ORGANIC PRODUCTION RESEARCH

AT CRA-W

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FOREWORD

Organic farming is a subject of major interest in the current context, responding to the growing demand for sustainable, environmentally-friendly agricultural practices. Faced with the challenges posed by soil degradation, biodiversity loss and food security concerns, organic farming research plays an essential role in providing innovative and effective solutions for the development of this production method.

At the heart of this research, the CRA-W (Centre wallon de recherches agronomiques - Walloon Agricultural Research Centre) plays a central role in Wallonia. For over 150 years, this institution has been dedicated to advancing knowledge and practices in the field of agriculture in Wallonia, with a constant focus on low-input farming practices. For over 30 years, CRA-W has been committed to exploring the different facets of organic farming, from natural resource management to improved cultivation techniques, including the promotion of biodiversity and the search for alternatives to synthetic pesticides and fertilisers.

This commitment was stepped up in 2013 with the "Strategic plan for the development of organic farming in Wallonia by 2020" (PSDAB). Since 2022, CRA-W has been taking part in the Plan Bio 2030, which brings together the various stakeholders in the Walloon organic sector, specialising in long-term research.

This collection covers all the research projects[1] carried out in organic production during 2023 and beyond. It follows two previous collections written in 2018[2] and 2020[3]. Some of this research is being carried out as part of the Bio 2030 Plan. The other projects are financed by other regional, Belgian and European funds.

Research work is presented under five sections, reflecting the skills developed at CRA-W to carry out these actions. Each project is described in a brief fact sheet outlining the context, the research and the results obtained. Further information can be obtained by contacting the trial managers directly, or by contacting CRA-W's organic production cross-disciplinary research unit. Websites are also listed at the end of the collection, where you can access publications written in the context of the research presented.

We hope you enjoy the collection !

Georges SINNAEVE

[1] These trials follow organic farming specifications.
[2] https://www.cra.wallonie.be/uploads/2018/08/002_Brochure_CRAW_21x21_ResearchEnAgrBio_Reimp.pdf
[3] https://www.cra.wallonie.be/uploads/2020/09/_Brochure_CRAW_2020_21x21_web.pdf

CONTENTS

SECTION 1

CREATING AND ASSESSING VARIETIES

Today, more and more organic farmers are choosing to do without synthetic pesticides. To achieve this, the application of good practices is essential, as is the use of varieties that are more robust and better adapted to the soil and climate conditions of our regions.

CRA-W has long been involved in creating and assessing new varieties, both in cereal and potato crops and in horticulture. Multiple crosses between several varieties of the same species are tested and evaluated to create population varieties adapted to different natural environments.

SECTION 1 | CREATING AND ASSESSING VARIETIES

HOW TO CREATE A NEW FRUIT VARIETY?
THE "DUCASSE", THE FRUIT OF A 100% ORGANIC SELECTION

CONTEXT

The loss of genetic diversity, climate change and the reduction in active ingredients are prompting our arboriculturists to turn to varieties that are more resistant to external aggressions and better suited to organic farming (AB).

The apple breeding programme began in 1998 thanks to the genetic material in our collections, which represent one of the largest gene banks in Europe.

RESEARCH

The aim is to create new varieties that respond to demand in the sector. This includes useful agronomic and organoleptic characteristics with long-lasting resistance (polygenic) to fungal diseases and climatic extremes (drought, sunburn).

To meet this demand, directed manual crosses with parents with resistance genes and useful agronomic traits are carried out in partnership with the Centre Régional de Ressources Génétiques (CRRG, France).

RESULTS

It is estimated that it takes between 10 and 15 years to properly evaluate a new variety, its production potential, its resistance to pests and diseases, its shelf life, etc.

A variety like the "Ducasse" stands out from the crowd and responds to expectations within the profession. Over time, the "Coxybelle" variety has shown productivity and quality to be too variable for professional growers. This apple is now on the CERTIFRUIT[1] list of "RGF[2]" varieties. These varieties, obtained at CRA-W, have been registered in the catalogue. The "Ducasse" keeps exceptionally well, enabling it to be present in a market and respond to demand when there are not enough other apples to compete with it.

The varieties are already being planted on a large scale by organic growers in Wallonia and France for participatory evaluation within the framework of the "NOVAFRUIT[3] " association.

[1] https://certifruit.be/ [2] RGF: Ressources Génétiques Fruitières (Fruit Genetic Resources)
[3] https://www.cra.wallonie.be/fr/novafruits-en-pommes-et-poires-des-varietes-creees-en-bio-et-bas-intrants

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PARTNERS : All the growers involved in the trials and our French partners.

WHAT NEW ROOTSTOCKS ARE SUITABLE FOR ORGANIC FARMING?

CONTEXT

Rootstocks are of major importance to the success of an organic crop. There has been a development in orchard management, as fruit growers wish to increase the sustainability of their trees. The aim of the trial is to find a rootstock capable of making trees more self-sufficient and suitable for use in mixed cropping systems (agroforestry) or for replanting.

RESEARCH

The aim is to compare ten rootstocks on seven apple varieties and three rootstocks on eight pear varieties with several factors:

- Vigour and speed of fruiting;
- Fruit size;
- Storage time;
- Susceptibility to pests and diseases;
- Root exploration of the soil;
- Dependence on inputs;
- Adaptation to water stress;
- Soil fatigue behaviour.

RESULTS

- For apples, since planting in autumn 2021, initial results already show differences between rootstocks in terms of growth, susceptibility to viruses (CG16) and better behaviour in relation to ash aphids (CG11). Flowering intensity (fertility) of 2nd leaf rootstocks in descending order is as follows: AR 295-6, M9, Mark, CG11, M116, CG202, M7, CG16 and M4 with half the trees without flowers;
- For pears, since planting in autumn 2020, Cognassier A has been setting fruit quite well in the second leaf. Pyrodwarf is more vigorous with a good relationship between production and vigour. Farold "OHF 87" is more vigorous with a one-year delay in fruit set compared to the other two rootstocks. Early production on the more vigorous rootstocks shows satisfactory fruit size.

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WHICH APPLE AND PEAR VARIETIES ARE BEST SUITED TO ORGANIC PRODUCTION IN OUR REGIONS?

CONTEXT

The sector has defined as a priority the search for varieties more resistant to disease, and better adapted to climate change and to organic production. Two approaches are being followed in a complementary manner:

- Setting up a participatory selection with growers, as part of the cross-border association 'NOVAFRUITS', which brings together 39 organic growers, the CRRG (Centre Régional de Ressources Génétiques - Regional Centre for Genetic Resources) in the Hauts de France region and the CRA-W;
- Based on the evaluation of our rich collections of genetic resources
- The most promising old varieties, as well as a few new ones that are sufficiently robust to be grown without treatment, are developed by the 'RGF-Gblx' and above all 'CERTIFRUIT' nursery owners to be offered to private individuals, farmers and market gardeners in agroforestry orchards and high-stem pasture orchards.

RESEARCH

- Research into innovative methods for creating varieties more resistant to disease and other biotic and abiotic stresses (e.g. climate).
- Studying the resistance of varieties to diseases and pests on the basis of numerous evaluation grids;
- Physico-chemical characteristics are analysed and organoleptic and preservation tests are organised by the institutions, but also in a participatory manner with producers and consumers;
- Highlighting varieties adapted to low-stem systems in organic farming, but also to untreated agroforestry systems (market gardening, poultry, sheep and cattle runs).

RESULTS

- The most promising varieties resulting from our crosses are planted on the one hand in our PEP and CEF experimental plots, and on the other hand, in a participatory way with organic growers who are members of NOVAFRUITS and GAWI.
- Two new, more robust apple varieties, 'Coxybelle' and especially 'Ducasse', are being planted by growers at a rate of several thousand trees and are beginning to stand out on the regional market;
- Group meetings between growers (NOVAFRUITS), programme managers (CRRG, GAWI & CEF) and CRA-W are organised several times a year to discuss the many observations and advances made by the research and to take decisions in a participatory manner.
- The most promising old varieties, as well as a few new ones that are sufficiently robust to be grown without treatment, are developed by the 'RGF-Gblx' and above all 'CERTIFRUIT' nursery owners to be offered to private individuals, farmers and market gardeners in agroforestry orchards and high-stem pasture orchards.

IN PARTNERSHIP WITH : CRRG, organic growers from NOVAFRUITS, GAWI ASBL and agroforestry growers, CEF (Centre Fruitier Wallon - the Walloon Fruit Centre), IFELW

ACKNOWLEDGEMENTS : This project benefits from financial support from Wallonia, as part of the Plan Bio 2030 and the "InnOBreed" project (Horizon Euope).

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OAT VARIETIES
ADAPTED TO THE ORGANIC FARMING CONTEXT

CONTEXT

Winter oats can be grown as a cereal, fodder plant catch crop or green manure. There are different types of oats: black or white grain oats or naked oats. The chemical composition of the grain varies according to type and determines its use: black oats are mainly used for equine feed, while white oats are used for human consumption, particularly in flaking, but can also be used for animal feed. Sensitive to lodging and frost (temperatures below -8°C before tillering and -10 to -12°C at tillering stage), oats are competitive against weeds and are appreciated for their hardiness against diseases with the exception of powdery mildew and crown rust. It's a potentially attractive crop for organic farming.

RESEARCH

Evaluating the performance and technological quality of winter oat varieties in order to recommend varieties for different uses, including flaking.

METHOD

An initial **winter oat variety trial** was sown in November 2023 in the Condroz region. It includes nine varieties: four white oats, three black oats and two naked oats.

RESULTS

The varieties are currently being evaluated. This concerns in particular cold tolerance, varietal earliness, disease tolerance, grain yield and grain technological quality.

