

A View of Organic Greenhouse Horticulture Worldwide

C.J.M. van der Lans^a and R.J.M. Meijer
Wageningen UR Glastuinbouw, Violierenweg 1
2665 MV Bleiswijk
Post Box 20
2665 ZG Bleiswijk
The Netherlands

M. Blom
Biologica
Postbus 12048
3501 AA Utrecht
The Netherlands

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Abstract

As a starting point for future international cooperation in research on Organic Greenhouse Horticulture, an inventory was done to map the state of art of organic greenhouse horticulture worldwide. This inventory resulted in overview of national area sizes, characterisation of practised organic growing systems, regulations, and topics on the national research agenda for each country. The overview is presented and discussed in this paper. The emphasis in this overview is on the EU countries because that information was best available.

INTRODUCTION

In 2008, during the ISOFAR/IFOAM Organic World Congress at Modena, a small group of researchers expressed an interest to meet on a regular basis to exchange research results and discuss opportunities for cooperation on research in the field of organic greenhouse horticulture; the foundation for the Working Group on Organic Greenhouse Horticulture was laid. In 2009 a larger group of researchers met again during a second meeting in Cologne, Germany. In October 2010, the Working Group was formally headed under the ISHS commission “Sustainability through Integrated and Organic Horticulture”.

The Working Group defined organic greenhouse horticulture as “the production of organic horticultural crops using inputs only from natural, non-chemical sources, in climate-controllable greenhouses and tunnels (permanent structures)”. Organic greenhouse horticulture includes vegetables and herbs, flowers and pot plants, as well as fruits. As a starting point for future cooperation in research, an inventory was done to map the state of art of organic greenhouse horticulture worldwide.

MATERIALS AND METHODS

In literature and open data sources, no official statistical information regarding areas and growing systems of greenhouse horticulture could be found. Therefore, almost all information was collected by interviews with experts in the different countries who work in or deal with organic greenhouse horticulture in their country. Through these expert interviews, several data were collected regarding the state of art of organic greenhouse horticulture worldwide. Topics in the interviews and questionnaires included the national area of organic greenhouse horticulture, type of greenhouse(s) used, heated area versus non-heated, number of operators, crops grown, types of growing systems used and the national research agenda to innovate organic greenhouse horticulture in the specific country.

In this paper, the emphasis within the overview is on the EU because that information was best available through the network of researchers within the Working Group.

^a carin.vanderlans@wur.nl

RESULTS AND DISCUSSION

Below, the collected information on areas, crops grown, standards and regulations, growing systems, conversion, marketing and national research agendas is presented and discussed.

Area, Crops and Marketing

1. Acreage. In Table 1, an overview is given of the areas of organic greenhouse horticulture (greenhouses, permanent and temporary tunnels) in the countries surveyed.

Looking at the EU, most striking are the large areas (more than 1,000 ha) of organic greenhouse horticulture in Italy and Spain. France ranks third, with an area of around 450 ha, followed by The Netherlands with a total area of almost 100 ha. Organic greenhouse production in the EU comprises 7.3% of the total greenhouse area (103,150 ha in 2007, according to Eurostat data). Also of interest for the EU is the Israeli production area, which totals 500 ha.

In the southern EU countries, greenhouse production is mainly done in unheated plastic greenhouses or tunnels. In some cases, like in Spain, production takes place in heated greenhouses for export. In The Netherlands, Belgium, Sweden, Finland and Denmark, production mainly takes place in heated greenhouses, in which fruit vegetables are being grown year round. Several lettuce types are being grown in cold (unheated) greenhouses. In some cases it is possible to grow in greenhouses that can be kept frost free.

The USA has around 195 ha of organic greenhouse horticulture. The organic greenhouse area of Mexico is estimated by some at around 800 ha, which is a rather large part of the total greenhouse area of 3,000–3,500 ha.

2. Crops. The main crops grown organically in the EU are tomato, sweet pepper and cucumber and several lettuce types. Flowers are seldom grown organically.

In the United States, tomato is also the leading crop, followed by (European) cucumbers, lettuce, peppers and culinary herbs (Greer and Diver, 2000). In Mexico, tomatoes are also the most commonly grown vegetable crop in organic greenhouses; production takes place almost exclusively in Baja California Sur (mostly cherry tomatoes). Yields in Mexico are generally lower than in Northern America. A complete overview of crops grown worldwide is shown in Table 2.

