



Organic Food and Farming in Flanders



NOBL

Netwerk Onderzoek Biologische Landbouw & voeding

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Research 2017-2018



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Dear reader,

With this publication we continue a biennial tradition. For the fifth time, we have gathered relevant information on research related to organic food and farming in Flanders. This overview shines a light on the research projects and results from 2017 and 2018.

Knowledge creation and dissemination is very important in the development of the organic sector. In the new Strategic Plan for Organic Agriculture 2018-2022, knowledge development and dissemination got a more prominent place and the government promised to further boost research for organic agriculture and food. This makes us very hopeful! For optimal use of the available resources, we want to continue to stimulate the cooperation between all knowledge centres and with the sector. The past year, the Flemish *BioKennisNetwerk* updated its 'Research strategy for organic agriculture and food: 2018-2022' together with its partners. With the design of a Living Lab for Agro-ecology and Organic agriculture, ILVO wants to create extra space to facilitate future knowledge development and sharing between and together with all research and knowledge partners and the organic sector.

On 10th January 2019, the NOBL seminar took place at the Agriflanders trade show. During this seminar, titled 'Organic agriculture, smart farming?', NOBL, together with Boerenbond, Inagro, CCBT and ILVO, focused on the value of new technologies for innovations in organic arable and vegetable production. The participants reflected on the role that new technologies can play for organic family farms that are often less specialized and limited in size. Discussions were held on the research themes and aspects that will best support 'smarter' production in Flemish organic agriculture and horticulture in the future.

Thank you to all who have contributed to this overview! To all, enjoy your reading!

Lieve De Cock
coordinator NOBL

Johan Van Waes
chairman NOBL





Organic agriculture in Flanders

Remarkable growth rates for the organic sector in Flanders

Consistent with previous years, the organic sector in the Flemish part of Belgium has continued to grow in 2017, both in terms of production and consumption.

Substantial increases in number of market players, cultivated area and livestock

The number of certified organic farms went up to 468 units, a growth rate of almost 9%. A majority of these farms engages in specialized activities in arable farming, horticulture or fruit production. Nearly one-third raises organic livestock, combined or not with crop production. The number of market players that do not qualify as primary producers has increased to over a thousand. These businesses are active as wholesaler, processor, retailer, importer and/or exporter of organic products. The organic crop area went up to over 7300 hectares, an increase of 45% over the past 5 years. About 1.2% of the entire agricultural area in Flanders is currently used for organic farming. Organic stock farming also recorded strong growth rates in 2017, with the cattle population (+68%) and the pig population (+40%) being the most striking growth areas.

Crops and animals highlighted

About 41% of the organic crop area in Flanders consists of grassland and forests. With a share of 24%, cover crops/green manures (mainly clover) are the second most common category of crops. Arable farming covers 16% of the organic area, whereas 11% is used to grow potatoes, vegetables and herbs. The remaining 8% is mainly utilized for fruit production. In 2017 the organic livestock totaled 5299 bovine animals, 6428 pigs, 517,775 poultry and 8348 ovine and caprine animals. The organic livestock count has grown by 13% over 2016.

Public expenditure to promote the organic sector

Public expenditure in favor of the organic sector rose to more than € 4 million in 2017. With a share of 48%, the focus was on direct financial support for organic farmers by means of financial support for organic farming per hectare, investment aid, subsidized consultancy services for organic farms and contribution for certification costs. Of the total public expenditure for organic, 18% was used for market and chain development and 18% for research and knowledge sharing. The remaining 16% was assigned to communication, promotion and improving consumer acceptance. The



Flemish public expenditure for organic research accounted for 700,000 euros in 2017. More than one-third of this went to research projects on crop protection.

Increasing organic consumption

Flemish households spent 284 million euros on organic products in 2017, an increase of 37% over the last five years (as monitored by GFK Belgium on behalf of VLAM). Spending on organic fresh products amounted to € 193 million, 11% more than in 2016. Organic fresh products have a market share of 2.4% in Flanders. Nine out of ten Belgian consumers buy at least one organic fresh product each year. Spending on organic fresh products is led by the category of potatoes, vegetables and fruit. When taking the market share of fresh products into consideration, organic meat substitutes have the largest market share (26%). Traditional supermarkets still are the main sales channels, while hard discount is the fastest growing channel. Farm shops and farmers' markets are sales channels that offer a higher share of organic products in their product range than average: 1 in 5 products is organic.

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Partners: Department of Agriculture and Fisheries, VLAM (Flanders' Agricultural Marketing Board) and ILVO

More information: the report on organic farming is available at www.vlaanderen.be/landbouw/studies

ONDERZOEKS- & KENNISNETWERK



COCREATIEF



SYSTEEM



MULTIDISCIPLINAIR



BOEREN

VLAANDEREN



BIOLOGISCHE
LANDBOUW
& VOEDING

INNOVEREN



DUURZAAM

AGROECOLOGIE



EUROPA

PARTICIPATIEF

VRAAGGESTUURD

communiceren

onderzoeksdatabase

onderzoekers

onderzoeksstrategie

BIOpraktijk.be

faciliteren

draagvlak

adviseurs

TPOrganics

kennis

projecten

kennisontsluiters



NOBL

www.nobl.be

Biobedrijfsnetwerken

www.bioforumvl.be



CCBT

www.ccbt.be

Meer weten? info@ccbt.be

Met steun van de
Vlaamse overheid





Research organisation and knowledge exchange

Research on organic farming within the Government of Flanders

The new Strategic Plan for Organic Agriculture 2018-2022 started in 2018. This policy plan, which outlines the policy for organic agriculture, was officially launched by the Flemish Minister of Environment, Nature and Agriculture on 8 March of this year. It is the result of a close collaboration between the Flemish Department of Agriculture and Fisheries, Algemeen Boerensyndicaat, Boerenbond, BioForum Vlaanderen, Comeos Vlaanderen, Fevia Vlaanderen and VLAM (Flanders' Agricultural Marketing Board).

Regarding the central ambition 'together towards more and better organic agriculture', research is very much present in the word 'better'. This stands for the qualities and strengths of organic agriculture in Flanders. They are an incentive for further sustainability and innovation in agriculture and horticulture. The organic sector is a pioneer and innovator in various fields. A well-developed research and knowledge network provides the organic farmer with tools to further optimize his management. Therefore, the Government of Flanders will make substantially more resources available for research in this new strategic plan.

A selection from 2017 and 2018 in the field of research

In 2017 and 2018 the Government of Flanders, Department of Agriculture and Fisheries, continued supporting and subsidizing the activities of the CCBT, NOBL and the Organic farmers' networks. More information can be found on their websites:

www.ccbt.be, www.nobl.be and www.bioforumvlaanderen.be.

The Department of Agriculture and Fisheries continued to publish an annual report on organic farming in Flanders in 2017 and 2018. This report still is the reference on the status, progress and special features of organic farming in Flanders. It also provides an overview of government spending for the organic sector (including research and knowledge) and the distribution and consumption of organic products.

In the framework of the Flemish call for research in organic farming, the Department of Agriculture and Fisheries awarded four project subsidies:

- "Creating added value in organic farming through sustainable combinations of vegetable crops with an outdoor for poultry" LEBCOMBIO "(ILVO)
- "Source-oriented control of Galinsoga on organic vegetable farms" (Ghent University)
- "Ensiling mixed crops of humid legumes and grains for organic hens - KUILEG" (ILVO)
- "Healthy rearing in organic dairy goat farming" (Odisee vzw)



Flanders will also continue to seek contact with European research on organic farming. From the COREOrganic PLUS call in 2018, the innovative projects “Strip-cropping and recycling for waste for biodiverse and resource-efficient intensive vegetable production - SUREVEG” (ILVO) and “Organic and biodynamic vegetable production in low-energy greenhouses - sustainable, resilient and innovative food production systems - GREENRESILIENT” (PCG) were selected.

In 2017 and 2018, both NOBL and the Department of Agriculture and Fisheries will continue to actively participate in the negotiations of a next call, so the Flemish research needs can meet as much as possible with the identified themes. That call is expected in 2019.

What the future will bring ...

The new Strategic Plan for Organic Agriculture 2018-2022 sets out the guidelines for the actions of the coming years. The focus of this new plan lies on the so-called organic clusters (“bioclusters” in Dutch), the first of which will be launched in 2019. The bioclusters will be proactively inform regional farmers and chain participants about organic farming. The bioclusters aim to bring together farmers that already have potential for conversion and guiding them throughout the conversion process, by informing them and bringing them into contact with local organic farmers, potential clients, researchers, etc. By repeating those activities, these bioclusters will create a regional dynamic around organic farming, in which research will also have an important role. Core in this approach is that cooperation and knowledge building will allow to build an even stronger locally anchored network of organic farming.

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Collaboration: Government of Flanders, Department of Agriculture and Fisheries

Organic farmers' networks, a basis for demand-driven research

Organic farmers' networks are networks of organic farmers who meet regularly to exchange practice-based knowledge. After all, knowledge is not exclusively developed in laboratories or research centers. Research by individual farmers about what they experience on their farm is an irreplaceable source of knowledge. Sharing this experience - gaining experience from other farmers, but also bringing experience from your own farm - is the engine of these farmers' networks.

Every sector has its network

The networks started in 2009 on the initiative of BioForum, Landwijzer and the Dutch Louis Bolk Institute. BioForum acts as a facilitator. The experimental research centers advisors active in organic research and agricultural advisors in the relevant sectors are also involved. In this way, topics that cannot solely be solved by farmers' experience and raise additional questions are addressed by the appropriate source of knowledge. Experimental research centers and information officers share lessons learned from earlier research and from other farms, and also take questions from the networks to launch new research.

Organic farmers' networks: indispensable to the the whole

The Organic farmers' networks are embedded in the Flemish Organic Research and Knowledge network (FORK-network). We work together with CCBT and NOBL. These institutions ensure that questions from the Organic farmers' networks are taken into account in practical-oriented research and applied/fundamental scientific research. As a result the research is increasingly demand-driven from the sector. Conversely, they also ensure a feedback loop from the research results to the sector.

This means that the Flemish organic sector is at the forefront of innovation in the field of scientific research and knowledge development: collaboration from all knowledge institutions, based around the central role of the farmer's experiential knowledge in the day-to-day practice of farming.

Since 2009, besides the fruit growers group, which has long served as a farmers' network for the pome fruit growers, networks for dairy farming, goat farming, beef farming, poultry farming, small fruit growing and arable farming / field vegetables, and pig farming has been created.



Across sector boundaries

Often the Organic farmers' networks also works across sectors (e.g., consultations between livestock farms and farms with crop production about exchanging feed and manure and cooperation) and within the sectors in specific theme groups (e.g., in the vegetable sector: short supply chain, own seed production, bees etc.). Since 2018, the vegetable network have been split into two networks: short-chain vegetables and long-chain open air vegetables, and a new network for organic flowers has started.

Getting started

The networks are normally reserved for established, organic farmers. In addition, the networks are also open to farmers in conversion or in a preparatory trajectory with 'Organic seeks farmers' or organic farming consultants. Over the years, the network coordinators have also done a lot of work on the methodology of how to stimulate this type of practical knowledge exchange among farmers. Organic farmers' networks wish to share this experience with anyone who wants to work in the context of research with farmers' groups, including conventional agriculture.

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Funding: Department of Agriculture and Fisheries, Government of Flanders

More info: www.BioForumvlaanderen.be/biobedrijfsnetwerken

CCBT vzw - Coordination and communication on applied research and extension on organic farming in Flanders

As the umbrella organization for practice-oriented organic research, CCBT forms the bridge between research and practice. The annual subsidy from the Government of Flanders enables CCBT to manage a budget for research projects. These projects are demand-driven from the sector and are carried out by the member research stations with an expertise in organic production. The monthly "BIOpraktijk" newsletter reaches more than 1000 farmers and other interested parties with an updated overview of related research news for organic farmers.

Demand-driven projects

The full name of CCBT is 'Coordination centre for applied research and extension on organic agriculture' and aims to coordinate and stimulate practice-oriented research and information for organic production in Flanders. This non-profit association was founded in 2010 as part of the Strategic Plan for Organic Agriculture.

The structural grant from the Government of Flanders enables CCBT to fund a limited number of projects each year. These projects are always initiated by the farmers and provide readily applicable results. The research needs that are defined during the Organic farmers' networks (in Dutch Biobedrijfsnetwerken) or other farmers' meetings are translated together with the research stations into research questions and further into practice-oriented projects. Since 2010, CCBT has already funded 69 demand-driven projects. The six research stations that are committed to the organic sector are Inagro, PCG, pcfuit, Proefcentrum Pamel, Proefbedrijf Pluimveehouderij and PIBO Campus.

Tailor-made for the farmer

Much attention is being paid to the translation of the project results into useful and readily applicable information for farmers. A summary report is made of every finished project with the most important conclusions and recommendations. New research results are published monthly via the website and newsletter (BIOpraktijk.be). Subscribing to BIOpraktijk is free and open to all. To gather all existing Dutch-language knowledge, including from the Netherlands, CCBT entered into a collaboration with Wageningen-UR under the banner 'bioKennis'.



CCBT in the knowledge network

In Flanders, CCBT is working together with NOBL and the Organic farmers' networks on a research and knowledge network for organic agriculture and food. Within this Flemish Organic Research and Knowledge (FORK) Network, joint actions are taken to support research for organic agriculture.

Advising the government and updating the research agenda for Flanders are important tasks. In addition, a research database is kept, which collects all current and past projects for organic agriculture in Flanders. Also the expansion of the national and international network is an important strategy.

CCBT also organizes the 'Network Day for Mechanization in organic horticulture' every two years. This day offers room for demonstrations, knowledge transfer, meetings with researchers, knowledge exchange, etc. In addition, CCBT facilitates participation in study trips, such as the visit to Tech & Bio in France and the study trip of the FORK-network to a neighbouring country every two years.

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Partners: Research: Inagro, Proefcentrum Pamel, PCG, pcfruit, Proefbedrijf Pluimveehouderij, PIBO Campus vzw and NOBL; Other: Department of Agriculture and Fisheries, BioForum, Organic farmers' networks, Boerenbond, ABS, Belorta

Funding: Government of Flanders, Department of Agriculture and Fisheries

More info: www.ccbt.be

NOBL: Reflecting together about research for organic farming and food in Flanders

NOBL, the Network for Organic Food and Farming Research in Flanders, brings together a large group of representatives from relevant research institutes, farmers' organizations and the Government of Flanders. By sharing information, ideas and experiences, and supporting and organizing activities, the network aims to strengthen agricultural research and knowledge dissemination for the benefit of organic agriculture and food in Flanders. Flanders Research Institute for Agriculture, Fisheries and Food (ILVO) has committed to continue to coordinate the network within the new Strategic Plan for Organic Agriculture 2018-2022 in Flanders.

More focus on fundamental and applied research

The tasks and activities of NOBL try to respond to current needs and opportunities. For example, researchers and the sector are brought together around themes to search for answers to current questions, opinions are formulated on priority research topics and opportunities are jointly explored for funding new research projects for the organic food and farming industry.

The network increasingly focuses on fundamental and applied scientific research and expands international contacts. In this, NOBL wants to work closely together with the Living Lab for Agro-ecology and Organic Agriculture that is currently being developed at ILVO with plans to launch in 2019. This Living Lab will become a place where researchers are easily approachable, organic farmers can ask their questions to ILVO researchers, experiments can take place in real life settings, policy makers are involved and challenged in their agro-ecological approach and researchers are brought together with other relevant stakeholders around specific themes.

Also across borders, NOBL looks for research possibilities and for collaboration and knowledge exchange through active participation in international workgroups and networks (e.g., TPOrganics, COREOrganic ERA-Nets, Organic E-prints, and others). Hereby NOBL wants to promote the awareness of its partners outside Flanders as contact points of research for organic agriculture in Flanders. Researchers are encouraged to participate in national and international calls for organic research such as from COREOrganic, VLAIO, H2020, etc.

NOBL is not alone

Together with CCBT and Biobedrijfsnetwerken (the Organic farmers' networks), NOBL forms the 'Vlaams BioKennisNetwerk' (the Flemish Organic Research and Knowledge Network, FORK-network). Starting from their own



strengths, the networks NOBL, CCBT and Biobedrijfsnetwerken work together and coordinate their activities in order to arrive at a coherent knowledge policy for the organic sector within Flanders. In addition to their specific tasks and objectives, reaching different target groups (farmers, researchers, and policy makers), they inform each other about their activities, define joint objectives and develop joint actions.

For example, NOBL and CCBT jointly manage a research database with an overview of current and past projects and results for organic agriculture and food in Flanders. But NOBL and Biobedrijfsnetwerken are also getting better together. The farmers can count on NOBL for finding solutions to problems and Biobedrijfsnetwerken are involved as partners in research projects. In 2018 NOBL, CCBT and Biobedrijfsnetwerken published an update of their research strategy adapted to new insights and challenges for the future.

More than ever, they stress that we must strive for an agri-food system in balance with the ecological capacity of our planet, and organic agriculture is seen as the basis for this. In the past period, the joint research strategy served as the basis for advising Flemish and European research programs on Flemish research priorities.

Smart technologies and innovations in agriculture

The focus on the deployment of smart technologies and innovations in the further development of agriculture and the pursuit for further sustainability and optimization of production systems is currently considerable. But what is its value for organic farming? And what can the so-called "agriculture 4.0" mean for the development of organic agriculture in Flanders? Is this also reserved for organic farms in Flanders that are diverse and relatively limited in size? On 10th January 2019, NOBL and ILVO, Inagro, Boerenbond and CCBT invited interested parties during the Agriflanders trade show to dig deeper into this. The public was inspired by various speakers from Flanders and abroad, and the day was closed off by a debate with organic farmers.

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Funding: Government of Flanders, Department of Agriculture and Fisheries
- ILVO-own capital

More info: www.nobl.be

The Flemish Organic Research and Knowledge (FORK) Network: bridging practice and research

The three networks - Biobedrijfsnetwerken (Organic farmers' networks), CCBT (Coordination Center for applied research and extension for organic agriculture) and NOBL (Network for Organic Food and Farming Research) - have been working together since 2012 and are the driving force of the expanded Flemish Organic Research and Knowledge Network (Vlaams BioKennisNetwerk in Dutch). The focus is demand-driven and system-oriented research and co-creation of knowledge: research based on needs from the sector, attention to the whole production system, exchange of experience and knowledge between actors, and knowledge tailored to the farmer.

Three networks, one mission

The three networks - Biobedrijfsnetwerken, CCBT and NOBL - together with their partners, form the basis of the Flemish Organic Research and Knowledge (FORK) Network. In addition to their specific tasks and objectives aimed at different target groups (farmers, researchers, policy), they emphasize the importance of good mutual coordination of their activities to implement a coherent knowledge policy for organic food and farming within Flanders.

Together, the networks pursue the following objective for research on organic food and farming in Flanders:

- Achieving support and recognition
- Improving understanding of research needs together with the end users
- Optimizing efficient use of research and knowledge capacities
- Stimulating dissemination and exchange of research results and knowledge

Strength in unity

Through continuous coordination, the networks try to bring different actors within the knowledge and research landscape in Flanders closer together and to collaborate with each other. In addition to individual activities aimed at their different target groups (fundamental and practice-oriented researchers, chain actors, (organic) farmers, and policy), the networks reinforce each other by aligning their activities and by organizing joint actions (such as seminars, study trips, a shared research strategy, etc.).

For example, the questions and problems addressed in Biobedrijfsnetwerken, are put on the research agenda of researchers or policy makers by CCBT and NOBL. To execute research that can provide an answer to these questions, NOBL and CCBT search for possible sources of financing and expertise. The knowledge acquired in the research, eventually finds its way back to



the farmer through the various information channels of CCBT, NOBL and Biobedrijfsnetwerken. Not only research but also knowledge exchange, translation and dissemination of foreign research results gets attention.

A joint research strategy

In 2018, the Flemish Organic Research and Knowledge Network published an update of its research strategy 2013-2017 adapted to new insights and challenges for the future. From a vision on organic agriculture as the basis of an agro-ecological food system, the strategy describes thematically where research efforts can contribute to:

- creating insights into how robust and resilient agro-food systems can develop and
- understanding and scientifically underpinning the strengths of organic food and farming to make agriculture and society as a whole more sustainable.

The joint research strategy served as the basis for advising Flemish and European research programs on research priorities in Flemish organic farming.

The stimulation of demand-driven and system-oriented research, carried out via a co-creative process, remains the central principle. Collaboration between different scientific disciplines and expertise is necessary to unravel and understand the complexity of agricultural and food systems. In addition to researchers, farmers and other actors from the chain are actively involved in the planning and execution of the research as co-facilitators of knowledge and the validation and implementation of results in practice. The Flemish Organic Research and Knowledge Network aims to continue its role as facilitator.

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Funding: Department of Agriculture and Fisheries, Government of Flanders

More info: www.nobl.be, www.ccbt.be, www.bioforumvlaanderen.be

Research for organic farming as the basis of an agro-ecological food system

new

With the 'Research Strategy for Organic Food and Farming in Flanders 2018-2022', the Flemish Organic Research and Knowledge Network (Biobedijfsnetwerken, CCBT and NOBL), together with its partners, aims to contribute to the central ambition of the new Strategic Plan for Organic Agriculture 2018-2022: "Together towards more and better organic agriculture". The thematic research strategy sets out where research efforts can contribute to creating insights about how to develop robust and resilient agro-food systems and also to understand and scientifically underpin the strengths of organic agriculture and food to make agriculture and society more sustainable.