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VARIETIES OF DURUM WHEAT
ADAPTED TO THE ORGANIC FARMING CONTEXT

CONTEXT

Durum wheat is a straw cereal with a hard, glassy kernel used, in particular, to make pasta and semolina. Italy is Europe's leading producer, followed by France, while Canada is the world's leading producer.

In Wallonia, durum wheat production is currently practically non-existent. Durum wheat is imported in raw or processed form. In addition, the effects of climate change represent an opportunity to diversify agricultural production. Within this context, the CRA-W is coordinating a project **to support the development of an industry based on local durum wheat production**. Started in 2023, the project is financed by the SPW following the "Relocalising food in Wallonia" call for projects.

RESEARCH

Evaluatinge a range of durum wheat **varieties for organic farming in order to identify varieties adapted to the agro-ecological conditions of Wallonia and the agronomic context of organic farming**, while meeting current quality criteria for durum wheat processing.

METHOD

A durum wheat variety trial has been set up every year in Condroz since the 2020-2021 campaign. Between 9 and 14 varieties are tested, mainly from France, Germany and Italy. Varieties are characterised, both from the agronomic and technological quality points of.

RESULTS

The first multi-year results will be released at the end of the 2023-2024 campaign.

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TRITICALE VARIETIES ADAPTED TO THE ORGANIC FARMING CONTEXT

CONTEXT

Triticale has many assets that are particularly valuable in organic farming: a powerful, vigorous root system, competitive against weeds, appreciable straw height, and good tolerance to biotic and abiotic stresses. It is used exclusively in animal feed.

RESEARCH

Evaluating the performance of triticale varieties in order to **recommend** productive varieties with high protein content for animal feed.

METHOD

- Setting up a varietal trial on an organic plot. The trial generally includes between ten and fifteen triticale varieties;
- Rigorous characterisation of varieties, from both agronomic and technological perspectives.

RESULTS

The results of the trials highlighted the following varieties, which have been recommended for at least two years between 2020 and 2023: Bilboquet, Brehat, Lumaco, Ramdam and RGT Rutenac.

The results will be published in the Livre Blanc Céréales, the Itinéraires BIO review and Sillon Belge in September.

FIND OUT MORE :

- Results of variety trials:
  - Itinéraires Bio n°54: 48-57 (2020), n°60: 45-49 (2021), n°66: 58-61 (2022); n°72, 49-51 (2023) - Summaries of articles available at www.biowallonie.be
  - Full articles available at www.livre-blanc-cereales.be
- Using triticale in poultry farming: Itinéraires BIO n°63: 51-54.

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VARIETIES OF WHEAT AND SPELT ADAPTED TO ORGANIC FARMING

CONTEXT

Organic farming prohibits the use of synthetic fertilisers and plant protection products (European Regulations (EC) No 834/2007 and 889/2008). This results in specific growing conditions that lead to the s**earch for adapted varieties that perform well in relatively limited growing conditions.**

For cereal crops, we look for varieties that are disease-tolerant, efficient in terms of nitrogen use, and that cover the soil as much as possible. In the case of wheat and spelt in particular, organic production is also characterised by an interest in **varieties suitable for bread-making.**

RESEARCH

Evaluating the agronomic and technological performance of wheat and spelt varieties in organic farming in order to **recommend**:

- **Productive forage varieties** for animal feed, and
- **Bread making varieties with baking quality**, intended for human consumption and that meet the quality criteria of the organic food processing sector.

RESULTS

The results of the trials highlighted the following varieties, which have been recommended for at least two years between 2020 and 2023:

- Bread wheat: Alessio, Arminius, Christoph, Montalbano and Posmeda;
- Forage wheat: Chevignon, Cubitus, Gwenn, Imperator, Lennox and Winner;
- Bread spelt: Convoitise, Franckentop and Sérénité;
- Forage spelt: Sérénité, Vif and Zollernperle.

The results will be published in the Livre Blanc Céréales, the Itinéraires BIO review and Sillon Belge in September.

METHOD

- Setting up varietal trials on an organic plot. Trials generally include around thirty wheat varieties and between ten and fifteen spelt varieties;
- Rigorous characterisation of varieties, from both agronomic and technological perspectives.

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FIND OUT MORE : Itinéraires BIO n°54, 48-57 (2020) ; n°60, 45-49 (2021) ; n°66, 58-61 (2022) ; n°72, 49-51 (2023) (www.biowallonie.com) www.livre-blanc-cereales.be

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POPULATION VARIETIES IN WHEAT AND SPELT:
DEVELOPMENT AND EVALUATION OF COMPOSITE CROSS POPULATIONS (CCPS)

CONTEXT

CCPs are diversified populations developed from multiple crosses between several varieties of the same species. As a result, they offer greater genetic diversity than mixtures: on a field scale, each plant is potentially unique. These populations evolve from year to year as a result of natural selection and, possibly, human selection. The positive effects expected from this diversity are the ability to adapt to different environments and yield stability, thanks to compensatory and complementary relationships between genotypes.

RESEARCH

- Creating CCPs: crosses, creating CCPs by assembling third-generation seeds from these crosses;
- Population evolution/adaptation: natural selection in different environments and possibly mass selection to avoid the accumulation of competitive traits (such as height) to the detriment of agronomic performance. Seedlings are sown from seeds harvested the previous year (adaptation to the environment);
- Evaluation of performance and evolution.

RESULTS

Creation of two spelt CCPs (blending in 2020) and participative creation of a wheat CCP (2023) made from ancient wheats. The populations, which are being grown in different environments, are currently being evaluated. The evaluation covers performance (yield, disease tolerance, covering power, quality for use in bakeries) as well as the evolution of phenotypic and genetic diversity.

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PARTNERSHIPS : ULB, Biowallonie, Li Mestère

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PERFORMANCE OF VARIETAL MIXES AND ON FARM SEEDS IN WHEAT

CONTEXT

By introducing diversity at plot level, the cultivation of mixed varieties is one of the fundamental practices of the agro-ecological transition. The idea is to increase cultivated biodiversity to mimic, to some extent, natural ecosystems and benefit from advantages in terms of production and/or production stability.

On farm seeds, on the other hand, come from the farmer's own harvest and are dedicated to his / her own use. They are generally produced from seeds purchased from seed companies. Their use appears to be fairly widespread and may be coupled with that of varietal mixes.

RESEARCH

Beginning in 2019-2020, this study has a **twofold objective**: (i) to assess the performance of varietal blends in relation to their varietal components, and (ii) to assess the performance of farm saved seeds in relation to certified seed.

The chosen crop was **winter wheat** grown to be **used by bakeries.**

METHOD

- Creating varietal mixes based on three or four winter wheat varieties. Mixres tested include Evina, Campesino, Cubitus, Avignon, Alessio and Arminius.
- Annual assessment of the performance of varietal mixres in relation to that of the pure varieties of which they are composed, with mixres and pure varieties derived from R1 certified seed on the one hand, and from the previous season's harvest on the other - in line with the practice of producing one's own seed.

RESULTS

The initial results of this study suggest two observations. Firstly, the **performance of the varietal** mixres in terms of grain yield and grain technological quality appears similar to the performance expected on the basis of the yield and quality potential of their varietal components.

Secondly, the **performance of self-produced pure varieties** seems to remain stable, while the **performance of self-produced mixres** in terms of quality, protein content and Zeleny index in particular, seems to decline over the generations. This could be explained by the fact that the composition of the mixres has shifted in favour of their most productive component, reducing their qualitative performance. This study will continue during the 2023-2024 campaign. The results will enable us to confirm or refute our initial observations.

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FIND OUT MORE : Itinéraires BIO n°75, 47 - 53

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CHARACTERISING THE COVERING POWER OF CEREALS

CONTEXT

Weed control is a major constraint in organic farming. In addition to mechanical weeding, crops themselves are also a means of weed control, thanks to their **covering power**, or the ability to cover the soil and thus compete with weeds. In cereal cultivation, triticale is known to be more competitive than common wheat, while varietal differences exist in terms of their ability to smother weeds.

RESEARCH

The main aim of the study is to improve the method for characterising the covering power of cereals to support varietal recommendations for organic farming. The study has two specific objectives:

- Assessing the benefit of image analysis for characterising the covering power of cereals, and
- Determining the relationships between leaf coverage and various morphological parameters that may be connected.

METHOD

Since 2020, covering power has been the subject of in-depth characterisation within organic cereal variety trials. In concrete terms, **leaf coverage** is determined by analysing photos taken on each trial plot. It is also rated visually on a scale of 1 to 9, as are **tillering habit** and **leaf width**. The heading date is recorded. In 2021 and 2022, the **number of tillers at tillering stage** was determined. Since 2023, the trial platform has been flown over by a drone equipped with multispectral sensors. Images acquired by drone flights can be used to calculate a **vegetation index**, the **NDVI**, which is a priori correlated with leaf cover.

RESULTS

The **use of imagery** appears **promising** for characterising leaf cover. In fact, the measurements of leaf coverage appeared to be more consistent between trials when based on image analysis rather than visual ratings. In addition, there was a high correlation between the leaf coverage determined from the photos taken on the trial plots and the NDVI.

No relationship was found between leaf coverage and leaf width. Significant relationships between leaf coverage, on the one hand, and number of tillers, tillering attitude or earliness at heading, on the other, were only observed in some trials. This reflects the **complexity** of the covering power of cereals, which appears to be more the result of a combination of morphological characteristics than the influence of any one major feature.

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FIND OUT MORE : Livre Blanc Céréales, February 2023, Chapter IV.6.
Itinéraires BIO n°71, 50-53

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EVALUATING THE TECHNOLOGICAL QUALITY OF WHEAT, SPELT, DURUM WHEAT, MALTING BARLEY, TRITICALE AND OAT VARIETIES IN ORGANIC FARMING

CONTEXT

It is essential to characterise the technological quality of cereal varieties to ensure it is technically feasible to use them in food transformation processes. The choice of variety determines the final product and the transformation process that should be used. In bread-making, it is essential to have high quality protein rather than aiming for large quantities of low quality protein.