3. Marketing. Spain is the major exporter within the EU. The country exports mainly to other EU countries. Also, in The Netherlands, Belgium and Denmark, organic production is focused on export abroad. To illustrate this export focus: 80% of the Dutch production is being exported, which are mainly fruit vegetables that are grown on 75 ha of the total area of 100 ha of organic production. Main export destinations for the Dutch vegetables are Germany, the United Kingdom and Switzerland. Organic greenhouse horticulture crops in the other EU countries are produced almost exclusively for domestic consumption. A major portion of Israel's organic greenhouse horticulture crops is sold to Europe, making Israel an import player in this market.

A lot of the Mexican organically-produced tomatoes go to the USA market, which makes Mexico the major foreign supplier for the United States.

Regulations

The European Union Regulation 834/2007 outlines the basic requirements with regard to production, labelling and control of organic products in the plant and livestock sector. More detailed rules for the implementation of those requirements are published in EC Regulation No 889/2008. These rules are meant to be a guide for every EU member state. Different interpretations of these rules are made by the different EU Member States, so as a result every EU country has its own specific rules for organic greenhouse horticulture.

In The Netherlands, the certifier SKAL allows a shorter conversion period than the standard of two years, for greenhouses in which the soil has been covered for at least two years so that no chemical products and other mineral nutrients can have entered the soil.

Also there is an agreement regarding specific rules for lighting and CO₂ supply. In some other countries, specific rules for greenhouse horticulture are included in the standard of organic cooperatives and/or associations (for example, Krav in Sweden, Bioland, Naturland and Demeter in Germany, BioBreizh in France). In the United Kingdom, specific rules were drafted, but were never put into force.

In the USA, the Organic Foods Production Act of 1990 is the overarching legislation for organic production. To implement this legislation, the National Organic Program was created, resulting in the National Standards on Organic Agricultural Production and Handling (National Organic Programme rules), which was issued in 2000. In US organic horticulture, only substances that are on the National List of Allowed Synthetic and Prohibited Non-Synthetic Substances are allowed in crop production.

Growing Systems

1. Soil or Substrates. In almost all EU countries, only growing in soil is allowed. An exemption is made for growing of seedlings and plants in pots (like potted plants and potted herbs), which may be grown only in a natural substrate. In Sweden and Finland, regulations allow plants to be grown in 'enclosed separate soil beds' or in pots with at least 30 litres of peat and compost. Although the Danish Ministry of Agriculture allows production out of soil in natural substrates, the Danish organic sector (united in Organic Denmark) does not support this.

If production in pots is allowed, countries have different criteria for the substrates that may be used or they refer to Annex 1 of EU Regulation 889/2008. In Spain sometimes fresh, natural substrate or soil is spread in strips on the ground as a growth medium. In summertime these strips are disinfected by solarisation rather well. In some provinces of Canada, horticultural production in big sacks/containers is allowed. A minimum of 100 L m⁻² of soil is requested to get the Quebec organic certification. However, organic hydroponics, where the major part of nutrients is provided by organic liquid fertilizers, is not allowed in Canada. In the USA, production in natural substrates out of soil is common. Here, five greenhouse production methods are suitable: soil culture, bag culture, vertical towers, straw bale culture and shallow bed culture (Greer and Diver, 2000).

2. Nutrients and Water Supply. In almost every country a maximum for N is set, which is 170 kg ha⁻¹ year⁻¹ with manure. Fertilization with other inputs containing N is allowed as long as the inputs are mentioned in Annex 1 of EU Regulation 889/2008. In some countries, a certain percentage of this input must be of organic origin (for example, in Denmark 75%). Liquid fertilizers are allowed in most countries, as long as they are on the list in Annex 1. There are no crop-specific rules. Furthermore, fertilizers have to meet the Nitrate Directive. In none of the countries are rules for water gift, water uses and leaching.

3. Crop Protection. There are no specific rules reported for crop protection. Within the EU, biologic control and plant protection products on Annex 2 of EU Regulation 889/2008 are allowed, just as for other organic crop production. Each EU state has different national admission requirements, which means that organic growers from different countries use different crop protection products.

4. Heating, CO₂ and Artificial Lighting. In the EU there is no regulation or legislation for the use of energy in organic production. There is only a common rule that asks for wise dealing with scarce resources. Heated production takes place, especially in The Netherlands, Belgium, Sweden and Denmark. In other countries, heating is often only allowed to keep the greenhouse frost free. In Sweden, 80% of the energy used needs to be from a renewable source. In Germany, producers are allowed to heat their greenhouses in autumn and spring to extend the production season, but heating is not allowed during wintertime. In Italy, heating is not allowed at all. In the southern countries of the EU, heating is not an issue for organic horticulture.