Vision

Organic agriculture is seen as the basis of a transition to an agro-ecological food system that uses fewer external resources, makes sustainable use of our agricultural soils and is resilient in times of increasing instability and unpredictability, and ensures stable production and a consistent food supply. Here we:

- opt for a self-regulating system that functions on the basis of agro-ecological principles.
- attempt to make optimal use of synergies between plant, animal, micro-organisms and humans.
- strive for equilibrium and resilience achieved at the level of field, farm or landscape.
- search for the preservation of nutrients through the processing of organic products with a minimum use of chemical additives.

Soil health is a key element here. Animal and plant production systems are balanced by adjusting stocking densities to the feed and food supply. More extensive farming systems means less livestock and sustainable animal production based on local or regional balanced fodder production. But choosing organic production methods is only part of the drive towards an agro-ecological food system. Creating a sustainable food system is a shared responsibility that requires collaboration at various levels. Fair trade, adjusted consumption patterns, local production and consumption and less food waste are other key elements within this food system.

Research themes

Based on this vision, the organic sector calls for research within three interconnected themes:

- Robust organic production systems

Here attention is given to optimizing soil fertility, increasing biodiversity, applying best practices in the field of the environment and animal welfare

standards. The search for innovative strategies and technological developments are essential in the pursuit of further sustainability and optimization of organic production systems.

- **Flexible organic chain systems**

To achieve stable market development, products must be available with a price/quality ratio that meets the consumers' expectations at a price that is cost-effective for the entire chain. Optimization, alignment and cooperation, based on the specificities of the organic chain, are necessary. Profitability, risk-limitation and healthy competitiveness are central to the search for economic sustainability. However, this economic sustainability must not be separated from the social and ecological sustainability of the organic sector.

- **High quality food and food processing**

The consumer of organic products expects food without the need to add any additives such as minerals, vitamins or other elements. Processing organic products implies more than just working with organic ingredients, and there is therefore a need for a specific, flexible approach that must still largely developed.

Research approach

In achieving this research strategy, attention is called for:

- Demand-driven research: starting from concrete questions and needs of farmers, market participants, policy makers or legislation.
- System-oriented research that takes into account the complexity of the agricultural and food system and the importance of viewing the production system as a whole instead of as a collection of individual parts or elements. This takes into account the ecological, economic and social impact of the system. A system approach goes beyond the individual field, farm or company. The entire economy and the environment, such as the rural community, a region or the catchment area, needs to be addressed.
- Co-creative approach with room for collaboration between different scientific disciplines and expertise. In addition to researchers, farmers and other actors from the chain are actively involved in the planning and execution of the research as co-facilitators of knowledge and in the validation and implementation of results in practice.

The Flemish Organic Research and Knowledge Network is willing to play a facilitating role in this.


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Robust organic production systems – crop production

soil and nutrient management

crop protection

cultivation techniques and systems

varieties and breeding

Innovative crops, processes,
strategies and technologies

Solutions to build up organic matter in organic farming

The nutrient supply in organic production relies heavily on crop rotation, animal manure, compost and (leguminous) green manures. A fertile soil is crucial to the production of a healthy crop - and by extension a healthy farm. Organic matter plays a key role in the proper functioning and fertility of the soil. The supply of fresh organic material stimulates soil biodiversity and can increase soil resilience.

Fertilization legislation limits carbon build-up

As a result of the stricter phosphorus standards in the new fertilization legislation (MAP 5), the fertilization dose per hectare is strongly limited for certain fields, so the possibility of maintaining the organic matter content on these plots through fertilization is limited. These rules also limit the nitrogen supply via fertilization. It is a challenge finding solutions to apply sufficient carbon and nitrogen and at the same time limit the supply of phosphorus.

What does the organic legislation say?

The organic legislation only restricts the use of animal manure, namely up to 170 kg of nitrogen per hectare. If you use livestock manure, at least 20% of the nitrogen applied must be from organic livestock farming. In addition to organic manure, the use of conventional manure from extensive livestock farming is also permitted.

In addition, an organic grower can only use forms of fertilization that are permitted by the organic legislation (Annex I of Regulation 889/2008). Compost from municipal green waste is not allowed in organic, compost from green waste from gardens and (public) parks is.

Possibilities for carbon build-up in organic farming?

Maximum recycling of organic farm residues, a well-thought-out crop rotation with the use of rest crops and a judicious application of organic fertilizers are measures that maintain soil quality and crop production while at the same time limiting phosphorus supply.

As part of a demonstration project, PCG, pcfruit, Inagro and Proefcentrum Pamel have demonstrated such practically applicable techniques in the field in 2016 and 2017 that (within the boundaries of the fertilizer standards of MAP5), increase or at least maintain organic matter content. All these demonstration trials took place on organic fields in the various organic subsectors (vegetables, arable farming, small fruit, pome fruit and greenhouse cultivation).

Koolstofopbouw in biologische teelten

O oplossingen voor organische stofopbouw onder MAP 5



As an example, it was confirmed that cover crops such as grass/clover and spring barley can deliver both organic matter and nitrogen, which can clearly increase yield in a subsequent crop like leeks, and by extension in the entire rotation. Where MAP5 limits the use of farm manure, cut-and-carry crops can offer a solution. Cut-and-carry crops have a similar nitrogen effect and soil-improving effect as stable manure. A number of compost types were compared both in pome fruit and in greenhouse vegetables, since they can differ greatly from each other, for example in terms of organic matter content. In the cultivation of strawberries and other berries it was examined how the cultivation technique can be adapted to get more organic material into the soil.

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Funding: Demonstration project 'Practical solutions to buildup organic matter in organic agriculture under MAP5' (Government of Flanders, Department of Agriculture and Fisheries, European Agricultural Fund for Rural Development) (1/01/16 - 28/02/18)

More info: Via <http://ccbt.be/carbon> buildup you can click through to the brochure. A printed version is available on request at CCBT.

Compost for greenhouse growers in conversion

Greenhouse growers who want to switch to organic production strive to get their soil ready for a robust production in as short a time span as possible. This is quite a challenge, especially for growers who are shortening the conversion period and who want to cultivate vegetables intensively. Soil that has been under plastic for a long time often has a low organic matter content, few nutrients and little soil life.

A wide range of composts is currently on the market, each with a corresponding price tag. Which is currently the best for basic fertilization remains unknown. Within a two-year on-farm compost test at two locations, we investigate six compost types. The soil is fertilized based on soil analyses using an organic grain.

Composts tested

The 5 commercial composts in the trial are mature green compost with biostimulator, champost, worm compost and two different green composts. In the long run, compost administration may entail a gradual soil-pH increase. Bringing this pH back down is not easy in organic production. Therefore, an experimental object was included in the trial, namely composted horse manure supplied with elemental sulphur. The enrichment with sulfur ensures the reduction of the compost pH. Care must be taken with the sulphur dosage, so that the soil pH does not drop too much.

In the first year, the dosage of the compost species is calculated according to a carbon yield of 6 tons/ha. In the second year, the same composts are used at the same locations, only the carbon yield is lowered to 4 tons/ha at one grower and increased to 8 tons/ha at the other. This is due to the difference in the carbon content of the soil on the farms.

Carbon build-up in the soil is a long-term story. To increase drastically the carbon content of the soil, a single application of compost is not sufficient. The grower must continue to commit to annual carbon addition to the soil. The compost varieties have no statistical influence on the yield figures and the storage of the vegetables in the trials.



Tips for ordering compost

In practice, compost is ordered per cubic meter or per ton. However, there are big differences in composition, volume weight and price between the compost varieties. Always ask for the complete composition of the compost you want to order. There can also be large differences in composition per batch of compost. This depends on the starting material that is available.

It is also important to be vigilant about organic fertilizers where the animals are fed with hay. There is a risk that the hay has been treated with the active substances aminopyralide or chlopyralide. These active substances are not broken down by the digestive system of animals nor by the composting process. They can cause growth abnormalities and hormone disruptions in the plant. An analysis of the compost can provide a definite answer. However, this is quite expensive and complete exclusion remains difficult.

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Funding: Demonstration project 'Practical solutions for organic matter building in organic agriculture' (European Agricultural Fund for Rural Development, Department of Agriculture and Fisheries, Government of Flanders), CCBT project 'OS - Converting in a smart way' (Department of Agriculture and Fisheries, Government of Flanders) (1/01/2016 - 31/12/2018)

More info: www.pcgroenteteelt.be

Optimization of fertilization strategies from the principles of organic farming



new

The tightening of the P fertilization standards within MAP5 makes it particularly difficult for organic fruit and vegetable growers to use fertilization to improve soil quality and supply nitrogen to their crops. These stricter rules make the phosphate standard sometimes more restrictive for the fertilization dose than the nitrogen standard. A sufficient organic matter supply is of great importance for good soil quality and healthy crop development in organic farming. Within this project, strategies are being sought to apply sufficient carbon and nitrogen with a limited external supply of phosphorus. This may require a 'changeover' in terms of fertilization and in the area of soil management in general. The project focuses primarily on the sub-sectors of large-scale vegetable production, pome fruit and fodder production on land-based livestock farms.

Scientific and participatory trajectory for the priority subsectors

The project includes a scientific pathway that should allow a better understanding of the impact of soil management measures and strategies on organic matter turnover and nitrogen dynamics, and of the underlying mechanisms. Results from Belgian research are bundled and tested against foreign research results. In addition, two multi-year scientific field trials will be started: one for vegetable and fodder production extraction and one for pome fruit.

Parallel to the scientific process, but also in interaction with it, there is a participatory process with strong involvement of organic growers. The effect of farm management on nutrient flows and organic matter dynamics is examined for three growers in each of the three subsectors. Growers take part in visits to research institutes and farms abroad. Via focus groups, organized per subsector in the first working year, potential solution directions were inventoried and evaluated for their effectiveness and feasibility. Farmers determined which measures will be tested in the multi-year scientific field trials. Also through validation tests on practical plots, solutions will be evaluated in order to acquire missing knowledge and experience. For vegetable growing and forage production, the scientific trial will concentrate on nitrogen input and utilization and on the application of organic matter in relation to the method of management of a green manure mixture with leguminous component, and in relation to whether to co-compost animal manure with brown feedstock material or not. For the



fruit-growing sector, a multi-annual experimental design will examine the extent to which cover crops cultivated in the green strip or black strip can contribute to an increase in organic matter supply to the soil and nitrogen availability for the fruit trees.

Translation to other subsectors and conventional agriculture

For the CSA companies, greenhouse horticulture and less (or not) soil-bound animal husbandry systems, focus groups are also organized. The project should deliver promising strategies for building soil organic matter in the entire organic sector. These strategies are also presented in focus groups with conventional growers. For a selection of these strategies, validation is also carried out on conventional growers' plots.

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Partners: ILVO, Inagro, pcfruit, Belgian Soil Service and Ghent University

Funding: Flemish Land Agency (2018 - 2021)

More info: www.ilvo.vlaanderen.be

Nitrogen release from cut-and-carry fertilizers in relation to mode of application and soil condition

completed

A cut-and-carry fertilizer is a cut of grass clover or another green manure that is used as basic fertilizer on another plot. ILVO, Inagro, PCG and Ghent University jointly investigated the use of cut-and-carry fertilizers, and investigated whether the method of application had an effect on the decomposition rate of the fertilizer and thus on the availability of the nitrogen applied with it. The effect of soil condition on the effectiveness of the cut-and-carry fertilizer was also investigated.

Good reasons to use cut-and-carry fertilizers

With cut-and-carry fertilizers, nutrients can be recirculated within the farm. Within the current manure legislation (MAP 5), the use of animal manure is restricted by a reduction of the phosphorus supply standard. In addition, availability and logistics are sometimes a problem for an adequate supply of the desired animal manure. Interesting strategies for organically managed vegetable farms are therefore the use of fertilization forms with a high nitrogen / phosphorus ratio (more supply of nitrogen per unit of phosphorus) and the use of leguminous green cover plants that fix nitrogen from the air, such as clover in a grass/clover field. The clippings of grass clover can be used as a cut-and-carry fertilizer. A cut-and-carry fertilizer can be used fresh or can be temporarily ensiled for use in the following season on the field.

Research approach

For organic vegetable production, protected and in open air, during two growing seasons (2015-2016) the nitrogen release from cut-and-carry fertilizers was investigated in (i) newly established field trials to investigate the effect of the method of application and (ii) existing multi-year soil management trials to investigate the effect of the soil condition. In this way, knowledge was acquired about the effectiveness of this form of green manuring in relation to soil management strategies. In the laboratory, the quality of the cut-and-carry fertilizers was determined and the quality of the soil on which the cut-and-carry fertilizers were applied. Furthermore, the nitrogen release from cut-and-carry fertilizers applied in the field was also studied under standardized laboratory conditions.

Nitrogen effect

The trials showed that the first-year effect of a cut-and-carry fertilizer on the nitrogen availability is difficult to predict in advance, as the field conditions also play an important role. The usually relatively limited effect indicates that a cut-and-carry fertilizer will contribute effectively to the organic matter



build-up and thus to the nitrogen supply capacity of the soil. The amount of organic matter used with cut-and-carry fertilizer varied between 4.3 and 8.8 tons/ha. However, when applying cut-and-carry fertilizer (ton/ha), a correct estimate of its dry matter content is crucial to prevent overdosing, which may lead to excessive residual mineral nitrogen values at the end of the growing season.

Comparison with farmyard manure

Compared to farmyard manure, cut-and-carry fertilizer has the advantage that more N per unit P is supplied, which is important in the context of the stricter fertilization standards for P. The N / P₂O₅ ratio of the cut-and-carry fertilizers used in the various trials was between 2.3 and 4.5, while the N / P₂O₅ ratio of cattle stable manure is 2.4 on average. The fraction of ammonia N is also smaller in the case of cut-and-carry fertilizer, which reduces the risk of N losses due to volatilization during application.

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Partners: ILVO, Inagro, Department of organic production, PCG and Ghent University (2015 - 2017)

More info: The final report (in Dutch) is available via <https://pure.ilvo.be/portal/>

Optimization of the vigor of Natyra®



SQ159/Natyra® is a new apple variety for organic fruit growing. In the orchards, however, it has a weak vigor, which results in too-low production volumes of the trees and too-small apples. Currently, the fertilizer companies are bringing various products on the market that would improve the vigor. In this project we want to see whether these products can add value to the growing SQ159/Natyra®. On the other hand, in 2018 production and vigor are still being monitored in the Natyra® trial that was planted in 2016 as part of the demonstration project "Practical solutions for organic matter building in organic agriculture under MAP5", in which various soil improvers were applied during planting.

Construction of a new orchard

An important step in the construction of a new orchard is to prepare the parcel for planting. Since we have in apple growing a crop rotation of 10 to 15 years, we only can work constructively on the soil structure every 10 to 15 years. Here, the use of organic material (manure, mushroom manure, green compost, cover crops, ...) is certainly important. In addition to the provision of minerals, this will affect the soil structure, the pH and the organic matter content. These are parameters that influence the soil life and the mineralization and so can influence the root activity and the vigor of the trees. In addition, soil improvers can also be incorporated into the planting hole. This is a better way to work in a more targeted manner and to access the root system.

Stimulation of the vigor in new orchards

Once the trees are planted, it becomes more difficult to stimulate the vigor. In spring 2018, therefore, a comparative trial was started in which various products that claim to improve vigor. This happened on 2 different parcels of Natyra® in the 3rd growing year. Both parcels have different soil types and there is also a difference in standard fertilization by the grower.



control



BVB Peat

Results

The preliminary conclusions of the project "Practical solutions for organic matter building in organic agriculture under MAP 5" are:

- Using BVB Peat in the planting hole gave after 2 years the best result for vigor. This object also had the highest production. At the end of 2016, this object also had the highest organic matter content, but this decreased quite sharply in 2017.
- Vivimus also caused a little more shoot growth. But here the lower calcium content in the fruits is still a point of attention. The organic matter content was not strongly influenced.
- The impact of all other treatments on the organic matter content was very limited. It was noticeable that 2 applications of organic material + the extra sowing of Japanese oat (which was not equally available everywhere) had only a limited influence on the organic matter content.

For the second part of the project, it is still too early to have results. The various products that claimed to stimulate vigor were only used in the spring of 2018.

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More info: www.ccbt.be (projects)

European Consortium develops strategies to avoid contentious inputs in organic production

new

The organic specifications guarantee high environmental protection and healthy, natural products. But there is always room for improvement. For example, the use of certain products is somewhat contentious in organic farming, such as copper, conventional manure, antibiotics or anthelmintics. The RELACS project was set up to address this. RELACS stands for 'Replacement of Contentious Inputs in Organic Farming Systems': the aim is to assist the organic sector to minimize or even eliminate the use of such products.

Alternatives and management techniques

Various inputs are being discussed. In particular, RELACS wants to work on:

- reducing or even avoiding the use of copper as crop protection or leaf fertilization by testing alternatives and introducing reduction strategies;
- the development of strategies to reduce the use of mineral paraffin oils, including by replacing them with plant extracts, using functional biodiversity and biological control methods;
- the identification of sustainable sources for fertilization, as an alternative to non-organic animal manure and non-renewable phosphate sources (rock phosphate), for example technologies to recycle nutrients from human waste streams;
- searching for alternatives to anthelmintics for small ruminants;
- development of preventive health management measures and alternatives to antibiotics, in particular for mastitis;
- finding solutions for the needs of vitamin B2 in poultry and pigs, and vitamin E in ruminants. The availability of GM-free vitamin B2 is becoming increasingly limited, and vitamin E is only available in synthesized form.

Trials will be carried out, both on experimental fields and on-farm.



Wide European consortium

The Relacs project started on 1 May 2018, 28 partners from 11 different European countries will work together for four years on this project. The project is led by the Swiss research institution FiBL. The partners are research institutions as well as organic farming organizations, farms and companies. IFOAM EU is responsible for communication and will facilitate the dialogue between science and practice.

BioForum Vlaanderen is also one of the partners and will mainly commit itself to the part that relates to copper. In turn, BioForum will work together with pcfuit on this. More specifically, some tests will be carried out with alternative products for copper for the protection of apple. Furthermore, BioForum will carry out the communication tasks at the Flemish level and will collaborate with IFOAM for the part that should result in policy recommendations.

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Partners: BioForum and pcfuit in collaboration with 27 partners from 11 European countries (Switzerland, Italy, Germany, Spain, Estonia, Bulgaria, Denmark, United Kingdom, France, Norway and Belgium), Coordinator: FiBL Switzerland, Lucius Tamm (lucius.tamm@fibl.org)

Funding: EU Horizon 2020, European Commission (1/05/2018 - 30/04/2022)

More info: <https://relacs-project.eu>

Flea beetles under the microscope

new

Flea beetles are small beetles that cause serious damage in various crops. Dry and warm weather conditions are ideal for flea beetles, which resulted in a high pest pressure in 2017 and 2018. To date, few biological control techniques have been tested under Flemish conditions. This is why Inagro started this year with a two-year CCBT project entitled 'Aardvlooien Uitgevlooid' in Dutch, or "Flea beetles under the microscope".

A problem in cabbage crops

Flea beetles are very small beetles with a length of 2-5 mm. They belong to the leaf beetle (*Chrysomelidae*) family. Their name comes from their great ability to jump because of their strong hind legs. In Flanders three species occur that can cause damage to cabbage crops: the crucifer flea (*Phyllotreta cruciferae*), the large striped flea (*Phyllotreta nemorum*) and the small striped flea (*Phyllotreta undulata*). The adult specimens cause the most damage in the period from April to August by eating holes in young leaves. These holes grow along with the leaves, giving the leaves a typical 'hail shot' appearance. If there is a large pest pressure, the damage to the crop can lead to the complete disappearance of young plants and to unmarketable end products.

Monitoring populations on organic farms

On three Flemish organic farms, the population of the flea beetles was monitored with traps. In addition, the weather conditions on the farms were monitored. Based on this monitoring we wish to determine the influence of weather factors on the population size as input for building a predictive model. The monitoring showed that the flea beetle population was active from the end of April with a first (small) peak around mid-May. Towards the end of June, the number of captured specimens decreased, then increased explosively again in July. In the first weeks of August, the highest numbers of the flea beetles were observed. This is consistent with life cycle of these flea beetles. The insects overwinter as adults and become active when the temperature reaches 14° C. Then the adults feed, mate and lay eggs. New beetles typically appear starting in July, with possible overlap of the two generations.



Cover with fine-mesh net is effective

In the spring and summer of 2018, two field trials were carried out in cultivations of bok choy (paksoi in Dutch) on the Inagro experimental farm. In the first two field trials, preventive methods as well as not yet certified bio-pesticides were tested using bok choy as model crop. These tests showed that a number of bio-pesticides could reduce feeding damage during cultivation, but that these differences disappeared towards the end of cultivation. Only cover with a fine-mesh net (mesh size 1x0.8mm) resulted in a significant reduction of feeding damage and a better end result in both tests.

Trial set-up 2019: bigger and more focused

In order to be able to experiment more specifically with bio-pesticides in 2019, a growth chamber test was also carried out. For this we dipped leaf segments of bok choy into spray solutions and placed 15 flea beetles per pot to evaluate the effect after certain time periods. Based on these tests, we can already scratch a number of bio-pesticides as potential measures. A new trapping technique with a catch plate, mounted on a manual roller hoe, will also be tested during the experimental design in 2019.

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Funding: CCBT project 'Aardvlooiën uitgevlood' (Flea beetles under the microscope)

(Department of Agriculture and Fisheries, Government of Flanders)

(2018 - 2019)

More info: www.inagro.be

Integrated control of the Allium leafminer in Flanders

The Allium leafminer (Phytomyza gymnostoma) is a fairly recently-occurring pest that has been common on leek farms since 2013. In 2016, a project was started with the aim of developing an integrated management for this new pest insect.

