



**EUROPEAN COMMISSION**  
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT  
Directorate H. Sustainability and Quality of Agriculture and Rural Development  
**H.3. Organic farming**

## **Expert Group for Technical Advice on Organic Production**

**EGTOP**

### **Final Report On Greenhouse Production (Protected Cropping)**

The EGTOP adopted this technical advice at the 7<sup>th</sup> plenary meeting  
of 19 and 20 June 2013

### *About the setting up of an independent expert panel for technical advice*

With the Communication from the Commission to the Council and to the European Parliament on a European action plan for organic food and farming adopted in June 2004, the Commission intended to assess the situation and to lay down the basis for policy development, thereby providing an overall strategic vision for the contribution of organic farming to the common agricultural policy. In particular, the European action plan for organic food and farming recommends, in action 11, establishing an independent expert panel for technical advice. The Commission may need technical advice to decide on the authorisation of the use of products, substances and techniques in organic farming and processing, to develop or improve organic production rules and, more in general, for any other matter relating to the area of organic production. By Commission Decision 2009/427/EC of 3 June 2009, the Commission set up the Expert Group for Technical Advice on Organic Production.

### *EGTOP*

The Group shall provide technical advice on any matter relating to the area of organic production and in particular it must assist the Commission in evaluating products, substances and techniques which can be used in organic production, improving existing rules and developing new production rules and in bringing about an exchange of experience and good practices in the field of organic production.

### *EGTOP Permanent Group*

- Alexander Beck
- Jacques Cabaret
- Niels Halberg
- Sonya Ivanova-Peneva
- Lizzie Melby Jespersen
- Ursula Kretzschmar
- Nicolas Lampkin
- Giuseppe Lembo
- Mariane Monod
- Robin Frederik Alexander Moritz
- José Luis de la Plaza Pérez
- Bernhard Speiser
- Fabio Tittarelli

### *Contact*

**European Commission – Agriculture and Rural Development**

**Directorate H: Sustainability and Quality of Agriculture and Rural Development**

**Unit H3 – Organic Farming**

**Office L130 – 03/232**

**B-1049 BRUSSELS**

**BELGIUM**

**Functional mailbox: [agri-exp-gr-organic@ec.europa.eu](mailto:agri-exp-gr-organic@ec.europa.eu)**

---

The report of the Expert Group presents the views of the independent experts who are members of the Group. They do not necessarily reflect the views of the European Commission. The reports are published by the European Commission in their original language only.

[http://ec.europa.eu/agriculture/organic/home\\_en](http://ec.europa.eu/agriculture/organic/home_en)

### **Acknowledgments:**

Members of the Sub-group are acknowledged for their valuable contribution to this technical advice. The members are:

- Fabio Tittarelli (chair)
- Lizzie Melby Jespersen (rapporteur)
- Bernhard Speiser
- Roberto García Ruiz
- Roger Hitchings
- Eckhard Reiners

### **Secretariat:**

- João Onofre
- Luis Martín Plaza
- René l'Her
- Suzana Median
- Natalia Brzezina

All declarations of interest of Permanent Group members are available at the following webpage:

[http://ec.europa.eu/agriculture/organic/home\\_en](http://ec.europa.eu/agriculture/organic/home_en)

## TABLE OF CONTENTS

<b>1. BACKGROUND</b>	<b>9</b>
<b>2. TERMS OF REFERENCE</b>	<b>9</b>
<b>3. CONSIDERATIONS AND CONCLUSIONS</b>	<b>11</b>
<b>3.1. INTRODUCTION</b>	<b>11</b>
3.1.1. <i>Greenhouse production: a highly controlled form of agriculture</i>	11
3.1.2. <i>Socio-economic importance of greenhouse production</i>	11
3.1.3. <i>Concerns over highly intensive production</i>	12
<b>3.2. DEFINITIONS</b>	<b>12</b>
3.2.1. <i>Definition of ‘greenhouse’, ‘under cover’ and ‘protected cropping’</i>	12
3.2.2. <i>Definition of ‘seedling’, ‘vegetative material’ and ‘transplant’</i>	13
3.2.3. <i>Definition of ‘growing medium’, ‘soil conditioner’/ ‘soil improver’ and ‘peat’</i>	14
<b>3.3. NUTRIENT AND SOIL FERTILITY MANAGEMENT</b>	<b>14</b>
3.3.1. <i>Sources of nutrient supply</i>	14
3.3.2. <i>Leaching of nutrients and salinisation</i>	15
<b>3.4. MANAGEMENT OF SOIL AND CROP HEALTH</b>	<b>16</b>
3.4.1. <i>Preventive methods, including crop rotation</i>	16
3.4.2. <i>Control of soil-borne pests and diseases</i>	17
3.4.3. <i>Use of natural enemies (‘beneficials’)</i>	19
3.4.4. <i>Plant protection (Annex II of the Reg. (EC) 889/2008)</i>	20
3.4.5. <i>Cleaning and disinfection (Annex VII of the Reg. (EC) 889/2008)</i>	20
<b>3.5. MULCHING</b>	<b>23</b>
3.5.1. <i>Mulching materials</i>	23
3.5.2. <i>Reflections of the Group</i>	24
3.5.3. <i>Conclusions and recommendations</i>	24
<b>3.6. IRRIGATION AND DRAINAGE SYSTEM (WATER USE, RAIN WATER, DESALINISATION, RECYCLING OF WATER AND NUTRIENTS)</b>	<b>24</b>
3.6.1. <i>Conclusions and recommendations</i>	25
<b>3.7. CONTROL OF LIGHT, TEMPERATURE AND USE OF ENERGY</b>	<b>25</b>
3.7.1. <i>Energy use in general</i>	25
3.7.2. <i>Light</i>	26
3.7.3. <i>Heating source / heating system</i>	27
<b>3.8. CARBON DIOXIDE (SOURCE, REBALANCING AND ENRICHMENT)</b>	<b>27</b>
3.8.1. <i>Previous findings of the EGTOP</i>	27
3.8.2. <i>Carbon dioxide enrichment and yield</i>	27
3.8.3. <i>Carbon dioxide originating from fossil fuels</i>	27
3.8.4. <i>Carbon dioxide originating from other sources</i>	28
3.8.5. <i>Conclusions and recommendations</i>	28
<b>3.9. GROWING MEDIA</b>	<b>28</b>
3.9.1. <i>Growing media composition</i>	28
3.9.2. <i>When should growing plants in substrate be authorized?</i>	30
3.9.3. <i>Recycling of growing media</i>	31
<b>3.10. CONVERSION PERIOD FOR GREENHOUSE PRODUCTIONS</b>	<b>31</b>
3.10.1. <i>Conversion period for greenhouse crops growing in the soil</i>	31
3.10.2. <i>Conversion period for greenhouse crops growing in substrate</i>	31
3.10.3. <i>Comments on the general conversion rules</i>	32
3.10.4. <i>Conclusions and recommendations</i>	32
<b>4. LIST OF ABBREVIATIONS / GLOSSARY</b>	<b>33</b>
<b>5. REFERENCES</b>	<b>33</b>
<b>6. ANNEXES</b>	<b>35</b>
<b>6.1 ANNEX 1 – IN-DEPTH DISCUSSION ABOUT PEAT</b>	<b>35</b>

## EXECUTIVE SUMMARY

The expert group for technical advice on organic production (EGTOP; thereafter called "the Group") has discussed whether the use of the substances/products/techniques mentioned below is in line with objectives, criteria and principles as well as the general rules laid down in Council Regulation (EC) No 834/2007 and whether they can therefore be authorised in organic production under the EU legislation. The Group defined the terms 'greenhouse', 'under cover', 'protected cropping', 'seedling', 'vegetative material', 'transplant', 'growing medium', 'soil conditioner'/'soil improver', 'peat' and 'mulch' and concluded the following:

### 1. Nutrient and soil fertility management:

- a) *Sources of nutrient supply*: In the Group's opinion, greenhouse crops should be fertilised primarily from slow release organic fertiliser materials like compost and animal manures, ideally from certified organic sources, but otherwise by means of materials from Annex I to the Reg. 889/2008. The use of supplementary soluble nutrients (especially N) should be justified by the calculation of total nutrient balances as described in Section 3.3.1.2.
- b) *Leaching of nutrients and salinisation*: The use of irrigation to flush surplus nutrients is not an acceptable practice consistent with the organic principles. When choosing the quantity and type of fertilisers, the nutrient balances must be taken into consideration as described in Section 3.3.1.2 to avoid salinisation or leaching of nutrients. If problems do occur, solutions consistent with the organic principles should be used.

### 2. Management of soil and crop health:

- a) *Preventive methods*: The main tools for pest and disease prevention are choice of varieties, grafting on to resistant rootstock, crop cultivation techniques and the management of greenhouse ambient conditions (e.g. air humidity), the encouragement of soil-borne pathogen suppression through the use of biologically active compost and other organic materials. The need for soil sterilisation is greatly reduced by all of the above mentioned practices. In the Group's opinion, wider use of crop rotations in greenhouses would be desirable, but this is difficult for the reasons described in Section 3.4.1.2. The Group recommends changing Art. 12(b) of Reg. (EC) 834/2007 to include in the crop rotation concept, diversity in space rather than in time, including short term green manure crops and legumes, to assure consistency with the underlying principles of Reg. (EC) 834/2007, in particular Art. 5(f) and 12(b).
- b) *Control of soil-borne pests and diseases*: In the Group's opinion, soil health should be maintained primarily by means of preventive methods including practices such as rotation and other forms of plant diversity and the addition of biologically active compost and other organic materials to suppress plant pathogens. 'Biofumigation', solarisation and shallow steam treatment of the soil (to a maximum depth of 10 cm) are also in line with the objectives, criteria and principles of organic farming and should be authorized. Deep steam treatment of the soil (to a depth of more than 10 cm) should only be allowed under exceptional circumstances (e.g. severe infestation with nematodes), which must be documented by the grower, and should require special permission from the competent authority or the control body. Steam sterilisation of growing media should not be allowed.

