Organic Knowledge Update

Greenhouse vegetables

October 2009

Organic greenhouse horticulture in the Netherlands

Total area, consumption, organisation and knowledge development

The total area occupied in the Netherlands by organic horticulture under glass is growing steadily. Several growers convert to this form of horticulture every year and some existing organic growers are expanding their businesses. However, increasing imports from Spain and other south European countries, together with rising costs, means less room for economic development within this sector. The market share for organic products in the Netherlands is still limited, being about 2.1% of the total. That is why large quantities of Dutch organic greenhouse products are exported. Another issue is that cultivation systems are vulnerable because of intensive soil use and this demands specific knowledge. Entrepreneurs and researchers work together closely in seeking to ensure cultivation success. Bioconnect helps the sector to realise its ambitions and to plan suitable research projects.

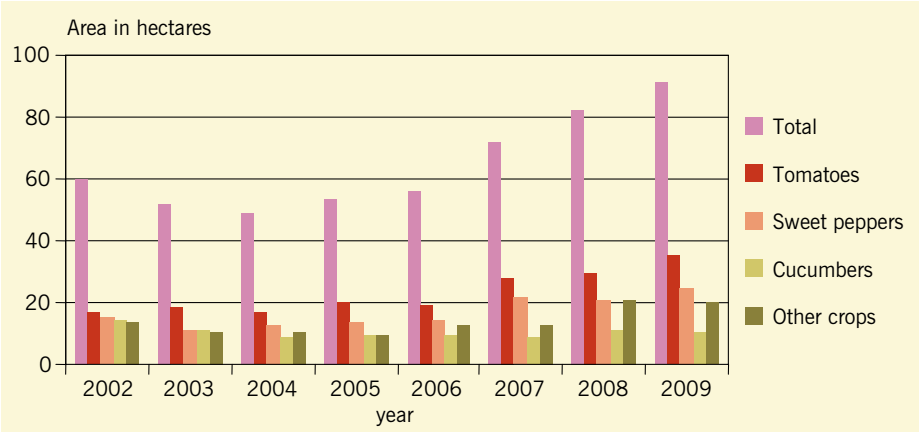

Figure 1. Area for organic greenhouse horticulture

Area under cultivation

Some 100 hectares is being used for cultivating organic greenhouse vegetables. More than 75% of this (72 ha) are devoted to tomatoes, sweet peppers and cucumbers, as well as aubergines. Most of the vegetables produced in this way are exported. In recent years, the consumption of organic products has increased further, with two new organic growers starting up every year. This year, 2009, there are 28 specialised greenhouse vegetable (tomatoes, etc) growers, as well as 10 growers with a wider range of crops. In addition to sales in the locality, these products end up in the usual distribution channels for organic foods.

Market

The market share for organic foods in the Netherlands grew slightly in 2008 to 2.1%. Sales of organic fruit and vegetables remained stable at around 3.8%. Dutch consumers are buying more organic products in the supermarkets – 44% of the total market share

Aspirations

By 2017 organic greenhouse production is a healthy sector, that uses natural processes and means to create products that are sustainable, distinctive, healthy and tasty. A constant group of consumers buys these products based on their trust of both production methods and quality. These consumers are willing to pay sustainable prices.

The Product Working Group 'Greenhouse vegetables and mushrooms' is dedicated to:

- Energy conservation, the use of renewable fuels and carbon compensation. Much research on energy reduction is currently being carried out for the greenhouse sector.
- Increasing the resilience of greenhouse crops. More knowledge on soil organisms and their interactions can increase resistance to diseases. Of equal importance are less vulnerable rootstocks and the use of effective organic pest control.
- Compliance with the European Water Framework Directive by 2019.

Current research projects

- Energy efficient organic greenhouse production
- Rootstocks for organic vegetables
- Controlling root nematodes in soil-based greenhouse production
- Improving water management to reduce emissions
- Combating aphids in capsicum
- Soil resilience, crop rotation and antagonistic crops
- Containing diseases in leafy vegetables
- Control agents for Verticillium in capsicum
- Controlling downy mildew in organic cucumber

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in 2008. The health food markets followed with a 40% share. In the Netherlands, the per capita spending on organic foods is €31.50, just above the European average of €29. Dutch glasshouse growers depend on exports, estimated to be around 70%, with the most important customers being Germany, UK, Italy, Austria, Scandinavia, Switzerland and the USA.

The ambitions of the product working group Organic Greenhouse Vegetables

The Product working group consists mainly of greenhouse growers, but representatives from the trade also have their say on research plans. Mari Marinussen is the knowledge manager and he takes care of the agenda for the Product working group (PWG). ***Energy, soil and water*** are on the working group's agenda: "We would like to take the lead in matters of energy consumption and the use of alternative energy sources, so we can be climate neutral in 2020. This means no longer being dependent on fossil fuels and introducing as many energy-saving measures as possible. The related research questions are generally in line with the demands of the whole greenhouse horticulture sector. Research into energy for organic greenhouse horticulture has therefore been included in the energy research programme".

