molecules, the "decomposition" works out at merely a power of ten per time unit. And linear relationships are a rarity in nature.
4. With that we have already cited the most significant factors as to why the analysis can only detect a fraction of the agrochemicals, which have been employed. So long as certain detection is first possible at an amount of 1 microgram of individual active ingredient per kg of analysed material (and frequently only first from 10 micrograms or more) then multiple pollutant residues and products of decomposition disappear from perception, although they are present on the molecular scale in enormous numbers.

Conclusion: Year for year enormous amounts of agricultural chemicals are employed world-wide. Even if the tracking analysis is rapidly developed it is still very far away from detecting the actual distribution and content in the entire biosphere. In spite of that it can be deduced from simple calculation models that in the whole environment, in the soil, the water, plants and animals, agrochemicals and the products of their decomposition must of necessity be present in great molecular numbers.

Study on Long Distance Transport with Example of Pendimethalin and Prosulfocarb in Brandenburg⁶

In the context of a project with the title "Performing a Bio-indication on Pesticide Intermediate Residues by Means of Air Quality: Bark-Monitoring, Passive Collection and Vegetation Sampling" carried out by TIEM Integrierte Umweltüberwachung GbR on order of LUGV Brandenburg (State of Brandenburg Office of Environment, Health and Consumer Protection) the long distance transport of pesticides using the example of the two herbicides Pendimethalin and Prosulfocarb was examined.

A quotation from the study:

The findings lead to the following summarising assessment:

- *The results from the screening for the immission load show for both herbicides, Pendimethalin and Prosulfocarb, a clear contamination of the region extending beyond single locations.*
- *The data situation from our own and other examinations permit the unanimous conclusion of an undesired wide-spread and continuing dissemination in the environment, particularly of Pendimethalin.*
- *In this connection concentrations were reached which lie in the range of POPs (persistent organic pollutants) classified as dangerous such as Lindane and DDT.*

⁶ http://www.bioland.de/fileadmin/dateien/HP_Dokumente/Pressemitteilungen/LUGV_BB-Studie_Ferntransport_Pestizide.pdf

*Brazilian (Endosulfan)*⁷

The increased use of the insecticide "Endosulfan" in conventional farming in Brazil has led to carry-over transport, among others by rain and atmosphere. As a result of this, residues of Endosulfan have been detected through laboratory analysis also in organic soya beans.

The sale of agrochemicals and in particular of pesticide formulations containing Endosulfan had significantly grown in Brazil in the years 2007 through 2009. As a consequence correspondingly large amounts of Endosulfan reached the environment (plants, soil, air, water). This situation was confirmed by data from chemical-industrial based farmers and co-operatives. In the 2009/10 season the amount of Endosulfan used in Brazil was some 2.5 times greater in comparison to the previous year's season. In consideration of the weather conditions, in particular the amount of rainfall and the air temperature and the increased application amounts in Brazil's chemical-industrial agriculture a clear correlation can be shown which imposes an increased danger of Endosulfan contamination for the organic soya bean cultivation. The analysis results show a definite increase in the content of Endosulfan in the organic soya bean crop from the season 2008/9 to season 2009/10. While the average content in the 2008/9 season was at 0.028 mg/kg, it grew in the 2009/10 season to 0.058 mg/kg. If one sets the 2.5 factor increase in the Endosulfan application in Brazil in comparison to the 2.1 factor increase of the average content of Endosulfan in the organic soya beans, it permits a corresponding correlation to be derived.

As a conclusion, the content of 0.05 mg/kg of Endosulfan in organic Soya beans from Brazil was ascertained as unavoidable and so also was confirmed by the organic control bodies⁸ involved as well as by an official position statement of the BNN e.V.⁹ (the German Association of Organic Processors, Wholesalers and Retailers) for the 2009/10 and 2010/11 seasons.

*USA/Canada (Glyphosate)*¹⁰

The herbicide Glyphosate is employed world-wide for the chemical fight against "weeds" and in the chemical-industrial agricultural scene already to an extent replaces mechanical-farming technology.¹¹ Furthermore Glyphosate is employed intensively as a siccative ("chemical drying", stock ripening) of pulses and to an extent for grain. Visits and interviews were made to organic farmers in Montana (USA) and Saskatchewan (Canada) in August 2014 in the framework of a project for assessment of the current stock position and a situation analysis of Glyphosate findings in organic

⁷ Report "Endosulfan: Environmental circumstances in Brazil 2010 and assessment of its impact on organic soy bean production" from Lach&Bruns Partnerschaft, Hamburg on order of the firm Gebana AG, Zürich, Juli 2010

⁸ http://www.n-bnn.de/sites/default/dateien/bilder/Downloads/statement_endosulfan_21052010_0.pdf

⁹ http://www.n-bnn.de/sites/default/dateien/bilder/Downloads/OeffentlicheStellungnahme_Soja_August2011.pdf

¹⁰ Report "Report and Conclusions related to glyphosate levels in organic KAMUT® Khorasan Wheat of origin, Montana, USA and Saskatchewan, Canada" from Lach&Bruns Partnership, Hamburg on order of the firm Kamut Enterprises of Europe bvba, Oudenaarde, Belgium, June 2015

¹¹ Personal information from farmers in Montana, USA and Saskatchewan, Canada to Lach & Bruns Partnership, August 2014

Khorasan wheat. Parallel to that the business premises and the corresponding arable acreage for the organic Khorasan wheat was inspected and samples of both the soil as well as the Khorasan were taken. As much as possible samples were also taken from the neighbouring fields, which were being farmed using chemical-industrial methods. Rain-water samples which were collected from the farmers according to specification were also a component of the examination. The following were identified as causes for what proved to be as a rule accidental and hardly reproducible instances of Glyphosate findings in magnitude ranging between 0.01 mg/kg and up to 0.076 mg/kg (average value at approx. 0.035 mg/kg):

- 1) Local contamination through drift and cross-contamination in harvesting vehicles from directly adjacent neighbouring fields during a Glyphosate application or during the harvest after a preceding siccative treatment with Glyphosate;
- 2) Lack of barriers in the form of bushes, hedges, shrubbery or other borders;
- 3) Long-distance transport of contaminated dust particles through erosion and corresponding weather and wind conditions;
- 4) Long-distance transport of contaminated dust particles through swirling-up and transport in upper atmospheric layers during the harvest of siccative-treated produce;
- 5) Environmental influences through rain, which by itself either contains dust particles with Glyphosate attached or washes these out from the atmosphere.

The majority of these effects occur by chance and not predictably, so that a forecast is not possible regarding whether and which areas will possibly become contaminated. On the basis of the situation portrayed here of the intensive, world-wide employment of Glyphosate, then the production of organic produce with Glyphosate contents of less than 0.01. mg/kg is already today hardly possible any more.

Currently control stations in North America (USA and Canada) regularly confirm Glyphosate contents of up to 0.05 mg/kg as general background pollution and thereby the products as equivalent to the legal provisions for organic farming. With that all measures in Europe, which go further are prohibited in the framework of the bilateral treaty-agreements, even when the same content in European goods would lead inexorably to complaints.

***Conclusion:* As long as conventional farming is driven by large amounts of chemical-synthetically plant protection products (csPPP), the presence of these csPPP neither can be avoided in organic agriculture nor the presence of csPPP can indicate irregularities of organic products. Consequently an isolated laboratory finding within the trace range cannot be sufficient ground for doubt regarding the regulation-conformity of the operating methods. Only a loophole-free process control can ensure the integrity of the products from organic farming.**

Hamburg/Karlsruhe, 18th January 2016