- c) *Use of natural enemies ('beneficials')*: In the Group's opinion, the use of beneficials is in line with the objectives, criteria and principles of organic farming and should not be restricted. The Group sees no need for specific legislation in this area.
- d) *Plant protection*: In the Group's opinion, the same substances should be authorized for plant protection in organic greenhouse as in outdoor organic production (Annex II of the Reg. (EC) 889/2008). The Group sees no need for specific legislation in this area.
- e) *Cleaning and disinfection*: In the Group's opinion, the list for cleaning and disinfection materials should not only be developed solely for greenhouse production but also for plant production in general. This is already addressed in Art. 12(1)(j) and Art. 16(1)(f) of Reg. (EC) 834/2007. In addition the Group recommends that Annex VII of the Reg. (EC) 889/2008 should be reviewed as a whole as part of this process. The aim should be a 'basic toolbox' of substances, which can be used for disinfection and/or decalcification in all situations. If necessary, this should be complemented with a list of substances which are authorized only for specific purposes. Other components of commercial cleaners and disinfectants ('additives') should not be restricted at the moment. The evaluation should include all substances currently listed in Annex VII of the Reg. (EC) 889/2008, substances for which a request for inclusion is pending, and the substances listed above as candidates for use in plant production. The effects and implications of transversal legislation should be taken into account when this matter is addressed.
- 3. Mulching**: Mulching is in line with the objectives, criteria and principles of organic farming and it is the Group's opinion that the following materials should be authorized. Non-biodegradable mulching sheets should be allowed in organic farming and they should be reused or recycled after use as far as possible. Biodegradable mulching materials should be allowed, as long as all components of them comply with the Reg. (EC) 889/2008 for fertilisation and soil conditioning. This implies that starch based sheets based on starch derived from GM crops (maize, potatoes etc.) are not allowed (see Reg. (EC) 834/2007, Art. 4).
- 4. Irrigation and drainage system (water use, rain water, desalinisation, recycling of water and nutrients)**: The Group acknowledges that efficient water use and/or water recycling are important issues for organic farming, but it is not a specific issue of greenhouse cropping. The Group recommends the development of guidance for responsible water use including rain water collection systems in organic farming as a whole (to include greenhouse cropping, outdoor cropping, animal husbandry and processing).
- 5. Control of light, temperature and use of energy**:
- a) *Energy use*: In organic greenhouse production, as in other organic systems, as little energy as possible should be used. For that, awareness of responsible energy use among the operators is needed.
- b) *Light*: In the Group's opinion, the provision of artificial light is in line with the objectives and principles of organic farming, if the normal daylight is insufficient for the normal growing of crops. It should only be allowed on dark, overcast days and for extending the daylight period, and only during autumn, winter and early spring. However, the intensity of artificial light used in overcast or short days should not exceed the Photosynthetically Active Radiation (PAR) of the country during a summer day (21<sup>st</sup> of June) and the number of hours should not exceed 12 hours of daylight including artificial light.

Artificial light should also be allowed for the production of seedlings and herbs in pots, for the forcing of herbs, and for photoperiodical induction of flowering.

- c) *Temperature*: Greenhouses vary greatly in the extent to which they are heated, and with respect to the energy source used for heating. Due to the great variation in climate, it is not adequate to apply the same criteria to heating for greenhouse cropping in different regions of the EU. As stated above for energy in general, greenhouse operators should be aware of the issue of energy use, and they should make efforts to minimize energy consumption and/or maximize the use of energy from renewable sources. For details, see discussion on energy use in general (Section 3.7.1).

**6. Carbon dioxide (source, rebalancing and enrichment):** The group accepts the practice of CO<sub>2</sub> enrichment, but is concerned about the widespread tendency of burning fossil fuels in summer for the main purpose of obtaining CO<sub>2</sub>. Operators should minimize the loss of CO<sub>2</sub> to the environment through responsible energy management in the greenhouses. It may be a problem to produce CO<sub>2</sub> for CO<sub>2</sub> balancing/enrichment in greenhouses using renewable energy sources like windmills, hydropower plants or sun power panels without CO<sub>2</sub> production or common biogas plants situated a distance away. Research is needed to find the most energy and production efficient alternatives for CO<sub>2</sub> enrichment based on burning of fossil fuels. Fossil fuel burning with the main purpose of CO<sub>2</sub> enrichment of greenhouses should not be allowed. CO<sub>2</sub> enrichment should not discourage energy saving and the use of alternative renewable energy sources. CO<sub>2</sub> should preferably be used from processing or burning of biomass sources. In the long run it is recommended that only biomass sources are used for CO<sub>2</sub> rebalancing/enrichment.

## 7. Growing media:

- a) *Growing media composition*: As regards the composition of growing media, it is the Group's opinion that the use of all materials listed in Annex I (including peat) is in line with the objectives, criteria and principles of organic farming. The Group recommends that soil from certified organic areas of organic farms may be used for mixing into substrates (e.g. in plant nurseries), for use on the farm itself. Annex I of the Reg. (EC) 889/2008 should be amended as follows: (I) To the listing of peat, the following restriction should be added: 'maximum 80 % by volume of growing media'. (II) The listing of 'stone meal and clays' should be amended as follows: 'stone meal (including sand) and clays'.
- b) *Authorisation of growing plants in substrates*: The Group recommends that growing in substrates is accepted for seedlings and transplants, and for plants which are sold to the consumer together with the pot/container in which they grow (e.g. herbs in pots, ornamentals), while harvested organic vegetables or fruits (e.g. strawberries) should come from plants grown in the soil, and not from substrate cultures. However, the Group makes an exception for the growing of vegetables in growing media in demarcated beds in the future for farms which grew such cultures before 2013 in Finland, Sweden, Norway and Denmark, on the condition that the growing media and plastic is recycled. In fact the Group recommends that any excess or spent growing media or plastic used in organic greenhouse production and farming in general should be reused or recycled. As regards plants, fungi and algae which naturally do not grow in the soil, e.g. water plants (e.g. water cress), some mushroom species and sprouts, the Group recommends that the production of such organisms should be authorized.

---

c) Recycling of growing media: Under the conditions proposed in Section 3.9.1, growing media are either transferred to the field together with the transplant, or they are sold together with potted plants. Under such conditions, growing media cannot be recycled. Otherwise, the Group recommends that excess growing media from potting, unsold potted plants or growing media used in demarcated beds should be recycled.

**8. Conversion period for greenhouse productions:** The Group recommends that the conversion period should be the same for greenhouse cropping in the soil as for outdoor cropping. For greenhouses, where plants are grown in substrate with no contact with the soil, (see Section 3.9.2) no conversion time is required from the technical point of view, if appropriate measures are taken to avoid contamination risks. The Group suggests that conversion periods in general should be reconsidered in the review of the whole Organic Regulation. A shorter conversion period for greenhouse and outdoor crops (possibly 1 year) could be considered as recommended by the FP6 project on revision of the Reg. EC 2092/91.



## 1. BACKGROUND

The general rules and principles for organic plant production contained in the EU regulation applies also to production systems in greenhouses, or more generally, under cover.

There are no specific rules on organic production for such particular production systems. This may result in differences in the practices used and allowed at MS level, some of which could be based on differences in climate. On the other hand, there is a need to follow the basic principles of organic farming, such as contributing to and maintaining biological diversity and to make responsible use of energy and other resources, such as water, soil, organic matter and air (see Art. 3 of Council Regulation (EC) No 834/2007).

This issue was discussed in the Standing Committee on Organic Farming (SCOF) in 2008 and 2009. Horticulture in greenhouses is one of the subjects identified for further work by the Commission in its declaration to the 75<sup>th</sup> meeting of the SCOF. This mandate is the first step towards a discussion with the Member States and the possible elaboration of specific rules on protected cropping.

The results from the EGTOP Final Report on fertilizers and soil conditioners EGTOP/2/2011 concerning the use of carbon dioxide should also be taken into account and followed up.

## 2. TERMS OF REFERENCE

In the light of the most recent technical and scientific information available to the experts, the Group is requested to elaborate a draft organic standard including the following issues:

### *a) General*

- Definition of (1) protected cropping, (2) greenhouse and (3) under cover
- Definition of vegetative materials, seedling
- Considering the basic principles of organic production, which existing production practices are difficult to fulfil in greenhouses and/or protected cropping?
- Conversion practice: for existing greenhouses, would it be necessary to consider another (other than 2 years) conversion period? If yes, what would be a reasonable period of conversion and why?

### *b) Growing media and planting material*

- Use of substances of Annex I, use of peat in pots and bags.
- As seedlings may be produced in pot with an appropriate growing medium, which growing media should be allowed to be used in such plant nursery activities?
- As tomatoes, cucumber, lettuce and herbs, or other horticultural products may be grown in plastic bags/containers with growing media, should such plants be grown in bags/containers with an appropriate growing medium be considered as organic under the principles of organic production regulation?
- Recycling of growing media
- Nutrient management (including how to limit leaching of nutrients, nutrient supply from the soil/growing media system. Is there a need for nitrogen norms for specific crops?)

**c) Optimization of soil fertility management**

- How to implement the more common organic farming practices for building and maintaining soil fertility management (i.e. crop rotation, green manuring, farm yard manure and organic amendments application)?

**d) Optimization of soil and crop health**

- Which principles/techniques could be set up to deal with crop pests (e.g. insects, nematodes) i.e. steam sterilization, biological control, traps, etc.
- Which principles/techniques could be set up to deal with soil and crop diseases (e.g. virus, bacteria and fungi) i.e. use of crop rotation, steam sterilization etc.)
- Biodegradable mulch: classification, purpose of mulch (plant production technique and/or fertilization and soil conditioning)

**e) Energy use**

Which renewable energy sources could be used for making heating and lighting more environmental friendly.

Best practice to reduce overall energy input in greenhouse production.

**f) CO<sub>2</sub>**

- Best practices for reducing GHE and improving Carbon footprints of greenhouse production
- CO<sub>2</sub> rebalancing and CO<sub>2</sub> enrichment
- CO<sub>2</sub> origin and organic farming principles

**g) Water use (including the possible use of rain water, desalinisation) and effluents**

Requirements as regards max leaching of nutrients, recycling of water, etc.

**h) Products for cleaning and disinfection**

In preparing its final report the Group may examine technical documents delivered from MS and made available by the Commission. In dealing with the various topics the group should not only refer to the questions/points made under the main issues (e.g. growing media) but to elaborate them in a wider sense. The Group may also explain and suggest further issues.

## 3. CONSIDERATIONS AND CONCLUSIONS

### 3.1. Introduction

This report discusses organic production in greenhouses but does not discuss organic production under cover (for a definition of ‘greenhouse’ and ‘under cover’, see Chapter 3.2). It is important to note that the majority of organic greenhouse crops are grown in soil. The report also discusses the production of crops in horticultural substrates. Substrate culture does not only take place in greenhouses but also outdoors in plant nurseries.

Organic greenhouse cropping must respect the principles and rules of organic production specified in Reg. (EC) 834/2007<sup>1</sup> and (EC) 889/2008<sup>2</sup>. However, due to the specialized nature of the production, the Group proposes some specific production rules for organic greenhouses. By contrast, the Group considers that there should not be specific production rules for cropping under cover, as these crops should be produced according to the rules for outdoor crops. Separate production rules are especially needed to ensure responsible use of energy, water, soil and organic matter. In the Group’s opinion, it is important that organic greenhouse production has an outstanding performance in these areas as they are important aspects of sustainability, and are also declared objectives of organic farming (Art. 3(a)(iii) of Reg. (EC) 834/2007).

At present, the EU regulation on organic farming contains no rules for greenhouse cropping, apart from a ban on hydroponic production. Therefore, considerable differences in practices among the various EU member states exist. The most important differences relate to energy use and to the use of substrates. Mushroom culture is also a form of protected cropping and specific though very limited production rules already exist (Art. 6 of Reg. (EC) 889/2008). Mushroom production is therefore not discussed in detail in this report.

#### 3.1.1. *Greenhouse production: a highly controlled form of agriculture*

In general, greenhouses are environments which can be controlled to a much higher degree than outdoor fields. Temperature, light, air humidity, water supply and carbon dioxide in the air can be regulated by the grower. In some modern greenhouses, even the access of pests and pathogens can be restricted or prevented. There is also soilless production, either in substrates of organic or inorganic materials or as hydroponics, but the inorganic growing media and hydroponics are not allowed in organic cropping.