RESEARCH

- Characterising technological quality using global analysis methods (protein content, Zeleny and SDS sedimentation index[1], hardness, Hagberg falling number, weight per hectolitre) and specific methods (Chopin alveograph, Mixolab, dynamic viscosity, particle size distribution, colour, congress mash).
- Variety trials evaluated: Wheat, Spelt, Durum wheat, Malting barley, Triticale and Oats
- Suitability for transformation processes: Milling, baking, biscuit-making, semolina-making, dough, malt-making, brewing.

RESULTS

- Classification of wheat and spelt varieties into categories according to their suitability for milling and baking.
- Classification of durum varieties into categories according to their suitability for the semolinaand pasta production· Classification of malting barley into categories according to their suitability for malting and brewing.
- Classification of triticale and oat varieties by soluble fibre content

Variety classifications by cereal and use are made available through the "Livre Blanc Céréales, Itinéraires Bio" (, Organic Itineraries) and variety trial field visits.

[1] Sedimentation index with Sodium Dodecyl Sulfate (SDS)

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FIND OUT MORE : www.livre-blanc-cereales.be - Itinéraires Bio n°72, 49-51
https://www.cra.wallonie.be/fr/laboratoire-technologie-cerealiere
https://www.cra.wallonie.be/fr/valcerwal

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Wallonie Relance

PILOT LABORATORY FOR SORTING AND MILLING EDIBLE CEREALS ALONE OR IN COMBINATION TO ENSURE TECHNOLOGICAL AND SANITARY QUALITY

CONTEXT

It is essential to optimize grain sorting equipment by defining type of sorters and their settings according to quality issues and the intended use. This is essential if organically grown cereal batches are to meet the expectations of food processors.

Milling trials using a technology similar to that of the transformation process are essential to assess the quality of a batch before its specific use.

RESEARCH

- Impact on the technological and sanitary quality of cereals using different types of sorting techniques:
  - Physical: Pre-cleaner, Cleaner-calibrator, Alveolar, Densimetric Table and Brush
  - Optical: Visible and infrared
- High-throughput, real-time assessment of technological and sanitary quality of cereals using infrared optical sorting
- Impact on the technological and sanitary quality of cereals using different types of sorting techniques:
  - Flour on cylinder mill, Flour on millstone and Semolina on cylinder and purifier

RESULTS

Putting in place sorting and milling strategies based on the quality issues encountered and the intended end use.

Thanks to this, a significant proportion of the grain that would otherwise be lost will no longer be. Reducing these losses represents an economic gain for farmers and processors of organic cereals.

The strategies drawn up will be disseminated via the foodgrain industry support days.

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ROBUST POTATO TRIALS

CONTEXT

Organic potato variety trials are part of the "robust potato pledge". As with the first pledge (2019-2021), the new pledge commits the entire sector to ensuring that, by the end of 2026, the proportion of robust varieties in the organic sector approaches 100%. This new agreement brings together both Belgian and French players in the organic potato sector. Robust varieties are, in order of importance, highly tolerant (even resistant) to late blight; more tolerant to abiotic stresses (mainly drought and heat); and less demanding in terms of nitrogen.

RESEARCH

Since 2019, varieties identified as robust (or that are potentially of interest based on the opinion of the breeder or the seed company) have been evaluated in the Gembloux experimental plot (trial in collaboration with FIWAP and Biowallonie). There are also clones from the CRA-W plant breeding programme in Libramont.

For the past five years, varieties have been characterised on the basis of four criteria: plant growth (vigour, speed of emergence, senescence, etc.), phytosanitary status (essentially resistance to late blight), quantitative aspect of the harvest (yield, size distribution) and qualitative aspect of the tubers (dry matter content, presentation and processing quality).

RESULTS

The 2019, 2020 and 2022 seasons enabled quantitative and qualitative characterisation of the varieties tested under rather dry and hot conditions. The 2021 and 2023 seasons enabled us to characterise the resistance of varieties to late blight mildew in seasons with very high mildew blight pressure. Some sixty varieties were tested over the five years of experimentation. At the end of each year, a Belgian list of robust potato varieties is drawn up by the working group (Bioforum, Biowallonie, CRA-W, FIWAP, Inagro and PCA) on the basis of the season's trials.

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FIND OUT MORE : Test reports are published on the CRA-W website: https://www.cra.wallonie.be/fr/pdt-robustes-bio

PARTNERSHIPS : This research is being carried out in partnership with Biowallonie and the Walloon potato industry.

ACKNOWLEDGEMENTS : This project benefits from financial support from Wallonia, as part of the Plan Bio 2030.

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SEMENCES D'ICI (SEEDS FROM HERE) – WALLOON VEGETABLE SEED PRODUCTION AND BREEDING NETWORK (2023-2026)

CONTEXT

In Wallonia, almost all the vegetable seeds used are imported from abroad. What's more, the hybrid varieties offered by the major seed companies are gaining market share, making it harder to maintain local varieties with recognised qualities. Even though non-reproducible hybrid varieties can be of very high quality, their costs are high and the purchase of these varieties leads to a loss of local cultivated biodiversity. However, both amateur and professional market gardeners are looking for varieties that not only perform well, but are also original, resilient and particularly suited to their soil and climate conditions.

RESEARCH

The aim of the *Semences d'Ici* (Seeds from here) project is to encourage local seed production and the adoption of varieties adapted to market gardening in Wallonia. To this end, the project addresses the following questions: Which varieties should be produced and are of interest to market gardeners, in terms of reproducible varieties? What types of contracts and fair prices should be applied between seed producers (multipliers) and seed companies (depending on the species)? What are the technical, economic and organisational requirements to facilitate seed production? How should a breeding and varietal improvement programme be defined? What types of financing could be envisaged to support such an industry?

EXPECTED RESULTS

- Documentation of technical itineraries to link the operational needs of market gardeners to the feasibility of production in Wallonia;
- Market study to identify strategic varietal choices;
- Development of contract tools and a fair price reference system, with a view to the fair and sustainable development of the sector;
- Assessing the need for mechanisms to manage and compensate for the risks of agro-ecological innovation;
- Characterisation of the technico-economic models of seed multiplication and the essential success factors;
- Design of the tools needed to set up a breeding and varietal improvement programme.

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HRB 152

SECTION 2

TECHNICAL PRACTICES AND ITINERARIES

The constraints and challenges raised by organic production call for the development of adapted livestock management and innovative crop production techniques. CRA-W tests these potentially interesting practices and itineraries in trial plots or documents them directly with growers. The growth of organic production is creating a demand for research to meet more specific needs, such as finding alternatives to synthetic vitamin B2, developing poultry runs, and studying the impact of farming practices on the abundance and diversity of mycorrhizal fungi populations.

SECTION 2 | TECHNICAL PRACTICES AND ITINERARIES

HOW SHOULD YOUR POULTRY RUN BE SET UP TO FUNCTION PROPERLY?

CONTEXT

Poultry farming specifications require organic farmers to provide an outdoor run for their poultry. Beyond the regulatory dimension, this type of run offers a number of benefits.

RESEARCH

The aim is to set up properly functioning poultry runs on two farms as a way of improving:

- use of space;
- animal welfare;
- production diversification;
- functionality with regard to dietary supplements;
- environmental quality and biodiversity.

RESULTS

- In terms of functionality, the poultry run's various features (rows of hedges, groves, etc.) play their part as soon as they are installed;
- Planting high-stemmed fruit trees with a selection of old varieties is much in demand in the sector in terms of diversification;
- Demonstrations with livestock farmers on planting, pruning and maintaining orchards within the poultry run, to give them all the tools they need to achieve good results.

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FIND OUT MORE : "L'élevage des volailles en agriculture biologique - Le parcours aménagé" (organic hicken farming - the chicken run) guide(http://www.cra.wallonie.be/fr/lelevage-des-volailles-en-agriculture-biologique-le-parcours-amenage)

IN PARTNERSHIP WITH : Coq des Prés (Jean-François Noël)

ACKNOWLEDGEMENTS : This research is financed by Wallonia, as part of the Plan Bio 2030.

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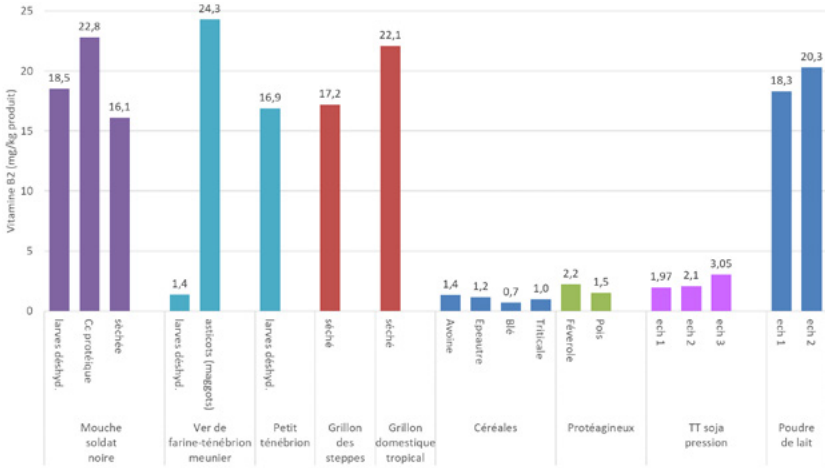
INVENTORY AND CHARACTERISATION OF VITAMIN B2 CONTENT IN RAW MATERIALS FOR ORGANIC POULTRY FEED

CONTEXT

Vitamin B2, or riboflavin, is essential for poultry. Prolonged deficiency leads to serious health problems, animal suffering and reduced performance. The vitamin B2 previously used in organic poultry feed was derived from a GMO process, which is strictly forbidden under organic production regulations. The search for alternative sources is therefore becoming a necessity for the organic poultry industry.

