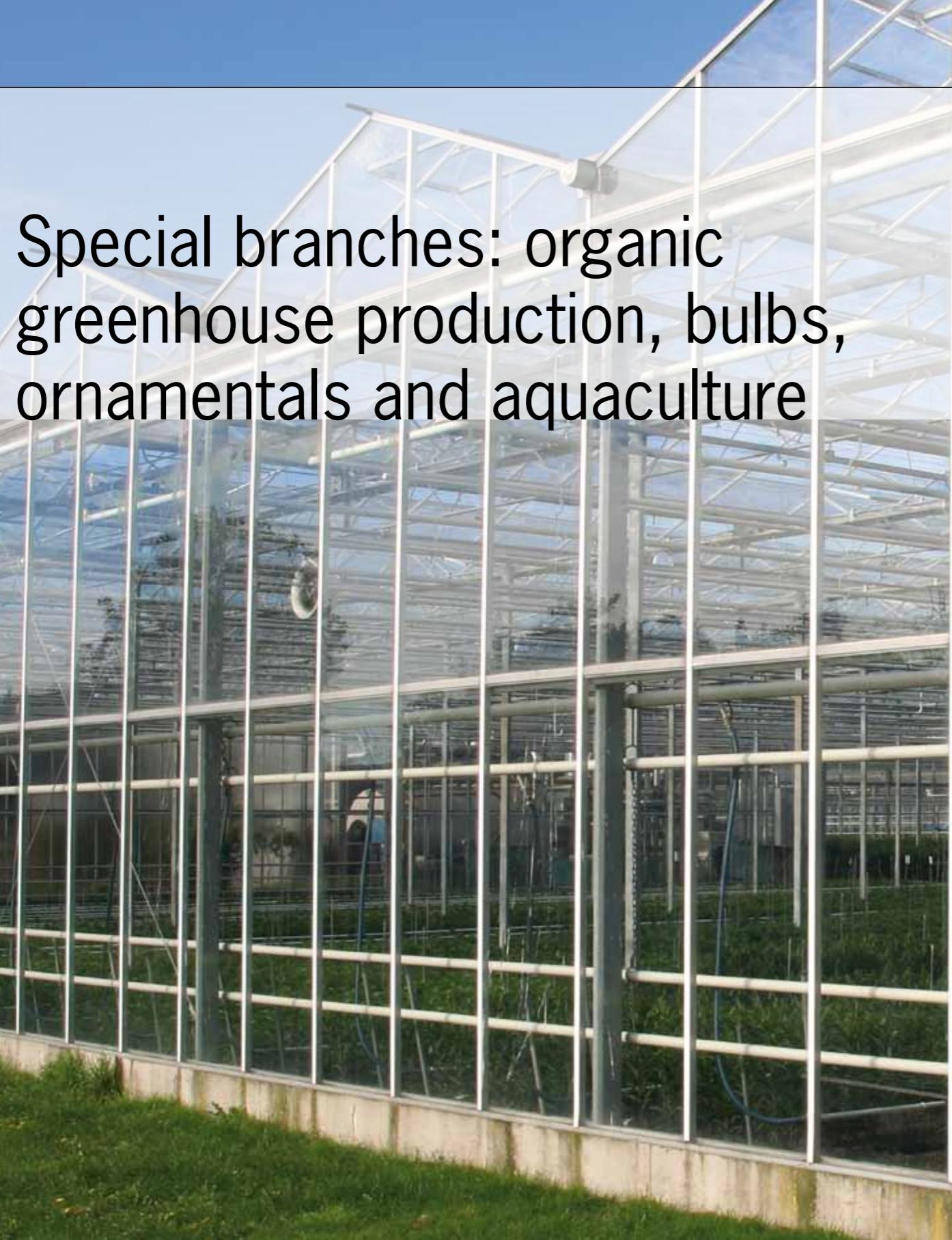


10



Special branches: organic greenhouse production, bulbs, ornamentals and aquaculture

Organic production methods are gaining ground in Dutch specialised production branches. Interest is growing among greenhouse horticulturalists and growers of flower bulbs, ornamentals and mushrooms. In organic horticulture Dutch research is unique in the world in thinking up innovative concepts and pioneering solutions. Ultimately this will also inspire change in the conventional sector.