#### 3.1.2. *Socio-economic importance of greenhouse production*

Agriculture in the European Union faces some serious challenges in the coming decades that include: competition for water, resources, rising costs, decrease in agricultural productivity growth, competition for international markets, changes in climate and uncertainties in the effectiveness of the current European policies as regards adaptation strategies. Greenhouse production has the potential to present an alternative approach to some of the upcoming challenges. In 2009, the area dedicated to global greenhouse production was about 800 000 ha,

---

<sup>1</sup> Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91.(O.J. EU L 189 , 20/07/2007, p. 1.)

<sup>2</sup> Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control, OJ L 250, 18.9.2008, p. 1–84

of which 20% (160 000 ha) was situated in Europe. This production system is characterized by the ability to change climatic conditions using a diversity of technologies and practices for greenhouse vegetable production.

Greenhouse production extends the growing season for crop production and allows production in regions where outdoor cropping is not normally possible. While this is not entirely consistent with Art. 3(a)(i) of Reg. 834/2007 (*'respect nature's systems and cycles'*), greenhouse production is an accepted part of organic farming. Greenhouse vegetables such as tomatoes, cucumbers, peppers, aubergines and many more have become important components of the European diet. Retailers depend on supply with low fluctuations, and consumers expect year-round availability. Greenhouse production can also provide good quality transplants for open field agriculture early in the season. Vegetables, herbs, ornamentals and transplants are the main greenhouse crops. Greenhouse production is more labour intensive and much more capital intensive than outdoor cropping and represents an important source of income for many specialised farmers throughout Europe.

### 3.1.3. *Concerns over highly intensive production*

The group noted that some organic greenhouse production systems are very intensive. Intensification is a general trend in agriculture, but it is much more pronounced in greenhouses. It is characterized by high yields, but also by high use of resources such as nutrients, light, heating, carbon dioxide and other external inputs such as plastic mulches, containers, packaging materials etc. Excessive increases in production intensity threaten the sustainability of greenhouse production, and this is also true for some organic greenhouse productions. The Group is therefore concerned about this trend and recommends a more efficient use of external inputs to maintain the public trust in the sustainability of organic greenhouse production. Organic greenhouse production should be consistent with the organic principles.

## 3.2. Definitions

### 3.2.1. *Definition of 'greenhouse', 'under cover' and 'protected cropping'*

The Group made a distinction between permanently and temporarily covered crops (see Figure 1). In the Group's opinion, separate production rules should only apply for permanently covered crops. The terms 'greenhouse', 'under cover' and 'protected cropping', are not always used in the same way across Europe. To clarify what is meant in this report, the Group gives definitions below. However, it is acknowledged that different definitions may be used in other contexts.

<b>'protected cropping'</b>		
<b>'greenhouse'</b> greenhouses and plastic tunnels	<b>'under cover'</b> plastic sheets, plastic foil, fleece, netting, etc.	<b>'mushroom culture'</b>

**Figure 1** Relationship between the terms 'greenhouse', 'under cover', 'mushroom culture' and 'protected cropping'. In the Group's opinion, separate organic production rules should only be applied for greenhouses.

### *3.2.1.1. Definition of 'greenhouse'*

In this report, the Group uses the following definition of 'greenhouse': "*all permanent structures, with or without heating, covered by glass or plastic or other material that lets daylight through, in which crops, transplants or ornamentals are cultivated, are considered as 'greenhouses'*" (definition adapted from Tun, 2012).

The Group noted that a slightly different definition is given in Art. 3(27) of Reg. (EC) 1107/2009 concerning the placing of plant protection products on the market: "*'greenhouse' means a walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products into the environment. For the purpose of this Regulation, closed places of plant production where the outer shell is not translucent (for example, for production of mushrooms or witloof) are also considered as greenhouses*".

The Group considers that the first definition is more adequate in the context of the Organic Regulation and the mandate.

### *3.2.1.2. Definition of 'under cover'*

Under cover means the temporary covering of plants using low tunnels or flat layer of plastic film, fleece, nets etc. This is done mainly to accelerate crop growth, prolong the growing season or protect crops from weather or pests.

### *3.2.1.3. Definition of 'protected cropping'*

Protected cropping is the most general expression and includes both greenhouse and under cover as defined above, as well as mushroom culture. 'Protected cropping' should not be confused with 'crop protection' (the protection of crops against pests, diseases and weeds).

## **3.2.2. Definition of 'seedling', 'vegetative material' and 'transplant'**

### *3.2.2.1. Definition of 'seedling'*

According to the botanical definition, a seedling is a young plant that is generated from seed. 'Seedling' covers transplants (e.g. cabbage) as well as young stages of field crops grown from seed (e.g. wheat).

### *3.2.2.2. Definition of 'transplant'*

Transplant is a seedling or sprouted vegetative propagation material grown in a substrate or in the field, for transfer to the final cropping site.

### *3.2.2.3. Definition of 'vegetative materials'*

Vegetative propagation materials (propagules) are parts of plants taken for propagation, e.g. a tuber (potatoes), a bulb (onion), a part of a root, a section of stem (fruit tree cuttings) or a leaf or meristem culture (tissue cultivation in the laboratory) is also a form of vegetative propagation.

### **3.2.3. Definition of ‘growing medium’, ‘soil conditioner’/ ‘soil improver’ and ‘peat’**

#### **3.2.3.1. Definition of ‘growing medium’**

Growing media are materials, other than soils *in situ*, in which plants are grown (CEN 223: Technical Committee on Soil Improvers and Growing Media). Another expression for ‘growing medium’ is ‘horticultural substrate’.

#### **3.2.3.2. Definition of ‘soil conditioner’ /‘soil improver’**

The CEN 223 Technical Committee on Soil Improvers and Growing Media has defined soil improvers as materials, which may be added to the soil *in situ* - primarily to maintain or improve its physical properties, and which may improve its chemical and/or biological properties or activities (CR 13456:1999, Soil Improvers and growing media - Labelling, Specifications and Product Schedule). In the present Reg. (EC) 834/2007 and 889/2008 ‘soil conditioner’ is used instead of ‘soil improver’. However, for the sake of harmonisation of definitions and expressions in European standards and legislation the Group recommends that the wording ‘soil improver’ is introduced instead as part of the on-going revision of the EU Organic regulations.

#### **3.2.3.3. Definition of peat**

Peat is a heterogeneous mixture of more or less decomposed plant material, especially of the genus *Sphagnum* (the so-called peat mosses) that has accumulated in a water saturated environment in the absence of oxygen slowing the rate of decomposition (IPS website<sup>3</sup> Parish et al., (2008)). Peat is an important component of growing media. For a detailed discussion, see Annex 1 to this report.

#### **3.2.3.4. Definition of mulch**

Mulches are protective coverings, which are placed on the soil around plants to protect them from negative environmental influences. For a detailed discussion, see Section 3.5.

## **3.3. Nutrient and soil fertility management**

### **3.3.1. Sources of nutrient supply**

#### **3.3.1.1. How to implement soil fertility in protected cropping**

In general, the same rules (regarding fertilisation, crop rotation etc.) apply as for general plant production, and as laid down in Art. 5(a) and 5(f) and 12(1)(b) of Reg. (EC) 834/2007 and Art. 3(1) of Reg. (EC) 889/2008. However, due to the very costly and market-sensitive production in greenhouses, crop rotation may not always be possible (for a detailed discussion, see Section 3.4.1).

---

<sup>3</sup> <http://www.peatsociety.org/peatlands-and-peat/what-peat> (accessed April 2013)

### *3.3.1.2. Supply of nutrients*

Soil fertility and an active soil ecosystem are the basis for plant nutrition in organic systems. The types of fertiliser (a mixture of slowly and easily available N-fertilisers), the application method (in solid or liquid form) and the timing are normally chosen by the farmers to match the availability of the nutrients with the plants' needs. Addition of nutrients by the use of materials listed in Annex I to Reg. (EC) 889/2008 is permitted, but fertilisers based on sources from operations managed in accordance with the organic regulation, should be preferred. The Group underlines the importance of slow release fertilizers like compost, solid manure, etc., which should provide the majority of the nutrient input. A higher minimum percentage for slow release organic nutrient sources could be specified, but further research is needed to determine what this limit should be.

Since the rate of mineralisation of stabilised organic material such as compost and animal manure is not easily predictable and N availability is not always synchronised with the needs of the plants, the Group recommends that nutrient balances should be calculated for each greenhouse crop to determine the need for soluble nutrient input supplements. An input-output balance of the nutrients (in particular N, P and K) in the rotation is an important way to reduce the risk of over-fertilisation and salinization of the soil. It is difficult to calculate all nutrient inputs and removals, but a practical solution would be to estimate either annually or for individual crops the output based on the N, P, K nutrient content of harvested crops on the basis of expected yields, while input shall be calculated on the basis of the total amount of the nutrients applied. A more accurate assessment would include consideration of residual values from previous nutrient applications and the nutrients removed as crop residues. Due to the high diversity of organic greenhouse production systems all over Europe, the Group does not recommend or support any specific fertilisation "recipe".

### *3.3.1.3. Conclusions and recommendations*

In the Group's opinion, greenhouse crops should be fertilised primarily from slow release organic fertiliser materials like compost and animal manures, preferably coming from operations managed in accordance with the organic regulation, but otherwise by means of materials from Annex I to the Reg. 889/2008. The use of supplementary soluble nutrients (especially N) should be justified by the calculation of total nutrient balances as described in Section 3.3.1.2.

## **3.3.2. Leaching of nutrients and salinisation**

### *3.3.2.1. Introduction of limits /nutrient balance documentation*

The leaching of nitrate and other soluble plant nutrients should not be a major problem providing irrigation and fertilisation are managed accurately and are targeted at the needs of the crops. Leaching can occur if excess water is applied to nutrient rich soils.

Indeed, nitrate leaching occurs in case of wrong fertilisation or irrigation. Voogt (2011) reported that when the supply of nutrients by organic fertilisers is high, the residual salts content (Na, Cl and SO<sub>4</sub>) supplied with them may overcome the uptake capacity of the crop. In this case, the main practice used to reduce the problem of soil salinity is over-irrigation (i.e. to flush out the nutrients (with the risk of nitrate leaching and environmental pollution)). An alternative option more consistent with the organic principles would be the use of catch crops with removal of the vegetation for composting or mulching.

### 3.3.2.2. *Conclusions and recommendations*

The risk of nutrient leaching depends mainly on the type and amount of fertilisers used as well as on the irrigation management. The use of irrigation to flush surplus nutrients is not an acceptable practice consistent with the organic principles.

When choosing the quantity and type of fertilisers, the nutrient balances must be taken into consideration as described in Section 3.3.1.2 to avoid salinisation or leaching of nutrients. If problems do occur, solutions consistent with the organic principles should be used.

## 3.4. Management of soil and crop health

The rules for general plant production apply (Art. 12(g)) of Reg. (EC) 834/2007: “*The prevention of damage caused by pests, diseases and weeds shall rely primarily on the protection by natural enemies, the choice of species and varieties, crop rotation, cultivation techniques and thermal processes*”.