RESEARCH

A literature review was first carried out to establish the vitamin B2 content of raw materials and ingredients. This made it possible to define categories. The richest in vitamin B2 are yeasts, followed in descending order by milk powder, certain algae (spirulina), certain insect meals (black soldier fly), brewer's yeast, forages, cereal and oilseed co-products, grain protein crops and finally cereals. Samples were then collected in the field (on farms and from manufacturers) and their vitamin B2 content was determined by analysis. By ingredient category, vitamin B2 levels vary widely. For cereals, the dosed values are lower than those given in the food tables. Milk powder, co-products and pulses have values comparable to those of the food tables.



RESULTS

There are few raw materials rich in vitamin B2 that can be used in poultry formulations (yeast, milk powder, dehydrated fodder). Their incorporation rate in formulas is limited and their cost sometimes prohibitive (milk powder for example). Their availability is also a relevant parameter. The search for alternative forms of vitamin B2 must continue. Germination has been studied in laying hens. Poultry runs are an interesting source, as long as they are consumed by the animals. Insect meals are a promising source. However, their use in organic poultry diets is currently being studied, and regulations governing organic insect production are currently being drawn up.

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FIND OUT MORE : vitaminB2 - Germinated seeds

ACKNOWLEDGEMENTS : Research conducted with the support of Wallonia

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SOWS GIVEN TOTAL FREEDOM
TO FARROW AND NURSE!

CONTEXT

Maternity pens with freedom of movement for sows are becoming compulsory in many European countries for conventional breeding. Germany has declared that the use of permanent cages will be banned by 2035, and that only partial confinement for 5 days after parturition in pens at least 6.5 m² in size will be permitted. In organic farming, sows must be able to move freely in their pens, and their movements must only be restricted for short periods.

RESEARCH

In 2019, as part of the MBconfort project, CRA-W installed two WelCon Bio pens from Schauer® (Austria) for a Walloon organic breeder who had eight conventional pens. The aim was to enable farmers to discover them in situ, and to become familiar, at a local level, with a practice that is developing in other countries. The WelCon Bio pen gives sows total freedom throughout the farrowing and suckling period, and organises sows' movements to access an outdoor run. Equipping the pen with straw helps to achieve adequate nesting behaviour, which is associated with natural stress control before and after farrowing, itself associated with favourable piglet vitality.

RESULTS

The breeder's assessment and technical results were collected from June 2019 to January 2023 for 34 litters in WelCon Bio pens, some with video recording, and 168 litters in conventional boxes. Among the criteria that score lowest among farmers are the difficulties of entering the pen, intervening during births and clearing muck from the inner area, especially as sows are more reactive. On the other hand, farmers are delighted with the way the pen functions, emphasising how quickly the sows adapt to their new home. Farmers also appreciate the fact that the sows have total freedom, depending on the space available.

Welcon boxes produced more weaned piglets per litter (9.15) than conventional boxes (8.66), while the number of live births was slightly lower. In terms of behaviour in the Welcon boxes, nest building took 11.5 hours, sows gave birth mostly in the ideal position, lying along the anti-crush bar (32%) and spent 79% of their time resting and suckling almost exclusively indoors during the first 5 days after birth, after which they frequently used the outside space with their piglets.

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ACKNOWLEDGEMENTS : This project is carried out with the support of SPW

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WHEN SMARTPHONES MAKE THEIR WAY INTO PIG PASTURES!

CONTEXT

The subject of animal welfare is often at the heart of many debates in the pork industry: the central question being "are our farm animals in a state of well-being?" That's a big question when you don't talk pig! Researchers, advisors and breeders have pooled their experience - on a European scale - to provide concrete answers to the industry and its detractors.

RESEARCH

Since 2019, the European PPILOW project has been using a multi-stakeholder & multi-criteria approach to study solutions for tangibly improving the welfare of pigs & poultry reared in organic and low-input systems. Scientific research & participatory approaches have led to useful results and tools for the sector. One example is the Belgian PIGLOW tool (www.piglow.eu.).

RESULTS

PIGLOW is a Smartphone application developed by ILVO (the Flanders Research Institute for Agriculture, Fisheries and Food) that provides a quick and easy way to objectively assess pig welfare. The app was developed in collaboration with Walloon breeders. It is rooted in observations made on the animals and is fairly intuitive to use. Breeders or advisors can thus obtain coefficients for animal welfare levels assessed in terms of environment, health, feeding and behaviour. The application is free and is available to breeders and advisors.

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ACKNOWLEDGEMENTS : This project is financed by SPW and the European Horizon 2020 programme

PPILOW

HORIZON 2020

WHICH FRUIT SPECIES SHOULD BE INCLUDED IN A MULTIFUNCTIONAL HEDGE IN ORGANIC FARMING?

CONTEXT

The profession is looking for differentiated crops to increase biodiversity and use in production.
Fruit hedges provide various answers. They:

- Diversify production within crops;
- Generate more value from fruit in terms of transformation;
- Extend the production period from May to October;
- Increase biodiversity in the plot;
- Encourage a microclimate around crops by acting as a windbreaker;
- Are a good option for pick-your-own crop schemes.

RESEARCH

- Study of new fruit species and their combinations;
- Comparison of four hedge modules grouped by maturity (early to late);
- Individual trellising for raspberries, vines and kiwai;
- Comparison of different biodegradable mulches.

RESULTS

- Four hedge modules added to an organic orchard in March 2023;
- Placement of four types of biodegradable mulch (100% jute, Viltbio, 100% hemp and Bioweedtex). The 100% jute method was less effective against weeds at the end of the first season.
- Study of the hedge's behaviour, with evaluation reports on recovery, growth, production, harvest date, diseases and pests.
- Design study of several fruit hedge projects for growers.

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IN PARTNERSHIP WITH : Centre Technique Horticole de Gembloux

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TECHNICAL ITINERARY FOR GROWING BROWN MUSTARD ON ORGANIC FARMS

CONTEXT

While growing mustard for its seeds has a well-established history in our regions, it had virtually disappeared, only to be revived very recently. Indeed, since 2021, Walloon farmers working together in the Farm For Good cooperative have been producing mustard to supply local organic seeds to Bionat, which markets its mustards under the Bister brand. Demand for local mustard seeds is focused on white mustard (Sinapis alba) and especially brown mustard (Brassica juncea). Faced with the many technical issues raised by this new crop, agronomic support is essential.

RESEARCH

The general aim of this research is **to improve the technical itinerary for growing white and brown mustard.** It is part of the FIBIOM project, launched in 2023, coordinated by CePiCop and in which CRA-W is a partner.

METHOD

In 2023, an initial trial was set up with organic mustard. This one focused on **nitrogen fertilisation**. Six different doses of organic nitrogen fertilisation (0, 30, 60, 90, 120 and 150 units of N per ha) were tested on the Etamine brown mustard variety in six replications on a 4.5 ha plot.

In 2024, two trials will be set up side by side:

- A trial testing two **sowing dates** on two mustard **varieties**, one white and the other brown, and
- A trial testing three **seeding densities** for brown mustard.

RESULTS

The trial sown in 2023 encountered two major difficulties: poor emergence resulting in low plant density, and heavy weediness. It did, however, enable us to gain an initial experience of growing mustard, which will be put to good use in the coming trial campaign.

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PARTNERS : CePiCop, FarmForGood

ACKNOWLEDGEMENTS : : This project benefits from financial support from Wallonia, as part of the Plan Bio 2030.

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NITROGEN FERTILISATION OF DURUM WHEAT IN ORGANIC FARMING

CONTEXT

The use of durum wheat grain in semolina requires a **high protein content** and a **low level of mitadinage** (when a portion of the grain's albumen, which is normally vitreous, becomes floury).

These two characteristics are closely linked to **nitrogen supply**. Indeed, the more nitrogen the plant absorbs up to flowering, the higher the grain protein content at harvest, and a high grain protein content is associated with a low mitadin rate. It is generally accepted that a protein content of over 14% tends to keep the mitadin rate below 20%.

RESEARCH

The overall aim of this study is to establish recommendations for nitrogen fertilisation of durum wheat in organic farming. More specifically, the effect of the total dose of fertiliser applied and its fractionation is evaluated for grain production and quality.

METHOD

Since the 2022-2023 campaign, an annual trial has been set up to test ten fertilisation methods on a variety of durum wheat #(Casteldoux in 2022-23, Anvergur in 2023-24). Modalities vary according to the total dose applied (0, 40, 80 or 120 units of nitrogen) and the fractionation (1, 2 or 3 fractions).

These trials are an integral part of a project coordinated by the CRA-W to support the development of an industry based on local durum wheat production. The project, which started in April 2023, is financed by the SPW following the "Relocalising food in Wallonia" call for projects.

RESULTS

Organic fertilisation methods for durum wheat are currently being evaluated. This involves characterising the nitrogen status of plants during growth, grain yield, grain protein content mitadin rate and speckled grain levels.