The Netherlands has a variety of specialised, capital-intensive branches of agricultural production, which are characterised by high turnover and a strong focus on exports. Researchers and farmers are exploring the opportunities for organic production in these branches. So far little or no research has been conducted and in some cases organic standards are still to be developed. Yet these branches do offer opportunities for organic production. Moreover, the alternative approaches needed for the organic sector can inspire the conventional production to move towards a more sustainable production.

Research programmes are linked as closely as possible to practical needs. "We work in close cooperation with producers and chain partners", says Rob Meijer, coordinator for Covered Organic Cultivation. Researchers work together with the organic sector on sustainable organic farming systems that are economically viable.

Organic greenhouse horticulture

Growing market demands have stimulated an increase in organic production, especially of greenhouse fruit vegetables and leafy vegetables. About 35 organic greenhouse vegetable farms (25 of which have intensive heating systems) together cover an area of 85 hectares. "Each year the number of organic farms increases", says Meijer. "This steady growth takes place primarily in greenhouse vegetables, such as cucumbers, tomatoes and sweet pepper. More than 80 per cent of these vegetables are exported".

Organic greenhouse cultivation has its own specific problems, such as high yield loss due to diseases and plagues caused by intensive use of the soil. In open-field organic cultivation the soil stays healthy thanks to a diverse crop rotation. "But greenhouses are far too expensive to leave fallow or to produce crops with a low turnover", says Meijer. "And crop rotation is not as easy. Tomatoes and capsicum, for example, both belong to the Solanaceae family, and they therefore contract pretty much the same soil-borne diseases, such as root-knot nematodes. And cucumbers are not very far away in the family tree either."

Conventional fruit vegetable growers begin each new crop on a clean substrate. But this is not an option for organic growers, nor can the corresponding solutions using synthetic fertilisers be applied in organic cultivation.



Rob Meijer

"Achieving soil resilience is the biggest challenge in organic greenhouse horticulture"

Rob Meijer



Root damage caused by root-knot nematode

Meijer: "In spite of the compulsory crop rotation of 1 to 2, disease-causing nematodes and the wilt disease *Verticillium*, sometimes increase dramatically. Due to disease and damage, the yields after a few years will average no more than 70 per cent of the normal yield."

Much research is therefore being conducted into the disease-resistant characteristics of soil life, and the optimal application of organic fertilizer to feed soil life and stimulate antagonists.

In a project called 'Biowisselkas', researchers are experimenting with antagonistic crops, alternative crops and fallow periods. This has led to the development of an interesting cultivation system in which cucumber plants in the greenhouse are alternated with beds of Tagetes (see box 'Controlling soil pathogens in greenhouses'). We have also thought about summer flowers as an antagonistic crop, but most fruit vegetable growers are not very interested in cultivating cut flowers. Organic flower cultivation requires different know-how and the distribution channels are not as well developed yet. It is difficult for organic flower growers to stay on the market year-round using only natural cultivation techniques and no assimilation lighting."

The new 'Biovitaalkas' project, aims to find precise and measurable criteria to define soil health and resilience. Meijer: "Achieving soil resilience is the biggest challenge in organic greenhouse horticulture." Generous use of compost and other organic material to improve the soil in organic cultivation can lead to excessive leaching of minerals. Research is therefore also focused on creating a better mineral balance through efficient fertilisation techniques or recycling nitrate.

Energy use in greenhouses is another issue that needs attention. Lower yields in organic cultivation lead to higher energy use per ton of product compared to conventional cultivation. Extra heat is also lost when the greenhouses are aerated in the mornings. Organic growers are always concerned about condensation on their plants, which can lead to fungal diseases. Soil-based organic cultivation also requires more energy than substrate cultivation because moisture is lost from the soil when windows are opened to air out the greenhouses. Both organic and conventional greenhouse growers strive to drastically reduce the energy use in their greenhouses. The ultimate goal is to make greenhouse production climate neutral.

Research towards reducing the energy use in glasshouses for conventional and organic agriculture is carried out jointly. Several innovations are already being used or tested in practice. One example is using residual warmth and CO₂ of the generators that produce electricity for the greenhouse. Some greenhouse growers are also using waste materials for their heating. A new development is to store the surplus of warmth in the summer in underground water layers. During winter the warm water is pumped up and used for heating. Developments progress fast and greenhouses have the potential to eventually become net producers of energy.