Life cycle and damage

The Allium leafminer flies are small grey flies, 3 mm long, with a yellow spot on the head and yellow "knees". The larvae are white-yellow and have a length of 5 to 7 mm; pupae are dark brown-red and about 3.5 mm long. The fly has two generations per year. The insect overwinters as a pupa in plants (residues) or in the ground. The first adults appear in the spring. Eggs are laid in the plant tissue, in feeding spots. Larvae mine the leaves and pupate at the end of their corridors, near the leaf base. The pupae of the first generation go dormant during the summer (diapause/estivation). The flies emerge at the end of the summer; new maggots can be present from the end of September until the end of November. Several larvae per plant can cause considerable economic damage: from extra peeling to almost 100% unsaleable leek on harvest.

Successful breeding at ILVO

In order to be able to examine the life cycle in all its facets and to be able to carry out targeted experiments, ILVO started to breed Allium leafminer flies. This offers opportunities to study the specific parameters that influence the duration of the different phases of life and diapause, as well as to study the cold tolerance of the insect. In addition, pupae from the culture are used to determine their chances for survival in compost heaps and in piles of leek waste.

Monitoring in Flanders and identification

The project group follows the population pressure on various fields spread across Flanders with yellow sticky traps. The leaf miners showed a striking prevalence in the provinces of East Flanders and Antwerp, with indications of a growing plague in West Flanders.

Morphological identification of the flies on the basis of external characteristics is not easy. Therefore, the possibility of a molecular DNA technique was investigated. The LAMP ("Loop-mediated isothermal AMPLification") method proved to be the best option. With the help of a small, simple device (Genie III from Optigene) it is now possible to identify the leaf miner flies in a



relatively short period with great certainty on the basis of DNA material extracted from captured flies.

Field and cage trials with bio-pesticides

In the past years, various field trials were conducted to test bio-pesticides under practical conditions. Until now, no important decisions could be made based on these experiments. This is probably due to the lack of high pressure on the experimental fields as the main cause, combined with the lack of knowledge about the crucial treatment time due to the long period of egg laying and the long duration of the larval stage.

Field trials show that covering with a fine-mesh net (mesh size 0.8 mm) is a good preventive measure, at least if the cover is used in both spring and autumn.

In order to be able to test the effectiveness of (bio)pesticides on flies and larvae, we are now concentrating on cage and growth chamber experiments. Thanks to the successful breeding of the leaf miner at ILVO, we can achieve artificially high pressure in these cages and in the growth chamber.

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Funding: VLAIO LA-Programme (Agency for Innovation and Entrepreneurship, Government of Flanders) (1/05/2016 - 30/04/2020)

More info: www.inagro.be

Development of a prediction model for the cereal leaf beetle

In May and June the larvae of the cereal leaf beetle feed on the young leaves of cereal plants. Their presence is highly variable, but can cause economic damage. To determine this risk and the optimal timing for control, if necessary, Ghent University developed a prediction model in close collaboration with Inagro and the Belgian Soil Service.

Species of the cereal leaf beetle identified

The cereal leaf beetle is a pest complex consisting of several species of the genus *Oulema* (fam. Chrysomelidae). In Flanders, it was not known which the dominant species that cause damage are within this complex. Therefore researchers from Ghent University and Inagro collected adult beetles on several grain plots in Flanders with a trawl during 2016, 2017 and 2018. The collected beetles were identified in collaboration with the University of Antwerp (Martijn Van Roie). Identification shows that there are three dominant species in Flanders: *O. melanopus*, *O. duftschmidi* and *O. gallaecianna*.

Control of the cereal leaf beetle

Under certain circumstances the population densities of the cereal leaf beetle can reach harmful levels, this is often the case in organic cultivation of summer grains. Until now it was unknown what impact these population densities have on the yield and to what extent population control is recommended. Moreover, a control is only effective when executed at the right time, i.e. before visible damage occurs in the crop. The development of a prediction model for the population dynamics of the cereal leaf beetle and the determination of an economic damage threshold can provide an answer to this.

Determination of a damage threshold

In order to determine the relationship between the density of larvae of cereal leaf beetle and the impact on the yield, we performed cage trials in wheat for three years at two locations. In each cage trial cereal leaf beetles are introduced in different densities and damage was determined. These tests result in an economic damage threshold of 0,4 larvae per wheat culm. If the amount of larvae is lower than this threshold value, the cereal leaf beetle will not cause any economic losses.



New model predicts when the larvae will peak

Inagro, Ghent University and the Soil Service of Belgium monitored the cereal leaf beetle on more than 30 wheat fields for four consecutive seasons (2015 to 2018). We counted eggs and larvae on 240 plants per field. In addition, climate parameters have also been registered via local weather stations and parcel data were collected. An extensive data analysis by Ghent University - after selecting the most reliable regression technique and the most essential parameters - resulted in a useful prediction model. After entering the location and sowing date of the wheat the model predicts the moment when most larvae will be present in the crop.

The model and the damage threshold will be integrated in 2019 into an online decision tool for consultants and farmers. With the help of this tool, a more focused monitoring is possible and the grower can then perform a treatment at the most efficient time.

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More info: www.inagro.be, www.lcg.be

Wireworms: Monitoring and knowledge as basis for prediction models

Wireworms can cause economic damage in many crops. Potatoes, maize and chicory are among the most susceptible crops in Flanders. Since 2015, a number of Flemish research centres have been working on this issue, in collaboration with other Flemish and European partners.

A pest complex

Wireworms live underground and feed there for 3 to 5 years with living plant material. The feeding damage is expressed in different ways. In spring, feeding damage to the root system causes deformation and loss of young maize and chicory plants. In the autumn, the wireworms tunnel into potatoes and other bulbous, root or tuber crops.

Flemish research project in the final phase

The National Research Centre for Chicory, Inagro and the Hooibeekhoeve monitored wireworms in the period from 2015 to 2018 on more than 50 fields distributed across Flanders. Through this extensive monitoring, we have gained more insight into the occurrence of the wireworm species and the damage in maize, chicory and potato crops. Flanders Research Institute for Agriculture, Fisheries and Food (ILVO) has identified all trapped wireworms. This was done both morphologically and with the aid of molecular techniques. The results indicate that mainly *Agriotes* sp. occur with *A. lineatus* and *A. obscurus* as dominant harmful species. In addition, two other genera have been identified from the wireworm catches: *Adrastus* and *Hemicrepidius*.

Predicting the wireworm damage risk with 'Agriorisk'

The researchers also investigated which cultivation and soil-related factors increase the risk of wireworm damage. An extensive analysis of all monitoring data from three years showed which factors had the most important influence on the presence of wireworms on a field: the crop history of the past five years, the soil texture, the pH and the organic carbon content. Based on a statistical analysis and predictive modelling, the project group created an application for farmers and advisors to estimate the risk of damage by wireworms on a selected field. The 'Agriorisk' app will be available online in 2019.



Research into control methods

Alternative control strategies are tested in several countries, including in our project. Among the alternatives tested in lab and field experiments were: a combination of attractants with classical or biological pesticides, preventive cultivation measures and biological control organisms. Some of these alternatives gave promising results and offer perspective within the framework of IPM. However, further steps are needed for effective implementation in practice.

European partnership

In 2016 the European project 'Spotting the Needle in a Haystack: Predicting Wireworm Activity in Topsoil for Integrated Pest Management in Arable Farming' started. In this project, 14 partners from six different countries (Austria, Germany, Switzerland, Italy, France and Belgium) work together. The project partners, each with their own expertise and in their own region, look for key elements that can explain the complex behavior of wireworms in the soil. The ultimate goal is to optimize the existing Austrian prediction model "Simagri-W" for use in the European countries concerned.

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Funding: VLAIO LA-programme (Agency for Innovation and Entrepreneurship, Government of Flanders) (1/04/2015 - 31/03/2019)

More info: www.inagro.be, www.proeftuinherent.be
www.innovatienetwerk.be/projects/2361

SMARTBIOCONTROL – An innovative alternative for chemical crop protection

The use of biological crop protection products to control pests and diseases plays an important role in organic farming. Currently, only few biological crop protection products are used. These products often present a good efficiency in labs, but not always on the field as they are often applied in sub-optimal conditions, which can explain a lower efficacy. For this reason, growers are not convinced of the efficacy of these products. In addition, the field of biocontrol against plants diseases is not well studied and consequently the knowledge of this subject has not progressed sufficiently during recent years.

SMARTBIOCONTROL, an innovative approach for Belgian and French farmers

The project portfolio SMARTBIOCONTROL is a unique Interreg V-project that brings together a large panel of expertise (26 partners) in the Belgian-French border region in order to develop new effective biological products to fight crop diseases. SMARTBIOCONTROL was launched on the 1st of October, 2016 and aims to offer the Belgian and French farmers an innovative and alternative approach as a replacement for chemical crop protection.

SMARTBIOCONTROL is based on a pilot project and four distinct but strongly interconnected projects to select new bio-sourced ingredients (molecules or micro-organisms, BIOSCREEN), to develop their production on an industrial scale (BIOPROD), to evaluate their efficiency under agronomic conditions (BIOPROTECT) and to assure their monitoring on the fields (BIOSENS).



BIOPROTECT, optimization of the efficacy of biological crop protection products in (field) trials

As the project leader of BIOPROTECT, PCG is investigating the effect of certain environmental conditions such as temperature, relative humidity and light on the efficacy of biological crop protection products. We also study the optimal application timing, in particular the crop stage and the stage of the disease, and the application method (crop spraying, pouring, seed treatment, etc.). Not only authorized biological crop protection products are tested, but also new biocontrol products that are currently under development (including those that have been validated under lab conditions in the BIOSCREEN project and formulated in the BIOPROD project). After determining the most optimal application strategy for each of the retained products, the acquired knowledge will be transferred to all actors (farmers/growers, advisors, researchers, suppliers, local authorities,...) in the agricultural and horticultural sector via demonstration platforms.

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Partners: PCG, ULG, Inagro, UCL, Lipofabrik, Ghent University, CRA-W, FREDON, ULCO, ISA, PLRN, CAR, Arvalis

More info: www.pcgroenteteelt.be, www.smartbiocontrol.eu

Source-oriented control of Galinsoga (Gallant soldier) on organic vegetable farms

Galinsoga (known as gallant soldier, kew weed, quickweed, and many other names) is the number one weed on many organic vegetable farms. In 2017, analyses of 50 organic fields were done and various field trials were carried out. This resulted in new knowledge that enables organic vegetable growers to tackle Galinsoga in a more source-oriented way.

Galinsoga soil samples analysed

In the spring of 2017, we took soil samples in 50 fields at 39 organic farms. The Galinsoga seeds were filtered out and analyzed. The number of seeds present in the soil (the seed bank) varied greatly. In about a third of the plots, Galinsoga make up more than half of the total seed bank. Hairy Galinsoga is clearly more dominant than its smooth counterpart. Smooth and hairy galinsoga are not easy to distinguish, but it is possible.

Crops and management have the most influence

The size of the seed bank is mainly determined by the local crop and soil management. The smallest seed banks were found on farms with a low frequency of inverted tillage and season-long, well-filled crops and green manures. The type of main fertilization did not make a clear difference. Galinsoga is more present in soils that are sandy, lighter and contain more humus. The analysis of the soil samples shows that on plots with a high phosphorus supply the microbial biomass is smaller and less arbuscular mycorrhiza are present. The presence of these fungi is associated with smaller seed banks of Galinsoga. This phenomenon deserves more research. It also appears that Galinsoga is more common on soils with a low pH, good drainage and less plant-available magnesium and calcium.

Strengths and weaknesses of Galinsoga

In another part of the research, we investigated the use of curative techniques. The weeds have a number of strengths and weaknesses that we can exploit. Galinsoga has generally little dormancy: fresh seeds germinate almost immediately. In the summer, the cycle from seed to new seed can be completed in 6 to 8 weeks. As a result, Galinsoga can produce successive generations in one season and thus quickly enrich the seed bank. The seed longevity is quite short, usually 2 years, and Galinsoga germinates very shallow in the soil, usually up to 4 mm deep. However, it appears that the variation in these parameters between fields is considerable.



Thermal control most effective when creating a false seedbed

Thermal weed control does not disturb the soil and therefore results in rapid reduction in germination. In the trials, more than 90% reduction was determined after 2 to 3 effective operations. For fine crops that are sown later in the spring, this technique can be used to prevent potential handwork in the row. The sowing technique has to shift as little ground as possible. Just before the emergence of the crop, for example in carrot, a thermal control is also carried out.

Mechanical control reduces the seed supply

Hoeing, harrowing and other mechanical operations are disrupting the soil to a larger amount and are thus less effective in lowering the field emergence in the false seedbed. However, they can exhaust the seed supply in the top layer over the long term. After five effective operations with hoe or harrow, we saw reductions in seed density up to 5 cm deep from 30 to 60%. Depleting the seed supply during or between crops can be a realistic strategy if further seed production remains under control and if there are no major ground movements (e.g. plowing) that bring seed-rich soil back to the surface.

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Funding: Department of Agriculture and Fisheries, Government of Flanders (1/01/17 - 31/12/17)

Controlling root knot nematodes



new

Within the 4-year project "Controlling Meloidogyne spp. in intensive organic fruiting vegetable production in greenhouse" we want to develop an economically and practically feasible, robust cultivation system for intensive organic fruiting vegetable production in greenhouses. The goal is to build knowledge about the population dynamics of various Meloidogyne species and by putting together a practically feasible control strategy to keep the populations under control.

Organic is grown in the soil

Organic production starts in the soil. This is the starting point of organic greenhouse horticulture, the soil is the key to the success of an organic farm. That is why organic greenhouse growers pay a lot of attention to soil fertility and soil health. Fruiting vegetables such as tomato, pepper, cucumber, zucchini and eggplant (aubergine) are crops with a very high heat demand. These crops therefore make specific demands on the greenhouse infrastructure, which means that it is only economically justified to use the greenhouses for crops with a high added value.

The bad guys are lurking...

By growing the same crops over and over, populations of pests and pathogens build up. Root knot nematodes are the biggest challenge for the organic fruiting vegetable grower. *Meloidogyne incognita*, *M. hapla* and *M. javanica* occur on a regular basis in soils of organic greenhouses. The generation time or life cycle of root knot nematodes differs per species and depends on the temperature and the host plant. When the juvenile stage (J2) penetrates into the roots and settles there, the plant reacts by forming root nodules. The sedentary nematode nourishes itself with the plant and develops further. As a result, the absorption of nutrients and water has been disturbed, resulting in poor crop development. The eventual damage consists of the plant 'going limp', greatly reduced growth or even plant death, resulting in a considerably lower production.



Impaired root system of cucumber by Meloidogyne in the greenhouses of PCG

Work on every possible link

Four work packages are provided to achieve our objectives. In the first work package, resistant cultivars and rootstocks are tested for their workability against *Meloidogyne* populations present in Flanders. Practical-oriented research will also monitor their level of resistance through yield measurements. In a second work package, cultivation techniques (intermediate crops, addition of organic material) are tested to suppress the root knot nematode population. These cultivation techniques are discussed beforehand with the growers in order to increase the likelihood of later use. Natural resources (antagonists, soil improvers) that are assumed to be able to control root knot nematodes at the practical level are examined in work package three. Finally, all activities will be bundled and we will disseminate the accumulated knowledge and expertise to the sector.

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Funding: VLAIO LA-Programme (Agency for Innovation and Entrepreneurship, Government of Flanders) (1/09/18 - 01/09/22)

More info: www.pcgroenteteelt.be

Rational and orchard specific management of scab on apple

Scab, caused by Venturia inaequalis, is one of the major fungal diseases in Belgian fruit production. Approximately 50% of the pesticides used in apple cultivation are used to control this fungus. Good control of the primary infection moments, caused by ascospores originating from the overwintering infected leaves of the previous season, reduces secondary infections risks (via conidia) in the summer. An accurate warning system in the spring is, therefore, an ideal strategy to reduce primary infections as well as the ideal way to regulate the number of treatments.

Current scab management strategy

The current scab warning system from the Research Station of Fruit Cultivation (pcfruit vzw) is based on a worst-case scenario in which ascospore releases from heavily infected scab leaves are evaluated during rainy periods. The warning system is additionally based on the climatological infection risks calculated by weather data gathered by the agro-meteorological network in Flanders. The warning system is considered very valuable and allows fruit growers to control their applied treatments, products and dosages.

However, the use of a worst-case scenario does not take the initial inoculum pressure of a specific orchard into account. Consequently, the warning system provide potentially biased information concerning the intensity of scab infections, which leads to maximal treatment on each possible time of infection. Too many treatments (or at the wrong times) is not only costly in terms of time and money, it also accelerates the occurrence of resistant species.

Optimizing scab management strategy

In this project, the initial inoculum pressure is determined using a molecular method (qPCR). The protocol has been validated in depth, in order to obtain an accurate assessment of the initial inoculum pressure. In addition, the same technique can be used to monitor the real ascospore release or the end of the ascospore release during the season in individual orchards. Such information is critical to better advise fruit growers in their use of pesticides to control scab infections. Last, the same method will be used to study the latent presence of scab on fruits. The presence of latent scab on apple can lead to a prediction of the degree of scab infection during storage.



This research at pcfruit vzw is performed in collaboration with Flanders Research Institute for Agriculture, Fisheries and Food (ILVO) and KULeuven. The project, funded by the Agency for Innovation and Entrepreneurship, will lead to an even more detailed scab management strategy. When the real primary inoculum pressure and the latent presence of scab on leaves are taken into account, a more rational and site-specific warning shall be provided for fruit growers. In addition, fruit growers can be advised concerning the risk on development of scab during storage.

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Funding: VLAIO LA-Programme (Agency for Innovation and Entrepreneurship, Government of Flanders (1/10/2014 - 30/09/2018))

More info: www.pcfruit.be, pcfruit vzw - TWO Mycologie

Management of scab on Conference pears with minimal input of copper

Conference pears are economically very important for (organic) fruit growers. However, more and more problems with scab on Conference have occurred in recent years. In organic farming, copper is still very important for the control of scab on pear. Nevertheless, recently, the use of copper has been increasingly under pressure.

Copper to control scab

Besides copper, organic fruit growers can use other products like sulphur or potassium bicarbonate containing products or Vacciplant, but without the use of copper it is not possible to have a good scab management on Conference pears. Furthermore, in different studies it became clear that alternatives for copper are not yet available. So copper is still indispensable as a preventive treatment in the management strategy of scab in organic farming.

Minimal effective dose of copper

It is important to know which is the minimal dose rate of copper necessary for a good scab management on Conference pear. To this end, clear insight into the relation between the dosage of copper and the effectiveness towards scab on Conference pear is needed. At this moment only some experiences of fruit growers on this topic are available but more research is required.

In this project, research based on dose-response curves, is conducted to determine the minimal dose rate of copper needed in the general management strategy to have an optimal control of scab on Conference pears. This project focuses primarily on organic farming in Belgium and is conducted in collaboration with organic farmers.



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Funding: CCBT – project 'Beheersing van schurft bij Conference met een minimale input aan koper' (Management of scab on Conference pears with minimal input of copper) (Department of Agriculture and Fisheries, Government of Flanders)
(1/04/2017 - 31/12/2018)

More info: www.pcfruit.be, pcfruit vzw - TWO Mycologie

Biocontrol to protect against fire blight infections with or without the help of bumblebees

Fire blight (Erwinia amylovora) remains a threat to apple and pear orchards. Biocontrol organisms (BCOs) can offer concrete opportunities to prevent flower infections which is of key importance. The possibility of bumblebees to disseminate BCOs directly to the flowers was tested.

Flowers are most susceptible to fire blight

The flower stage is very susceptible to fire blight as the *E. amylovora* bacteria can enter easily through the open flowers. Rain or heavy dew rinse the bacteria from the stigmas to the flower hypanthium where they can enter the flowers through the nectarthodes. In this way, flowering periods are very susceptible for fire blight infections. Moreover, the infection risk increases with increasing temperatures resulting in an even higher infection risk during the secondary flowering period.

Flower colonization by BCOs

BCOs, in this case fungi and bacteria which establish themselves on the stigma and hypanthium, can protect flowers against subsequent fire blight infections by competition for site and nutrients with *E. amylovora* bacteria. At this moment, only Blossom Protect, which contains the fungus *Aureobasidium pullulans*, is registered in Belgium for the use against fire blight. Other BCOs like *Bacillus subtilis* and *Pseudomonas* sp. were tested in this project.

Entomovectoring

Given the unequal anthesis of flowers, there is a need for an effective application method of BCOs to assure sufficient protection against fire blight infections of newly opening flowers. Repeated BCO dispersal via standard spray application is often difficult and can result in phytotoxicity problems like fruit skin russeting. However, pollinating insects, especially bumblebees, can offer a potential in transferring BCOs directly to the flowers as the bumblebees visit the flowers to gather nectar and pollen. Moreover, bumblebees are active through the entire flowering period, visiting flowers that come at full flowering at different times. Bumblebee nests, equipped with dispensers which contain BCOs in powder form may facilitate continuous BCO dispersal in the orchard. With this system, bumblebees acquire sufficient BCO powder on their legs and body when passing through the dispenser. When visiting the flowers the bumblebees can deposit the BCOs at the flower stigmas and hypanthium (entomovectoring).