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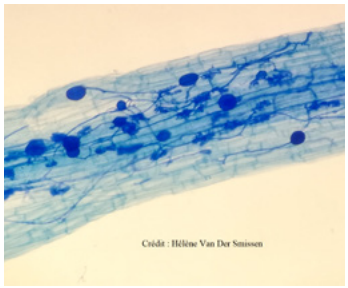

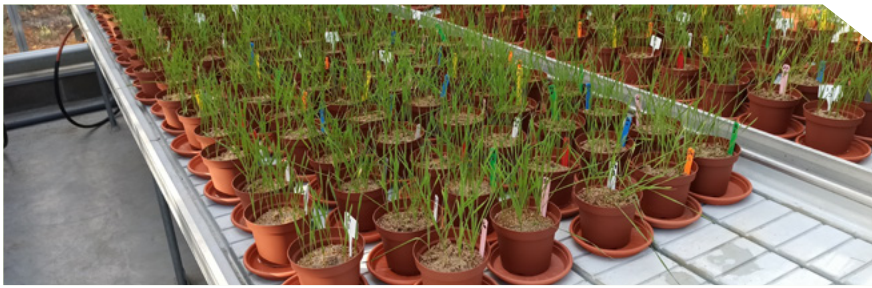

MYCORRHIZAL SYMBIOSIS IN WINTER WHEAT:
IMPACT OF FARMING PRACTICES AND BIOSTIMULATION TRIALS

CONTEXT

Optimising the services provided by soil microorganisms can increase crop resilience. Among beneficial micro-organisms, arbuscular mycorrhizal fungi are known to improve water and mineral nutrition in plants, as well as their resistance to pests and diseases. In this context, the MicroSoilSystem project studied the reduction of inputs through the application of microbial consortia (assemblies composed of a bacterium and a mycorrhisal fungus) and the effect of agricultural practices on populations of arbuscular mycorrhizal fungi naturally present in Walloon agricultural soils.

RESEARCH

During the course of the project, CRA-W's missions were to:

i) assess the effect of agricultural practices on the abundance and diversity of arbuscular mycorrhizal fungi naturally present in Walloon agricultural soils. A network of 48 on-farm winter wheat plots was monitored for this purpose during the 2019-2020 season.

ii) conduct field trials to test the effectiveness of microbial consortia under different cropping systems (organic, conventional and soil conservation agriculture).

RESULTS

- Mycorrhization in wheat is closely linked to the crop's preceding year. Temporary grassland and maize boost mycorrhizae populations, while beet (Chenopodiaceae) and rapeseed (crucifers) weaken them because they do not mycorrhize;
- The highest rates of mycorrhization were found on organic polyculture-livestock farms;
- No link was observed between mycorrhization and tillage or available soil P content. Nevertheless, these factors are known to have an impact on the abundance or diversity of mycorrhizal fungi;
- A greenhouse study has shown that seed treatments delay mycorrhization. Those approved for organic farming (vinegar, Cerall) have less impact but tend to reduce symbiosis;
- Mycorrhization decreases with nitrogen fertilisation. Mycorrhiza therefore seems to have an insurance role for plants: if the services rendered are replaced by phytotechnology, plants invest less in symbiosis.

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PARTNERSHIPS : UCLouvain, ULiège

ACKNOWLEDGEMENTS : This project is funded by Wallonia.

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SECTION 3

SOIL FERTILITY MANAGEMENT

Soil is far more than a simple "support material" - it plays a central role in the balance of organic production systems. Fertility management is a field of study investigated as part of organic farming research, through monitoring reference situations on various long-term experimental platforms, and evaluating specific practices and their agronomic benefits.

SECTION 3 | SOIL FERTILITY MANAGEMENT

MANAGING SOIL FERTILITY AND ORGANIC MATTER, A CENTRAL ISSUE IN ORGANIC FARMING

CONTEXT

In organic farming, the use of synthetic fertilisers is forbidden by specifications. Soil fertility and fertilisation management is essentially based on organic matter (OM) and its management. This is essential to guarantee the development and sustainability of these systems.

RESEARCH

- Develop a knowledge base by carrying out a review of the scientific and technical literature, supported by results collected since the 1980s;
- This summary is devoted to organic matter (farmyard manure, composting manure, plant cover crops) and to the essentially biological fertility of soils;
- The aim of the knowledge base is to provide the keys to understanding OM and soil fertility in order to manage them more effectively.

EXPECTED RESULTS

The first part of the knowledge base will cover:

- chemical, physical and especially biological soil fertility;
- organic matters, their characterisation in the laboratory (chemical, biochemical and biological incubations) and in the field.

This is based on the experience, data and knowledge acquired by CRA-W researchers.

The second part sets out findings, aimed at developing a more concrete approach to soil fertility and OM management in different organic systems (mixed farming-livestock, field crops, grassland, etc.), highlighting the lessons learned from trials and studies carried out over the last 40 years.

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ACKNOWLEDGEMENTS : This research is financed by Wallonia, as part of the Plan Bio 2030.

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WHAT LEVERS CAN BE USED TO STORE CARBON IN SOILS?

CONTEXT

Soil organic matter is the main pillar of fertility in its physical, chemical and biological components: It recycles nutrients through mineralisation, helps retain them in the root exploration zone, fuels biological activity and is one of the main factors controlling the formation of stable aggregates, limiting soil susceptibility to compaction and erosion. Composed mainly of carbon, soil organic matter plays an important role in regulating the earth's climate.

RESEARCH

Through various research and development projects, CRA-W is studying the effects of agricultural practices on soil organic matter and carbon storage, and is engaged in monitoring the science relating to this topic. CRA-W system trials (SOL-Plateformes) and farm networks (ClieNFarms, Transae, etc.) are used to monitor and compare contrasting cropping systems and cropping practices.

RESULTS

- Generally speaking, the more organic matter you add to the soil, the more carbon you store;
- It is necessary to design the rotation and intercropping management (livestock effluents, cover crops) so that inputs at least compensate for losses through mineralisation, to limit the loss of organic matter in field crop rotations;
- For equivalent carbon inputs, N-rich biomasses (low C/N) are generally more effective at storing carbon than carbon-rich biomasses (high C/N);
- Spreading liquid manure on chopped straw improves straw C storage efficiency and reduces the risk of N starvation;
- Composted biomasses are effective in storing carbon in soils;
- The main lever for increasing the return of organic matter in arable crop rotations is diversified intercropping;
- Inputs of biochar (plant charcoal) can sustainably increase soil carbon stocks, but without improving biological activity or soil structure.

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WHAT PRACTICES SHOULD BE USED TO MAINTAIN SOIL STRUCTURE?

LESSONS LEARNED FROM THE QUANTISLAKE TEST, AN INNOVATIVE APPROACH TO MEASURING STRUCTURAL STABILITY

CONTEXT

Soil structure is one of the main factors controlling the fertility of agricultural soils. CRA-W's "Soil, Water and Integrated Crop Production" unit has developed a pragmatic and innovative test to measure soil structural stability: the QuantiSlake test (soil-9-573-2023.pdf (copernicus.org)). The test principle involves dynamic weighing of a structured soil sample introduced into demineralised water. The test characterises both the overall structural stability of the soil and certain specific properties (resistance to slaking and physico-chemical dispersion).

RESEARCH

The QuantiSlake test is used to compare soil structural stability between different cultivation systems or practices within CRA-W systems trials or farm networks.

EXPECTED RESULTS

- The results highlighted that the SOC to clay ratio indicator (ratio between soil organic carbon and clay content) reflects the soil's "potential" structural stability. Nevertheless, the presence of a crop or cover crop influences the structure beyond the SOC to clay ratio;
- Reduced tillage techniques are particularly effective in improving resistance to erosion, as they accumulate organic matter and nutrients (and therefore biological activity and root biomass) on the soil surface;
- With equivalent tillage and crop precedent, temporary grassland (two years) also seems to have a positive effect on structure more than a year after its destruction;
- For an equivalent quantity of organic matter, manure is more effective at storing carbon, while crop rotation is more favourable to structure.

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ACKNOWLEDGEMENTS : This project is financially supported by Wallonia

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SECTION 4

WEED, DISEASE AND PEST MANAGEMENT

In organic farming, one of the main principles of plant protection is prevention: avoiding that the plant is affected by a disease or pest, as far as possible. When diseases of pests are present, it is important to limit their impact on the crop as much as possible.

Studies are being carried out at CRA-W to assess the effectiveness of biocontrol products, to better target the pest through a better understanding of its life cycle, or to combine the use of agronomic levers. Preventive weed management is also studied through cultural techniques (mixed cropping, soil cover, diversified rotation, etc.).

SECTION 4 | WEED, DISEASE AND PEST MANAGEMENT

USING BIOCONTROL PRODUCTS
TO MANAGE DISEASES IN FRUIT TREES

CONTEXT

Through various projects, the Interreg V Bioprotect project (2016-2020) and the Walloon Region Lipomme Bio project (2023-2024), CRA-W is studying the use of biocontrol products when growing fruit. In agriculture, the use of pesticides can be justified by the need to protect crops and ensure a certain level of yield. However, in both conventional and organic farming, repeated use of the same active ingredients leads to pathogen resistance to fungicides. What's more, both conventional and organic growers are faced with increasingly stringent regulations and requirements concerning the use of pesticides. Biocontrol products are therefore a practical alternative to traditional pesticides in the fight against diseases affecting agricultural and horticultural crops in our regions. Fruit growers, particularly in the organic sector, are pioneering in the use of biocontrol products. Many are already recognised, but these products don't always live up to expectations. In particular, their effectiveness in the field is sometimes disappointing. For biocontrol products to be used on a wider scale, further research into their optimal conditions of use is essential. Furthermore, their benefits need to be demonstrated and growers need to be trained in how to use them. CRA-W aims to meet these objectives.

RESEARCH

- Study of agricultural practices in the cross-border basin (France-Wallonia-Flanders) and the current level of knowledge and use of biocontrol products by growers;
- Identifying existing biocontrol products and research priorities (e.g. fruit storage diseases, alternatives to copper-based products);
- Testing the efficacy of biocontrol products under controlled conditions and in the field;
- Studying the integration of these products into adapted treatment schemes.

RESULTS

- Production and distribution of product sheets summarising the pathogens and crops targeted, the dose, the mode of action of bioproducts, the optimal application technique and the time of application;
- Identification of promising active ingredients or molecules for biocontrol of apple scab (e.g. sodium bicarbonate, lipopeptides, rhamnolipids).
- Raising awareness and training growers to use biocontrol products.