### 3.4.1. *Preventive methods, including crop rotation*

#### 3.4.1.1. *Preventive methods in general*

The maintenance of plant health by preventive measures is a principle of organic farming. It is equally important in greenhouse crops as in outdoor crops. The main tools for pest and disease prevention are choice of varieties, grafting on to resistant rootstock, crop cultivation techniques and the management of greenhouse ambient conditions (e.g. air humidity), the encouragement of soil-borne pathogen suppression through the use of biologically active compost and other organic materials. The need for soil sterilisation is greatly reduced by all of the above mentioned practices.

#### 3.4.1.2. *Crop rotation*

Art. 5(f) of Reg. (EC) 834/2007 requires that plant health is maintained by preventive measures such as appropriate crop rotations. In the context of plant nutrition, the inclusion of legumes and green manures in crop rotations is explicitly mentioned in Art. 12(b) of Reg. (EC) 834/2007. According to the Group, it seems that these requirements are derived from arable cropping, but they are inadequate for other cropping systems such as permanent crops, pastures, mushroom cultures and greenhouses. The Group recommends that these requirements are adapted to the specific conditions of each growing system, encouraging plant diversity in space as well as time, during the revision of the Organic Regulation.

In greenhouses, it is more difficult to implement crop rotation than in arable production. Most of the crops belong to 3 plant families: Solanaceae (tomato, pepper, aubergine), Cucurbitaceae (cucumber, melon, courgette) and Asteraceae (a wide range of lettuce). Thus, greenhouse rotations are simpler than arable rotations. Although they have some advantage, they will not always be sufficient for controlling pests and diseases. The use of annual legumes and green manure crops, which are an important element of arable crop rotations and which are explicitly mentioned in Art. 12(b) of Reg. (EC) 834/2007, usually cannot be grown in greenhouses for economic reasons, but shorter term green manure crops including legumes can be grown.



### 3.4.1.3. *Conclusions and recommendations*

In the Group's opinion, wider use of crop rotations in greenhouses would be desirable, but this is difficult for the reasons described in section 3.4.1.2. The Group recommends that greenhouse growers use plant diversity (diversity in space as well as in time), including short term green manure crops and legumes, to assure consistency with the underlying principles of Reg. (EC) 834/2007, article 5(f) and 12(b).

## 3.4.2. *Control of soil-borne pests and diseases*

### 3.4.2.1. *Steam-sterilisation of soil*

Thermal processes are allowed for crop protection against pests, diseases and weeds according to Art. 12(g) of Reg. (EC) 834/2007. However, this may be in contradiction with Art. 12(1)(b) of Reg. (EC) 834/2007, which requires maintenance of the biological activity of soils. In outdoor crops the build-up of soil-borne pests and diseases is prevented mainly by means of crop rotations. This can be difficult in greenhouse cropping as discussed above. Therefore, soil sterilisation may sometimes be considered to be necessary. The pesticides used for soil fumigation in conventional farming are all synthetic and prohibited in organic farming. Steam sterilisation is the main method used for sterilisation of the soil in organic farming. It is mainly used in greenhouses, but is also used outdoors in some Member States.

The Group distinguishes between deep and shallow steam sterilisation. In *deep sterilisation*, the hot steam penetrates to a depth of more than 10 cm, and up to 70 cm. Deep steam sterilisation is effective in combatting severe pests and diseases (e.g. persistent soil-borne fungal or bacterial diseases or nematodes). In *shallow sterilisation*, the hot steam penetrates the soil to a maximum depth of 10 cm. Shallow sterilisation has a short-term effect only, and soil life regenerates a few days after treatment. It is mainly effective against weeds. The Group considers shallow steam treatment as a method of thermal weed control (as the Group interprets the Art. 12(g) of Reg. (EC) 834/2007).

The main arguments in favour of steam sterilisation are that physical methods are authorized in organic farming, and that it leaves no residues in the soil and in the crops. The main criticisms of deep steam sterilisation are that it uses a lot of energy, and that it kills all soil life, not just the pathogens. Shallow steam sterilisation uses considerably less energy than deep steam sterilisation, and its effect on soil life is only transitory.

### 3.4.2.2. *Steam sterilisation of growing media*

Steam sterilisation is sometimes also used for disinfection of used growing media for seedlings and transplants for recycling into new growing medium. The Group underlines that steaming of used growing medium does not only kill weeds and pathogens, but also beneficial micro-organisms, which may be responsible for suppression of some soil borne diseases (Avilés *et al.*, 2011).

### 3.4.2.3. *Other methods / alternatives for maintaining soil health*

#### *Compost suppressiveness*

Suppressive composts similar to suppressive soils are examples of natural biological control of disease as the result of a more or less complex three-way interaction between microorganisms in the composts, plant pathogens and plants. The roles of the physical properties and chemical composition of composts are also important in the suppressive effect, not only because they are responsible for the type and quantity of the microorganisms established but also because of their effect on pathogens, plant root health and leaf nutrient status. Two classic modes of action of microorganisms involved in the suppression of soil-borne plant pathogens can be defined in composts (general and specific suppression). In specific suppression only one or a few species are involved, while in contrast, a great diversity of microorganisms contributes to general suppression. A third mode of action may also be induced by microorganisms in composts: systemic resistance similar to challenge inoculation with a pathogen or beneficial organism (Avilés *et al.*, 2011).

#### *Biofumigation*

In ‘biofumigation’, plants from the mustard family (*Brassicaceae*) are grown on a field, then mulched and incorporated into the soil. When the green material breaks down, toxic substances are released and these are responsible for the fumigant effect. There are varieties which were specifically bred for the purpose of biofumigation, and it has been used with some success in outdoor crops (Michel, 2008). In addition to *Brassicaceae* residues, other organic materials have been demonstrated to be producers of biofumigant compounds. Such organic materials are: animal manures, compost, agroindustrial residues etc. (Ros *et al.*, 2008; Nuñez – Zofio *et al.*, 2011). Another method involves the incorporation of organic materials (in some cases wheat flour), followed by sealing with airtight plastic. This leads to anaerobic conditions in the soil, and may kill unwanted pathogens within a few weeks (e.g. Ludeking *et al.*, 2010).

#### *Solarisation*

A further method is ‘solarisation’. The soil is watered thoroughly, after which it is covered with translucent plastic for 4 – 6 weeks during a hot period. The top 15 cm of soil will heat up to approximately 40 - 45°C (strongly dependent on weather and season), which controls many weeds, plant pathogens, nematodes and insect pests (Elmore *et al.*, 1997, Ros *et al.*, 2008). Solarisation tends to be found only in the Mediterranean countries where the climate is sufficiently hot for the method to be effective. Combinations of these methods may also be used.

### 3.4.2.4. *Conclusions and recommendations*

In the Group’s opinion, soil health should be maintained primarily by means of preventive methods including practices such as rotation and other forms of plant diversity and the addition of biologically active compost and other organic materials to suppress plant pathogens. ‘Biofumigation’, solarisation and shallow steam treatment of the soil (to a maximum depth of 10 cm) are also in line with the objectives, criteria and principles of organic farming and should be authorized.

Deep steam treatment of the soil (to a depth of more than 10 cm) should only be allowed under exceptional circumstances (e.g. severe infestation with nematodes), which must be documented by the grower, and should require special permission from the competent authority or the control body. Steam sterilisation of growing media should not be allowed.

### 3.4.3. Use of natural enemies ('beneficials')

The term 'beneficials' is a synonym for natural enemies of crop pests. It includes various animal taxa such as insects, mites and nematodes, but it does not include micro-organisms such as fungi, bacteria or viruses, which are covered by Annex II of the Reg. (EC) 889/2008. Beneficials play an important role in the regulation of pest populations. Outdoors, beneficials are naturally present to some extent, but their numbers can be increased by passive biological control approaches including the provision of natural habitats (refuges), fields or orchard understoreys with a high plant diversity, green fallows and structures such as 'beetle banks'. To some extent this approach can be replicated in greenhouses by the inclusion of flowering plants between the crop plants or just outside the greenhouse if the beneficial insects can access the crops through ventilation openings. Active control measures involve the deliberate release of beneficial organisms, e.g. parasitic wasps (*Trichogramma brassicae*) in maize against the corn borer. In greenhouses, release of mass-reared beneficials is much more important. The major beneficials used are ladybirds (Coccinellidae), lacewings (*Neuroptera*), gall midges (Cecidomyiidae), predatory bugs (Heteroptera) and parasitic wasps (Ichneumonidae), as well as predatory mites and parasitic nematodes. Some beneficials need to be released regularly, while others survive for more or less prolonged times or establish permanent populations. In some cases habitat enhancement can support the survival of deliberately released beneficials.

#### 3.4.3.1. Current authorisation of beneficials in organic farming

Beneficials are not listed in Annex II, because they are not considered as plant protection products by EU legislation (in contrast to the legislation of some Member States). However, 'natural enemies' are explicitly mentioned in Art. 12(1)(g) of Reg. (EC) 834/2007, and thus allowed.

#### 3.4.3.2. Reflections of the Group

The use of beneficials is one of the most preferable methods of pest control in organic farming. In comparison with insecticides, the practice has very few negative side-effects on the environment, is harmless for the operator and leaves no residues on the harvest. In the past, beneficials have sometimes been introduced into new habitats without proper testing of their biology. In some cases, they established and multiplied uncontrollably, thus threatening the native fauna. One such example is the 'Japanese ladybird' *Harmonia axyridis*, which was introduced into Europe and North America at the end of the 20<sup>th</sup> century, where it now outcompetes native ladybirds. Such premature releases of non-native beneficials are undesirable and must be avoided. However, this must be achieved through general legislation and not through the Organic Regulation, because beneficials are also widely used in conventional greenhouses.

#### 3.4.3.3. Conclusions and recommendations

In the Group's opinion, the use of beneficials is in line with the objectives, criteria and principles of organic farming and should not be restricted. The Group sees no need for specific legislation in this area.

#### ***3.4.4. Plant protection (Annex II of the Reg. (EC) 889/2008)***

In the Group's opinion, the same substances should be authorized for plant protection in organic greenhouse as in outdoor organic production (Annex II of the Reg. (EC) 889/2008). The Group sees no need for specific legislation in this area.

#### ***3.4.5. Cleaning and disinfection (Annex VII of the Reg. (EC) 889/2008)***

Cleaning and disinfection are important in plant production in general, and not only in greenhouses. In greenhouse cropping, disinfectants are sometimes applied to the greenhouse itself (structure, glass and plastic covers), to the greenhouse installations (benches, tables etc.), the greenhouse equipment (trays, containers, pots etc.) the tools (knives, scissors etc.), the irrigation system and/or the irrigation water. Disinfection is also important in mushroom culture and has similar applications. In outdoor crops, disinfection is important only under specific conditions. For example, in areas where fire blight occurs, tools must be disinfected regularly while pruning apple trees, otherwise the disease may be spread from one infected tree to the whole orchard. Facilities, installations, equipment and tools used in the storage and/or transport of foods have to be disinfected regularly. Disinfection of hands/gloves and boots can also be important.

Note: soil sterilisation, which is sometimes also called 'soil disinfection', is discussed in Section 3.4.2.