Organic production of ornamentals

There are about 50 organic ornamental tree growers in the Netherlands. "Together with producers and potential institutional customers, we are looking at the marketing perspectives of organic tree



In the Köver system the strips of soil with different crops are separated to prevent cross-contamination

Controlling soil pathogens in greenhouses

In organic greenhouse production, controlling soil borne pathogens such as *Verticillium* and nematodes is a big challenge. Endoparasitic nematodes cause high yield losses. They invade the roots, damage plant tissue and obstruct root functions. Important species in this respect are the root-knot nematodes (*Meloidogyne spp.*).

Research has been looking at the possibilities to prevent or control these parasitic nematodes. Preventive measures are the first to be considered. Resistant or tolerant rootstocks could be used, but these rootstocks only prevent the damage. They do not influence the propagation of nematodes.

Crop rotation is an important preventive measure. Unfortunately however, most fruit crops grown in greenhouses are genetically closely related and suffer from the same

pathogens. Researchers and growers are therefore experimenting with other kinds of rotations. A fallow period could help, especially when this period is used to grow green manure crops which reduce the nematode population. Marigold is a good option. But greenhouses are very expensive, so from an economical point of view fallow periods should be as short as possible.

A special kind of crop rotation that can be effective to prevent nematode infection is so-called strip cropping. The cultivation beds are divided into strips and alternatively culture plants and green manure crops are grown on the strips. The green manures that are used are able to reduce populations of soil pathogens. Marigold for example is effective against nematodes like *Meloidogyne* species. In the so-called Köver

system one further step is taken by also separating the strips of soil physically. The Köver system is tested in practice by greenhouse farmers. In cucumber and tomatoes this system proved to be applicable without any yield loss. With sweet pepper yield losses of 10% were measured. When the population of parasitic nematodes becomes too high, control measures have to be taken. Soil steaming is an option but it is not a very sustainable solution as this method requires a very high energy input. Researchers are experimenting with biofumigation in greenhouses. With this technique a large volume of green manure is incorporated in the soil. Specific types of green manures are used; the manure should contain compounds toxic to plantparasitic nematodes, for example mustard.



Perennial ornamental plants combine well with ornamental tree cultivation

nursery products", relates project leader Henk van Reuler. "This is the common dilemma of which comes first, the chicken or the egg. As long as buyers are not aware of what is available, where it can be found and when it can be supplied, demand will remain limited. And this does not stimulate supply. Moreover, tree nursery products are attractive, regardless of whether they are cultivated organically. They are not edible, so consumers will not specifically request organic products for health reasons."

In recent years research has been conducted into combining other crops with ornamental tree cultivation. "Our research has led to interesting, practical recommendations and crop combinations. In the cultivation of ornamental trees, for example, natural enemies can be stimulated by a combination with the cultivation of perennial ornamental plants that attract insects. Veronicas, for example attract hover flies, which feed on the larvae of aphids."

"Weeds are a big problem in organic cultivation of ornamentals", Van Reuler continues. "And weed control is always very time-consuming. Organic growers of ornamental plants use mechanical weed control methods and are experimenting with soil covers that are applicable in organic cultivation. With mechanical weed control there is a big risk of damaging the crop, which would result in an unmarketable product. We are looking into new mechanical techniques, such as a guided hoe, in combination with torsion weeders. These techniques have already proven their value in arable farming."

Organic bulb and flower cultivation

The Netherlands is the world's largest producer of flower bulbs, with a market share of about 70 per cent. Tulips, daffodils, lilies, crocuses, hyacinths, grape hyacinths, dahlias and other flowers are grown on an area covering more than 22,000 hectares. The flower bulb branch is among the most profitable Dutch agriculture. Currently only one per cent of this area is cultivated organically. The cultivation of flower bulbs and the production of cut flowers from bulbs are important economic activities. Both in organic bulb and bulb flower production, researchers and farmers have been working together to develop knowledge for a sustainable and economically viable production. Research has helped to overcome important bottlenecks for organic production, such as fertilisation and pest control.

The dry bulb mite, *Aceria tulipae*, is the most important pest in tulip crops. Without control measures cropping of tulip bulbs in the Netherlands is impossible. Researchers have developed a new treatment with a short ULO (Ultra Low Oxygen) treatment of flower bulbs in the storage which is effective. However the treatment is quite expensive and hard to organise. Scientists and farmers are still working hard to find a solution (See box 'Combating dry bulb mite in tulips').