In almost all EU countries CO₂ may be used. However, in Spain this is not allowed, as CO₂ is considered to be a fertilizer, but one that is not on the Annex 1 list. In

The Netherlands, CO₂ may be used only as a by-product of heating. In Ireland, only CO₂ from a renewable source is allowed. For the USA and Canada, there are no restrictions reported.

For artificial lighting there is no legislation or, in most countries this is only allowed for propagation of plant material and for day extension in floriculture. In Sweden and Iceland, lighting is allowed during part of the cropping in the dark period.

5. Crop Rotation and Steaming. There are general rules for crop rotation in the regulations for organic production. Countries have adapted those general requirements at their own discretion, but this has not led to major differences. The issue of soil disinfestation by steaming and crop clean-up is particularly an issue in heated intensive fruit vegetable production because there is actually no real crop rotation in this type of production, which means that pests and diseases build up in the soil. Therefore, in The Netherlands for example, it has been agreed not to grow the same crop two years in a row.

For steaming, most countries have no provisions in the organic regulation. In The Netherlands, disinfection by steaming is allowed once every two years. In other countries, cultivation is less intensive, with more rotation of crops and with a break in wintertime or, as in Spain, in summertime. In the latter case, disease pressure in the soil is reduced by solarisation (heating of the covered soil by solar radiation in summer) during the cultivation break in the summer period.

6. Conversion. The conversion period according to EU regulations is 2 years. When production takes place in pots, there is in general no conversion period. Iceland has no rules for the length of the conversion period. In Sweden, 2 years is required for soil production, but when production takes place in enclosed separate soil beds (in allowed substrates) no conversion period is required. In The Netherlands, the conversion period can be shortened to 6 months if, for that specific land, no production has taken place during the two previous years and the soil has been covered with plastics so that no chemical products and other mineral nutrients could have entered the soil.

National Research Agendas

Organic greenhouse horticulture still has a way to go to overcome its problems. Overall, growers need to increase sustainability, stability and profitability. Therefore, they have to overcome several types of problems in organic cultivation, which is reflected by the research topics mentioned in the inventory (Table 3). Particularly, the topic of plant protection (pest and disease control) is much mentioned, as well as the need for research on fertilization and soil management to control soil borne diseases and improve soil fertility. Other hot topics are sustainable and/or lower use of energy, and breeding of new cultivars. The latter is mainly heard from some East-European countries, while plant protection, fertilization and soil management are mentioned especially by the intensive greenhouse production countries, like Belgium, The Netherlands, Denmark, Sweden and UK, but also by southern countries as Italy, Spain and Israel.

CONCLUSIONS

The inventory on organic greenhouse resulted in worldwide overview of national area sizes, intensity and characterisation of practised organic growing systems, regulations and the topics on the national research agenda for each country.

Italy, Spain, Mexico and Israel have large areas with organic greenhouse production. Within the EU most production is for domestic consumption, except for Spain, The Netherlands, Belgium and Denmark. Also organic products are imported from Israel. The organic production in Mexico is of major importance for the US and Canadian markets.

In southern (EU) countries greenhouse production takes place in unheated plastic greenhouses or tunnels. In The Netherlands, Belgium, Sweden, Finland and Denmark, organic horticulture is more intensive with heated greenhouses for year round production. The major crops grown are tomato, sweet pepper and cucumber.

Within the EU overarching regulations for organic production, each EU member

state has interpreted these requirements to apply to its own national rules.

In almost all EU countries, only growing in soil is allowed, except for growing of seedlings and plants in pots (like potted plants and potted herbs). In some of the EU countries, some Canadian provinces and in the USA, it is acceptable to grow out of soil: in enclosed separate soil beds, pots, big sacks/containers and in natural substrates.

Organic greenhouse producers still face several problems for a sustainable and profitable production. Major topics in the national research agendas regard plant protection, fertilization, soil management, sustainable/lower use of energy and breeding of new cultivars.

Literature Cited

Greer, L. and Diver, S. 2000. Organic greenhouse vegetable production. ATTRA, January 2000. <http://attra.ncat.org/attra-pub/ghveg.html>.