##### ***3.4.5.1. Need for sanitation***

Sanitation is one of the most important methods for preventive crop health management. Sanitation encompasses tidying up of materials, removal of weeds, brushing, cleaning and disinfection. It is important to thoroughly clean before disinfection, as dirt and other residues can significantly reduce the effectiveness of disinfectants leading to excess use of the products and incomplete disinfection in some cases. Sanitation can sometimes be achieved with thorough cleaning with water alone but often the use of chemical disinfectants is necessary. Cleaning, decalcification and disinfection involve the use of chemicals. They are often performed in one step, and there are many combined products on the market which serve two or three of these purposes at the same time.

##### ***3.4.5.2. Physical methods for disinfection***

UV light and heat (e.g. steam) are effective disinfectants. They can be used to disinfect some types of equipment, but there are practical limitations. UV light acts only on surfaces, where it has direct access to pathogens, and does not penetrate into gaps or scratches. For reasons of worker safety, it can only be used in closed cabinets. This greatly limits its application in greenhouses (see also the EGTOP report 3/2011 on plant protection products). Heat can be used for autoclaving equipment, but not all materials are heat tolerant.

The use of physical methods is preferred in organic farming (see Art. 12(1)(g) of Reg. (EC) 834/2007). In the Group's opinion, the use of such methods should be encouraged where it is possible and practical. Where physical methods cannot be used, chemical disinfectants are a necessary alternative (see Section 3.4.5.3).

### *3.4.5.3. Chemical disinfectants*

Disinfectants can have a complex composition. On one hand, they contain one or several ‘active substances’, which are responsible for killing the target organism. On the other hand, they usually contain a number of ‘additives’, which serve a wide range of purposes and are individually tailored to the uses of a given commercial product. Typical functions of additives are: improvement of surface wetting and penetration of porous objects (surfactants), decalcification, prolongation of shelf life (stabilizers, mainly necessary for hydrogen peroxide).

In the Group’s opinion, only authorized active substances and decalcifiers should be used in organic farming. Other components (including surfactants) are important to ensure good effectiveness of disinfection with minimal quantities of disinfectants. As very specific components may be necessary to achieve this effect in certain situations, there should be no restrictions on such components at the moment. However, the Group strongly recommends the use of substances which degrade rapidly and completely, and leave no residues.

The main targets of disinfection are fungi, bacteria, viruses and algae. Most disinfectants discussed here have a broad activity against these organisms. The choice of disinfectant therefore does not depend much on its species-specific activity, but mainly depends on whether the object to be treated tolerates the disinfectant.

### *3.4.5.4. Authorisation of disinfectants under biocide legislation*

The use of disinfectants falls under the scope of biocide legislation (currently Directive 98/8/EC<sup>4</sup>, from 1 September 2013 Regulation (EC) 528/2012<sup>5</sup>). Active substances must be approved at the EU level, while commercial disinfectants are regulated at Member State level. Decalcifiers and additives are not considered as active substances under the biocide legislation.

Note: Use of disinfectants on seeds or vegetative material falls under plant protection product (rather than biocide) legislation, and such products are recommended by the Group to be included in Annex II rather than Annex VII of Reg. (EC) 889/2008. For example, see the use of sodium hypochlorite on seeds, discussed in the EGTOP report 3/2011 on plant protection products.

### *3.4.5.5. Authorisation of products for cleaning and disinfection in crop production*

When Reg. (EC) 834/2007 was adopted, a clear intention to regulate the use of disinfectants in crop production was expressed in its Art. 12(1)(j). Until now, however, no disinfectants have been authorized for this purpose at the EU level. Some Member States (e.g. Austria) have filled this gap with national legislation. In most countries, however, there is no such legislation and certifiers tolerate the use of disinfectants without authorisation, although they may require the use to be recorded. In practice, hydrogen peroxide, peracetic acid and other organic acids, potassium soap and alcohol are used most frequently in organic greenhouses. These substances are authorized for disinfection of buildings used for livestock production (Annex VII (1) of the Reg. (EC) 889/2008). A number of other substances are also used including surfactants, ozone

---

<sup>4</sup> Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market (OJ L 123, 24.4.1998, p. 1)

<sup>5</sup> Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products (O.J. EU L 167, 20/07/2012, p. 1.)

(authorized as disinfectant in aquaculture) and benzoic acid. None of these substances are currently authorized for the disinfection of buildings or installations used for livestock production or aquaculture according to the EU Organic Regulation.

As soon as one disinfectant for plant production is listed in Annex VII of the Reg. (EC) 889/2008, all other disinfectants will be unavailable for further use. It is therefore important to authorize a set of disinfectants simultaneously which is sufficient to cover the full range of sanitation requirements in organic plant production.

In an earlier report (EGTOP report 5/2012 on organic food), the Group proposed a ‘basic tool box’ approach, whereby some highly acceptable substances are generally authorized for all current and potential future uses, while the less acceptable substances are authorized only for restricted uses. The Group suggests that a similar approach is implemented for disinfectants. This report proposes a list of candidate substances for disinfection of greenhouses. Their final evaluation should be carried out in conjunction with candidates for disinfection in outdoor plant production, and with new substances proposed for aquaculture and stables.

#### *3.4.5.6. Candidate substances for disinfection in organic crop production*

The Group identified the following candidate substances for a final evaluation for a ‘basic disinfection toolbox’ (authorisation without restrictions):

- Alcohols: ethanol
- Organic acids: acetic acid, citric acid
- Peroxides: hydrogen peroxide, peracetic acid
- Ozone

The Group identified the following candidate substances for a final evaluation for restricted authorisation:

- Alcohols: isopropanol
- Organic acids: benzoic acid
- Peroxides: sodium carbonate peroxyhydrate, sodium and calcium hypochlorite
- Chlorine dioxide

The use of formaldehyde needs to be reviewed as mentioned in the EGTOP report 4/2012 on poultry production, see Section 3.7.

#### *3.4.5.7. Candidate substances for decalcification*

The following organic acids were identified as candidate substances for decalcification: citric, peracetic, formic, lactic, oxalic and acetic acid.

#### *3.4.5.8. Conclusions and recommendations*

In the Group's opinion, the list for cleaning and disinfection materials should not only be developed solely for greenhouse production but also for plant production in general. This is already addressed in Art. 12(1)(j) and Art. 16(1)(f) of Reg. (EC) 834/2007. In addition the Group recommends that Annex VII of the Reg. (EC) 889/2008 should be reviewed as a whole as part of this process. The aim should be a 'basic toolbox' of substances, which can be used for disinfection and/or decalcification in all situations. If necessary, this should be complemented with a list of substances which are authorized only for specific purposes. Other components of commercial cleaners and disinfectants ('additives') should not be restricted at the moment.

The evaluation should include all substances currently listed in Annex VII of the Reg. (EC) 889/2008, substances for which a request for inclusion is pending, and the substances listed above as candidates for use in plant production. The effects and implications of transversal legislation should be taken into account when this matter is addressed.

### **3.5. Mulching**

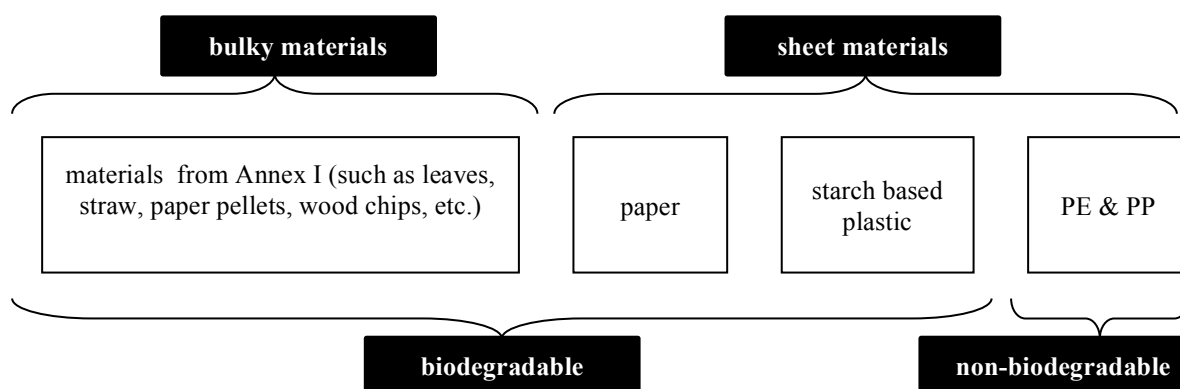
Mulches are protective coverings, which are placed around plants to protect them from negative environmental influences. Mulching is mainly done to regulate weeds, to protect the soil from erosion and from silting up (outdoor crops), to retain soil moisture and to accelerate the warming of the soil (for activation of soil life, to make nutrients more available for plants, and to allow earlier harvesting). Mulches also help to keep crops dry and clean (e.g. strawberry, melons etc.), keep humidity low in the greenhouse atmosphere (prevention of fungal and bacterial diseases), protect crops from soil-borne diseases, and protect roots from freezing (outdoor crops). White mulches are sometimes used in greenhouses to reflect light and thus increase the photosynthesis of crops. The major proportion of mulching materials is used in outdoor production.

#### *3.5.1. Mulching materials*

There are two broad types of mulching materials. Originally, mulches were always bulky materials but today plastic or paper sheets are used for the same purpose and are also called mulches. Bulky materials are organic materials such as leaves, straw, wood chips, compost, animal manures, paper pellets or peat, and they are always biodegradable.

Mulching sheets can be made either from biodegradable or from non-biodegradable materials. Non-biodegradable films are mostly made from polyethylene (PE). They are usually coloured black, but sometimes can be white. Fleece (non-woven polypropylene (PP)) is sometimes described as a 'floating mulch' as it is usually used to cover both crops and soil. Woven PP textiles are extensively used as ground cover in nurseries and are also used in outdoor cropping systems and demarcated beds.

Biodegradable sheets are based on starch (mainly from maize), paper and other materials. After use, these sheets are incorporated into the soil where they decay. This is mainly done to save the work for collection for recycling or dumping, and also reduces the environmental impact of non-biodegradable film use. The amount of nutrients incorporated into the soil together with the biodegradable mulch is minimal.



**Figure 2** Overview over mulching materials. PE=polyethylene; PP=polypropylene.

### 3.5.2. Reflections of the Group

Biodegradable sheets can be allowed, as long as they comply with the normal rules for fertilisation and soil conditioning (Annex I of the Reg. (EC) 889/2008). However, the Group is sceptical concerning the use of starch based plastic sheets, because they contain not only starch or paper, but also other additives (e.g. glues, pigments).

Non-biodegradable sheets can also be allowed. After use, these sheets should be re-used in the next cropping cycle where the quality and strength of the sheets/film permits. Otherwise they should be collected for re-cycling wherever possible.

### 3.5.3. Conclusions and recommendations

Mulching is in line with the objectives, criteria and principles of organic farming and it is the Group's opinion that the following materials should be authorized. Non-biodegradable mulching sheets should be allowed in organic farming and they should be reused or recycled after use as far as possible. Biodegradable mulching materials should be allowed, as long as all components of them comply with the Reg. (EC) 889/2008 for fertilisation and soil conditioning. This implies that starch based sheets based on starch derived from GM crops (maize, potatoes etc.) are not allowed (see Reg. (EC) 834/2007, Art. 4).