Flower bulbs are traditionally cultivated in a rather limited crop rotation, which leads to many soil-borne diseases. The project 'Topsoil+', is directed toward developing new organic farming systems in which flower bulbs, such as tulips, daffodils or hyacinths, are rotated in an extended crop rotation supplemented with summer flowers, small ornamental shrubs and sometimes alternated with green manure crops. Smaller varieties of the more expensive ornamental shrubs, such as smoke trees (*Cotinus*), are of particular interest. Van Reuler: "The sand in the flower bulb cultivating region is rather coarse, and can thus be flushed out pretty easily. This makes it lucrative to export flower bulbs together with ornamental shrubs in one package to the United States. For phytosanitary reasons, the United States does not accept import products containing soil."

In addition to creating a more varied crop rotation, the increased supply of organic matter also helps suppress soil-borne diseases. Tests have demonstrated a clear effect of the previously cultivated crop and the level of organic matter on the presence of root-knot *Meloidogyne hapla*, which is a problem for many perennials. This effect has been supported by field data. Says Van Reuler: "Apparently the soil's resilience is enhanced by a richer soil life, which is stimulated by a bigger



Combating dry bulb mite in tulips

Dry bulb mite (*Aceria tulipae*) is a major problem for Dutch organic tulip bulb producers. The mite causes a lot of damage to the bulbs, especially during storage. If the mite cannot be controlled, organic tulip bulb production is virtually impossible. The most effective way to combat dry mite is the Ultra Low Oxygen treatment (ULO). This method however, is costly and logistically difficult. Also, with ULO all bulbs are treated whereas less than 50 per cent are actually infected.

In recent years, researchers and growers have tried to come up with a way to suppress dry mite using mite pathogens. Although half the infections could be

resolved, the side-effects of these treatments were too severe. The main problem of this wet treatment is that the conditions are beneficial to the fungus *Fusarium*, which causes severe damage to the bulbs. Because ULO is expensive and treatment with mite pathogens was not a good option, new ways out of the *Aceria*-problem are sought. Growers are in need of a good detection method, to quickly discover whether a batch of bulbs is actually infected with dry bulb mite. This way only the batches that are actually infected can be treated using ULO. Costs for treatment would then go down by more than half,

as less than 50 per cent of all bulbs are expected to be diseased. Researchers are now developing early-detection methods for dry bulb mite. One option is a special mite trap, the so-called Bt-trap. These Bt-traps are currently being tested in a number of bulb storage units. Growers use the traps to determine whether mites are actually present in their bulbs. Early detection of dry bulb mite can also be beneficial to conventional bulb producers, as it can save time, money, labour and chemical disinfectants.

Three tulip bulbs with from left to right: no infection, light infection and heavy infection with dry bulb mite



Selecting organic flowers

Organic flowers are sold mostly in bouquets and sunflowers are the main flowers in these bouquets during the summer season. To facilitate organic bouquets year-round, new flower species should be grown in greenhouses. Unfortunately, research has shown that not all types of conventionally cultivated flowers and varieties are suitable to organic cultivation. Tests on Marigold (*Calendula*), Star-of-Bethlehem (*Ornithogalum*), Lesser Bullwort (*Ammi visnaga*), Mexican marigold (*Tagetes erecta*), False Spirea (*Astilbe*) and Peruvian Lily (*Alstroemeria*), among other flowers, were conducted on test farms and cultivation guides were compiled for growers.

Most cut flowers can be produced relatively well under organic conditions. But not all periods in the year are feasible. It is especially difficult during periods in which conventional growers also have problems. The shelf life of *Calendula*, for instance, is a problem when this species is harvested during hot periods. And *Ammi visnaga* is susceptible to secondary growth and neck rot. A few general issues that growers have to pay close attention to are: the vigour of the soil, the limited marketing channels, and the availability of organic means to control the most important pathogens.

supply of organic matter. This knowledge could be of interest to conventional growers as well". Another developing branch is the organic cultivation of cut flowers. These are produced in the greenhouse, in open cultivations and as flowers from flower bulbs. Sunflower is an important product for the summer season. The main challenge in this sector is to solve the problems with downy mildew. There is a demand for cut flowers all year round, not just for sunflowers in summer. Therefore, research is searching for a wider range of species and varieties that can be produced organically in the greenhouse (see Box 'Selecting Organic Flowers').