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FIND OUT MORE : Interreg Bioprotect project
http://www.smartbiocontrol.eu/fr/projet-bioprotect/

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IMPROVING KNOWLEDGE OF PEAR MIDGE BIOLOGY AND CONTROL METHODS

CONTEXT

The pear gall midge *(Contarinia pyrivora Riley)* is a small diptera whose larvae can cause serious damage to pears. Over the last ten years, this insect, previously considered a pest of secondary importance, has become increasingly problematic, causing up to 80% fruit loss depending on variety and year. The biology and factors influencing the life cycle of the pear gall midge are not well known, and this makes the effectiveness of growers' control actions very unreliable.

This is why the CRA-W has joined a partnership of English, Dutch, Flemish, Italian and French institutions to better understand and act against this insect.

RESEARCH

- Study of the composition and synthesis of the sex pheromone of the pear gall midge;
- Flight monitoring for a better understanding of the factors affecting adult emergence;
- Experimentation with mass trapping control methods.

RESULTS

- Identification of major sex pheromone compounds and reproduction of an effective and selective formulation;
- Better monitoring of adult emergence and flight.

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PARTNERSHIPS : Natural Resources Institute, University of Greenwich, NIAB, East Malling, Mole End Farms Ltd, Delphy, Proefcentrum Fruitteelt vzw, Consorzio Fitosanitario, Orogel Fresco Soc, CTIFL.

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CONTRÔLE DES RAVAGEURS
DES CULTURES MARAICHÈRES ET FRUITIÈRES SANS PULVÉRISATION

CONTEXT

Market gardening and fruit growing face many difficulties in managing pests, due to the wide variety of plants grown on the same farm and the specific nature of most of these pests. The cost of using pesticides and the need to reduce their use prompted the CRA-W and five other partners from northern France and Flanders to cooperate in a research project on these issues, the Interreg Zéro-Phyto F&L project. The aim of this project is to identify non-spraying protection methods against the main pests of fruit and vegetable crops in our regions. This project has laid the foundations for further research and collaboration between the partners involved.

RESEARCH

- A participatory approach with a call for ideas from professional growers and amateur gardeners;
- Studying the behaviour of certain pests to improve knowledge;
- Use of agronomic levers (system approach, rotation, biodiversity, mixed cropping, diversification of production, cultivation techniques, etc.);
- Evaluation and comparison of non-input protection methods (mass trapping, physical methods, etc.).

RESULTS

- 36 methods tested, of which 10 are effective with certain adaptations or precautions and 18 show some potential;
- Creating an open-access knowledge base;
- Creating a map of innovative producers sharing their practices;
- Creating a website and YouTube channel summarising the results of experiments and testimonials received.

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PARTNERSHIPS : Provinciaal Proefcentrum voor de Groenteteelt Flandre Orientale (PCG), INAGRO, FREDON Hauts-de-France, Université Picardie Jules Verne, Bios en Hauts-de-France

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Interreg France-Wallonie-Vlaanderen
ZERO-PH(F)YTO F&L(G)

CO-CULTIVATION TO CONTROL WEEDS
IN ORGANIC FIELD CROPS

CONTEXT

Integrating no-till practices into organic farming itineraries raises weed management issues. The BioCoCrop project is designing a phytotechnical solution based on the co-cultivation of a permanent legume cover with two successive cash crops (spring and winter). The main challenges are choosing the right legume and ensuring it is controlled so that it doesn't compete with the crop, while keeping weeds under control.

RESEARCH

In concrete terms, the solution studied consists of a permanent crop of legumes sown in strips (15 cm wide, 45 cm apart) with the main crop planted in between. In addition to an overall study of the feasibility of such a technical itinerary, the aim is to compare the impact of three legume types, particularly on production performance and soil structural stability: (1) Alfalfa, (2) White microclover, (3) Mixture of alfalfa, lotus and red clover.

Set up in the summer of 2023, the trial involves a total of ten types in three replications.

After assessing the potential of microplot co-culture, a trial will be set up in pilot plots with growers.

EXPECTED RESULTS

- By taking its place in the inter-row, the legume should help prevent the development of weeds, while providing additional nitrogen (in the medium and long term) for crops during the rotation.
- Successfully planting the cover crop is essential to ensure weed control, and to produce sufficient mulch through repeated mowing.
- Ultimately, the project aims to build a knowledge base around the topic of co-cropping, as a lever for improving crop resilience in low-input systems.

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PARTNERSHIPS : Greenotec, Biowallonie

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PREVENTIVE MANAGEMENT OF WEEDS IN ORGANIC FIELD CROPS

CONTEXT

In a context of reducing and even banning the use of chemical inputs, with a view to preserving biodiversity, water quality and health, weed control and the methods it employs are key factors in the productivity of organic field crops.

RESEARCH

The aim of this publication is to explore and review the levers that can be mobilised by farmers to ensure weed control through preventive management, while accepting that for some weeds, aiming for eradication or "zero weeds" can't be an objective. The idea is to find a way of living with weeds rather than without them. Weediness must be acceptable on a crop scale, with limited impact on yield and harvest quality, while being controlled on a rotation scale.

The document is based on a scientific and technical bibliography, as well as on feedback from a network of farmers active in organic conservation farming, working together as part of a European project (Transaé).

RESULTS

There are three strategies available for preventive weed management :

- The depletion strategy aims to limit the weed seed stock and/or the constitution of reserves at the base of vegetative reproduction of perennial weeds;
- The smothering strategy seeks to compete with the development of weeds once they have emerged;
- The avoidance strategy aims to induce dormancy among existing seed stocks.

The document provides an overview of the techniques available for these different levers. Each technique is more or less effective on a given weed species, which means they need to be combined to meet the diversity requirement.

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ACKNOWLEDGEMENTS : This synthesis was financed by Wallonia, as part of the Plan Bio 2030.

Interreg France-Wallonie-Vlaanderen TRANSAÉ
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SPW Service public de Wallonie
BIO mon choix PLAN BIO 2030

WEEDING ROBOTS : A MATURE, HIGH-PERFORMANCE SOLUTION ADAPTED TO MARKET GARDENING IN WALLONIA?

CONTEXT

Weed control is a major challenge in crop production, and all the more so in organic market gardening where weeding is mechanical, time-consuming and sometimes manual. With labour availability low and costs high, mechanical weeding faces a financial barrier. The emergence on the market of autonomous mechanical weeding robots will make it possible to do away with the use of herbicides and reduce the need for manpower for highly arduous tasks.

OBJECTIVES

The aim of the project is to evaluate weeding robots currently on the market, working mainly on inter-rows or allowing adjustment of the weeding tool.

The aspects evaluated in the project's hoed crops trials are weeding quality, selectivity, guidance precision, operator autonomy and economic feasibility.

RESULTS

The project delivered the following key results:

- **The weeding efficiency** of a hoed crop is over 90% in inter-rows and varies between 16 and 40% in rows. The results obtained with robots are comparable to the efficiency of a tractor-weeder. To limit labour requirements, it would be essential to develop a range of in-row tools;
- Provided that the tools are precisely and carefully adjusted and validated over a working length and a half-turn, there is no significant **loss** of crop over a weeding season;
- **Guidance accuracy** is less than 4 cm more than 50% of the time and depends on the technology onboard the robots. The detailed results for each robot provide data for fine-tuning the tools according to the risk of damage considered acceptable;
- A detailed study of the time required for different actions (adjustment, work, problem-solving, etc.) during weeding operations has highlighted the added value of on-board technologies that can increase work speed. However, it also reveals an increase in the number of problems encountered that are complex to resolve. The robots' actual **autonomy** from the user therefore depends on the reliability of the technology and the after-sales service provided;
- **The economic feasibility** study, estimating the cost of using robots on farms of different sizes and varieties of vegetable crops, identified economically viable scenarios for robots of small size and price on farms of 10 to 25 ha. For larger, more expensive robots, it may be necessary to consider a shared purchase or a multiplication of tasks that can be carried out using the robot.

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FIND OUT MORE : https://www.sillonbelge.be/11538/article/2023-09-08/les-robots-des-outils-efficaces-mais-relativement-couteux
https://www.cra.wallonie.be/fr/les-robots-desherbeurs-sont-arrives-au-cra-w-presse

ACKNOWLEDGEMENTS : This research is financed by Wallonia

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SECTION 5

SYSTEMIC AND PARTICIPATORY APPROACHES

In addition to research focused on technology and its optimisation, the organic sector also requires research on entire systems and the development of indicators to measure their evolution over time. Particular attention is also paid to the involvement of local players through the development of participatory research.

Systems approaches, co-design, networks of participants and field studies are thus increasingly present in our research projects.

SECTION 5 | SYSTEMIC AND PARTICIPATORY APPROACHES

BioCoCrop (CRA-W) seeding a double-density multispecies cover on the future crop row © Aline Fockedey, CRA-W

Tour of a plot of seed mustard © Aline Fockedey, CRA-W

Direct seeding of winter wheat in a white clover cover © Daniel Jamar, CRA-W

CO-DEVELOPMENT AND TESTING OF REDUCED TILLAGE SYSTEMS FOR FIELD CROPS IN ORGANIC FARMING – GROUPE ABC

CONTEXT

In organic farming, pressure from weeds can become critical. These systems generally use mechanical tillage (ploughing, stubble ploughing, etc.) to manage this pressure. This offers other short-term benefits, such as loosening (suitable seedbed and porosity for root exploration) and warming of the soil, making conditions more favourable for planting crops.

However, some organic farmers regret these interventions for a variety of reasons (disruption of soil life, increased susceptibility to crusting and erosion, soil destructuring involving reduced bearing capacity and susceptibility to compaction, weed emergence, mechanical wear, fuel dependency, workload and organisation, etc.), and would like to reduce mechanical tillage over and above the low-input nature of their systems.