## 3.6. Irrigation and drainage system (water use, rain water, desalinisation, recycling of water and nutrients)

The responsible use of water in farming and gardening is a very relevant issue at the present time and will be even more relevant in the future, and it is specifically mentioned in Article 3(a)(iii) of Reg. (EC) 834/2007. This should therefore be a topic for organic agriculture in general not just for greenhouse production. In greenhouse systems irrigation water is usually drawn from an external supply (e.g. a well, a reservoir or a common water supply). Efficient use of water and rainwater collection should therefore be encouraged. As far as desalinisation is concerned, salinization should be avoided through proper fertilisation management (see Section 3.3.2).



### **3.6.1. Conclusions and recommendations**

The Group acknowledges that efficient water use and/or water recycling are important issues for organic farming, but it is not a specific issue of greenhouse cropping. The Group recommends the development of guidance for responsible water use including rain water collection systems in organic farming as a whole (to include greenhouse cropping, outdoor cropping, animal husbandry and processing).

### **3.7. Control of light, temperature and use of energy**

As pointed out in the introduction, greenhouses are environments where ambient conditions such as light, temperature and carbon dioxide levels can be controlled to a large extent by the grower. This results in higher yields, but it requires substantial inputs of external resources, especially energy. The principles of organic farming state that responsible use of energy should be made, and that the use of non-renewable resources and off-farm inputs should be minimized (Reg. (EC) 834/2007, Art. 3(a)(iii) and Art. 5(b)). However, the organic regulation does not contain specific production rules relating to these principles.

#### **3.7.1. Energy use in general**

Responsible use of energy is an important element of sustainability. Therefore, the Group recommends the development of strategies for responsible energy use in organic farming. The EU rules for organic greenhouse production, to be considered, may provide a good opportunity in the first instance. In the context of greenhouse production, there should be a focus on light, heating and carbon dioxide. However, the final aim should be a responsible use of energy in all production systems and over the entire production chain.

As far as renewable energy is concerned, there is a precedent in the Reg. (EC) 710/2009, Art. 6(b)(5) concerning aquaculture, stating that: “*Aquaculture and seaweed business operators shall by preference use renewable energy sources*” and a definition for ‘renewable energy’ is given in Art. 2(k): “*energy from renewable sources means renewable non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, landfill gas, sewage treatment plant gas and biogases*”. Remark: This definition should be supplemented with biomass products like wood or straw products, and products thereof. The Group recommends that this approach is also applied to organic greenhouse production.

It would be desirable to set upper limits for energy use in organic greenhouses, but there is no scientific basis for this at the moment. The IFOAM EU group (2013) has suggested a limit of 130 KWh/m<sup>2</sup> per year; if this limit is exceeded, an energy analysis should be required and a plan for increased energy efficiency and/or greater use of renewable energy should be produced. No reference to a scientific basis for the limit has been provided, and the Group cannot evaluate the validity of this value.

The need for lighting and heating, the availability of different sources of energy and the state of the art of greenhouse production vary greatly between different regions of Europe. Depending on such regional conditions, different strategies may be necessary to achieve the goal of responsible energy use. The Group recognizes that there is no single recipe for the most responsible use of energy. This task will therefore be difficult to achieve with EU-wide regulation, as long as no scientifically based limit exists.

### *3.7.1.1. Conclusions and recommendations*

In organic greenhouse production, as in other organic systems, as little energy as possible should be used. For that, awareness of responsible energy use among the operators is needed. Maximal heating temperatures, maximal heating periods and energy saving production methods as well as good heat insulation are in the foreground in addition to a reasonable use of CO<sub>2</sub> (see Chapter 3.8). For that the Group recommends that the heating of green houses to assure frost protection to 5°C is allowed without limitation. Heating to higher temperatures is in line with the Organic Regulation if the green house is insulated. These higher heating temperatures should be justified in relation to the crop. Heating with renewable energy is in line with the principle of organic farming and is highly preferred. The Group also recommends that greenhouse operators, who heat for more than frost protection, must keep records of their energy consumption and draw up and implement a plan based on elements of environmental management systems on how to reduce their consumption and replace fossil energy with renewable energy. The Group further recommends that energy reduction plans should also be considered for other types of organic production systems.

### *3.7.2. Light*

Light has two different functions in plants:

- it is the energy source for photosynthesis and thus for plant growth;
- variations in day length can trigger certain developmental processes in plants, e.g. induction of flowering.

The Group has distinguished between light for crop production and light for photoperiodical induction (e.g. to initiate flowering in some ornamental plants).

In the Group's opinion, normal daylight should be the primary source of light in greenhouses. Artificial light should only be applied under circumstances where normal daylight is insufficient. This can be the case on dark, overcast days and for extending the daylight period during autumn, winter and early spring, when it can be too short for adequate production in some regions. This is especially a problem in the northern part of Europe. Artificial light should also be allowed for the production of seedlings and herbs in pots, for the forcing of herbs, and for photoperiodical induction of flowering.

Large production units using artificial light can create a dome of light above the production units ('light pollution'), which can lead to the disruption of natural behaviour patterns of birds, bats and insects.

Lighting during night hours should therefore be avoided, and an appropriate dark period provided for the plants. Where possible, energy-efficient light bulbs, electricity from renewable sources and/or intelligent greenhouse management systems should be used.

### *3.7.2.1. Conclusions and recommendations*

In the Group's opinion, the provision of artificial light is in line with the objectives and principles of organic farming, if the normal daylight is insufficient for the normal growing of crops. It should only be allowed on dark, overcast days and for extending the daylight period, and only during autumn, winter and early spring. However, the intensity of artificial light used in overcast or short days should not exceed the Photosynthetically Active Radiation (PAR) of the country during a summer day (21<sup>st</sup> of June) and the number of hours should not exceed 12 hours of daylight including artificial light. Artificial light should also be allowed for the production of seedlings and herbs in pots, for the forcing of herbs, and for photoperiodical induction of flowering.

### *3.7.3. Heating source / heating system*

Greenhouses vary greatly in the extent to which they are heated, and with respect to the energy source used for heating. Due to the great variation in climate, it is not adequate to apply the same criteria to heating for greenhouse cropping in different regions of the EU.

As stated above for energy in general, greenhouse operators should be aware of the issue of energy use, and they should make efforts to minimize energy consumption and/or maximize the use of energy from renewable sources. For details, see discussion on energy use in general (Section 3.7.1).

## **3.8. Carbon dioxide (source, rebalancing and enrichment)**

### *3.8.1. Previous findings of the EGTOP*

The Group has previously discussed the rebalancing and enrichment of carbon dioxide in greenhouses (see EGTOP report 2/2011 on fertilizers). In the opinion of the group, CO<sub>2</sub> rebalancing, as well as enrichment to elevated levels, does not contradict the Organic Regulation. The group concluded that certain forms of carbon dioxide enrichment techniques could be in line with organic farming principles. However, the Group has not concluded whether carbon dioxide from all origins should be acceptable. Here, this technique is reconsidered in the wider context of greenhouse production standards. Carbon dioxide can be obtained from two kinds of sources: combustion gases from the burning of gas and bottled carbon dioxide from various processes (exceptionally it can be obtained from natural sources).

### *3.8.2. Carbon dioxide enrichment and yield*

It has been observed that in closed greenhouses, the air concentration of CO<sub>2</sub> can go below the normal CO<sub>2</sub> atmospheric concentration because of photosynthetic uptake with a significant negative effect on growth and yield. Furthermore, it has been observed that CO<sub>2</sub> enrichment above atmospheric concentration (up to 1200 ppm) leads to an increase in dry matter production of 20-30% (Nederhoff, 1994).

### *3.8.3. Carbon dioxide originating from fossil fuels*

Since CO<sub>2</sub> enrichment is more effective in summer rather than in winter, there is a widespread tendency of burning fossil fuels not only in winter (for heating), but also in summer to obtain CO<sub>2</sub> (both in conventional and in organic heated greenhouses). In this case, the main purpose of fossil fuel burning is CO<sub>2</sub> production and the heat produced represents a by-product. The heat produced is mainly stored in buffer tanks as hot water for utilisation during the night, or it may be stored deep in the soil (to be utilized some months later) (Vergote and Marien, 2011).

According to the data reported by Stanghellini and van Os (2004), the amount of natural gas utilised in a heated greenhouse can be up to 40-45 m<sup>3</sup>/m<sup>2</sup> per year (corresponding to 400 000 – 450 000 m<sup>3</sup>/ha per year). The CO<sub>2</sub> produced by the utilisation of this amount of natural gas is about 800 t/ha per year and is entirely utilized in the greenhouse in order to increase CO<sub>2</sub> concentration above normal air concentration (380 ppm).

#### **3.8.4. Carbon dioxide originating from other sources**

Carbon dioxide recycling in greenhouses does not have a mitigating effect on climate change (carbon credit). This is due to the fact that a great part of CO<sub>2</sub> recycled in greenhouses is lost in the atmosphere during ventilation or its utilisation is poor because of a relatively low efficiency of the plant uptake of CO<sub>2</sub>, so only a residual part of it is utilized for the production of biomass. According to IPCC Guidelines for National Greenhouse Gas Inventories (2006), “*The non-woody biomass, turns over annually or within few years and hence net biomass carbon stocks may remain roughly constant...*”. In other words, the sequestered carbon is re-released within a short time period because greenhouse crops have a short life cycle (a few months, at most), so there is no long term effect with respect to climate protection. For this reason, the Group supports the utilisation of CO<sub>2</sub> produced as a by-product of natural processes or of burning of biomass sources. The Group is concerned that greenhouse owners could be discouraged from switching to renewable energy sources (geothermal, wind, solar power etc.) because these alternatives do not have the added value of CO<sub>2</sub> emission for recycling through the greenhouse. In the Group’s opinion, these tendencies would conflict with the principle of making responsible use of resources (see Section 3.7.1).

#### **3.8.5. Conclusions and recommendations**

The group accepts the practice of CO<sub>2</sub> enrichment, but is concerned about the widespread tendency of burning fossil fuels in summer for the main purpose of obtaining CO<sub>2</sub>. Operators should minimize the loss of CO<sub>2</sub> to the environment through responsible energy management in the greenhouses. It may be a problem to produce CO<sub>2</sub> for CO<sub>2</sub> balancing/enrichment in greenhouses using renewable energy sources like windmills, hydropower plants or sun power panels without CO<sub>2</sub> production or common biogas plants situated a distance away. Research is needed to find the most energy and production efficient alternatives for CO<sub>2</sub> enrichment based on burning of fossil fuels. Fossil fuel burning with the main purpose of CO<sub>2</sub> enrichment of greenhouses should not be allowed.

CO<sub>2</sub> enrichment should not discourage energy saving and the use of alternative renewable energy sources.

CO<sub>2</sub> should preferably be used from processing or burning of biomass sources.

In the long run it is recommended that only biomass sources are used for CO<sub>2</sub> rebalancing/enrichment.

### **3.9. Growing media**

#### **3.9.1. Growing media composition**

Growing media should ideally contain ingredients that are from certified organic sources wherever possible. It is the Group’s opinion that the use of all the materials listed in Annex I of the Reg. (EC) 889/2008 (including peat) should be allowed as ingredients in growing media for organic production. An in-depth discussion of peat is given in Annex 1 to this report.