Bumblebees visiting flowers in apple and pear orchards

Bumblebee hives, equipped with a dispenser containing Blossom Protect *A. pullulans*, were placed during the primary bloom period in 'Conference' pear and 'Jonagold' apple orchards. However, the results indicate poor BCO dispersal to the flowers. The rate at which bumblebees visited flowers in apple was very low and even lower for pear. Likely causes are the sucrose-poor nectar of pear flowers compared to apple and other simultaneously flowering fruit trees which makes them unattractive to pollinating insects. The use of an attractant did not improve the bumble bee flower visitation.

Conclusion

The tested candidate-BCOs showed potential to protect against *E. amylovora* flower infections. However entomovectoring by bumblebees is not sufficient. Hence the most viable strategy for BCO dispersal in an orchard might be the combination of one or more BCO spray applications followed by secondary BCO dispersal from the sprayed flowers to newly opening flowers by other pollinating insects.

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Funding: VLAIO LA-Programme (Agency for Innovation and Entrepreneurship, Government of Flanders) (1/10/2016 - 31/09/2018)

More info: www.pcffruit.be

Parasitoids as a biological control agent against aphids in fruit tree crops

The European Union attaches great importance to an integrated approach to pest management (IPM) in agricultural crop systems. In this strategy, biological, mechanical or non-chemical control is preferred above the use of chemical crop protection agents. Not only the government but the general public is also asking for more qualitative and sustainable products. To encourage the use of biological control agents, the EU has funded a four-year project (BIOCOMES) in which several pests have been investigated to find and develop efficient and sustainable control methods. Aphids in pome and stone fruit crops are one of the pests for which new biological control agents have been developed. Furthermore, there was also a focus on the biological control of the fungus *Monilinia fructigena*.

Biological pest management of aphids

In nature, parasitoids or parasitic wasps are very efficient against aphids. During their short life span, these minuscule creatures can easily parasitise 50 to 200 aphids using their ovipositor. The larvae of the parasitoid will develop inside (koinobiont) the aphid, eventually causing the aphid to die and subsequently birthing a new generation of parasitoids. Under field conditions, parasitoids can have several generations per year (5-6). In a natural ecosystem, plants can survive thanks to the help of the aphid's natural enemies. But in many fruit tree crops, aphids like *Eriosoma lanigerum*, *Dysaphis plantaginea* and *Myzus cerasi*, are more numerous than parasitoids or they appear much earlier, causing important economic damage.

Which parasitoid for which aphid?

The research was focused on finding, screening and developing efficient parasitoids against aphids that harm fruit tree crops. The following species of aphids were in the limelight of the project: *Myzus cerasi*, *M. persicae*, *Hyalopterus pruni*, *Brachycaudus helychrisi*, *B. cardui*, *B. persicae*, *B. schwartzi*, *Aphis pomi*, *A. spiraecola*, *Dysaphis plantaginea*. For two years, aphids were sampled in fruit tree orchards and adjacent plant communities for the different EPPO zones. For Central Europe, pcfruit has screened orchards in Belgium on aphids. Parasitized specimens (mummies) were collected and the host plants were registered. The emerged parasitoids were identified by the Faculty of Biology of the University of Belgrade and subsequently tested for their usability as a biological control agent by the company Viridaxis in collaboration with pcfruit. Besides life span and fecundity, all potentially valuable identified parasitoid species were evaluated for their efficiency in parasitism and production. They were first tested under small-scale laboratory conditions. When successful, the production process for mass



rearing was set up and tested. Additionally, other insects of influence in the fruit tree orchards, like ladybirds, hover flies, ants, etc. were monitored and taken into account during the testing period. In the final phase of the project, a method to release the parasitoids in the best conditions in the fruit tree orchard was developed. For this purpose several field trials in Belgium as well as in Spain were organized. In in Belgian cherry orchards, parasitoids dispersed efficiently and mummies were found in abundance through the orchards. However, full control of aphid infestations has not been reached. It appeared that this situation was mainly due to external factors such as adverse climatic conditions in outdoor conditions. Results in the peach orchards in Spain were very encouraging, as parasitoid mummies were observed regularly in all the fields where releases had been performed. Up to 50% of the trees being followed up were sheltering mummies in several of the trial orchards. The use of parasitoids helped reducing considerably the aphid infestation level compared to control plots (without parasitoid releases).

Micro-organisms: the good ones vs the bad

Furthermore beneficial micro-organisms against *Monilinia fructigena* were tested in field trials in cherry within this project.

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Funding: BIOCOTES (EU FP7-KBBE-2013-7) (2014 - 2018)

More info: www.pcfruit.be

Applied research on alternative crop protection agents for biological control of pests in organic pome fruit growing

completed

Even in organic horticulture, crop protection agents are sometimes needed. Naturally, the compounds used must be of biological origin and compatible with organic agriculture.

Prerequisites for crop protection agents for registered use in organic fruit growing

For the moment the range of crop protection products compatible with organic fruit growing is limited in Belgium. In order to be able to use a compound in organic growing there are two prerequisites:

- the compound has to meet the requirements for the implementation of Council Regulation (EC) No 834/2007 on organic production and labeling of organic products with regard to organic production, labeling and control.
- The crop protection product have to be registered in Belgium for the control of pest(s) in (fruit) culture (consultation via www.fytoweb.be).

One of the major obstacles is the lacking of biological efficacy data of (organic-compatible) crop protection compounds for controlling particular pest insects in fruit growing.

Natural pyrethrins as biological curative crop protection compound

Natural pyrethrins are a class of organic compounds normally derived from Chrysanthemum flowers that have potent insecticidal activity by targeting the nervous systems of insects. It is often combined with the synergist piperonyl butoxide, which is problematic for organic fruit growing.

Need for alternative biological control compounds

The goal of this project is to determine the biological efficacy of a range of (organic-compatible) plant protection products against problematic pest insects including sawflies, pear gall midges and blossom weevils.

Therefore we executed a total number of 10 GEP (Good Experimental Practices) field trials with biological crop protection products within this project. Biological compounds tested included different formulations of natural pyrethrins (with rapeseed oil), azadirachtin, spinosad, terpenes, and carboxylic acid potassium salts. We determined the optimal timing, the optimal dose rate and spraying interval in terms of control efficacy against



the target pests. Furthermore, also other important characteristics like the side effect on relevant natural enemies (for instance predatory mites in apple) were tested in the field. All executed field trials and their outcomes were reported in GEP reports, which were provided to contacts involved in registration dossiers with the abovementioned products. Hence, with this project we supported current and future registration dossiers, in order to offer more control possibilities to organic fruit growers.

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More info: www.pcfruit.be

More nature for seedy fruits

*Bees are important pollinators of many agricultural crops and are thus a crucial link in the food production chain. In the past years, one of the prime pollinators, the honey bee (*Apis mellifera*), has suffered heavy losses. Wild or solitary bees can help the honey bees to pollinate fruit trees, as they have proven to be efficient pollinators.*

Nesting possibilities for bees

The goal of this project is to stimulate the presence of (wild) bees in fruit orchards. Therefore we investigated which bees occur in the orchard during the blossoming period, which species inhabit the nest boxes, if the bees really visit the apple flowers and if – as a consequence - fruit set and pollination level are increased. Doing so, we placed nest boxes in many orchards in Belgium (and the Netherlands) in order to offer wild bees nesting possibilities. In addition, a detailed analysis of the environment is executed, revealing important obstacles or opportunities for the wild bees.

Food for bees

Bees must have sufficient food in order to survive. To provide pollen and nectar during the whole growing season we investigate the influence of flowering plants/trees in and at the borders of fruit orchards. The impact of the increased biodiversity and pollen/nectar supply is followed up. These mitigation measures are also applied on a larger scale in the surrounding environment.

How is fruit set and pollination level?

In each orchard tree, particular flower clusters are marked and followed up during the season in order to get an idea of fruit set (number of fruits/number of flowers per cluster). Fruits are counted and weighted, seeds are counted as indicator of the pollination level, and the quality is determined.

Other beneficial predators against pest insects and (water) voles in fruit orchards?

The mitigation measures for increased biodiversity also offer opportunities to other beneficial organisms in fruit orchards like natural enemies of pest insects and (water) voles (e.g. mustelids).



What is the impact of the increased biodiversity elements?

The honey bee *Apis mellifera* turned out to be the most abundant in the orchards investigated (61%), followed by bumblebees *Bombus* species (18%) and Mason bees *Osmia* species (13%). The latter group is of particular interest for this project because they preferred to inhabit the nest boxes. Furthermore, interesting observations and insights were obtained regarding natural control of pests (insects and voles) by natural enemies.

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Funding: Interreg V, provincie Limburg, provincie Vlaams-Brabant (2016 - 2019)

More info: www.pcfruit.be

“Biofruit debuggers”: an operational group in the battle against stink bugs



new

*Stink bugs have been a major problem for several years in organic pear growing. They also cause damage in organic apple cultivation and integrated pip fruit cultivation, and are very difficult to combat with the current registered crop protection compounds. Moreover, this family of harmful stink bugs threatens to grow even more with the introduction of the invasive Asian brown marmorated stink bug *Halyomorpha halys*, which has been already detected in southern Europe and recently in our neighboring countries France and Germany. In a short time it has become one of the most important pests in pome fruit. The aim of the EIP Operational Group “Biofruit debuggers” is to stop the advance of this threat.*

Knowledge is power in the battle against stink bugs

In order to determine the optimal (temporary) use of nets (see below), we want to know exactly if and when stink bugs migrate in and out of the orchard. For this purpose, we will conduct systematic monitoring in orchards and adjacent forests/hedgerows/biodiversity borders in the network of this operational group and examine sampled stink bugs for the presence of mature eggs. Our hypothesis is that stink bugs (when they develop in the pear orchard) need proteins for ripening their eggs in the course of June. At that moment they will start looking for protein in the nearby (forest/hedge) edges, and after feeding, they will fly back into the orchard to lay their ripened eggs in the pear trees (which would explain why there are more stink bug problems in orchards than in vegetative (forest) edges).

In addition, we aim to combine new knowledge, mainly originating from recent (international) research efforts on the invasive Asian stink bug *H. halys*, but also on the native red-legged shield bug *Pentatoma rufipes* (= forest bug), and to use it for the elaboration of new control strategies against stink/forest bugs in organic fruit cultivation in Flanders.



Exclusion nets against stink bugs

Given the higher presence of forest bugs along biodiversity elements (forest/hedge/flowers) edges, we suspect that certain plants/shrubs as a food source have an important impact on the development of local pest populations. With the aim to disrupt the migration to and from these food sources, we have installed exclusion nets over pear rows at several organic pear orchards of fruit growers taking part in the Operational Group 'Biofruit debuggers'. These nets prevent adult forest bugs from flying back and forth between pear (side) rows and surrounding hedges/forests. By closing these nets in the right period (when the bugs become adults and looking for proteins), we prevent this important food intake and thus the production and ripening of eggs. The effect of the nets is evaluated through sampling of bugs and assessments of insect damage to the fruits.

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Funding: EIP Operational Group, Government of Flanders – EU (2017 - 2019)

More info: www.pcfruit.be

Automatic monitoring of insects



new

*In both organic and integrated cultivation, monitoring of insects (pests and beneficials) is crucial. However, the current monitoring and warning system in Flemish fruit and vegetable cultivation is labor-intensive and often requires specific expertise for the identification of the various pest insects. The rapid progress in the areas of electronics, sensors, camera technology and artificial intelligence (image analysis/detection) offers perspectives for automation of the monitoring system. In this project we focus on the possibilities and development of automated observation and warning systems for 4 target cases: codling moth (*Cydia pomonella*), *Drosophila suzukii*, lettuce root aphid (*Pemphigus bursarius*) and chicory miner fly (*Napomyza cichorii*).*

Automatic identification on photos using camera-equipped traps

Great progress has already been made in the so-called camera-based automated monitoring systems. This is simply a common pheromone trap in which a camera is mounted above the glue plate. On a regular basis, the camera takes pictures of the glue plate, and these photos are stored via a wireless connection on a server (in the cloud). The photos can be consulted via a personal login at any time and from anywhere by the grower or advisor to see if and how many target insects have been caught. Moreover, for a number of target insects, an automated recognition has already been developed via image processing software. However, it is difficult to estimate how accurate, and therefore how reliable, this automatic recognition is. The practical validation of these systems is the subject of this automated monitoring project. We also want to make improvements such as the automatic replacement of glue plates and improved camera and smart detection technology. We also investigate the possibility of combining multiple attractants/pheromones in one trap, so that such camera-equipped traps can be used to monitor as many different pest insects as possible.

Automatic identification by measuring the wingbeat frequency

Another option for automated monitoring is the electronic identification of insects with the aid of an optical sensor. The principle of this detection technique is innovative, but actually surprisingly simple. When an insect flies between a light detector and a light source, the light intensity that falls on the detector will change. If the wings are fully open there is a maximum



'shadow' on the light detector, and with fully folded wings there is a minimal 'shadow'. Typically an insect folds its wings in the order of magnitude of 100 to 600 times per second. The change in light intensity on the light detector will then have the same frequency as the beat (i.e. somewhere between 100 and 600 Hz). Because this wing frequency is characteristic of each type of insect, such a measurement signal results in a sort of unique 'barcode', which means that the insect can be identified automatically. In this project we also want to further develop this technique for the target case insects.

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More info: www.pcfruit.be,
www.pcfruit.be/nl/geautomatiseerde-monitoring

Ecological "Attract & Kill" in the battle against *Drosophila suzukii*

new

The Asian fruit fly *Drosophila suzukii* or 'Spotted Wing *Drosophila*' has in a short time become the most damaging insect pest for both stone fruit (cherry), strawberries and woody small fruit (raspberries, blackberries and other berries) both in Europe as well as in the USA. In order to cope with this problem, the project "Knowledge-based practical solutions for the protection of Flemish fruit cultivation against *Drosophila suzukii*" (VLAIO LA-Programme IWT-LATR 135079 (2014 - 2018) was recently completed. This project has yielded knowledge and insights together with the investigation and testing of various practical control measures in the context of Flemish fruit growing conditions. The most promising control measures were obtained in the 'Attract & Kill' section, which included the discovery of the control potential of the European bird cherry (*Prunus padus*) as a so-called "dead-end host plant". This project aims to further exploit the (ecological) 'Attract & Kill' control potential and to develop its practical application.

European bird cherry *Prunus padus* as natural enemy of *D. suzukii*

In laboratory studies, we were able to show that the fruits of European bird cherry *P. padus* are very attractive for egg laying of *D. suzukii*. In fact, when they have a choice between ripening sweet cherries and ripening European bird cherries, *D. suzukii* females show a significant preference to lay their eggs in the European bird cherry fruits. However, these fruits do not support development of the *D. suzukii* larvae. So it is a so-called "dead-end host plant", which is very interesting to naturally suppress the *D. suzukii* populations.

How to lure and how to kill?

With this project, we first want to find out which (volatile) components of *Prunus padus* are responsible for the strong attraction of *D. suzukii*. We also aim to unravel the 'killing mechanism' in the 'dead-end host' fruits.



From knowledge to practical control solutions in the field

With the acquired knowledge we will develop a control strategy based on *Prunus padus* “dead-end host” plants in fruit plantations. We are considering placing *P. padus* hedges in the edges of cherry or small fruit parcels. Or *P. padus* hedges between the rows if the control effect of *P. padus* hedges in the edges does not reach far enough. We also investigate the possibility of *P. padus* grafting on cherry rootstocks. Finally, we investigate the possibilities for fitting identified (attract) substances for application in a classic ‘Attract & Kill’ strategy (‘bait sprays’ and/or ‘mass trapping’) independent of dead-end host plants.

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More info: www.pcfruit.be

Sustainable control of *Drosophila suzukii* in cherries, strawberries and ligneous small fruits

The Asiatic fruit fly Drosophila suzukii or "spotted wing *Drosophila* (SWD)" has in a short time become the most damaging insect pest of cherries, strawberries and small fruits in Europe. In Belgium first damage was noticed in 2011, and in every following year SWD has multiplied further and has now spread over all the fruit growing regions in Belgium.

Incapacity of chemical crop protection products to control *D. suzukii*

Concerning spraying applications with chemical crop protection products, it turned out that only broad active compounds (pyrethroids, spinosyns, organophosphates) have a sufficient fast control activity against *D. suzukii*. However, the (multiple) applications with this type of insecticides are detrimental for integrated control of (other) pests, as all beneficial insects and mites are killed. Therefore we focus in this project on control measures compatible with biological control for a sustainable control of *D. suzukii*.

Knowledge is power in the battle against *D. suzukii*

First we collected valuable knowledge concerning key aspects of biology of *D. suzukii* in our fruit growing conditions. We were able to determine that SWD has 7 generations in Flanders, and that they overwinter as adults in protected habitats, preferentially in woody (bushy) structures. Furthermore ripening cherries were found to be the first important host plant in the season. From the very first coloration (or ripening) host fruits are susceptible for infestation. We also noticed big differences in behaviour between summer and winter SWD morphs.

Mass trapping and Attract & Kill

The "attract and kill" and "mass trapping" strategies in which pest insects are attracted to a trap and killed are interesting control alternatives for organic fruit growing. They allow to monitor and control *D. suzukii* without massively spraying chemical insecticides. Based on the gained insights into the biology of SWD we are currently developing and testing these strategies in field trials. The outcomes of these trials will determine the efficacy of these biological control strategies against SWD in fruit growing in Flanders.



Sanitary control measures during and after harvest

Crop hygiene and fruit waste disposal are very important to prevent further multiplication and spreading of SWD in orchards. In this project we also developed a practical fruit waste container in which SWD is killed quickly and effectively. Furthermore the fruit waste is transformed to a valuable fertilizer for other (fruit) crops.

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Optimal biological control strategies for a sustainable protection of strawberries against thrips

completed

Anthophilous thrips are a severe pest in strawberry: they cause damage to the fruit including bronzing, deformation and a seedy appearance. For a fruit with very high quality standards like strawberry, such imperfections have great economic consequences. Reinfestation due to their high mobility and wide variety of host plants, a quick build-up of resistance due to their short life cycle, and a low reachability due to thigmotactic behaviour, make thrips hard to suppress using chemicals. Other incentives for seeking alternative control measures are legal limitations in the use of chemical control and the rising demand for minimization of (extra-legal) residue on fruit.

Biological control by predatory mites is the key

Biological control by means of predatory mites is one control option. Their greatest advantage is their short life cycle which implies a population build-up fast enough to control thrips, even in crops with a relatively short cropping season like strawberry. Despite the potential for natural presence of predatory mite species, augmentation does not occur naturally in strawberry due to production in greenhouses, production in a monocropping system and annual replanting. For these reasons introducing of predatory mites is favorable.

Many generalist species are commercially available and are advised for the control of thrips. Until now, these commercial predatory mites used to be advised and chosen based on their geographic origin and the few known temperature-dependent life history parameters. Climatic conditions of strawberry production vary greatly, driven by the constant aim of producing when supply is low and therefore prices are high. In this project we have matched the commercial thrips-predating phytoseids with the highly diversified climatic conditions of different strawberry production systems. Therefore all (Belgian) production systems and time spans are categorized into three climate types. For each climate type (and hence for each strawberry production system) we have developed specific integrated control schedules. In this control schedules we selected the optimal species of natural enemies (predatory mites) and the optimal timing of introducing them according to the specific (climatological) conditions in the strawberry production system.



Other biological control compounds

In this project we also investigated the potential impact of entomopathogenic fungi. In laboratory and field trials we analysed their added-value in biological control schedules for control of thrips in the different strawberry cultivation systems.

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More info: www.pcfuit.be

Biological control of aphids in ligneous small fruits

In ligneous small fruits there are fewer and fewer possibilities for chemical control of pest insects. One alternative can be the release of natural enemies. They offer an alternative biological control approach and decrease the likelihood of resistance development. Within this project we test and validate several biological control programs in protected cultures of raspberries and strawberries.

Aphids: highly destructive and hard to control

Aphids are one of the most destructive pest insects and responsible for consistent and considerable crop losses in small fruits. Their sucking activity weakens the plant and the secreted honeydew results in quality problems with the harvested fruits. Aphids can also be the vector for disease. They have a complicated life cycle with typical periods of asexual reproduction, resulting in exponential population increases in a very short time.

A biological army against aphids

Within this applied/demonstration research program, we develop biological control strategies with the release of preventive as well as curative beneficial insects. At several times during the growing season (before blossoming, during blossoming, after blossoming) beneficial insects like parasitoids, *Adalia* ladybirds, lacewings (*Chrysopa carnea*) and predatory midges (*Aphydoletes*) are released and their impact is analyzed.



Preventive versus curative

Parasitoids parasitize aphids; the parasitoid larvae develops inside the body of the aphid. As a consequence, the next generation of parasitoids appears always later than the next generation of aphids. Hence, for this type of beneficial insects the preventive control approach depends on action against the very first aphid stem mothers (fundatrices) in a preventive control approach.

Curatively, other beneficial insects such as predators can be applied. The advantage in this case is that when introduced after the first pest/damage presence they will find some prey to build their population on. The optimal release strategies are tested in this project.

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More info: www.pcfuit.be

IPM for blackberry, red currant and primocane raspberry

At pcfruit, integrated management strategies for a variety of pest and diseases are evaluated each year. Particularly since there are few registered chemical products available (especially under protected cultivation), the introduction of natural predators can be an alternative way to manage insect pests such as two spotted spider mite and aphid. Use of biological alternatives primarily reduces the build-up of resistant pest populations. The purpose of IPM is still to maximize implementation of natural predators and minimize the use of insecticides.