For greenhouse growers, it is important to ensure cultivation success as intensive cultivation under glass is rather vulnerable. "This is why we are looking for new cultivation systems and control methods in order to avoid crop failures and to ensure sufficient production and yield. There is a great deal of interest, therefore, in the soil and in functional soil organisms, as well as in measures that increase disease resistance and limit damage to crops. Above ground, pest infestations also play a role, so the control of plant aphids is a particularly important research topic for us".

Because the soil is so important for organic greenhouse horticulture, leaching of minerals into the groundwater or surface waters is also a focus of attention; within the next 10 years, the Product working group wishes to see total compliance with the Water Framework Directive. And this means reducing nitrogen and phosphate leaching to more or less zero.

Energy – towards climate neutrality

Various projects are being carried out in the field of energy conservation. Organic greenhouse growers are therefore taking part in projects that can supply them with useful information. There are new ideas for greenhouses involving the storage and re-use of solar energy. The organic cultivation company Bijo has invested in a closed glasshouse concept which makes lettuce cultivation completely independent of fossil fuels.

Other measures, besides these new concepts, are necessary to reduce consumption of fossil fuels. However, organic growers are faced with special problems in a closed greenhouse, such as climate control and removal of undesirable gases. In the research greenhouses belonging to Wageningen UR Greenhouse Horticulture in Bleiswijk, researchers experiment with systems in which external air is heated and then subsequently allowed to flow into the greenhouse under the crops. This ensures the relative humidity does not increase too much and that the crops remain dry. With the aid of special fans such as Aircobreeze, the greenhouse air is refreshed and moved around to prevent the relative humidity becoming too high. It also means the crops remain dry and the greenhouse emits as little CO_2 as possible.

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Soil, resistance by means of prevention and control

The Dutch interpretation of the EU rules is that organic cultivation under glass should take place in the soil. The Dutch certification organisation Skal does not certify cultivation in natural substrates. The demand to recognize substrate cultivation as organic is nevertheless increasing and has led to intensive discussions with the government and with various organisations at home and abroad. Many years of intensive cultivation of greenhouse vegetables in the same soil causes production to drop off and soil infections and infestations to increase. An increasing occurrence of root-knot nematodes and/or soil fungi such as *Verticillium* means the problem now needs to be tackled. The greenhouse growers require considerable skills to manage this problem, as prevention and control need to complement each other.

External air is warmed up, ensuring low relative humidity and drier crops

According to research coordinator Rob Meijer, at Wageningen UR Greenhouse Horticulture, soil-associated cultivation systems need to be altered. "In the short term, steaming the ground can have an effect, but it undermines natural resistance. Many growers have therefore stopped steaming and are looking, together with researchers, for more suitable measures. The soil is a complex system, and we know relatively little about it, so we are planning a long-term research project in which the results from fundamental research will be tested in practice at the cultivation companies. The biorotation greenhouse project looks at the effect of alternative rotation systems; it could lead to suitable preventive measures. In addition, we are investigating greenhouse soil vitality measures that will make the soil more resistant to infections and infestations. Two companies are now cultivating greenhouse vegetables in strips in such a way that 50% of the ground is cultivated and the space is utilised in the best possible way".

Bio-rotation greenhouse

Including the crops in a spacious fruit rotation plan can help to prevent the occurrence of soil-associated infections and infestations. That is why growers and researchers are looking for systems with intelligent crop rotation. Biodynamic grower Marc Baijens is already using a cultivation system in which cucumbers are rotated with *Tagetes* (African marigolds). The inclusion of a fallow period with Tagetes means the soil is used less intensively and this helps to suppress the nematode population. The Verbeek Brothers use a variation on this theme, the Köver system, in which foil is placed vertically between rows, extending down into the soil. Instead of two rows, the plants are cultivated in double density in one single row. The consequence is that one of the cultivation strips is not used, so there is room for a fallow or for suppressive crops in between. This year (2009) a second company has started a practical experiment in which sweet peppers and various green manures are combined.

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Soil vitality greenhouse

By increasing or maintaining the levels of organic matter in the soil, soil organisms are stimulated, and this helps with resistance to infections in general. Higher biological activity does not, however, automatically mean that the resistance to infections is good; specific antagonistic microorganisms are necessary for this. Several fungi can suppress the development of plant pathogenic fungi such as *Fusarium*, *Botrytis* and *Pythium*. The best known of these suppressors, Trichoderma, is now available commercially. Several compost companies routinely add *Trichoderma* to their compost, and plant cultivators introduce this fungus at the seedling stage if requested.