### 3.9.1.1. *Use of soil in growing media*

In the Group's opinion, soil is a valuable resource which must be utilized carefully. Therefore, the Group does not see a compelling case for the use of soil in growing media. Mineral components such as clay, gravel, sand, and stone meal should be allowed providing they are derived from unpolluted sources. Soil from certified organic areas of the farm may be used for mixing into the substrate (e.g. in plant nurseries) for use on the farm itself.

As regards the composition of growing media, in the Group's opinion the use of all materials listed in Annex I of the Reg. 889/2008 (including peat) is in line with the objectives, criteria and principles of organic farming.

The Group is concerned about the environmental impact of peat harvesting, but considers at the moment peat as a necessary ingredient in growing media for transplants and potted plants, but not as ingredient in soil improvers because many other alternatives are available for this purpose. Further, the use of peat in growing media is in line with the objectives, criteria and principles of organic farming, and should therefore be authorized. The Group recommends that peat should not be the only organic material and its use in growing media should be limited to maximum 80% by volume, as normally 20-30% by volume in growing media for professional use could be replaced by compost (Delgado *et al.*, 2009). In addition, the content of peat in growing media should be progressively reduced. The development and use of alternative materials should be promoted, and except for recycled peat, peat should under no circumstances be used as an ingredient in soil improvers. The authorisation of peat should be reconsidered after a period of 5 years to determine if further restrictions on the use of peat or phasing out of peat in organic farming are necessary.

As regards soil for mixing into substrates (e.g. in plant nurseries) for use on the farm itself, the Group recommends to source it from certified organic areas of organic farms.

Some substances that may be used as ingredients in growing media or soil improvers are not listed in Annex I of the Reg. 889/2008 at present, e.g. sand and biochar. Sand may fall under the term 'stone meal', but for clarification the Group recommends to amend the list as follows 'stone meal including sand'. As regards 'biochar', this substance should undergo a careful evaluation before considering it for inclusion in Annex I of the Reg. 889/2008.

### 3.9.1.2. *Conclusions on the composition of growing media*

As regards the composition of growing media, it is the Group's opinion that the use of all materials listed in Annex I (including peat) is in line with the objectives, criteria and principles of organic farming. The Group recommends that soil from certified organic areas of organic farms may be used for mixing into substrates (e.g. in plant nurseries), for use on the farm itself.

Annex I of Reg. (EC) 889/2008 should be amended as follows:

- To the listing of peat, the following restriction should be added: 'maximum 80 % by volume of growing media'.
- The listing of 'stone meal and clays' should be amended as follows: 'stone meal (including sand) and clays'.

### *3.9.1.3. Side remark of the use of peat as soil conditioner*

In contrast to growing media, the Group does not consider peat to be necessary as a soil improver. Thus, peat should not be used as a soil improver, or as an ingredient thereof. As an exception, the Group accepts the use recycled peat as a soil improver.

### *3.9.2. When should growing plants in substrate be authorized?*

In general, organic growing and the production of organic plants should take place in soil, and ‘soil’ means that the upper soil is in contact with the subsoil, so that roots can grow into the subsoil. As an exception from this principle, the Group accepts cultivation in substrates for seedlings and transplants, and for plants which are sold to the consumer together with the pot/container in which they grow (e.g. herbs in pots, ornamentals).

In these cases, production in horticultural substrate is obvious to consumers and there is no risk that they are misled regarding the production method of the plants. By contrast, organic produce harvested out of sight of consumers should always come from plants grown in soil, and not from horticultural substrate cultures. This would also be important if a shorter conversion period is established for substrate cultures to avoid unfair competition between substrate-grown and soil-grown crops (see Section 3.10.2).

#### *3.9.2.1. Growing organic vegetables in demarcated beds as an exception for growing in soil*

Authorities in Finland, Sweden, Norway and Denmark, have authorised a practice of growing organic vegetables in ‘demarcated beds’, which is a form of substrate culture, where the plants are grown in large containers, bags or beds surrounded by plastic sheets/fleece where the roots may or may not be in contact with the soil. The total area is very small (about 18 ha). The Group strictly opposes to any enlargement of such practices in organic farming because it is not in line with the objectives and principle of organic farming.

Some urban organic production systems (e.g. rooftop production) may not comply with the requirement of growing in soil. These systems may be encouraged as private initiatives, they are outside the scope of the organic farming rules and will need to be addressed separately.

#### *3.9.2.2. Side remarks on special cases, where the principle of growing in soil is not applicable for biological / technical reasons*

There are some plants, fungi and algae which naturally do not grow in the soil. For such plants, the principle of growing crops in the soil obviously does not apply.

- Exceptions for mushroom culture are defined in Art. 6 of the Reg. (EC) 889/2008.
- Sprouts are young seedlings, which are produced by moistening of seeds. Production of sprouts in the soil would raise hygienic concerns, and it would not make sense, because at this stage of development, seedlings utilize exclusively the reserves in the seed and do not take up nutrients from the environment. Sprout production therefore does not fall under the definition of ‘hydroponics’, given in Art. 2(g) of the Reg. (EC) 889/2008. The same argument applies also to the ‘forcing’ of vegetative materials, e.g. chive bulbs (*Allium schoenoprasum*).

- Freshwater plants such as water cress (e.g. *Rorippa amphibia*) and freshwater algae (e.g. *Spirulina*) naturally grow in water and are often certified as organic. However, there is some doubt as to whether freshwater plants and algae can strictly be grown organically, because under the Organic Regulation their cultivation may be considered as hydroponics, and they do not fall under the Reg. (EC) 710/2009. A distinction could be made between stream bed production and greenhouse production. In greenhouses, they could be used in combined systems, where freshwater plants or algae are used to recycle nutrients originating from freshwater fish production.

The Group concludes that the circumstances under which the production of such freshwater plants and algae can be authorized should be clarified, possibly in the framework of revision of the Reg. (EC) 710/2009. However, the Group does not want to set a precedent for any kind of hydroponic cultivation of plants which would normally grow in the soil.

### *3.9.2.3. Conclusion on when growing plants in substrates should be authorized*

The Group recommends that growing in substrates is accepted for seedlings and transplants, and for plants which are sold to the consumer together with the pot/container in which they grow (e.g. herbs in pots, ornamentals), while harvested organic vegetables or fruits (e.g. strawberries) should come from plants grown in the soil, and not from substrate cultures. However, the Group recognised that in Finland, Sweden, Norway and Denmark a practice was authorised where vegetables are grown on growing media in demarcated beds but strictly opposes to any enlargement of such practices in organic farming because it is not in line with the objectives and principle of organic farming. Therefore, the Group recommends that only those farms which have used demarcated beds in the past (i.e. before 2013) should be allowed to use them in the future and that there should be no expansion of the use of demarcated beds neither on these holdings nor in the rest of the EU. The Group recommends that any excess or spent growing media or plastic used in organic greenhouse production and farming in general should be reused or recycled.

As regards plants, fungi and algae which naturally do not grow in the soil, e.g. water plants (e.g. water cress), some mushroom species and sprouts, the Group recommends that the production of such organisms should be authorized.

### *3.9.3. Recycling of growing media*

Under the conditions proposed in Section 3.9.1, growing media are either transferred to the field together with the transplant, or they are sold together with potted plants. Under such conditions, growing media cannot be recycled. Otherwise, the Group recommends that excess growing media from potting, unsold potted plants or growing media used in demarcated beds should be recycled.

## **3.10. Conversion period for greenhouse productions**

### *3.10.1. Conversion period for greenhouse crops growing in the soil*

In the Group's opinion, conversion rules for greenhouses, where the plants grow in the soil should be the same as for outdoor cropping.

### *3.10.2. Conversion period for greenhouse crops growing in substrate*

For greenhouses where plants are grown in substrate with no contact with the soil, no conversion period is required from the technical point of view. This is applied for mushroom production for which no conversion time is stated in Reg. (EC) 889/2008. Organic production could start without a conversion period, when a new production cycle is set up, and the substrate, seeds, vegetative propagation material etc. comply with the rules for organic production. To avoid contamination risks, the entire greenhouse and equipment must be cleaned thoroughly, before organic production starts. Cleaning measures should be carried out according to a risk assessment, and subject to a management plan agreed with the control authority/body before organic production begins. It should normally include the cleaning of the glass from inside, the tables, the change of fleeces on the tables and the irrigation system etc. In the Group's opinion, entire greenhouses must be converted at the same time. It should be noted that these provisions will only apply to those systems producing transplants, herbs in pots and ornamentals.

The Group notes that having no conversion period increases the risk of producers moving in and out of the organic system, which may lead to unwanted fluctuations in the market.

### ***3.10.3. Comments on the general conversion rules***

At the moment the conversion time for outdoor cropping is 2 years before sowing for annual crops, grass land and perennials for forage; for other perennial crops it is 3 years (Reg. (EC) 889/2008, Art. 36(1)). The Group did not discuss conversion rules in detail, but it noted the conclusions of the EU FP6 project "*Research to support revision of the EU regulation on organic agriculture*" ([www.organic-revision.org](http://www.organic-revision.org)). According to this project, a lot of bureaucracy could be eliminated, if a standardised conversion period of 12 months were imposed, and at the same time the system of retrospective recognition was given up. The project further concluded that consumer trust could be improved and the inspection process simplified by a medium-term perspective of full farm conversion.

### ***3.10.4. Conclusions and recommendations***

The Group recommends that the conversion period should be the same for greenhouse cropping in the soil as for outdoor cropping. For greenhouses, where plants are grown in substrate with no contact with the soil, (see Section 3.9.2) no conversion time is required from the technical point of view, if appropriate measures are taken to avoid contamination risks. The Group suggests that conversion periods in general should be reconsidered in the review of the whole Organic Regulation. A shorter conversion period for greenhouse and outdoor crops (possibly 1 year) could be considered as recommended by the FP6 project on revision of the Reg. EC 2092/91.