Observations IPM 2017

Blackberry

In 2017, a blackberry crop under glass had large populations of aphids present due to a preceding aphid trial. Aphids were consequently treated two times with Plenum, but treatment efficiency was minimal. After the treatment with Plenum, 5000 lacewings were released; their effectiveness was inconclusive. In case of effective control by the lacewings, parasitized aphids or mummies should have been visible. It is probable that the number of lacewings released was not sufficient to control the large pest population. Optimization of predator-to-pest numbers requires further research.

Following the distribution of lacewings, the crop was sprayed 10 times with Eradicoat. Eradicoat has a physical mode of action on insect pests and appeared in 2017 to have a better efficacy than Plenum. Eradicoat may be applied up to a maximum of 20 times during one season due to its non-chemical mode of action. A good spray technique is required, with adequate contact with the insect so that the product can work. Eradicoat can also be used in combination with insect predators.

In 2017 a trial took place on the establishment of predators on blackberries under plastic multi-span tunnels. Two pre-flower treatments of abamectine were applied (= Vertimec was carried out). Predators were introduced 14 days after the last spray, but almost no predators could be confirmed. It is probable that the breakdown of abamectine under plastic occurred much slower than in open field conditions and consequently killed the introduced predator populations.

Primocane raspberry

Predators were introduced to a crop of primocane raspberries to control spider mite. Both protected and open field parcels were used. Californicus was distributed as a preventive measure and Persimilis was used curatively. Californicus was introduced at 20 insects per running meter to manage spider mite in the greenhouse and no corrective sprays were carried out. The presence of slight visual spider mite damage was both expected and tolerated.

In an unheated multispan greenhouse both Californicus (3 x 20/lm) and Persimilis (2 x 20/lm) were introduced. Due to the high pest pressure, 2 corrective sprays of Floramite had to be applied.



Table: Establishment and mortality trial of introduced predators on leaves of primocane raspberry after treatment with Raptol

object	14-03		15-03		16-03	17-03	20-03
	present	introduced	present	introduced			
control	1	3	3	3	4	4	4
Raptol 2 l (03-03-17)	0	3	2	3	4	3	2
Raptol 2 l (07-03-17)	0	3	0	3	3	3	1
Raptol 4 l (07-03-17)	0	3	2	3	1	0	0

For the natural enemies of spider mite an establishment test for the crop under glass was carried out. Here Raptol was sprayed at different doses and at different times. The sprayed treatments were 2L/ha vertical canopy on 03-03-17, 2L/ha vertical canopy on 07-03-17 and 4L/ha vertical canopy on 07-03-17. Following the spray treatments, on 14-03-17, leaves were collected and inspected for the presence of Californicus. Afterwards, in the lab (14-03-17 and 15-03-17) predator insects were introduced to the collected leaves and resulting populations of predators were followed up (from 15-03-17 to 20-03-17). The results of this test are given in the table above.

The table gives a clear indication of the effect of Raptol prior to the introduction of predators. By the control treatment, 4 of the 7 predators remained. After treatment with Raptol 2L (11 days prior to introduction), only 2 from the 6 predators remained (17 days after treatment). When predators were introduced at a further reduced interval after treatment with Raptol, the establishment of predators was further reduced. In this case, only 1 from the 6 predators released survived after 13 days after spraying with Raptol. When the rate of Raptol was doubled and the introduction of predators soon afterwards released, then no surviving predators could be afterwards detected.

This predator establishment test demonstrates the negative impact of spraying Raptol on predator insect populations. Ten days after spraying and even up to 14 days after spraying was not enough time to enable the natural pyrethroids of Raptol to sufficiently break down under glass.

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Biological control of aphids on trees



new

Trees are important for human life but when trees are infected by aphids, they often become a source of frustration. Aphids damage the trees with their sucking mouthparts and produce honeydew, a sugar-containing substance. The honeydew falls onto the cars or benches below, making them feel sticky. Honeydew on plant leaves is also a food source for sooty moulds, which decreases the horticultural value of plants.

Into the trees

As the demand for alternative pest management techniques is rising, we study two environmentally-friendly ways of coping with harmful aphids in an applied scientific research project at University College Ghent (HoGent) from 2018 - 2020. We release natural enemies that feed on aphids, such as ladybug or lacewing larvae, in trees at nurseries and in public green spaces. To assess the impact of those releases, we monitor aphid densities every two weeks. We also investigate cultivar susceptibility to aphid infestation by monitoring aphid densities on five species or cultivars of lime, maple and oak in a nursery.



Larva of the lacewing fly that is feeding on aphid

To be continued...

Preliminary results demonstrate that the susceptibility to aphid infection varies among cultivars. For maple and lime (linden) trees, the least susceptible cultivars were *Acer platanoides* 'Drummondii' and *Tilia tomentosa* 'Brabant'. For oak, *Quercus petraea* and *Quercus rubra* seemed to be most susceptible. Further monitoring in the coming years will show us whether the release of natural enemies and planting resistant cultivars can help controlling aphids.

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Funding: applied scientific research project funded by the Government of Flanders to promote scientific research within the educational program of 'professional bachelor agro- and biotechnology' at University College Ghent (HoGent) (1/01/2018 - 31/12/2020)

SUREVEG - Strip-cropping and recycling of waste for biodiverse and resoURce-Efficient intensive VEGetable production

new

The rise in demand for organically grown vegetables requires further optimization of the current organic cultivation systems, with even more attention for biodiversity and soil fertility. That is why this year the new, European partnership SUREVEG is starting. The focus is on strip-cropping and on the use of vegetable residual streams as soil improvers and as fertilizers.

Looking for new cultivation systems

The goal of the project is to renew and intensify cultivation systems for organic field-grown vegetables with the ultimate goal of increasing biodiversity and more efficient use of resources. The plant fertilizers and soil improvers that are being studied serve to recycle residual flows as nutrients and to improve carbon storage in the soil. Strip-cropping systems have some potential benefits, the most important of which is a higher yield, through more efficient nutrient and light use and improved natural pest and disease control.

First field trial: leeks and celeriac

Inagro and ILVO installed a first field trial in 2018 at Inagro's experimental organic farm. We chose leeks and celeriac as experimental crops because they both have a similar growing period and because the mechanical weed control is somewhat similar for the two crops. In addition to the classical cultivation of leeks and celeriac, the two crops are planted in alternating rows. In addition, three fertilization strategies are being investigated. As a reference we use cattle farmyard manure. For the second variant, the same cattle farmyard manure was composted together with straw and wood chips and the third variant consists of composted plant waste from Brussels sprouts, grass silage, straw and wood chips.

The season started off wet, which delayed destruction of the grass clover cover crop. This meant that the superficially incorporated grass sod was insufficiently decomposed. These plant residues clogged the mechanical weeding machinery which led to the destruction of quite a few young leeks and celeriac plants. The dry conditions of June-July caused growth retardation and low weed pressure. From August onwards, we started ridging the leeks. In the fields where leek and celeriac were planted next to each other, extra manual labor was needed to remove the earth from the celeriac or to press down celeriac plants that were loosened by this action.



During the visual assessments of the two crops, no differences have been noted so far with regard to disease and pest damage. The celeriac in the strip-cropping fields shows a more stretched-out and erect foliage than in the classically planted fields, although this difference is not very pronounced.

Further analyses and sampling

During the harvest both crops are evaluated for pest damage and yield. At the end of the cultivation, soil samples are also taken to examine the effects of the strip-cropping on the soil life in the rhizosphere and the root architecture. Using pot traps and water containers we monitor the aboveground biodiversity in the strip-cropping and in the conventional fields.

In 2019 we will repeat the trial, afterwards the results from the various European participating countries will be combined and analyzed.

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More info: <http://projects.au.dk/coreorganiccofund/research-projects/sureveg/>

European knowledge on organic arable production gathered at www.farmknowledge.org

Organic farming is complex and demands a great deal of knowledge and skills from farmers. The active exchange of knowledge and experience is largely restricted by national borders. In addition to geographical factors, language is also a limiting factor. The thematic network project 'OK-Net Arable' broke through this impasse.

The 'OK-net Arable' project

OK-Net Arable was one of the first four so-called thematic networks funded under the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). This policy instrument aims to support innovation by bringing together farmers, advisors and researchers. OK-Net Arable (March 2015 - February 2018) included 14 farmers' innovation groups that were actively involved in the implementation of the project. Inagro and BioForum Flanders were the Flemish project partners. The project started from the observation by the EIP Focus Group Organic Agriculture that organic arable production achieves 75 to 80% of the yield of conventional farms, with large differences between the companies and the regions.

The core of the project were 14 farmers' innovation groups that described the "state of the art" per Member State. What are you good at? Which yields do you realize? Which problems do you encounter? Which media channels are used to gain new information? During three regional meetings, the growers' groups or a representative also effectively came together to deepen this discussion and exchange ideas with each other. Social media and YouTube proved to be very important.





Each Member State also had a specific issue. In Flanders, we focused on weed control in grains and during a demonstration, different machines were brought together. The report is available at <https://www.youtube.com/watch?v=jk5ZcGep66Y>.

www.farmknowledge.org

The website www.farmknowledge.org collects the most efficient 'tools' for organic arable production from the 12 participating countries in 5 clusters: soil quality and fertility, nutrient management, pest and disease control, weed control and crop-specific solutions. Around the questions that arose during the farmers' meetings, new 'practice abstracts' or short handouts were made that are publicly available at www.farmknowledge.org. In addition, farmers and researchers can also share new ideas via the platform. This platform is also available in Dutch via digital translation. Seventeen partners from 12 European countries developed the online platform.

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Funding: HOR2020 research and innovation programme – grant agreement No 652654 (1/03/2015 – 28/02/2018)

More info: www.farmknowledge.org

Organic legumes as an engine for innovation and cross-border value chains



new

The amount of organically cultivated area has grown quickly in Belgium and in France. Nevertheless, the necessary nitrogen supply is a challenge in arable farming and vegetable growing. Legumes offer a solution.

Development of a value chain with legumes: an important challenge

Legumes provide nitrogen for the following crops and contribute to soil fertility. Thanks to these advantages, legumes are the engine of organic farming systems. But the commercialization of legumes is currently difficult. Development and structuring of a value chain for organic legumes is needed, both for animal feed and for human food.

Cross-border cooperation

Located between the cities of Brussels, Lille and Paris, Belgium (Flanders and Wallonia) and the north of France offer important development opportunities for organic farmers and for market participants in the organic chain. To develop the cultivation method and value chain of organic legumes, the Flemish partners Inagro, BioForum Flanders and CCBT, Walloon partners CRA-W and Biowallonie and the French partners AgroTransfert, Université Picardie Jules Verne and Bio and Hauts-de-France are joining forces. They are working together for four years in the cross-border Interreg project "SymBIOse".

The exchange of knowledge and experience is central. In an innovative research program, the partners, together with farmers, look for the right cultivation technique for legumes and their place in the crop rotation. Farmers and consultants will exchange experiences during annual visits and via videos. Through round-table discussions with market players, the partners also want to promote cross-border exchange and transparency in the value chain for cereals and protein crops and for field-scale vegetables.

SymBIOse officially started at an on-farm meeting for farmers and governments

Farmers Guy and Sébastien Vanlerberghe from Rosières (France) have included legumes in their rotation since the recent switch to organic farming. At their farm, experiments are currently underway with alfalfa and mixtures such as lentil and spelt in outdoor cultivation.



On Friday, June 29, 2018, Guy and Sébastien's farm became the setting for a meeting of farmers and local authorities.

Leafy legumes as alfalfa can be harvested in fractions. The leaves of such legumes are rich in proteins and the stems are mainly fibrous. On the day of meeting, Guy and Sébastien introduced the participants to an innovative technique that is being tested at their farm: the de-leafing of alfalfa in order to use the leaf fraction in feed for monogastric animals. With a large protein content, legumes can meet the challenge of 100% organic feed by 2021. "For me, alfalfa is the soy of Europe", says Guy enthusiastically.

The meeting was a first opportunity to exchange knowledge and experience about innovation and further growth in the project. Host Guy applauds these goals: "We are at the beginning of the knowledge that will ensure cleaner agriculture without nitrogen input. The research enables us to innovate and make progress," he said.

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Funding: Interreg France - Flanders - Wallonia
(1/04/2018 - 31/03/2022)

More info: www.symbiose-interreg.eu

DiverIMPACTS moves farmers towards more diverse cropping systems



Research has shown that the more a cropping system is diversified, the more stable and resilient it becomes. A broad and diversified crop rotation, intermediate crops, and intercropping are three possible instruments for this, but in practice they face many obstacles. DiverIMPACTS actively seeks ways to break through these barriers through an integrated chain approach.

The project

DiverIMPACTS or 'Diversification through crop rotation, intermediate crops and intercropping, supported by the entire chain for more sustainability' is an EU research project that aims to strengthen the application and impact of diversified cultivation systems through crop rotation, intermediate crops and intercropping in practice. The aim of DiverIMPACTS is to explore the full potential of diversified crop systems for yield, ecosystem services, resource efficiency and sustainable value chain development by:

- Supporting research (10 long-term trials are being continued) on crop rotation, intermediate crops and intercropping
- Performing 25 case studies spread across the European Union as natural experimental environments where farmers, together with actors from the entire value chain, look together to find leverage and innovations to eliminate existing obstacles and to make full use of the benefits of diversified cultivation systems on the level of the farm, the production chain and the environment.
- Developing recommendations for policy, chain actors and sector organizations for optimal facilitation of this process.

BioForum Flanders and Inagro are the Flemish partners in this project and are developing two case studies in Flanders. In this co-innovation process we are methodologically supported by the project partners of Wageningen University.

Case study 'Field food' ('Akkerfood')

Food patterns in society change over time. The demand for vegetarian food is picking up and is creating a demand for new raw materials. Soy and quinoa are examples of this, but the demand is much more diverse. Today these are often imported from abroad while some crops can also be grown in Flanders. In the case study entitled 'field food', we are looking for ways to connect Flemish organic arable farmers and regional processors in order to expand arable rotation in this way. The challenges are diverse: agricultural, logistics, process, fair price and spreading risks, etc. Two arable farmers and one processor have committed to try this.



Case study 'Interfarm'

Organic livestock farms and organic arable/vegetable farms are generally specialized in Flanders. This is necessary in function of craftsmanship, work organization, efficiency, scale, etc. Nevertheless, the ideal organic farm is a mixed farm in which manure, feed, straw and soil circulate between and across the different specializations on the farm. The case study 'Interfarm' strives to realize this ideal situation through collaboration between specialized companies. Three cooperating couples are followed up and supervised. We look at what motivates them, how they tackle it, which obstacles they encounter and how they can handle them. An important issue also appears to be the mutual (financial) valuation of exchanged goods and land.

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More info: www.diverimpacts.net

Greenresilient - Agro-ecological production systems for organic greenhouses



new

The COREOrganic Cofund ERA-NET project 'Greenresilient' was launched on 2nd April 2018. Within this European project, an international research team aims to design agro-ecological production systems for organic greenhouses in various European regions. In Flanders, the focus will be on energy use and reduced light in winter, while the Mediterranean area focuses on crop protection. Eight European countries participate in the project, with ILVO and PCG as Belgian partners.

Local agro-ecosystems for organic protected crops

The demand for organic vegetables is increasing, as evidenced by an increase in the amount of organic cultivated area. Winter production in unheated or low energy greenhouses remains a challenge. In Europe, greenhouse and tunnel sections are often intensive, which is detrimental to the sustainability of these systems. But it is possible to develop less intensive systems with attention for energy, crop rotation, local inputs and the use of green manures. These innovations are being developed for different regions in Europe with experimental sites in Italy, France, Switzerland, Denmark and Belgium. Within this project we wish to develop new systems for greenhouses and tunnels (GREENhouses) that are resilient (RESILIENT), sustainable and locally adapted.

Unified forces

A thorough assessment of the new systems is carried out with a multidisciplinary team (specialists in agriculture and botany, agro-ecology, soil chemistry, entomology and plant diseases). We will investigate the effect of green manure crops and lesser-known crops. In addition, we monitor the influence of these systems on upper and underground fauna, but also on the flora. In order to assess the ecological sustainability of the systems, a Life Cycle Assessment (LCA) is performed. ILVO studies the different soil aspects and functional biodiversity in the new systems. Determining the diversity of soil life is done via DNA metabarcoding for nematodes. The PCG is one of 5 experimental sites where the innovations are tested and evaluated. All results will be announced to the sector through various channels.

The team therefore hopes to have a good overview of the feasibility of agro-ecology in organically protected crops in Europe in three years' time.



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(2/04/2018 - 1/04/2021)

More info: www.pcgroenteteelt.be

Transition to agro-ecological practices through a participative approach



new

The recently started INTERREG project TRANSAE unites 8 partners from Flanders (ILVO and Inagro), Wallonia (CRA-W and Greenotec) and northern France (Parc naturel régional des Caps et Marais d'Opale, APAD62, Université de Picardie Jules Verne, Initiatives Paysannes) in supporting about 40 pioneers in their transition to agro-ecology. During local and interregional contact moments knowledge about agro-ecological practices is exchanged and networks of partners and farmers are strengthened. The project aims to further develop and distribute agro-ecological practices. TRANSAE makes use of on farm experimentation and a participative approach to support the transition to agro-ecology.

Experimenting with innovative practices

In this project, farmers get the opportunity to experiment with innovative practices and combinations of practices at their farms. Participating farmers are guided in their transition through field trials, knowledge-exchange sessions and training sessions. Possible themes include: 1) reduced use of external inputs, 2) improving soil quality through a combination of reduced soil cultivation and green manures, 3) improving feed autonomy through the combination of optimal valorisation of roughage and the use of mixed cropping and 4) agroforestry (farming where trees are integrated in the agricultural system). However, these themes are not strict and depend mainly on the themes that are most appealing to the farmers themselves.

Trajectory analysis

In addition, the trajectory of the participating farmers is assessed (analysis of in-depth interviews) and their current situation and farm management are analyzed using a diagnostic tool. Knowledge and experience from these experiments and analyses will be used to strengthen the operational management of the participating farmers. In addition, the project also aims at revealing the opportunities and barriers that can either support or impede the transition to agro-ecological practices. The intention of TRANSAE is to transfer the experience and knowledge of this group of pioneer farmers to a broader group of interested farmers in the region. The project provides a number of training sessions for interested farmers.

Knowledge, courage and investments are all necessary

Changing agricultural practices inspired by agro ecological principles requires a lot of knowledge, daring and investment from farmers. TRANSAE is based on the principle that change starts from reflection and that real innovation is stimulated when it is supported by the collective - "change is never done on



your own". TRANSAE therefore relies on a participative approach: partners and farmers share their knowledge about agro-ecological practices through interactive group activities in which openness, equality and co-creation of solutions are central.

Interregional learning

During TRANSAE activities, the focus is on interregional knowledge exchange and stimulating learning between farmers, researchers and advisors across borders. Reflection, mobilization of different types of knowledge, and co-creation of innovation, should result in a framework with new ideas, values and norms to promote the transition to agroecology. The methods and tools used to promote learning during TRANSAE activities are evaluated. This should result in a proposal of a framework to support farmers in their transition to agroecology.

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Creative with cover crops

Cover crops bring balance to crop rotations. They bring nitrogen to the soil when the crop has removed the available pool. When the main crop has left too much nitrogen after harvest, cover crops can catch nitrogen. Cover crops can stop the build-up of detrimental soil pathogens, suppress weeds, contribute to improve the level of soil organic matter, improve the soil structure, etc. In the project 'Levende bodem' (Living soil), we investigate if a cover crop mixture can deliver more N, biomass and suppress weeds better than a monoculture cover crop. In addition, we also investigate if sowing a cover crop as mulch between the rows of a vegetable can contribute to a resilient agro-ecosystem.

Cover crop mixture vs. cover crop monoculture: 3-1?

Different cover crop species have different functions: leguminous cover crops can transfer nitrogen from the air to the soil, tagetes (marigold) can suppress nematodes, fodder radish is a champion in suppressing weeds and grasses contribute to improve the soil organic matter through a high biomass production. Is it possible to have all those functions in one when sowing cover crop mixtures? That is the research question of a trial on the organic experimental farm at Inagro, Belgium. After the harvest of spring wheat, we have sown phacelia, spring barley and hairy vetch in monoculture and in combination. Spring barley produces a lot of biomass (C-build up), phacelia is broad-leaved (weed suppression) and hairy vetch is a legume (N fixation). In addition we have sown very diverse mixture of 6 and 14 species to investigate if they have still an addition value compared to the mixtures of 2 or 3 species.

In situ mulch of faba bean in red cabbage

Normally a cover crop is sown after the main crop. In some cases, a cover crop is also sown in spring before the main crop. In this trial, we investigate if a cover crop together with the main crop is a feasible and valuable option. In this case we have sown faba bean two weeks before planting red cabbage. After 6 weeks, the faba bean has been terminated.

Why have we sown faba bean as living mulch? There can be several benefits: faba beans fix nitrogen which becomes available during the season. Red cabbage has a long growing period and can still benefit from this extra source of nitrogen. The faba bean is also an extra source of organic matter



for soil. A field with cabbage and faba bean can leave a better field for the next year's crop than a monoculture cabbage field.

Despite the dry growing season in 2018, the cabbages planted in between the faba bean had an equal start as those without faba bean. The faba bean was terminated on a very sunny day in a dry period. The cabbages in those field suffered from this and their growth stayed somewhat behind the other cabbages. By the end of September, the cabbages in the faba bean field where greener and had fewer dead leaves than the cabbages without faba bean. The harvest will tell us if the cabbages with faba beans will have made up their growth delay after termination during the autumn.