Compost provides organic matter and stimulates soil life

Rotation with *Tagetes* suppresses the nematode population

The Soil Vitality Greenhouse project involves identifying soil properties (both biotic and abiotic). In addition, soil samples from 12 companies are checked for degree of resistance. This allows any factors (and indicators) to be found which might affect the infection-resistant potential of soil by stimulating or adding these factors. Measurements carried out in 2008 showed that the development of soil life was different for each company. The less intensive companies all demonstrated a more varied soil later than the more intensive ones.

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Rootstocks for greenhouse vegetables

Rootstocks are used both in soil and substrate cultivation systems. These strongly rooting stocks may be less resistant to fungi, thus increasing production in grafted varieties. Sensitivity to nematodes, and especially to *Meloidogyne incognita*, but also against Verticillium, plays an important role in an organic grower's choice of rootstock. Little is known about the sensitivity of rootstocks, which is why they have been tested for sensitivity and the degree to which nematodes multiply after infection. These tests are carried out in buckets in order to regulate the concentration of infection. Several new rootstocks with high tolerance have been found for cucumbers and these are being tested for production and product quality in practice.

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Antagonistic crops

These crops reduce the numbers of injurious organisms in the soil. Some plants attract nematodes, ultimately killing them, thus causing the population to decrease. It is also possible to capture nematodes by interplanting with 'capture plants'; these are subsequently removed from the greenhouse together with the crop. For example, the 'capture plant' fodder radish can reduce populations of *Meloidogyne hapla*. This radish can be sown as a second crop and then worked into the ground or removed before the next planting. *Tagetes* is also known to attract populations of nematode, *Pratylenchus*, and kill them. The effect of *Tagetes* on *M. incognita* is not yet fully understood. Interim results with Tagetes in the Köver system in 2008 demonstrated that crop production fell while the numbers of nematodes scarcely decreased. However, bruising the *Tagetes* and digging it in may have more effect. Specific sweet pepper rootstocks with resistance or tolerance also appear to affect soil nematodes and this is being researched in the 2009 trials.

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Water – prevent leaching

The European Nitrates Directive sets out requirements for soil-based greenhouse horticulture. Standards of use apply at this moment but ultimately the goal is to achieve zero emission. To find out exactly how much mineral matter disappears into the ground water, six lysimeters have been buried in the ground in three greenhouses in order to capture the outflow of water plus minerals. These data are coupled to the watering system in use and this can then be adjusted if necessary. In the first year there was very little leaching of water, so mineral loss was limited.

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Control aphids with 100% biological control

Aphids are a constant threat to organically grown sweet peppers and aubergines. Although a large arsenal of natural enemies is available, some crops do fail each year because the control has been insufficiently successful. The control methods seem to fail for no real reason or they are not effective enough. One of the most important agents is the midge *Aphidoletes aphidimyza*, the larvae of which are extremely effective in getting rid of plagues of aphids.
Wageningen UR Greenhouse Horticulture has researched a number of aspects that could limit the effect of this midge.
An important problem appears to arise because other organisms (predatory mites and bugs used to control thrips in the crop) feed on the eggs of the midge. In theory, all these thrips predators can threaten the midge but the only one to cause problems in practice seems to be the predatory mite Amblyseius swirskii. Climate also plays a role. Experiments have shown that a lower relative humidity causes lower reproduction rates in the midge; its behaviour is affected so it becomes more vulnerable to predation by other control organisms. An understanding of these threats helps growers to use the right combination of control methods under the right conditions.

Predatory mite *Amblyseius swirskii* introduced to fight thrips disturbs biological control of aphids

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Diseases in leaf crops

Botrytis and downy mildew are difficult to control in leaf crops and cucumbers. There are now several methods on the market claiming to be effective against these pathogenic fungi. This year the effects of *Trichoderma* (Trianum) and *Coniothyrium minitans* (Contans) will be tested. In these trials, the effect of UV light on these fungi will also be noted. Also the effect of ventilation to control the air humidity is being studied.

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Growers network and exchange of bioknowledge

Since 2006, a company network has been organising seminars and special meetings on organic greenhouse horticulture, thus allowing knowledge and experience to come together. In the study groups, the entrepreneurs in particular can exchange knowledge and experience. The theme of each special meeting is introduced by experts and illustrated by means of demonstrations. Of the 38 growers, 32 are actively involved in this company network.

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Bioconnect aims to further develop and strengthen the Dutch organic sector by initiating and implementing research projects. Within Bioconnect organic entrepreneurs (from farmers to shopkeepers) work together with research institutes, colleges and universities and consultancy organisations. This leads to demand-driven research that is unique to the Netherlands.

Bioconnect
The innovation network of organic agricultural chains

The Ministry for Agriculture, Nature Conservation and Food Quality sponsors these research projects.

Ministry of Agriculture, Nature and Food Quality

Wageningen University and Research Centre and the Louis Bolk Institute together carry out these research projects. About 140 projects dedicated to organic agriculture are currently under way.

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