#### 4. LIST OF ABBREVIATIONS / GLOSSARY

Annex I, Annex II, Annex VII, etc.	Annexes to the Commission Regulation (EC) No 889/2008
CO <sub>2</sub>	Carbon dioxide
EC	European Commission
EU	The European Union
FP6	Framework Programme 6
GHE	Greenhouse Gas Emissions
GMO	Genetically modified organism
IFOAM	The International Federation of Organic Agriculture Movements
IPPC	The Intergovernmental Panel on Climate Change
IPS	International Peat Society
MS	Member States (of the European Union)
PAR	Photosynthetically Active Radiation
PE	Polyethylene
PP	Polypropylene
Reg.	Regulation
SCOF	Standing Committee for Organic Farming
The Group	The Expert Group for Technical Advice on Organic Production (EGTOP)
UV	Ultra Violet light
UVC	Ultra Violet C

#### 5. REFERENCES

Altmann, M. (2008) Socio-economic impact of the peat and growing media industry on horticulture in the EU, Co Concept

Avilés, M., Borrero, C. and Trillas, I. (2011) Review of compost as an inducer of disease suppression in plants grown in soilless culture. *Dynamic Soil, Dynamic Plant* 5.Special Issue 2 (1-11) Global Science Books

CEN TC 223 Technical Committee on Soil Improvers and Growing Media, available at: <http://www.cen.eu/cen/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/Pages/default.aspx?param=6204&title=CEN/TC%20223>, May 2013

Delgado, L., Catarino, A.S., Eder, P., Litten, D., Luo, Z. and Villanueva, A. (2009) End-of-waste criteria - final report, JRC Scientific and Technical Reports, EUR 23990 EN

Elmore, C. L., Stapleton, J. J., Bell, C. E. and DeVay, J. E. (1997) Soil solarization: a nonpesticidal method for controlling diseases, nematodes and weeds, Oakland: Univ. Calif. Agric. Nat. Res. Publ. 21377

IFOAM EU Position paper on organic greenhouse production, available at: [http://eu.ifoam.org/sites/default/files/page/files/ifoameu\\_reg\\_greenhouse\\_production\\_position\\_201302.pdf](http://eu.ifoam.org/sites/default/files/page/files/ifoameu_reg_greenhouse_production_position_201302.pdf), February 2013

Paustian, K., Ravindranath, N.H., van Amstel, A., Gytarsky, M., Kurz, W.A., Ogle, S., Richards, G. and Somogyi, Z. (2006) IPCC guidelines for national greenhouse gas inventories, Agriculture, Forestry and Other Land Use 4(1):21

Ludeking, D.J.W., Paternotte, S.J., Runia, W.T., Molendijk, L.P.G., Bohne, S., Streminska, M.A. (2010) Biological soil disinfection '2.0.', Dutch Ministry of Agriculture, Nature and Food Quality Program: BO-12.10-007.04 Innovative Biological Sectors

MacDonald, G. M., Beilman, D. W., Kremenetski, K. V., Sheng, Y., Smith, L. C. and Velichko, A. A. (2006) Rapid early development of circumarctic peatlands and atmospheric CH<sub>4</sub> and CO<sub>2</sub> variations, Science 314 (5797): 285–288

Michel, V. (2008) Biofumigation – Prinzip und Anwendung (4.2.2008), Agroscope ACW, 6

Nederhoff, E.M. (1994) Effect of CO<sub>2</sub> concentration on photosynthesis, transpiration and production of greenhouse fruit vegetable crops, Dissertation at Wageningen University – With ref. – With summary in Dutch ISBN 90-5485-318-2: 213

Núñez-Zofío, M., Larregl S., Garbisu C. (2011) Application of organic amendments followed by soil plastic mulching reduces the incidence of *Phytophthora capsici* in pepper crops under temperature climate, Crop Protection 30: 1563-1572

Parish F., Sirin A., Charman D., Joosten H., Minayeva T., Silvius M. and Stringer L. (Eds.) (2008). Assessment on peatlands, biodiversity, and climate change: Main report. Global Environment Centre, Kuala Lumpur and Wetlands International, Wageningen.

Ros, M., Garcia, C., Hernandez, M.T., Lacasa, A., Fernandez, P. and Pascual, J.A. (2008) Effects of biosolarisation as methyl bromide alternative for *Meloidogyne incognita* control on quality of soil under pepper, Biol. Fert. Soils 43: 37-44

Stanghellini, C. and van Os, E.A. (2004) Protected cultivations in Holland: environmental laws and economic situation, Proceedings of International Workshop entitled "The production in the greenhouse after the era of the methyl bromide": 157-165

Tún (2012) Vottunarstofan tún organic standards extract, Section 4.9: Protected Crop Production

U.S. geological survey (2005) available at:

[http://minerals.usgs.gov/minerals/pubs/commodity/peat/peat\\_myb05.pdf](http://minerals.usgs.gov/minerals/pubs/commodity/peat/peat_myb05.pdf), May 2013

Van Dijk Mangement Consultants, Arcadia International and BiPRO (2012): Study on options to fully harmonise the EU legislation on fertilising materials including technical feasibility, environmental, economic and social impacts, Contract no. 30-CE-0392420/00-18, European Commission, Directorate-General for Enterprise and Industry

Vergote, N. and Marien, H. (2011) Use of a gas absorption heat pump in combination with Borehole Thermal Energy Storage in organic protected horticulture, Acta Hort. 915, ISHS: 55-60

Voogt, W., de Visser, P.H.E., van Winkel, A, Cuijpers, W.J.M. and van de Burgt, G.J.H.M. (2011) Nutrient management in organic greenhouse production: navigation between constraints, I International Conference on Organic Greenhouse Horticulture, Acta Hort. 915, ISHS: 75-82

## 6. ANNEXES

### 6.1 Annex 1 – In-depth discussion about peat

The use of peat is not only an issue for greenhouse production, but also for open air production.

#### *Identification of substance, terminology, synonyms*

Peat is a slowly renewable, natural, organic material of plant origin. Peat is formed by gradual decomposition of organic matter of plant origin (mainly the so-called ‘peat mosses’ of the genus *Sphagnum*) under low oxygen /anaerobic conditions, as they occur in water-saturated environments, i.e. bogs or mires. Peatlands/bogs/mires are situated predominately in shallow wetland areas of the Northern Hemisphere (more than 90 % of the peatlands), where large deposits have developed (IPS website, April 2013: <http://www.peatsociety.org/>). More than 400 million hectares (Mha) of peatlands exists on Earth, of which 80% remains undisturbed. Of the 80 Mha that has been used by humans, 50% has been used for agriculture, 30% for forestry, 10% for peat extraction and 10% for miscellaneous uses. Peat accumulates on 60 % of global peatlands, but the volume of global peatlands has been decreasing at an annual rate of 0.05% owing to harvesting and land development. Finland and Ireland are the two main peat fuel users in the world, and in 2005 90 % of the peat mined in these countries was used as fuel (U.S. Geological Survey, 2005).

The structure of peat ranges from more or less decomposed plant remains to a fine amorphous, colloidal mass. Peat is a sedentarily accumulated material consisting of at least 30% (dry mass) of dead organic material. (IPS website, April 2013 <http://www.peatsociety.org/peatlands-and-peat/what-peat>). Peat has widespread use as a plant growing medium, and in a variety of horticultural and agricultural applications (growing media, soil conditioning, mushroom casing soil, animal bedding material, etc.), and is also used as a fuel for generating electricity and/or heat. The total peat usage in the European Union in 2008 was 68 million m<sup>3</sup>, of which: 42% is used for growing media; 50% for energy; 5% for soil improvers, 3% for other uses (Van Dijk Management Consultants et al., 2012).

#### *Authorisation in general agriculture*

At present, the Reg. (EC) No. 2003/2003 does not cover peat, and peat is a ‘national fertilizer’ which is placed on the market of the Member States in accordance with national legislation. ‘National fertilisers’ are covered by Reg. (EC) 764/2008 which ensures the intra Community free movement of foods in the non-harmonised area. The Commission intends to revise

Reg. (EC) 2003/2003 to extend the scope to other fertilisers and fertilising material including organic fertilisers, growing media, soil improvers and possibly biostimulants (Van Dijk Management Consultants *et al.*, 2012).

### ***Agronomic use, technological or physiological functionality for the intended use***

Peat is used in the production of vegetable transplants, potted herbs and ornamentals and as part of growing media in demarcated beds for growing of greenhouse vegetables in some Northern European countries. It is also used as a soil conditioner/soil improver outdoors and as casing in mushroom production. The fibrous structure and porosity of peat promote a combination of water-retention and drainage which is ideal for growing media. At the same time, peat has a low salinity and slow decomposition rate.

### ***Known alternatives***

Depending on the crop and the purpose, peat may be substituted partially. However a certain amount (50-80 % volume) is usually necessary. Composts and wood fibres are considered valid alternatives for partial substitution of peat. 'Coir', which is a waste product from coconut production, may also be a promising alternative or partial alternative to peat, but it has to be transported over long distances.

### ***Origin of materials, methods of manufacture***

Peat is harvested from bogs, then dried and milled.

### ***Environmental issues, use of resources, recycling***

The world's peatlands are thought to contain 180 to 455 billion t of sequestered carbon, and to release into the atmosphere 20 to 45 million metric tons of methane annually. The peatlands' contribution to long-term fluctuations in these atmospheric gases has been a matter of considerable debate (MacDonald *et al.*, 2006).

Globally the main cause of destruction of peatland is drainage for agricultural production. This not only destroys the habitat of many species, but also heavily fuels climate change. As a result of peat drainage, the organic carbon, which was built up over thousands of years under water, is exposed to the air, resulting in rapid decomposition with release of large amounts of CO<sub>2</sub> into the atmosphere. Total CO<sub>2</sub> emissions from the worldwide 500 000 km<sup>2</sup> of degraded peatland may exceed 2.0 Gtons (including emissions from peat fires) which is almost 6% of all global carbon emissions (Wetlands International, April 2013:

<http://www.wetlands.org/News/tabid/66/ArticleType/ArticleView/ArticleID/1919/PageID/1880/Default.aspx>).

In the EU peat extraction is clearly regulated by European and national legislation, mainly the Environmental Impact Assessment (= EIA) Directive (85/337/EEC amended by 97/11/EC), and the Habitats Directive (92/43/EC).

Today one of the main objectives of after-use of extracted peatlands, e.g. in Germany, is restoration, i.e. rewetting and re-growth of typical bog vegetation. In some EU Member States (e.g. Finland) agriculture or forestry is the predominant way of after-use of mined peat bogs. The process of bog restoration is complex and requires time (Altmann, 2008).

***Animal welfare issues***

No issues identified.

***Human health issues***

No issues identified.

***Food quality and authenticity***

No issues identified.

***Traditional use and precedents in organic production***

Peat has been traditionally used in organic production in Europe and elsewhere.

***Aspects of international harmonisation of organic farming standards***

The use of peat is allowed in organic farming in the USA. The Codex Alimentarius guidelines on organic production allow some uses of peat (e.g. for transplants and in pots), but do not allow the use as a soil improver. In the Canadian organic standard, there are no limitations on the use of peat.

***Necessity for intended use***

For transplants and potted plants, peat is at the moment needed as part of substrate mixtures for optimal physical properties (pore size composition and distribution, high water holding capacity) and decomposition stability of the product in relation to avoidance of compaction and to keep the electrical conductivity (salt concentration) low enough and a high cation exchange capacity (to avoid 'burning' of the plants).

Peat is not necessary as a soil improver, because many other alternatives are available for this purpose.

***Other relevant issues***

In the production of transplants, there has been a trend for minimizing the substrate block/container/tray module size used for growing transplants, which has greatly reduced the amount of peat utilized for growing media production.

A Technical Committee under CEN (European Committee for Standardisation), TC223 on "Soil improvers and growing media" was established already in 1986 to facilitate trade in soil improvers and growing media and reduce barriers to trade. Since then, TC 223 has worked on various standardisation issues on soil improvers and growing media, including definitions, labelling, sampling and analysis etc.

The EU has established criteria for the award of the Ecolabel to soil improvers (Commission Decision 2006/799/EC) and to growing media (Commission Decision 2007/64/EC). One of these criteria is that soil improvers and growing media, to be labelled with the Eco-flower must not contain peat and the organic matter content shall be derived from the processing and/or reuse of waste as defined in Council Directive 75/442/EEC on waste and in Annex 1 to the said Directive.