Leve(n)de Bodem is a project of Interreg Vlaanderen-Nederland

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Funding: Interreg Vlaanderen - Nederland (2016 - 2019)

More info: <http://levendebodem.eu/>

Robust varieties for resilient organic farming

Robust varieties and crops have good tolerance against diseases and pests, have a good nutrient efficiency and are resilient to various stress factors. We tested four concrete cases that can meet these challenges: CCPs in grain, variety mixtures in potato, N- and water-efficient broccoli and outdoor crop tomato.

Maximum diversity in grain fields with CCPs

Previously, the 'ORC Wakelyns Population' was sown at Inagro. This composite cross breeding population (CCP) of winter wheat produces a very diverse canopy and is comparable with commercial varieties in terms of yield and quality. In 2016, four organic farmers responded to our call to sow this CCP and in 2017 there were eight candidates! Together we sowed about 200 kg of 'ORC Wakelyns' every year and we could compare it with other varieties on the farm. The reactions were largely positive and confirm previous results. The population develops well, is fairly healthy and stable and has a decent yield. The crop is mature late, which has to do with the British origin of its ancestors. In the 2016-2017 season, the protein content was the same and the baking quality was slightly lower than that of the reference variety Activus, a 'pale ameliorant'. We experienced this on the trial site of Inagro as well as with a grower.

Cultivating a mixture of potato varieties slows the Phytophthora spread

Potato late blight is a 'polycyclic' disease, which means that a small infestation spreads locally and forms spots of disease. By mixing potato varieties, either in alternating rows or completely mixed, the plague degradation of sensitive varieties can be slowed down to some extent. This concept is interesting for farms using self-harvest or short chain marketing, e.g. by manually sorting or offering mixed products to the consumer. Four demo plots were installed at organic growers, all CSA companies. We always used the combination of a desired, culinary known breed such as Agria and Raja, with a new blight-resistant variety such as Alouette, Connect and Passion. When choosing a mixture of varieties, more or less simultaneous maturing is a requirement and in order to separate the potatoes at harvest, a visible external difference (e.g. peel color) is needed. When the harvested potatoes are sold in a mixture, somewhat similar properties for boiling and frying are needed.

Nitrogen and water-efficient broccoli

In these two variety trials of broccoli we experienced the conditions we were



looking for. Drought was certainly a stress factor present. The results show that the success of the cultivation without irrigation strongly depends on the weather conditions around the period of head formation. The differences between early and late varieties can be large depending on the moment of the first rain fall. Among others, Chronos, Covina and Ironman had satisfying results.

Outdoor cultivation of tomato

With a variety trial of tomatoes in the open air and under a high plastic tunnel, it was evaluated whether there are suitable varieties for outdoor cultivation, in which robustness mainly means *Phytophthora* resistance. It turns out that outdoor cultivation of tomatoes is difficult with the current varieties, despite the dry weather conditions during the experiment. All varieties looked much less healthy in the open air than the plants in the tunnels, and were often strongly affected by *Phytophthora*. The yield was therefore two to three times higher under the tunnels than in open air. Moreover, the taste of the tomatoes in the tunnel culture was perceived to be better. Finally, this research shows that the investment in a tunnel can be recuperated in less than one growing season.

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(1/04/2016 - 31/12/2017)

More info: www.biopraktijk.be

Search for resistant and/or less susceptible apple varieties

Variety testing is and remains an important issue for organic fruit growers. Especially Jonagold is grown, the same as on integrated orchards. The demand for disease-resistant varieties is therefore very important to organic growers.

Testing for susceptibility to scab, powdery mildew, nectria canker and storage diseases

Within the Proefcentrum Fruitteelt vzw – Proeftuin pit- en steenfruit unit, all new apple varieties are tested for their susceptibility to scab, powdery mildew, nectria canker and storage diseases. Therefore 4 trees per variety are planted in a separate parcel which is not sprayed against powdery mildew, nectria canker and storage diseases. Sprayings against scab are only done when there are very heavy infections. In this way we get an idea about the susceptibility of the new varieties and their opportunities for organic fruit growing. Since 2009 interesting new apple varieties for organic fruit growing are also planted in a separate parcel with an organic spraying scheme. Here we focus among other things on the influence of copper and sulphur sprays on the quality of the skin.

When choosing a new apple variety the aspect of “sustainability” is very important. Previously, the focus was primarily on scab resistant varieties. But also susceptibility to powdery mildew, storage diseases and susceptibility to pests such as woolly aphids and spider mites will play a role in the future selection of varieties.

If in the first screening, promising varieties are found for the organic fruit grower, we plant more trees to find solutions for the specific problems of the new variety (especially concerning cultivation techniques). At this moment we have 1 scab resistant apple variety e.g. SQ159/Natyra® planted on a larger scale.

Results

SQ159/Natyra® is a cross between Elise x a scab resistant variety from the Netherlands (WUR - Wageningen). It is a firm, sweet apple with a dark red striped blush and a very good taste. In taste tests, both in Belgium and abroad, SQ159/Natyra® is always in the top 3. The harvest time falls in the 2nd half of October, the same as Braeburn. To have enough colored fruits, 2 pickings are required. It is a moderately productive variety with a rather small fruit size. The storability and the shelf life are good.



SQ159/Natyra®

SQ159/Natyra® is a scab resistant variety (vf) and, moreover, not very susceptible to powdery mildew. In the Netherlands, the vf resistance on one plot has been broken. This has happened on a plot that was not sprayed against scab at all. That is why we recommend to treat scab resistant varieties in case of very heavy scab infections. In this way, the breakthrough of the vf resistance can be prevented. SQ159/Natyra® is very sensitive to Nectria canker. According to research in Klein-Altendorf (Germany), an interstem of Golden could already solve this problem for a large part. In 2016, infections of fire blight were also detected for the first time in late planted trees.

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More info: www.pcfruit.be

Pot marigold (*Calendula officinalis*) as an innovative crop for Flemish agriculture



new

*In the search for alternative crops to expand crop rotation and diversity in Flemish agriculture, marigold (*Calendula officinalis*) was identified as a possible candidate. In order to make marigold a profitable crop, some obstacles still have to be overcome. This is being addressed in the VLAIO LA-Programme "Goudsbloem, een gouden kans!".*

A golden opportunity

Pot marigold (*Calendula officinalis*) belongs to the family of the Asteraceae and originates from the Mediterranean area. Pot marigold has the ability to adapt to almost all climatic conditions and is therefore cultivated worldwide as an ornamental and medicinal plant. The flowers can be used in cosmetics and pharmaceuticals or as natural dye in textiles or food applications as they are edible. The flowers contain essential oils, carotenoids, polyphenols and triterpenoids (including faradiols). Seed oil has potential for the food industry and for use as a natural raw material in paints and resins. Pot marigold can be cultivated as a dual purpose crop of flowers and seeds, meaning multiple flower harvests before seed production. Pot marigold offers possibilities as an alternative crop for Flemish agriculture due to the good growing conditions in our region and the various sales opportunities. There is demand from various industrial sectors for new environmentally-friendly, bio-based raw materials and locally grown pot marigold can offer added value. In addition, it is promising for farmers to grow a new crop that could give both ecological and economic added value to their farm.

VLAIO LA-Programme: GOGO

Pot marigold is a completely new crop in Flanders. Proefcentrum Herent started in 2014 with the cultivation of pot marigold to investigate the possibilities of this crop. In October 2017 the VLAIO LA-Programme "Goudsbloem, een gouden kans!" (GOGO) started. This project will last four years and aims to offer pot marigold to the Flemish agricultural sector in the short term as an alternative crop that is feasible and profitable. Within this project we look at the entire process from cultivation to full product and aim to set up the market for locally grown pot marigold. This will be achieved by focusing on cultivation technique, mechanization and a dual purpose cultivation of the flowers and seeds. Furthermore, optimization of the processing and the realization of sales opportunities also form an important part of the project. In order to evaluate the cultivation of pot marigold in practice on a larger scale, farmers are also involved in the project.



Organic flowers

Currently there are no crop protection products recognized for pot marigold because it is a new crop. In addition, the processing sector often demands organically produced marigold flowers. For most applications of the flowers it is necessary that the flowers are free of residue. Weed control is still a challenge for the cultivation of pot marigold. To control the weeds, we rely on a false seedbed and mechanical weed control. The advantage of a new crop such as marigold is that the pest pressure is limited by the small scope of the cultivation.

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(Government of Flanders)
(1/10/2017 – 30/09/2021)

More info: www.vlaamsbrabant.be/goudsbloem

Eager for innovation? Start cultivating a new crop!



new

On 1st of January 2017 the Leader project 'Eager for innovation? Start cultivating a new crop!' was launched in the Leader area "Flemish Ardennes". In this project we want to familiarize growers with new, still unknown crops that offer potential for our region. In the current economic situation evolution is important, and modernization and innovation are therefore crucial. Not only producers but also the different markets are constantly searching for new products that can bring added value to the company. Also consumers are not insensitive to novelties that are promoted in the context of a healthy and diversified eating pattern.

Optimization of the cultivation of sweet potato

To optimize the cultivation of sweet potato in our region, we focus on different aspects of cultivation. A variety trial is performed to choose the varieties that do well in our climate. Different cultivation techniques are also compared to obtain an optimal yield. In 2017 we could clearly observe an added value when using black plastic foil. Better warming of the soil resulted in a clearly higher yield.

Comparing varieties of yacon

For five consecutive years a demonstration trial was set up with 11 varieties of yacon from different origins. Combining results over the years will enable us to select those varieties which are most suited to grow in our region. Also external features and taste characteristics are included in the assessment. As it is often the case, the first results indicate that varieties with the best yield do not necessarily correspond with those most appreciated by the consumers. Finding a compromise between yield and taste will be a challenge.

Consumer interested in mysterious tuber crops

In 2017 and 2018 we tested some lesser known crops such as oca, ulluco, mashua and crosne. These crops were planted in a demonstrative trial to test its feasibility.

To determine which crops are interesting for growers to cultivate, it is also important to know how consumers perceive the tubers and their indication of willingness to buy these new crops. Therefore, an online consumer survey was performed to estimate their potential on the Flemish market.

We see clear differences in familiarity and attractiveness between the crops. Sweet potato is clearly the most known crop with 81% of the participants



familiar with this product. Against all expectations, the tubers of yacon were considered more appealing than the better known sweet potato. Despite lower familiarity with yacon, 78% of the participants would be willing to buy these tubers. Another 24% of the participants indicated familiarity with oca tubers and 25% of the participants was able to give the correct name as the tubers of oca were very often confused with tubers of Jerusalem artichoke. Mashua was the least well known tuber and found to be the least appealing. The tubers of ulluco were considered by far the most appealing, with 48% of the participants calling them 'rather appealing' and 39% 'very appealing'. Despite the participants' lack of familiarity with the ulluco tubers, 83% made clear that they would be willing to buy these tubers because of their appealing appearance. The willingness to buy crosne tubers was the lowest (45%).

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Organic production of ancient wheats, einkorn, emmer and khorasan

Today, 95% of the worldwide harvested wheat is 'bread wheat' (Triticum aestivum). The other 5% consists of 'durum wheat' (Triticum durum), which is mainly used in pastas. Belgium is a net importer of wheat. In recent years, however, we see a shift in the diet and awareness of consumers. The food's origin - preferably locally or regionally grown - and transparency during processing are gaining importance.

The reintroduction of ancient wheats may both stimulate the diversity in the type of wheats as well as the provision of the consumer with a local, varied product. However, this is not a foregone conclusion. All of the steps of growing, harvesting and processing these alternative wheats require adjustments in comparison to modern wheat.

Back to the origin

The old wheats are the ancestors of our modern wheat. The two oldest species are einkorn and emmer, but also Khorasan is an ancient wheat. These ancient wheats are less demanding in terms of quality of the soil and fertilization. Furthermore, einkorn and emmer are, according to the literature, less susceptible to diseases and more drought resistant. Better disease resistance was not proven for Khorasan. In the trials carried out in the Altergrain project, differences were observed for emmer and with slightly less obvious differences for einkorn.

Alternative wheats, alternative cultivation

Due to their low-input requirements, the ancient einkorn, emmer and khorasan are perfect candidates for organic cultivation. Still, some aspects should be taken into account. These wheats tend to grow much higher than the modern wheats, which makes them more sensitive to lodging. This can have a negative effect on the yield and slow down the harvesting process. In addition, besides the sensitivity to lodging, the yields of these wheats are significantly lower than modern wheat. Based on the two years of trial experience (2017-2018) the following yield results (15% moisture) were recorded under organic summer cultivation:

- Einkorn: 1.8 – 2.4 ton/ha
- Emmer: 2.0 – 2.9 ton/ha
- Khorasan: 1.9 ton/ha.

A second important aspect that should be taken into account is that at harvest the husks are not separated from the grain. This means that the grains need an extra post-harvest treatment, namely peeling. Einkorn and emmer yields are based on peeled, processable grain, are therefore an extra 30-40% lower than the mentioned figures.



Ancient wheats: soon on your plate?

Ancient wheats are characterized by higher protein content, but a lower gluten content compared to modern wheat. This makes that ancient wheats are harder to process into bread but as they still contain gluten, they have no benefit for persons with gluten intolerance.

Nevertheless, these ancient wheats pique the interest of farmers and bakers because of the diversity that they create. This happens not only in the field, but also on the plate. Using these alternative grains products can be obtained that diversify from wheat products from common wheat. This distinction can be translated to an added value for the consumer. This requires further research in the field of processing and marketing.

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More info: <https://expertise.hogent.be/nl/projects/>; www.alterbake.be; www.hogent.be/over-hogent/vakgroepen/natuur-en-voeding/voeding/lokaal-brood/

Roller-crimper technique not yet ripe for organic vegetable cultivation in Flanders

Within the European SOILVEG project, ILVO, Inagro and Ghent University tested a new way to terminate cover crops. The green cover crop mixture is destroyed during the flowering phase by a roller crimper. The main crop is then sown or planted through the mulch layer. Application of this technique can provide benefits in terms of useful biodiversity, increased organic matter in the soil, and reduced fuel consumption. Unfortunately, to date, the application results in substandard yield results, as shown by tests with white cabbage in the context of the European project SOILVEG. More research is needed to make the roller crimper operational in Flemish vegetable cultivation.

Undersized yields in white cabbage trials

In trials at ILVO and Inagro, rye and pea and the combination of both were used as cover crop. The marketable yield in the roller-crimped fields was below par, with some 10 to 15 tonnes per ha in 2016 and no marketable crop in 2017. By contrast, yields of 40 to 59 tonnes per ha were found in fields without or with an incorporated green cover crop. A first explanation for the much less favorable development of the cabbage after destruction of the cover crop by the roller crimper was a lower nitrogen availability at the start of the cultivation. This is due to the omission of soil tillage as well as the longer-term nitrogen uptake by the cover crop. The disappointing yield may also be related to a lesser rooting in a more compacted soil. Compaction is not eliminated when using the 'roller crimper' technique as there is no deep tillage occurs before planting. However, if the use of the roller-crimper technique repeatedly increases the organic matter content of the soil, this will improve nitrogen availability and reduce the risk of compaction. The lesser yield of the main crop can also be related to the chosen test crop: cabbage species generally perform well on (strongly) disturbed soils. A moisture shortage also negatively influences yield. A green cover crop that has continued to grow until shortly before planting, especially in a dry spring period, will have used up most of the water available for the plant. For a sufficient weed suppression after roller-crimping, a well-executed green cover is required, with at least 7 tonnes of dry matter per hectare.

Positive impact of using the 'roller-crimper' technique on the agro-ecosystem

The roller-crimper technique has great potential in the area of carbon sequestration: the longer growth period of the cover crop will multiply its yield and the organic matter supply. Furthermore, roller-crimping was



positive in terms of biodiversity, savings in fuel consumption, weed and pest management and reduction of nutrient losses. Additional research questions are: which types and varieties of green cover crops and main crops are best suited to this method? Which sowing or planting densities are best? And with what fertilization? The prevention or elimination of compaction and innovation in the field of planting or sowing technology in systems with minimal soil tillage are also important points for attention in future research. Finally, further research should also focus on the long-term effects of repeated applications of the roller-crimper technique. After all, improving the soil is not a story that's done in a day.

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Funding: H2020 - ERANet COREOrganic Plus (Funder in Flanders: Department of Agriculture and Fisheries, Government of Flanders) (2015 - 2018)

More info: <http://projects.au.dk/coreorganicplus/research-projects/soilveg/>

Together well equipped for mechanical weed control in maize



Effective weed control is the most important success factor in organic maize production. Some organic dairy farmers and arable farmers in the Westhoek area of Flanders were wondering whether they could cooperatively purchase a modern camera-controlled maize hoeing machine. The challenge was twofold: which form of cooperation is ideal and which machine best meets the needs? In the operational group 'smart weeding, organic feeding', a major step forward was taken and the organic growers in question have trust again to grow maize on their farms to feed their cows.

New hoeing machines efficient but expensive

Hoeing equipment has evolved considerably over the past ten years. For maize, 6 m wide machines (8 rows) are standard. This requires a sturdy and collapsible bearer. The parallelograms are made with great precision by automatic cutting, profiling and welding machines. The hoeing machine functions like a big Swiss Army knife: it has various hoeing knives, crop protection discs, finger weeders, torsion weeders, ... The steersman on the back is replaced by steering with RTK-GPS or with a camera. This results in higher efficiency and capacity: the machine can easily hoe 1 ha per hour. However, these technological developments come up with a high price.

Collaboration offers a solution

The investment in this modern hoeing technology is too expensive for a single dairy farm with only a dozen ha of maize. Three dairy farmers from the Westhoek who are converting to organic farming questioned whether this investment would be possible by working together and were immediately applauded by a few colleagues who faced the same challenge. The forces were bundled in the operational group 'Smart Weeding, Organic Feeding' which started in August 2017. Lieven Delanote (Inagro) and Johan Devreese (independent consultant) were approached as process supervisors.

In the autumn of 2017 the framework was established:

- There is a combined area of 30 to 70 ha of maize that needs to be weeded 2-3 times.
- Because the plots are spread out over the entire Westhoek, a good logistical organization is necessary.
- Especially in difficult seasons, efficient planning and utilization of the machine is required.
- Experience with the machine is necessary for optimal results.



Hiring a subcontractor quickly appeared to be the best option. Johan Staelens from Ichtegem came into the picture fairly quickly. After several conversations with the growers' group and a reconnaissance round with some constructors, Johan got into action. He bought a new and fully equipped eight-row hoeing machine from the brand HAK with a Garford camera steering equipment. For the farmers involved, this commitment from Johan Staelens represents an important step forward.

Successful demo of mechanical weed control

On 8 June 2018 the growers of the operational group 'Smart Weeding, organic Feeding' shared their experiences with the general public during a demonstration day of mechanical weeding of maize in Reninge. The demo showed a good sample of the current technology with three harrows and four hoeing machines. At the same time it became clear that good tuning of the equipment still makes the difference. A full report is available at <http://leden.inagro.be/Artikel/guid/4488>.

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Funding: Operational group "smart weeding, organic feeding" runs with the support of the Government of Flanders and the European Union (1/09/2017 - 31/08/2019)

More info: www.inagro.be

Pilot project “Controlled Traffic Farming” inspires Flemish vegetables growers

new

The pilot project called “Controlled Traffic Farming on wide tracks”, which Inagro started on its experimental farm for organic agriculture, has generated a lot of experience since 2016. This has inspired some organic vegetable growers to use this same concept. In the research project “prevention and remediation of soil compaction”, this experiential knowledge gets scientific support.

Inagro pilot project “Controlled Traffic Farming on wide tracks”

Controlled Traffic Farming (CTF) is being implemented internationally in field production systems with minimum tillage of the soil. Dutch organic arable farmers have developed their own variant by adapting tractors to drive on a trackwidth of 3.2 m. In its pilot “Controlled Traffic Farming on wide tracks”, Inagro wants to introduce CTF into Flanders, to test it and to give it form. The small size and fragmented character of Flemish (organic) farming is a specific challenge. A new tractor was bought and adjusted to a 3m-wide track. Under it fit 4 rows with row distance of 70 cm. At the same time, the entire farm is converted to a no-till system.

Positive intermediate evaluation

Fixed paths on wide tracks create more degrees of freedom for mechanical weeding. The planting bed under the tractor is smoothly flat and allows more precise hoeing. Under less than ideal conditions, the parcels are better accessible, which allows faster action at critical moments in the field. In combination with well-developed mechanization, this ensured effective hoeing even during the wet spring of 2016.

To evaluate the impact on yield, in 2016 (leeks) and 2017 (celeriac) a “track experiment” was planted. Here we evaluated the driving-path system with the classical way of working (tractor on a normal track). In the wet year of 2016, significant differences were observed. With the track system, 35.5 ton/ha of leeks were harvested, while with the traditional system, only 31 ton/ha were harvested. In addition significant differences between the rows were seen, depending on the position of the row relative to the track in both systems. The measured yield was clearly related to the observed soil compaction caused by the tractor tire. In 2017, conditions were dry. In both systems, 47 ton/ha of celeriac was harvested. In the VLAIO LA-Programme “prevention and remediation of soil compaction” this is scientifically examined in the years 2019 and 2020.



Growers using it too

Four growers (3 of which organic) also started right away in 2016. In the operational group “controlled traffic farming”, they explored, with guidance from Inagro, ILVO and Ghent University, how they could implement CTF on their farm and what the bottlenecks were.