RESEARCH

A group of Walloon organic farmers, advisors (Greenotec) and researchers (CRA-W) has formed around the shared goal of "reduced tillage in organic systems", also known as the "Groupe ABC[1]" This group, with its complementary experience, skills and knowledge, is testing ABC systems under real conditions, on 1 ha on each farm. A number of levers have been devised collectively to deal with the difficulties presented by these systems. This system experiment also includes a control condition run by the farmer.

[1] ABC = Agriculture Biologique de Conservation des Soils (Organic Soil Conservation Agriculture) Soil conservation is based on reducing tillage, maximising soil cover and diversifying rotation.

RESULTS

The expected results of this collaboration are of a technical nature and include:

- Consideration and feasibility of implementing promising systems (combinations of practices including maximisation, composition, density and management of cover crops; direct seeding, living strip-till, crop alternation and strip intercropping; rotations, etc.);
- Monitoring the long-term performance of these experiments;
- Attempts to interpret and formulate collective hypotheses on the mechanisms at work in the system, via multi-stakeholder discussions based on their experiences, qualitative observations and measurements, literature, etc., in order to feed into conversations within the farming community (e.g. interests and risks of scalping; management of no-till seedbeds at different depths);

while taking socio-economic dimensions into account,

- By attempting to identify the barriers and difficulties to these exploratory attempts (mechanical, economic (markets, contracts), social, climatic, territorial (specialisation), etc.), their consequences and room for manoeuvre, and the themes or avenues to be explored.

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PARTENARIAT : Greenotec

EXPERIMENTING WITH MARKET GARDEN CROPPING SYSTEMS – SYCMA PLATFORM

CONTEXT

Vegetable growing is booming in Wallonia. These are high value-added crops, but the input and labour requirements are considerable. Maintaining and improving soil fertility, as well as managing weeds, diseases and pests, are among the sector's major problems. The challenge is to maintain a high production potential even though these crops destructure the soil, return little carbon to the soil, and many growers use organic fertilisers sourced directly from conventional production.

RESEARCH

This experiment began in 2020 and is a long-term project designed to answer fundamental agronomic questions. Its aim is to develop cropping systems that combine soil fertility, weed management, reduced inputs, production quality and profitability, while limiting environmental impact. The agronomic levers used are rotation, tillage intensity, fertilisation methods and intercropping. Each cropping system studied is managed in accordance with organic farming principles and includes its own technical itineraries, responding to specific objectives.

RESULTS

Evaluation of the agronomic, economic, environmental and social performance of four cropping systems:

- Cropping system 1: self-fertilisation, diversified 'food' rotation with vegetables, cereals and green manures, reduced tillage;
- Cropping system 2: self-fertilisation, diversified 'food/feed' rotation, with vegetables, temporary grassland and cereals, ploughing;
- Cropping system 3: exclusive vegetable production, use of local plant biomass (RCW and alfalfa), simplified cultivation techniques, zero-phyto;
- Cropping system 4: exclusive vegetable production, manure, commercial fertilisers, biopesticides, annual ploughing.

The impact of cultivation practices is measured annually by monitoring indicators such as yield, production quality, weed rates, bio-aggressors, chemical, physical and biological evolution of the soil, soil structural stability, abundance of earthworms, etc.

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PARTNERSHIPS : Multidisciplinary approach involving scientific collaborations inside and outside CRA-W

ACKNOWLEDGEMENTS : Research conducted with the support of Wallonia, under the Plan Bio 2030

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HOW CAN POLYCULTURE-LIVESTOCK SYSTEMS AND AGRO-ECOLOGICAL PRACTICES RESPOND TO LOCAL AND GLOBAL CHALLENGES AND THE TRANSITION TO MORE SUSTAINABLE AGRICULTURE? – SPOT

CONTEXT

The European Green Deal underlines society's high expectations of agriculture, particularly in terms of food security, climate neutrality, reducing nutrient losses to the environment by promoting circularity, and more. At Centre Ardenne, we are testing the hypothesis that polyculture-livestock systems, managed in accordance with agro-ecological principles including circularity, should contribute, in the local context, to maximising food security while reducing the climate footprint.

RESEARCH

Since 2022, we have co-developed and are monitoring three system experiments (S1, S2 and S3). They are based on a proportion gradient of permanent grassland (S1: 70%, S2: 30%, S3: 0%), and therefore of space taken by livestock farming and crops for direct human consumption (S1: 30%, S2: 70%, S3: 100%). For systems S1 and S2 (0 for S3), the number of cattle is adapted to grassland production and co-products from crops intended primarily for the production of food for direct human consumption. Limits are set in terms of nutrient inputs to systems and the conservation of permanent grassland. Products need to be sold, if possible, on a local market, which raises the question of product quality and the existence of value chains. Designed to be agro-ecological, the systems are designed to minimise the use of plant protection products on crops through long, diversified rotations. In terms of livestock breeding, we raise calves crossbred based on their ability to generate the most value from forage, while at the same time coming from milking systems considered to be more efficient. These systems are co-managed in accordance with a specific governance system, by a multidisciplinary team, in order to evolve independently towards maximising human food production and nutrient circularity while tending towards climate neutrality.

EXPECTED RESULTS

The agronomic and environmental performance of these systems and how they function (flows), particularly crop-livestock interactions, will be assessed. In particular, we will identify the obstacles and levers to the adoption of mixed crop-livestock systems.

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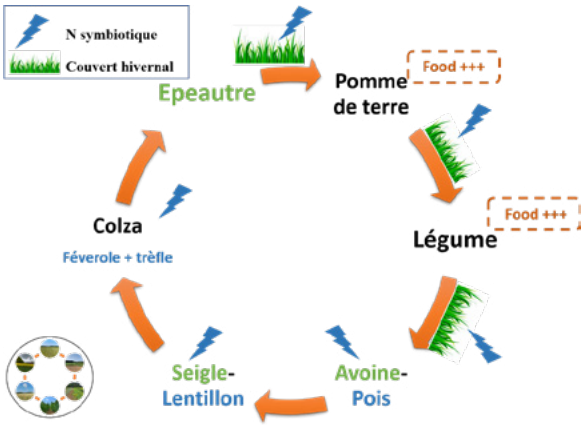
INNOVATIVE CROPPING SYSTEMS IN THE ARDENNES TO SUPPORT HUMAN NUTRITION – SPOT

CONTEXT

Today, around 70% of the agricultural land in the Province of Luxembourg is planted with permanent grassland, with the majority of the remaining area used for forage production (feed grain, maize, temporary grassland, etc.). In the SPoT platform's cropping section of mixed crop-livestock systems, we are testing a scenario that breaks with local practices by growing crops on arable land primarily intended for direct human consumption. Various phyto-technical innovations have been or will be implemented in order to meet the objectives of the European Green Deal.

RESEARCH

Three mixed crop-livestock systems have been put in place in Libramont and Mussy-la-ville. Initially (2023), they have an identical crop rotation (potato - vegetable (pumpkin or onion) - oat/pea combination - rye/lentil combination - rapeseed - spelt), but the proportion of permanent grassland (and therefore animal stocking) in their crop rotation differs. The rotation implemented is based on the activation of various agro-ecological principles: (a) diversity of species, but above all of plant families planted, in order to limit pressures from disease and pests, (b) planting mixed crops (cereal-proteaginous, rapeseed-beans-clover, etc.) or intercrops rich in legumes in order to supply the system with nitrogen and, above all, to manage weeds, (c) mobilisation of winter and spring crops, etc. Unused production and co-products from processing are fed to the animals.



Initial rotation implemented as part of the SPoT project's cultivation section

EXPECTED RESULTS

By respecting the coherence of each system (use of available farmyard fertilisers, re-use of co-products, etc.), crops and cultivation practices can evolve to reach set objectives. Flows (N,P,K), agronomic, economic and environmental performance and contribution to food security will be assessed. Lastly, various systems have been set up to monitor technical itineraries and the performance of cropping systems.

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ACKNOWLEDGEMENTS : This research is financed by Wallonia, as part of the Plan Bio 2030

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PRODUCING MEAT FROM CALVES FROM DAIRY SYSTEMS IN THE ARDENNES TO MEET LOCAL AND GLOBAL CHALLENGES (SPOT)

CONTEXT

Through this experiment, we are attempting to meet the objectives of the European Green Deal, and in particular to increase certified Organic Farming land, reduce greenhouse gas emissions and reduce competition between animals and humans for resources. These objectives call into question the livestock farming systems of the Ardennes, to which most of the region's land (90%) is given over, including arable land. To meet these challenges, we are testing practices that break with local practices. For example, we are raising male animals from dairy herds, fed exclusively on grass and by-products from crops whose main product is for human consumption.

Breeding section of the SPoT project: calves from a terminal cross, farmyard manure and dynamic rotational grazing

RESEARCH

Three mixed crop-livestock systems (SPoT experiment) have been put in place at the Libramont and Mussy-la-ville sites. Initially (2023), they have identical crop rotations, but the proportion of permanent grassland in their crop rotation differs, and consequently the number of cattle present too. For each system, the aim is to optimise meat production, and thus animal performance, using only permanent grassland and available by-products (e.g. rapeseed meal). To this end, we are currently testing the possibilities of fattening bull calves from dairy herds (mixed breed or terminal cross) using dynamic rotational grazing. There are also plans to maximise the grazing period, in particular by using intercrops for grazing. Depending on the system, we hope to finish the animals at 600 kg between 19 and 21 months. The type of animals, their number and the technical itineraries can evolve.