Tables

Table 1. Total area (ha) of organic greenhouse horticulture production, area (ha) in heated production and number of operators for several EU and non-EU in 2009.

| Country | Total area (ha) | Number of operators | Area of heated greenhouses (ha) | Number of operators |
|-------------------------|-----------------|---------------------|---------------------------------|---------------------|
| <i>EU countries</i> | | | | |
| Austria | 30 | | | |
| Belgium | 32 | 66 | 20 | 14 |
| Denmark | 25 | 34 | 15 | 9 |
| Estonia | 0.7 | | | |
| Finland | 9 | | | |
| France | 450 | 1400 | very little | |
| Hungary | 1.5 | | | |
| Germany | 150 | | 50 | |
| Italy | >1,000 | | 0 | |
| The Netherlands | 100 | 40 | 80 | 25 |
| Spain | >1,500 | 550 | very little | |
| Iceland | 1 | 9 | 1 | 9 |
| Sweden | 12 | 85 | 9 | 37 |
| Switzerland | 57 | 212 | 25 | 51 |
| United Kingdom | 80 | 500-1,000 | 30 | 7 |
| <i>Non-EU countries</i> | | | | |
| Israel | 500 | | | |
| Egypt | 30 | | | |
| Canada | 31 | | | |
| USA | 195 | | | |
| Mexico | 800 (estimated) | | | |

Table 2. Main crops grown in protected greenhouse horticulture, in total, heated and the number of operators for several EU and non-EU countries in 2009.

| Country | Vegetables | Herbs | Seedlings | Ornamentals | Other |
|-------------------------|---|---------------------------|----------------|-------------|----------------|
| <i>EU countries</i> | | | | | |
| Austria | Tom ¹ , cum, swp, salads | x | x | | |
| Belgium | Tom, leafy vegetables, swp, cum | x | x | x | |
| Denmark | Tom, cum, swp | | | | Table grapes |
| Estonia | Tom, cum, swp, salad crops, melon | dill, basilica and others | | | |
| France | x | | x | | |
| Hungary | Salad crops | | | | |
| Germany | x | | | x | nursery plants |
| Iceland | Cum, tom, swp | | Tree seedlings | | Fruit (2%) |
| Italy | Tom, zucchini, swp, aubergine, melon | | x | | |
| The Netherlands | Tom, swp, cum, salad crops | x | x | x | x |
| Spain | Tom, swp, green beans, melon, cum, zucchini | | x | x | |
| Sweden | Tom, cum | Aromatic plants | x | | Berries |
| Switzerland | Tom, corn salad, lettuce | | | | |
| United Kingdom | X | | | | |
| Israel | Swp, (cherry) tom, cum | | x | x | |
| <i>Non-EU countries</i> | | | | | |
| Egypt | Swp, cum | | | | |
| Canada | Tom, cum, lettuce, swp | | | | |
| Ghana | Tom, swp, carrot, cum, cabbage | | | | |
| Mexico | (cherry) tom | | | | |
| Saudi Arabia | Tom, cum, swp | | | | |
| USA | Vegetables, tom | x | | | Transplants |

¹Tom = tomato; cum = cucumber; swp = sweet pepper.

Table 3. National research agendas after 2010 for several EU and non-EU countries, as indicated through a survey of experts in each country.

| Country | Top 4 of topics mentioned | | | |
|-------------------------|--|---|--|-------------------------------------|
| <i>EU countries</i> | | | | |
| Austria | 'Real' ¹ organic fertilizer | Low energy production | Organic vegetable breeding | New systems of beneficial organisms |
| Belgium | Soil-borne diseases | | | |
| Denmark | Soil management: improvement by tilling, adding beneficial micro organisms | Irrigation management: equipment to measure water and air content | Fertilizer: basic compost feed and additional gift during season | Energy supply in future |
| Estonia | Suitable varieties | Use of manures and fertilisation | Pest and disease control | Hydroponics |
| Hungary | low energy use – unheated structures | Novel crops and season extension | | |
| Italy | Weed management | Soil fertility management | Pest and disease management | |
| Netherlands | Healthy soil: suppression of soil based diseases by preventive measures and control elements | Control of aphids by preventive measures and control elements | Control of fungi by climate control and varieties | Sustainability, energy and climate |
| Spain | Bio-disinfection to avoid diseases | Biological control of pests | Crop rotations | Quality |
| Slovenia | Varieties | Novel crops | Fertilization | Sustainable use of energy |
| Sweden | Reduce use of natural resources | Increase of yield by optimising the growing system | Overcome problems with soil borne diseases | |
| United Kingdom | Fertilization management | Bio control | | |
| <i>Non-EU countries</i> | | | | |
| Israel | Crop protection, wider use of beneficials | Organic nitrogen supply | Weed control | Post-harvest quality |
| Canada | Closed organic growing systems | Artificial lighting | Improvement of energy use | Soil and nutrient management |
| Saudi Arabia | Plant nutrition | Biological control | Marketing | |

¹Real organic fertilizer is organic fertilizer without any components of waste material.