For one grower, Frank Schelfhout, it was clear that he needed a fixed path of 2 m due to the mechanization and planting concept on his farm. The new spading machine still needed some adjustments, however. For the other two organic farmers, the idea got stuck in the conceptualization phase due to technical and logistical reasons: needing to drive on public roads, harmonization between equipment, need for specific software developments for the RTK-GPS guidance system, etc. In the meanwhile, 4 other Flemish organic growers have implemented CTF on wide tracks on their farms.

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Funding: Inagro, Province West-Flanders, EIP Operational Group ‘Controlled Traffic Farming’ (Government of Flanders), VLAIO LA-Programme “Prevention and remediation of soil compaction”

More info: www.inagro.be

Agroforestry in Flanders

Agroforestry is an interesting opportunity to stimulate the resilience of farms and to provide an answer to future challenges for Flemish agriculture, including a contribution to diversity in production and the delivery of a wide range of ecosystem services. Equally, given the expected increase in demand for quality wood and biomass, agroforestry can be a shock-proof investment. In other words, Agroforestry meets a societal demand for more agro-ecological production methods with a great deal of attention for biodiversity and potential social interpretation, in an economically viable way.

Nevertheless, the adoption of, and experience with, agroforestry in Flanders remains quite limited. In addition to bottlenecks concerning legal certainty and administration, a range of agricultural, management and farm-economic uncertainties remain up to date.

Agroforestry

In agroforestry, the cultivation of woody crops (trees or shrubs) is deliberately combined with that of agricultural crops or livestock. In that way, new products and/or services are created, economically, ecologically and socially. With a well-thought-out approach, agroforestry can increase farm profitability and help to preserve and protect natural resources for both current and future generations.

VLAIO LA-Programme "Agroforestry in Flanders"

Within the VLAIO LA-Programme 'Agroforestry in Flanders', which started in 2014 and runs until 2019, we aim for the following results:

- Identifying opportunities for different types of agroforestry in Flanders;
- Increasing knowledge about ecological interactions, ecosystem services, technical impact and above all economic opportunities. This applies to a number of agroforestry situations relevant to Flanders;
- Acquiring insight into intention, attitude, norms, perception and social identity of those involved, with a view to breaking through the socio-psychological barriers to adoption;
- Offering decision-support guidelines, practical recommendations and innovative solutions to farms concerning the application of agroforestry;
- Guiding farmers in the setup of agroforestry, adapted to their specific situation.



All information collected during the project is bundled in practical info sheets available in the online knowledge hub at www.agroforestryvlaanderen.be. You can also find thematic project reports, reports of excursions, practical experiences, etc. on this website.

Would you like to start with agroforestry, and would you like more information or guidance? Contact us via info@agroforestryvlaanderen.be.

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Funding: VLAIO LA-Programme (Agency for Innovation and Entrepreneurship, Government of Flanders)
(2014 - 2019)

More info: www.agroforestryvlaanderen.be

AFINET: Stimulating innovative agroforestry practices through improved knowledge exchange



The aim of AFINET is to stimulate innovative agroforestry practices by improving knowledge exchange between farmers and foresters, researchers, policy makers, advisors, extension research centers, etc. by starting Regional Agroforestry Innovation Networks (RAIN). This is a H2020 European thematic network with 13 partners from Spain, the UK, Belgium, Portugal, Poland, Hungary, Italy, France and Finland. In Flanders, ILVO and Inagro are partners.

Agroforestry?

In agroforestry, a woody crop (trees or bushes) are consciously combined with either other crops or farm animals, to create new products and/or services, on the economic, ecological and social level. If a well-thought-out approach is used, agroforestry can increase farm profitability and help to protect and enhance natural resources for the current and future generations.

How does the AFINET project work?

In each of the partner countries, RAINs are set up. These are working groups where farmers and other stakeholders come together regularly to share experiences and seek opportunities to optimize existing agroforestry practices. Each RAIN focuses on a specific theme, depending on the interests of the RAIN members. In Flanders the focus is on fruit and nut trees in various cropping systems.

What kind of information and knowledge are exchanged?

AFINET wants to create knowledge to gain more insight into the application of agroforestry. This will be done by responding to gaps in knowledge and challenges encountered by agro-forestry users, by providing better access to research results (both published and unpublished), and by identifying and disseminating good practices and innovative ideas.

AFINET will use a range of strategies to effectively disseminate information: technical data sheets, videos, manuals, newsletters, training courses, and other publications. These materials will be included in the "Knowledge Cloud" (KC), a user-friendly online archive that will summarize as much information about agroforestry as possible.

Regional activities, training sessions and conferences will also be organized during the project to share knowledge.



How will AFINET make a difference?

AFINET will support the application of the innovations developed within the RAINS, will encourage new operational groups, and will develop relations with regional/national policy makers. The AFINET partner network will further spread the local solutions developed within the RAIN to other regions and countries. AFINET is an active partner in the European Innovation Partnership on Agricultural Productivity and Sustainability, thus the ideas from the RAIN network will also contribute to the development of the future European research agenda. In the European Parliament in Brussels, a session will be organized to share the results of the AFINET project with the policy makers of the European Commission.

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Funding: HOR2020 research and innovation programme – grant agreement No. 727872) (2017 - 2019)

More info: www.agroforestry.eu/afinet, www.agroforestryvlaanderen.be





**Robust organic
production systems –
Animal production**

Animal welfare and health

Animal feed

Production systems

Dealing with the ban on surgical castration without anesthesia in organic pig farming



In Europe, surgical castration of male piglets (boars) is a routine procedure, both in conventional and in organic pig farming. This intervention prevents a small proportion of these boars from developing an undesirable odor, called boar taint, in the meat. In addition, aggression, sexual behavior and possibly unwanted gestation of gilts can occur more often with intact boars. However, surgical castration of piglets is a painful procedure, both during and after the intervention, and does therefore not correspond with the values of organic farming.

Looking for alternatives of castration without anesthesia

Since 2012, surgical castration without anesthesia is no longer allowed. In addition, several European countries have agreed to generally ban surgical castration in 2018. Therefore, both in conventional and organic pig farming, more animal-friendly alternatives are considered. Castration under anesthesia and/or with pain control, production of intact boars and application of immunocastration are among the possibilities. To date, each of these alternatives has its advantages and disadvantages, making a general implementation difficult. For example, immunocastration is not allowed within organic pig farming, and castration under anesthesia and/or with pain management results in extra costs and labor. The risk of boar taint, behavioral problems and a poorer pork quality are the main reasons that counteract the fattening of intact boars.

State of affairs in Europe

In this project, the state of affairs was requested from various European countries with a relevant share of organic pig farming. This survey showed that in most countries (Denmark, Germany, France, Italy, the Netherlands, Austria, Sweden and Switzerland) surgical castration with anesthesia and/or with pain control is chosen. While anesthesia should generally be performed by a veterinarian, this is also allowed for the pig farmer in Sweden and Switzerland, provided a special training is followed. Currently only the United Kingdom applies the production of intact boars.

Market acceptance of intact boars in Belgium

Also among Belgian organic farmers, there is an interest to stop castration and switch to intact boars. In this project, it was evaluated to what extent this would be accepted by slaughterhouses, the processing industry, organic butcheries and retailers. Several Belgian players in organic pig farming were questioned, of which eight shared their opinion.



For the production of fresh organic pork, all respondents choose for barrows (castrated boars) and/or gilts, but never for intact boars. For organic charcuterie, also barrows and/or gilts are selected, with only one respondent choosing for intact boars. The question whether one would consider intact boars as an alternative to barrows was negatively assessed by the other respondents. They mainly expect a reduced consumer satisfaction due to problems in terms of palatability and boar taint. In addition, problems with regard to suitability for processing are assumed. For fresh organic pork, problems are expected in terms of lean meat percentage and drip loss. Taken together, slaughterhouses, processors, butcheries and retailers are rather reluctant to market meat from intact boars, both in terms of boar taint as well as product quality.

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Funding: Department of Agriculture and Fisheries, Government of Flanders, 2018

Worms: a bottleneck for organic livestock farming!

Infections with gastrointestinal nematodes (GIN) pose a threat to the health of organically raised livestock because the specifications prescribe that the animals must have pasture access as long as weather conditions permit. This is a frequent conclusion in the scientific literature on bio-based animal health.

What is the situation with our Flemish organic dairy cows?

The level of contamination with GIN was estimated by examining tank milk for the presence of antibodies (ODR) against *Ostertagia ostertagi*, a abomasum worm and the most important GIN in cattle. In 2016, 14 farms were surveyed; in 2017 an additional 8 farms in transition were included. With an $ODR \leq 0.5$, there is hardly any effect of a GIN infection; above this loss of milk occurs. The higher the ODR, the greater the milk loss. In 2016, each herd had a score of > 0.5 . Seven (50%) herds scored an $ODR > 0.8$. These numbers are high and economically represent a milk loss of at least 1 liter/cow/day. In 2017 the ODR dropped at 12 farms, while 2 showed an increase. One herd managed to get the ODR value below the cut-off value, but the remaining 21 companies scored higher than 0.5, 7 of which > 0.8 .

In Flemish organic dairying, GIN pose a threat to the cows' health and the farm's profitability. Increasing awareness of the extent of the problem through diagnostics is therefore important.

How does an organic-dairy farmer get the ODR down without the use of anthelmintics?

It is crucial to prevent excessively high infection pressure for calves going to pasture during their first grazing season. Particularly during the second part of the season, the contamination increases to such an extent that there is a risk that the calves' growth will be stunted or that they even become clinically ill. The most important tool is therefore well-thought-out farm based pasture management. The intention is to bring the cattle into contact with the larvae under controlled conditions. In addition, there is currently a growing focus on the use of nutraceuticals. In the fight against GIN, especially condensed tannins appear to have an influence because they greatly reduce the vitality of the GIN nematodes. Esparcette is a leguminous crop rich in these tannins.

A case implemented during one grazing season

A farm-specific plan was developed in consultation with an organic dairy farmer, a veterinarian and the researchers. Here, an adapted pasture



management was combined with a supplement of either Lucerne (alfalfa) or esparcette pellets in the calves' feed during their first pasture season. The calve growth + egg secretion in the manure was measured twice per week. In September and October, pepsinogen, an abomasum enzyme, was measured in the blood as a measure of abomasum damage.

The feeding of esparcette appeared, as compared to Lucerne, to have no influence on daily growth in the calves ($p = 0.80$), did not suppress egg secretion ($p = 0.57$) and also did not protect against abomasum damage ($p = 0.13$).

Abomasum damage clearly increased from September to October. This means that starting in September, the calves are exposed to a high infection pressure of *O. ostertagi*. Treatment with an anthelmintic was necessary to ensure the health and welfare of the calves. Stabling the calves in September, could have prevented the treatment need.

We advise the dairy farmers to look at the grazing schedule with specialists and pay particular attention to the grazing of the calves and young stock. Decisions to treat or not can be made on the basis of a pepsinogen test in 6-7 calves at the end of the grazing season. In this way, the farmer is also able to evaluate the effect of the modified grazing schedule.

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Funding: Department of Agriculture and Fisheries, Government of Flanders (15/09/2015 - 15/09/2017)

Towards germ-free, herd-specific colostrum as a necessary lever for healthy rearing

new

The diseases 'caprine arthritis and encephalitis (CAE)', 'caseous lymphadenitis (CL)' and paratuberculosis (paraTBC) are the main reason why dairy goat farmers choose not to give maternal colostrum to their lambs. This colostrum is however very important for a healthy start of a lamb. A healthy growing lamb then has a greater chance of growing into a robust, resilient milking goat. Despite the major impact of these 3 diseases on management in dairy goat farms, there is currently little insight into the degree of occurrence of these diseases on the organic and conventional Belgian dairy goat farms. By financing a research project, the Department of Agriculture and Fisheries instructed the Odisee University College, department of Agro- and biotechnology to change this.

How do we get a better understanding of the occurrence of these 3 diseases and what do we do with that insight?

During the spring of 2018, more than 600 blood and milk samples were taken from 11 Flemish organic dairy goat farms to determine the prevalence of CAE, CL and paraTBC. Coupled with this sampling, a risk analysis was conducted, which examines possible routes for the introduction of diseases and spread of disease on the farm. Based on the herd prevalence and the prevailing risk factors, management recommendations will be formulated in collaboration with health and management specialists in dairy goat farming to eventually reduce CAE, CL and paraTBC in the participating companies. ParaTBC occurs on 10 of the 11 farms, with the number of animals with antibodies ranging from 10 to 70% on the positive farms. For CAE, 3 companies are certified-free of this disease. No antibodies were found to the virus on a fourth farm. On the remaining 7 farms, the number of animals with antibodies against CAE varies between 11 and 90%. CL antibodies were found in only one farm, this in the majority of the sampled animals.

Is blood collection a necessity for determining the farm's prevalence for CAE or can it also be less invasive?

During the reduction of diseases, reliable diagnostics is a necessary tool. Based on serum, the diagnostics (ELISA and PCR) have been validated, but this always requires invasive blood sampling. Therefore, the diagnosis for CAE on milk as a rapid technique to determine the presence of CAE on a farm is validated. It will be evaluated whether the ease of use of milk as a diagnostic sample outweighs a possible loss in sensitivity and specificity compared to diagnostic tests on blood samples.



What about the excretion of these pathogens in the colostrum and can we destroy these agents without destroying antibodies and immune cells in the colostrum?

As a third part of this research project, we will look for practical and applicable methods at the farm, in order to eliminate the CAEV, *C. pseudotuberculosis* and *M. paratuberculosis* from goat colostrum. This research will be carried out from January to April 2019. With the results we want to provide the goat farmers with tools that make it possible to re-supply the maternal colostrum to the lambs.

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Funding: Department of Agriculture and Fisheries, Government of Flanders

(1/03/2018 - 30/11/2019)

Management of grass/clover and alfalfa in cattle husbandry

Grass/clover, clover and alfalfa are interesting crops on the cattle farm that fix nitrogen from the air, bring more variation in the rotation, are more drought-tolerant than pure cultures of perennial ryegrass and moreover produce a palatable fodder. The cultivation of mixtures with legumes, however, places more demands on management than pure grassland. Moreover, it is not always easy to steer the botanical composition of the sod.

Spring sowing of legumes with peas as a cover crop

Mixtures of legumes, with or without grass, are best sown in April or September. Sowing later is risky because the conditions are too cold and too wet with the clover that becomes too weak in winter. It was examined whether the sowing of field peas as a cover crop could avoid production loss in the postponement of the sowing to spring.

In April 2015 and 2016, in 2 adjacent sandy soil fields (Merelbeke) with the same parcel history, following mixtures were sown, with and without the cover crop of field peas:

- (1) red clover
- (2) red clover + white clover
- (3) red clover + white clover + perennial ryegrass
- (4) alfalfa
- (5) alfalfa + white clover
- (6) alfalfa + perennial ryegrass
- (7) perennial ryegrass pure culture

In the sowing year, 3 cuts were taken, in the following year 5 cuts. On the pure legumes parcels no N fertilizer was given, the mixtures with grass were fertilized in the 2nd year with 120 kg mineral N per ha, the perennial ryegrass got 80 kg mineral N per ha in the sowing season and 300 kg in the 2nd year. In both parcels, the field peas in the sowing season average an extra yield of 1.7 tons dry matter/ha and 130 kg crude protein (2015) and 250 kg crude protein/ha (2016) more were harvested. This was entirely due to the extra yield in the 1st cut. In both trials, there was no further effect of the cover crop on the botanical composition and the crop yield from the 2nd cut of the sowing year on. In both trials, both years and all treatments (very) low nitrate residues were established in the autumn. The potential N-fixation of legumes was effective; perennial ryegrass was invariably lower in yield than the mixtures with legumes.

Alfalfa, usefulness of mixtures, necessity of grafting and mowing regime

Alfalfa is a beautiful crop that is strongly tolerant to drought, has a high yield and is very palatable for the cattle. However, it is intolerant to wetness, frequent or deep mowing and being flattened by heavy machinery. In 2015, the conditions at sowing of the trials described above were very good.

The alfalfa pure cultivation and the mixtures of alfalfa + white clover and alfalfa + perennial ryegrass were immediately dominated by the alfalfa and achieved high yields from the start. In 2016, however, the conditions at sowing were very wet. The alfalfa had a hard time and a difficult start. In the pure alfalfa culture, the yield was therefore disappointing. In the mixtures of alfalfa and white clover or perennial ryegrass, the clover or ryegrass took over the production in the parcel. In the 2nd year, the alfalfa was more prominent in the sod again. This indicates a weakness of alfalfa, but also that mixtures can offer added value. White clover and grass also cover the soil more, so that the introduction of weeds is limited. Moreover, they also tolerate more agricultural implements, so that they remain in wheel tracks and head of the fields, where the alfalfa disappears in the long term. In this trial parcel, no alfalfa was grown for over 35 years, and alfalfa was therefore always cultivated with the N-fixing bacterium *Rhizobium meliloti*. In the trials of 2015 and 2016, a treatment was also started with non-coated seeds. This resulted in a crop loss of no less than 50% in 2015 and 15% in 2016 in the year of sowing! In the 2nd year there was still a yield loss of 4-5%.

Alfalfa in practice

The above trials were carried out entirely with small field test machines and therefore did not have any passage of heavy tractors and harvesters. In a trial under practical conditions, it was checked whether the extensification of the cultivation of alfalfa had an effect on the persistence of the crop. Less frequent mowing system - from 4 to 3 cuts/year - showed that there was no higher persistence and that it results in a lower feed value in fresh condition due to the quick aging of the crop and the higher risk of flattening. Ensilage, however, reduces the difference in feed value. The total crop yield is over 10% higher in the 2nd and 3rd year after sowing at 4 cuts than at 3 cuts. Therefore, a mowing regime of four cuts seems to be the best option.

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Funding: Department of Agriculture and Fisheries, Government of Flanders

More info: www.ilvo.vlaanderen.be

Optimization of energy resources for a balanced ruminant ration: demand for resistant starch in ration

new

In organic livestock farming, crop rotation plays an important role in maintaining soil fertility and in particular the build-up of organic matter. The result of a cropping plan drawn up from this approach has the implication that the rations in an organic livestock farm deviate strongly from a conventional ration with a large share of grass clover and a limited or no presence of silage maize. Many farms that do not have maize in the crop rotation experience a shortage of resistant or rumen bypass starch in the ration. Rations with whole plant silage of grain sometimes in combination with field bean or pea contain starch that is rapidly fermented in the rumen, which entails a risk of rumen acidosis.

Maize is a good source of resistant starch. Many health problems in dairy cattle take place at the beginning of lactation and have to do with a negative energy balance as a result of peak production at that time. The negative energy balance can be tempered by the use of a resistant starch source in the ration.

Problems with maize cultivation

A minimal amount of silage maize in a ration has advantages in the ration. Many companies, however, experience difficulties in the cultivation of maize. The main bottleneck in organic production is weed control. The availability of varieties of organic maize seed is fairly limited and to date no variety trials of organic maize varieties have been performed in Flanders. The cultivation of maize certainly has a number of bottlenecks that we want to tackle in this project:

- points for attention in the choice of varieties (precocity, youth growth)
- weed control
- choice of planting distance
- place in the crop rotation.

Sorghum as an alternative fodder crop

Sorghum is a crop that resembles maize in terms of growth and cultivation. Sorghum, like maize, has a high starch content and comparable starch degradability. However, it has a deeper and more extensive root system, making it less drought-sensitive and more favourable to organic matter build-up in the soil. In this project, a number of available sorghum varieties will be compared with maize.



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Funding: CCBT project 'Optimization of energy crops for a balanced ruminant ration' (Department of Agriculture and Fisheries, Government of Flanders)

(1/04/2016 - 31/12/2017)

More info: <http://www.ccbt.be> (projects)

GPS of mixtures: a look at the feeding value of whole plant silage

Cereals, mostly triticale and barley, play an important role in the crop rotation on organic ruminant farms. On most farms, the grain is harvested as whole plant silage (GPS: gehele plant silage) to fill the roughage requirement. A high nutritional value of a mixed crop harvested as GPS is an important condition for achieving a high crude milk production. What is striking in feed value analysis is the low net energy value (VEM: voeder eenheid melk) that is attributed to grain whole plant silage. The lower VEM value is associated with the higher ash content (RAS), the lower starch content (ZET) with a lower digestibility (VCOS: digestibility of the organic matter in %). In practice, ruminants appear to produce better with GPS than the analysis indicates. This may have to do with the high absorbability, which means that the maximum dry matter intake is higher than that of silage maize. The high structure value can ensure good rumen stimulation which has an influence on the digestive efficiency.

Feed value in analysis is often higher in practice

On two organic dairy farms, the ration was evaluated with a GPS silage of a mixed grain/legume in the ration. At the first farm, energy was the limiting factor in the ration. In order to explain the productions with the given ration, the expected VEM value of the mixed silage should be estimated at 6% higher than indicated in the analysis. On the second farm, protein was the limiting factor in the ration. Based on the milk production data, the available protein (DVE: darmverteerbaar eiwit) should be estimated 11% higher.

Influence of silage agent

In order to optimally preserve the quality of harvested GPS, a good fermentation during silage is important. In order to determine the influence of the dry matter content on the silage characteristics of pea GPS and pea/barley GPS, micro silages were monitored and the influence of a silage additive with lactic acid bacteria was checked. In the case of pea GPS, the silage agent caused a decrease in fermentation losses and a lower ammonia and butyric acid content and a higher lactic acid content. The peas / barley GPS was wetter at ensiling, with 23% dry matter (DM) content for the wettest batch and 26% DM for the slightly drier batch. Although we would expect a greater influence of the silage agent, however, no effect of the treatment could be established.