EXPECTED RESULTS

Each system will be guided independently so as to mobilise agro-ecological practices and activate innovative agronomic levers. Zootechnical performance (GQM, meat quality, etc.) and environmental performance (grassland carbon storage, methane emissions, etc.) will be monitored in the pasture, in the barn and during organic matter storage.

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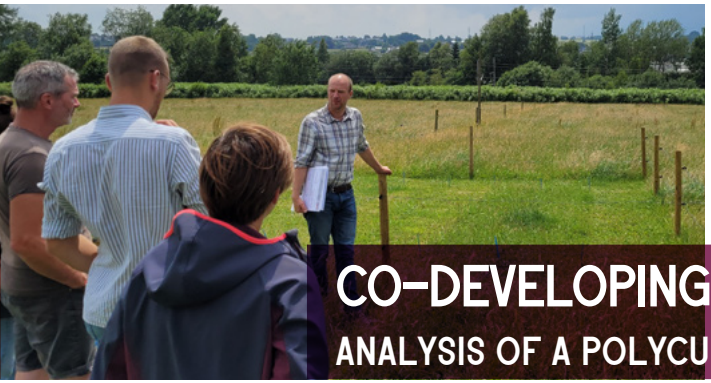

CO-DEVELOPING KNOWLEDGE AND TRANSFORMING SKILLS – ANALYSIS OF A POLYCULTURE-LIVESTOCK SYSTEM EXPERIMENT (SPOT)

CONTEXT

Onion and squash production in central Ardennes, fattening calves from dairy herds, transdisciplinarity, co-development, organic farming, etc.

An entire team of researchers and technicians from CRA-W's Haute Belgique experimental station in Libramont is coming together and seeking advice from a range of experts (scientists, farmers and distributors) to co-pilot, step by step, three mixed crop-livestock systems.

RESEARCH

Using a range of tools, we are supporting, facilitating and analysing these changes, as well as the knowledge and skills that are being acquired through this system experiment. Decisions taken by the three governance committees are recorded. Surveys of visitors are carried out to record their reactions and opinions. Solution co-development workshops are used to collectively make technical choices. Individual assessments are carried out with team members to arrive at a reflective appraisal of the project. A chrono-systemic timeline enables us to analyse these multiple data and report on the events, tensions and changes experienced.

EXAMPLES OF RESULTS

The many aspects of the SPoT platform have a major impact on researchers and farmers. Ways of doing things, ways of experiencing and understanding science and agriculture, and ways of representing the meaning and values of practices are constantly being questioned and transformed. This is the case, for example, following the discovery of a shortage of straw, the use of which is limited by the principle of circularity that guides the project. To compensate for this shortage, a number of avenues have been co-developed: purchasing straw, optimising use by reducing use through management practices, reducing livestock numbers, and so on. Some of these solutions run counter to the principles guiding the project. Reducing livestock numbers cannot be considered in the light of the principle of maximising food production. Other solutions involve ideas about what it means to "do a good job". These may constitute a "cultural block". For example, the desire to be prudent with this resource leads to an impression of reduced animal comfort and, by projection, casts doubt on the quality of the breeder's work and the identity of the breeder themselves. The timeline we've developed makes it possible to trace and analyse all our actions, questions and reflections, and to highlight the levers, obstacles and blocks we've encountered, whether technical, economic, political or cultural.

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SYCBIO: LONG TERM EXPERIMENTAL PLATFORM
FOR EVALUATING THREE ORGANIC FIELD CROP SYSTEMS

CONTEXT

The main issues identified as emerging from the organic farming sector when the experimental platform was launched concerned weed management and soil fertility on field crop farms without livestock. At present, these two constraints are managed by the use of high-performance mechanical weeding equipment, possibly in combination with manual weeding , and by the use of commercial organic fertilisers. These very costly inputs are made profitable by including high-value-added vegetable crops in the rotation.

The major challenge is therefore to maintain sufficient profitability without livestock and without vegetable crops. Not all farmers wishing to convert to organic farming are able to opt for these vegetable crops, so they have to find alternatives within their system.

RESEARCH

To meet these challenges, two systems have been defined within the framework of the Grandes Cultures Bio (Organic Field Crops) platform and aim to limit the use of these inputs in order to reduce costs:

- The autonomous system: aims to limit exogenous inputs of nitrogen and phosphorus and to compensate for them through the frequent use of legumes in various forms (as the main crop, mixed crops, cover crops, cover crop intercrops or during intercropping);
- The "ABC" ("Agriculture Biologique de Conservation" - conservation organic farming) system: in addition to limiting the use of external inputs, this system includes no-till farming to encourage the development of soil life and further improve fertility.

These two systems are compared with a reference system, which is characterised by high-performance weed control equipment and nitrogen fertilisation based on exogenous inputs (commercial organic fertilisers, farmyard manure or various organic fertilisers, depending on the availability of supplies).

RESULTS

The main lessons learned at this stage of the trial relate to several "compartments":

- Soil: little variation in chemical characteristics, but rapid change in structural stability from 2020 to 2023 (greater stability of the ABC system and marked contrast between the three systems).
- Agronomic dimensions: depending on the crop, the three systems perform differently (higher yields for the reference system in corn and for the autonomous system in spring barley). The number of weeds is unsurprisingly higher in the ABC system, and the populations are different, with a greater presence of grasses.
- Overall performance: the integration of several indicators aims to establish the overall performance of systems (agronomic, economic and environmental performance) in order to compare them using a common point of reference and assess their evolution over time.

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Orge – pois protéagineux de printemps

Triticale – féverole d'hiver

ASSOBIO CO-DEVELOPING AND VALIDATING TECHNICAL ITINERARIES FOR THE PRODUCTION OF PROTEIN CROPS IN ORGANIC MIXED CROP FARMING, WITH A VIEW TO SUPPORTING THE DEVELOPMENT OF ASSOCIATED SECTORS

CONTEXT

The economic competitiveness of farms - particularly in organic farming - is penalised by dependence on nitrogen inputs. In this context, seed legumes play a key role in developing symbioses that make it possible to use atmospheric nitrogen, a real alternative to rare and expensive organic fertilisers and nitrogen supplements for livestock farming. Mixed cropping, in which several species are grown together on the same plot, is an agronomic practice used in organic farming to overcome certain obstacles to growing protein crops. Nevertheless, this cultivation technique is more complex to manage, both for the farmer (place in the rotation, technical itineraries) and for downstream players (sorting, storage, distribution).

RESEARCH

This project works with the various sectoral stakeholders to develop and evaluate optimal agronomic itineraries for the production of grain legumes (protein peas, broad beans, lupins, lentils) grown in mixed cropping practices under our soil and climate conditions. A participatory approach, combining multi-stakeholder workshops and on-farm trials, is used to highlight actionable knowledge and remove obstacles to the development of mixed cropping with protein crops.

RESULTS

During this first year, a network of ten mixed crop-livestock farms in the south of the Sambre et Meuse region was set up. Based on individual interviews with each farmer, an inventory was made of the obstacles encountered in setting up mixed cropping as well as levers that could be mobilised. The performance of mixed crops harvested on the farms was recorded. In addition, interviews were carried out with various stakeholders in the sector to identify the problems encountered in collecting and generating value from products made from these crops. An roundtable discussion between farmers and stakeholders in the sector provided an opportunity to share the problems encountered by everyone and to identify possible solutions.

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ACKNOWLEDGEMENTS : This research project is financed by the Walloon Region's recovery plan

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TO FIND OUT MORE

TO FIND OUT MORE

1. VISIT THE CRA-W WEBSITE

CRA-W has a website where all publications related to its missions are posted. One page is dedicated exclusively to organic production research. You can find it at:

https://www.cra.wallonie.be/fr/tag/tag-bio

2. VISIT THE ORGANIC EPRINTS PLATFORM

Organic Eprints is an online archive providing (free) access to a wide range of information and publications on organic farming. Any organisation involved in organic farming research can submit documents relating to the research carried out. The CRA-W also contributes to the archive. You can find these publications at:

https://orgprints.org/view/projects/be-cra-w.html

3. USING THE FREDO TOOL

As part of the PSDAB 2020 and the Plan Bio 2030, CRA-W has been asked to create an 'inventory tool' that not only lists the requests/questions addressed to Walloon research institutions, but collects and organises publications relating to organic production. The site thus contains various resources documenting the organic production trials carried out at CRA-W. This tool is called Fredo and is now available online. You can find Fredo and the 'Publications' section of CRA-W at:

https://fredo.cra.wallonie.be/publications/list/?txtsearch=CRA-W

If you still have questions for which you haven't found an answer, don't hesitate to contact the project researchers directly (contacts listed in each data sheet) or write to the Cellule transversale de Recherche en Production biologique (multi-disciplinary organic production research unit) at:

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PREVIOUS COLLECTIONS

ORGANIC FARMING RESEARCH AT CRA-W – BIO2020 PROGRAMME

CRA-W began conducting organic farming research in the 1990s. In 2013, at the suggestion of the Walloon Minister for Agriculture, the Government adopted its first agricultural plan for Wallonia, the PSDAB 2020 (Plan Stratégique pour le Développement de l'Agriculture Biologique en Wallonie à l'Horizon 2020 - Strategic Plan for the Development of Organic Agriculture in Wallonia by 2020). This first collection provided a breakdown of the research work carried out at CRA-W, in four thematic areas. They reflect the specific skills developed at CRA-W in relation to producing organic farming reference materials as part of this regional program.

Publication date: June 2018

https://www.cra.wallonie.be/fr/la-recherche-en-agriculture-biologique-au-cra-w-programme-bio2020

ORGANIC FARMING RESEARCH AT CRA-W

This collection followed on from the first edition. It proposed a breakdown of the research work carried out at CRA-W, within the framework of the PSDAB 2020, through six thematic areas, reflecting all the skills developed at CRA-W in terms of producing organic farming reference materials.

Publication date: July 2020

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