Organic aquaculture

In recent years there has been a growing interest in the socially and ecologically responsible production of fish. Animal welfare and sustainability are key considerations. Certain cultivated fish species can help lower the pressure on overfished wild populations. With plant-eating fish species like tilapia, for example, farmers can avoid the use of high amounts of fishmeal in feed, for which other fish would have to be caught. The development of organic fish production can help to improve welfare and sustainability aspects of fish farming.

Organic wine from the Netherlands

Dutch wine tastes pretty good. On a scale of 5 points, consumers awarded the wine an average of 3.4. According to market researcher Dr Frans Verhees from Wageningen UR, the taste will still have to improve if winemakers want to move into new markets. "In the gift market, customers are willing to pay the higher price because of the story behind the wine, but serious wine buyers are looking for quality." Thanks to the emergence of new mildew-

resistant and early-ripening varieties, organic wine production in the Netherlands is growing. With increasing production, marketing has become an important issue. Therefore a survey was carried out among wine buyers, at the initiative of the association of winemakers in Groesbeek and the Wijnbouwcentrum Nederland. It turns out that only two per cent of Dutch consumers prefer to buy wine produced in their own country.

To improve the image of locally produced wines, courses, wine certifications and the introduction of a quality label could help. A better image could stimulate the production of quality Dutch wines. It would not be advisable to try and compete on price with the common wine-producing countries. Verhees: "Cost prices are relatively high here, so the market for Dutch wine will always remain a niche market."



"We are working on new methods to measure stress levels and welfare in fish"

Marnix Poelman

Currently there are no certified organic fish farmers active in the Netherlands, but interesting innovative concepts are being developed. "The Netherlands is an important global player in the use of recirculation systems to raise fish and shrimp", explains researcher Marnix Poelman of IMARES of Wageningen UR in Yerseke. "This system does not use a continuous stream of water: almost all the water is recycled in large breeding tanks. It is purified through filters and other technical means. The Netherlands would like to obtain an organic certification for these recirculation systems." The Dutch firm AgroEco is leading these efforts.

In a conventional fish production system the objective is to increase production. In an organic fish production the idea is to create conditions in which the fish can behave as naturally as possible, even if this reduces production capacity. "If a fish grows normally, is not sick, eats well and is not damaged, we generally assume that it feels good", says Poelman. "But these are definitely not the best parameters for animal welfare. That's why we are working on new methods to more accurately measure stress levels and welfare in fish."

Throughout the world there are various certifications for organically grown fish, but these pertain to pond systems or net cultures in open water: the cage constructions that can be found along the Canadian and Norwegian coasts, among other places. Poelman: "A European organic label for fish production is currently being developed. This label sets a number of requirements for aquaculture products such as the maximum fish density in the system, the allowable percentage of vegetable matter in fish feed, and various environmental demands. Poelman and his colleagues are evaluating



these regulations and are drawing up welfare criteria for organically raised fish. The IMARES expertise is used to contribute to the discussions in Brussels.

At this moment the focus is on common cultivated fish species, such as tilapia and catfish. But shrimp could also be produced organically in the Netherlands. Furthermore, IMARES started a feasibility study for the organic production of mussels. In this case the focus is on ecological aspects and water quality. "We have great expectations", says Marnix Poelman. "With mussels very little input is needed: it is almost organic to begin with. The only aspects that need to be optimised are the collection of mussel seed and the processing requirements."

Literature

Reuler H. van, Dalsen, P. van, Os, G.van, Helm, F. van der and P. van Leeuwen. 2008. Topsoil+ - Soil quality in open field ornamental crop production. Proceedings ISHS Symposium 20-24 April, 2008. Lisse, The Netherlands.

Baar, J. and J.G.M. Amsing. 2005. Greater success for organically grown exotics, Mushroom business 12: 24-25.

Information

- Rob Meijer MSc.**
e-mail: rob.meijer@wur.nl
**Researcher Organic Covered Crops and
Ornamentals**
Greenhouse Horticulture
Wageningen UR
- Dr Henk van Reuler**
e-mail: henk.vanreuler@wur.nl
Researcher Farming Systems and Soil Fertility
Applied Plant Research
Wageningen UR
- Marnix Poelman**
e-mail: marnix.poelman@wur.nl
Researcher Aquaculture
IMARES
Wageningen UR