To harvest GPS or grain at doughy stage?

On the basis of a variety test in which 6 pea varieties were compared in mixed cultivation with triticale, part of the plot was harvested as GPS and part as moist grain. The GPS was harvested at an average DM content of 41% and ensiled in micro silos. In addition, part of the plot was threshed, ground and ensiled with a moisture percentage of 24%. Although it was ensiled at a favorable DM content, the fermentation of the GPS did not proceed optimally with a high butyric acid and ammonia content. The fermentation of the moist grain went well. The DM yield as GPS amounted to 12 tons of dry matter per hectare. If only the wet grain and peas were harvested, the yield was 6.7 tons per ha. Naturally, the feed value of ensiled moist grain is higher and can be used as a ration. If we calculate the VEM yield per hectare, it is better for GPS in this case. However, the reverse applies to the DVE yield per hectare. Due to the better fermentation, the protein was better preserved with a higher DVE yield per ha as a result.

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Funding: CCBT-project "GPS of mixed crops" (Department of Agriculture and Fisheries, Government of Flanders)
(1/04/2016 - 31/12/2017)

More info: www.ccbt.be (projects)

“Pasture grain” in the rotation on the home fields of organic dairy farms

Clover fatigue can happen in pasturelands where grass-clover mixtures have been growing over a longer time. A higher percentage of clover can be expected when sowing after a cereal crop. On most farms, the amount of home pasture is limited, and ploughing a part of the pasture for an intermediate cereal crop before sowing new pasture thus limits the grazing options. The introduction of grains such as rye as a “grazing grain” in the rotation offers the possibility to keep grazing the home field without relying on a monoculture of grass-clover. When sowing a winter grain in the spring, the cereal will not come into ear because of the lack of a cold period. These grazing grains thus offer the possibility for organic (dairy) farms to maximize the use of the home field for grazing.

Winter rye, Italian ryegrass or Japanese oats?

On an organic dairy farm, a field with low clover percentage was sown with pasture grains and then grazed by the dairy cows. In 2016 winter rye was compared with a mixture of rye with Italian ryegrass. The field was sown in May with 200 kg/ha rye. For the mixture, 180 kg/ha rye with 20 kg/ha Italian ryegrass was used. The drought in the spring and summer of 2016 limited the yield. During two periods of grazing in June and July the rye yielded 3.5 tons dry matter, while the yield of the rye/grass mixture was limited to 1.2 tons. The regrowth of the rye largely stopped after two cuts, while the mixture with Italian ryegrass still delivered a substantial harvest of 4 tons between August and October.

At the end of 2017, the same field was sown with rye, Japanese oats, and a mix of both. The sowing density of rye was increase to 240 kg/ha. Japanese oats were sown at 100 kg/ha and the mixture was sown at 220 kg/ha rye and 30 kg/ha Japanese oats. Yield was high for the first two cuts but after two pasturing rounds, the Japanese oats were exhausted and did not regrow. The rye ultimately delivered a good yield of 12 tons of dry matter per hectare between June and August.



Nutritional value and palatability

The net energy value (VEM: voeder eenheid melk) of grazing rye is in June comparable with the reference values for fresh grass at that time, with less sugar and much more protein. The VEM value drops in later cuts due to a lower digestibility. Japanese oats have a lower digestibility, where the energy value drop under 900 VEM, which is rather low for highly-productive dairy cows. No influence on milk production was noted during the pasturing on grain. There was a drop in the number of milkings with the milk robot, which can point to the cows' liking the taste of the crop and thus putting off a visit to the milk robot. The farmer also noted the cows' enthusiasm for grazing on the experimental field.

Rye is the best "pasture grain"

The results of this field trial clearly show that rye, especially the first cuts, can produce enough dry matter with a high protein value. Rye also develops faster than Italian ryegrass. Italian ryegrass does make up for the later start during later cuts, and can possibly stay during another winter. The Japanese oats in this trial did not appear to be suitable as pasture grain due to bad regrowth and lower nutritional value.

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More info: www.ccbt.be (projects)

Ensiling mixed crops of humid legumes and grains for organic hens



new

Starting in 2018, organic poultry farmers are required to use 100% organic and regional feed. The search for regional sources of protein as an alternative for the modern, easily-available protein sources is thus crucial. Previous research shows that field beans and peas can fulfil this role. The presence of anti-nutritional factors (ANF) such as tannins and glycosides (vicine, convicine and divicine – a waste product of vicine and convicine), together with a low ileal digestibility of methionine and cysteine, limit the amount of field beans that can be included in the poultry feed. Within the KUILEG project, researchers seek ways to better use field beans in poultry feeds.

How produce a good mixed crop? How to ensiling?

The combination of field beans with grains is a possible solution to address the possible shortages of amino acids. We look here to a technique that is allowed within organic agriculture, namely the ensiling of field beans and grains. Ensiling dry beans or the entire plant is already done, but moist unripe beans is a new path to explore. When ensiling a combination of field beans and grain, it is possible to get an even ripening of both plants and the ratio of field beans to grain will have an important impact on the silage quality and its nutritional value. That is why we examine how the silage quality of a mixed crop can be optimized by adding silage additives (organic acids or lactic acid bacteria).

In the winter of 2017 and spring of 2018, various varieties of field beans were sown in combination with winter wheat and triticale for the winter varieties. For the summer varieties, field beans are sown in combination with summer wheat and oat. Both crops were sown in the organic fields of Inagro. The silage from the winter and the summer crops were ensiled in July 2018 at the University College Ghent (HoGent) in Bottelaere. At the end of October 2018, samples were taken to determine the silage quality and to determine whether any reductions in ANF were achieved.



What about the laying hens?

If the ensiling process is successful in reducing anti-nutritional factors, the question still remains whether the layers can cope with the higher amount of available protein from the field beans, and to which extent it will be possible to replace soybeans with this new silage product. Do the hens even like to eat this silage? Will their performance stay the same or even improve? What about the egg quality? Is there a transfer of metabolites (phenols) from the field beans to the egg, which might increase the quality of the egg for human consumption? And what about the nitrogen excretions and the carbon footprint – will these be reduced by using ensiled field beans? These are all questions we hope to answer within the KUILEG project.

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More info: www.ilvo.vlaanderen.be, www.inagro.be, www.ccbt.be

Chickens under trees? Sustainable combinations of trees or shrubs with a free-range area for organic poultry



Preceding research on the cultivation of short rotation coppice in chickens' free-range area is given a new dimension with the LegComBio project. ILVO examines how the same plot of agricultural land can be used more efficiently and sustainably by carefully combining trees or shrubs with a free-range area for (organic) poultry.

Good reasons for planting an outdoor run

The outdoor run for chickens can be made much more attractive by planting a crop of short-term coppice. Chickens are naturally forest dwellers that like shelter to feel safe. The wood chips harvested from the coppice could also provide the poultry farmer with an additional source of income. Earlier research has already taught us a lot about the pros and cons of these systems. More recently, ILVO has enhanced the experimental setup for a more in-depth understanding, and started to evaluate other combinations under practical circumstances.

Experimenting and evaluating in practice

The project consists of two complementary parts: an experimental setup under controlled conditions at ILVO and an evaluation of combinations under practical conditions, including an observation study at an organic farm. Specific objectives for the field research include an experimental study on how to promote the use of the free-range area by laying hens, evaluation of laying hens preference for two types of plantings in the run (short-term coppice (willows) and hazel trees), development and validation of an efficient method to quantify the use of the outdoor area by hens on practice farms, and to evaluate the effect of the presence of hens on the growth, yield and quality of the woody crops, on the presence of weeds and harmful pests, and on the nutrient levels in the soil.



Exchange of knowledge and experiences

For example, at the O’Bio farm, the combination of a kiwi berry crop with a run for broiler chickens has been evaluated under practical conditions. Different aspects are examined: use of the space by the chickens, impact on soil quality, The observations in the field and the experiences of the farmer concerned will be supplemented and validated on the basis of a literature study on such combinations of vegetable cultivation with a range for poultry. In this way experiences from Belgium and especially abroad can be made available to the organic sector in Flanders. Through practical experience and a number of networking events, the project is also stimulating the exchange of practical experience and expertise between plant producers, chicken farmers and involved researchers.

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(2017 - 2020)

More info: www.agroforestryvlaanderen.be

In September 2017, the operational group 'P'orchard: forestry for outdoor pigs' was started. Inagro, ILVO and a number of committed pig farmers work together in this project with agroforestry to set up the free-range area for pigs. Each of the farmers strives to place a local, sustainable and high-quality product on the market and this via short supply chain in order to restore the relationship between the consumer and producer. Each of them has a free-range meadow where the pigs can root without restriction.

Agroforestry

In Flanders, there is very limited experience with the outdoor cultivation of pigs and the spatial and economic integration of the outdoor area on the farm. Agroforestry in the form of an orchard can play a role in this. This project can be a first step towards this. Through the operational group, possible bottlenecks are identified, and knowledge, experience and innovative ideas are brought together and exchanged. This can range from very practical issues such as: "How can trees be protected against pigs in a cost-efficient way?", "Which pig breeds are more suitable?", "Can nuts and fruit be used as additional rations?", to earlier legislative and health aspects such as: "What about food safety when nuts and vegetables from the outside are used for human consumption?" etc.

Participative trajectory

Currently, three farmers are participating in the project. They are very different in terms of organization, pig breeds and marketing strategies. These makes cross-fertilization all the more interesting. They have one thing in common; they aim to create a quality niche product with added value.

Participating farmers see several advantages in the layout of an outdoor range with agroforestry: namely (i) improved animal welfare through shelter from wind, sun and rain, (ii) multilevel use of space where fruit/nuts can be used as additional feed ration or for human consumption, (iii) improving the image of pig farmers among the consumer, (iv) and indirect benefits in terms of the environment. During the project, two outdoor agroforestry projects have been set up at practicing farms, which will also function as a demonstration farm.



Because of the limited experience in Flanders with the outdoor cultivation of pigs in an agroforestry setting, this operational group can be an important step forward. Knowledge, experience and innovative ideas from different pig farmers and other players are brought together here, exchanged and possible bottlenecks are identified together.

Finally, through this project the possibilities of this cultivation system are made known to other pig farmers via farm visits and communication via partner organizations and specialized press. The results of the literature study and mutual exchange of practical experiences are also bundled in a practical guideline for pig farmers to optimally organize their outdoor area.

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More info: www.agroforestryvlaanderen.be



Cà phê Kín

Cà phê Cầu vồng

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Flexible organic chain systems

Is the upscaling of agroforestry running into barriers?

Agroforestry is increasingly recognized as a sustainable agricultural innovation because of the environmental, biodiversity and landscape services it delivers to farmer and society. However, despite these values, the adoption of agroforestry by Flemish farmers remains relatively limited. Therefore, the different barriers hindering the adoption of agroforestry Flanders were identified in a doctoral study. This doctoral study is part of a VLAIO LA-Programme on agroforestry.

How enabling is the agricultural innovation system for agroforestry?

Through qualitative research, such as interviews, focus groups and a literature study, we examined to what extent the current agricultural innovation system is receptive to agroforestry as an agro-ecological innovation. More specifically, information was collected through:

- a survey with farmers in which farmers' knowledge about agroforestry and their intention to adopt agroforestry was assessed;
- a stakeholder analysis, in which the various relevant stakeholders were identified;
- a discourse analysis, in which the perceptions of stakeholders about agroforestry were mapped;
- an exploratory analysis, in which new economic instruments were explored to turn agroforestry into a financially interesting option for farmers.

These analyses show that the current agricultural innovation system is not very enabling to agroforestry as a farming system. Barriers are found at technical, economic, institutional, organizational and social level.

Five suggested development pathways

For each of these barriers recommendations were formulated, which were bundled into five development pathways.

- A science and technology pathway: Further investments in agroforestry research are required. This research should focus on the productivity and the compatibility of agroforestry in Flanders, and should be conducted in close collaboration with agroforestry pioneers and farmers.
- A market and financial pathway: Market mechanisms must be created in which farmers' efforts for biodiversity, landscape and the environment are valorized. At the same time, private investments and consumer demand must be stimulated.



- A policy and institutional pathway: A full-fledged legal landscape for agroforestry has to be created, which should be clear and steadfast into the future. This improved legal landscape must be supplemented with an attractive and effective subsidy program.
- An educational and organizational pathway: Different communication and education channels must be used to inform the relevant actors and to familiarize them with agro-ecological farming practices and their benefits for society.
- A social and behavioral pathway: The dialogue between influential groups must be strengthened. This should help to build-up trust and common visions, leading in the long-term to various cooperation opportunities.

Due to the strong cohesion and interconnection of pathways, progress has to be in each of the development trajectories in order to arrive at an agricultural innovation system that enables agroforestry adoption. Only in this way opportunities can be created for the the sustainable upscaling of agroforestry systems in Flanders.

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Funding: VLAIO LA-Programme (Agency for Innovation and Entrepreneurship, Government of Flanders), ILVO (1/09/2014 – 31/08/2018)

More info: www.agroforestryvlaanderen.be

Opportunities and bottlenecks for a mobile slaughter unit in Flanders



The aim of the 'Mobile Slaughter Unit' Operational Group is to investigate the feasibility of a mobile slaughter unit in Flanders. The main questions are: what is the potential demand, can a solution be found for the legal obstacles, is the customer prepared to pay an extra price for animal welfare, which installation is workable and licensable, and will it be profitable?

Slaughter for direct sale

The operational group 'Mobile Slaughter Unit' (MSU) arose from the observation that small-scale (organic) cattle farmers who slaughter for direct sales since long have a problem finding an (organic-certified) slaughterhouse at an accessible distance. Smaller slaughterhouses have closed and larger slaughterhouses are often not equipped to slaughter a smaller number of animals. The long distances that have to be covered with the animals is a sticking point for many farmers and consumers. The final meat quality is also negatively affected by the animals' stress associated with transport.

Looking for knowledge

The operational group initially analyzed the available knowledge about mobile slaughter. Based on that knowledge, they drew up a list of questions and action points. At the same time, the network "Steunpunt Korte Keten" (Support for the Short Chain) conducted a survey of livestock farmers about their interest in mobile slaughter, their expectations and their needs. Odisee University College studied the added value of mobile slaughter in terms of animal welfare. We examined the extent to which consumers and / or customers (the meat processors) are willing to pay an extra price for animal welfare. The feasibility in terms of food safety, waste processing and permits was evaluated in collaboration with FASFC (Federal Agency for the Safety of the Food Chain), OVAM (Public Waste Agency of Flanders) and the Environment Department of the Government of Flanders.

How can mobile slaughter units function?

In the coming months, the functioning of a mobile slaughter unit (MSU) will be elaborated from a technical and farm-economic point of view. A business plan will also be drawn up and consideration will be given to the desired management structure. We are currently working on an MSU for poultry and one for cattle.

For the MSU for poultry, we are looking for a solution for a number of specific poultry farmers who are asking for it, because one slaughterhouse



has recently closed its doors and there is no full-fledged alternative foreseeable in the short term. Moreover, an MSU for poultry may seem the most feasible, both financially, technically and within the regulatory framework. One bottleneck is that enough animals must be slaughtered per location and per year to make the MSU profitable. Especially the expensive pre- and post mortem inspection by a licensed veterinarian is an important factor here. However, this inspection is required for B2B trade. The issue of the environmental permit is also being investigated further. As a test, one application file has been submitted for one poultry farm.

For the slaughter of cattle we have consulted with the Finnish company Kometos, a manufacturer of mobile slaughter facilities for cattle and sheep, among others. Kometos previously built a mobile slaughterhouse for cattle on behalf of the Swedish company Hälsingestintan. Here too, economic feasibility is the biggest challenge. We are investigating 3 possible scenarios, evaluating them for practical and economic feasibility.

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Funding: Government of Flanders and European Agricultural Fund for Rural Development (09/2017 - 08/2019)

More info: <https://www.bioforumvlaanderen.be/nl/mobielslachthuis>

Collective action for sustainable food systems: the role of social experiments and policy innovation

completed

Research groups from KU Leuven, Université libre de Bruxelles (ULB) and the Université catholique de Louvain (UCL) investigated how the transition to more sustainable food systems can be accelerated in a federal research project. More specifically, they investigated what the role of alternative food networks could be, both separately and in interaction with established actors (so-called 'regime actors').

The contribution of alternative food networks

In a first phase, a sample was taken of 104 collective food-purchasing groups (e.g. CSAs, Food teams, etc.) in Flanders, Wallonia and Brussels. Such initiatives have both an economic and a social dimension. An important success factor is to find as many synergies as possible between these dimensions. Coordinators of these initiatives emphasized the importance of being able to experiment and learn, as well as the decentralization of coordination and distribution. Increasingly, such initiatives enter into partnerships with other ecological and social initiatives, leading to positive network effects.

The interaction between niche initiatives and regime actors

In a second phase, the role of hybrid forms of cooperation was investigated in which niche initiatives cooperate with regime actors. In a first sub-study, the role of the province was studied in Hainaut, Liège and Flemish Brabant. This showed that it is important that the administration of platforms at regional level can be opened as widely as possible to increase the diversity of actors and the transformation capacity of the platform. In a second sub-study, qualitative research examined how locally produced food is integrated into two retail chains and a fast/casual food chain. This revealed a number of remaining mismatches. Our cases suggest, however, that the extent, to which adjustments are made, can vary and that they are largely dependent on the position of the local stores within the overall strategy of a retailer or a healthy fast/casual food chain. Moreover, our results suggest that the decision-making power must be reduced to the level of the store for the purchase and marketing of local goods. This enables more individual initiative and institutional entrepreneurship by store managers and employees, which contributes to the reconfiguration of existing practices towards more sustainability.

Recommendations

The research has shown that the main characteristic of a successful and thorough transformation is the embedding of a certain initiative in the



broader social network of organizations that experiment with and learn from profound changes in food systems. In order to make this embedding process possible, we recommend the support of bridging organizations, such as regional platforms, umbrella organizations, knowledge centres, etc. Such bridging organizations, which are supported both by the government and by the members, can solve a number of shortcomings related to inefficient distribution channels, lack of administrative support and poor infrastructure that often characterize basic initiatives. Also in the cooperation between retailers and local producers, space must be made available to organize such bridging and learning activities.

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More info:

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<http://www.belspo.be/belspo/fedra/proj.asp?l=en&COD=BR/121/A5/FOOD4SUSTAINABILITY>





High quality food and processing

Taste research on fruit and vegetables: bringing even tastier products to the market

Taste is a profession. Sensory analysis can predict how tasty vegetables or fruit will be for the average consumer. Not only taste, but also aroma, smell, mouth-feel and even the sound of biting determine the experience of how tasty fresh foods are. What the product looks like influences this experience because color, size or shape create an expectation of how the product will be. It is therefore a must to fulfil this expectation.

20 years of expertise in sensory analysis at PCG

Sensory research on fruit and vegetables has been conducted at the Provincial Research Center for Vegetables of East Flanders (PCG) since 1998. The sensory test room is equipped according to international standards (ISO 8589). This room has 14 individual booths, equipped with color filtering on the lighting to mask possible color differences between samples. Panelists taste and assess the fruit and vegetables. The sensory tests use good sensory practices and are blind, i.e. the panelists don't know from which variety or culture the samples are.

PCG has several panels for this research. The consumer panel, which consists of approximately 300 men and women of different ages, is used to determine which products are tasty and/or which properties are good/not good. The panelists of the trained, analytical panels have perfectly working senses. They are trained to distinguish and assess the different sensory attributes of specific fruits or vegetables. This panel is used to quantify the appearance, taste, texture, flavor and odor of a specific product using human senses in a consistent, machine-like way.

Which vegetables and fruit are tested?

The research responds to questions from the field via auctions, seed houses, government and industry. This allows us to assess an extensive range of fruit and vegetables at PCG. This research is funded in the context of projects, private assignments, sector contributions or subsidies.



Dissemination of results

Through publications in professional journals, the PCG newsletter and the PCG website, the research results are disseminated so that growers can include them in their cultivation.

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- **BBN**

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 Voort 71, 2328 Meerle - Belgium
www.proefcentrum.be
 info@proefcentrum.be, T +32(0)3/315 70 52

- **Proefcentrum Pamel**
 (Experimental research centre for organic small fruits and strawberries)
 Molenstraat 26, 1760 Roosdaal - Belgium
www.vlaamsbrabant.be/economie-landbouw/land-en-tuinbouw/
 T +32(0)54/32 08 46

- **PSKW, Proefstation voor de Groenteteelt**
 (Experimental garden for vegetables)
 Duffelsesteenweg 101, 2860 Sint-Katelijne-Waver - Belgium
www.proefstation.be, info@proefstation.be, T +32(0)15/30 00 60

- **Regionaal Landschap Zuid-Hageland**
 Schoolpad 43, 3300 Hakendover - Belgium
<https://www.rlz.be/rlzh/>

- **Ghent University**

Ghent University, Faculty of Bioscience Engineering

- Campus Proefhoeve Bottelare, Diepestraat 1, 9820 Bottelare - Belgium
- Department of soil management – Research group soil fertility and nutrient management, Coupure Links 653, 9000 Gent - Belgium
www.ugent.be/bw/environment/en/research/sofer
- Department of Plants and Crops,
Coupure links 653, 9000 Gent - Belgium
www.ugent.be/bw/plants-and-crops/en/

- **University College Ghent**

Faculty of Science and Technology, Department of Biosciences and Food Sciences, Campus Melle, Brusselsesteenweg 161, 9090 Melle - Belgium
www.hogent.be/en/research/



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