Visiting Friends of Agrobiodiversity Across Europe

A tour to explore how organic plant and animal breeding contributes to sustainable food systems

ENGAGEMENT. BIOBREEDING

FiBL

Agrobiodiversity from the past and for the future

To bring healthy, tasty, and fair food to our tables, organic agriculture works in alliance with agrobiodiversity. Agrobiodiversity is the first building block of our food chain and is made up of various components: plants, animals, microorganisms, and their interactions with the environment and humans. Indeed, human activities, cultural practices, and local knowledge are an integral part to shape and conserve biodiversity. Agrobiodiversity ensures sustainable food production through the interactions between all its components.

Organic agriculture sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of external inputs with adverse effects.

Agrobiodiversity heritage

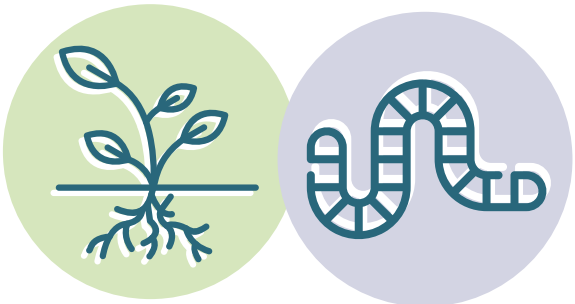
Over thousands of years, farmers have selected and adapted plants and livestock that have produced the best results on their farms. However, these requirements vary from region to region, and even from farm to farm. As a result, farmers created a high level of agrobiodiversity.

Agrobiodiversity today

Nowadays, only a few farmers take the management of agrobiodiversity into their own hands. Instead, a few corporations dominate the market, exporting their seeds and animals worldwide. Consequently, agrobiodiversity suffers, but so do farmers. When the same crop type or animal breed is used over a wide geographical area, the environmental conditions must be standardised. This is usually done with fertilisers and pesticides or concentrated feed and antibiotics. Organic farms have to cope with the changing conditions in our environment and only use as little as possible external inputs.

Agrobiodiversity for the future

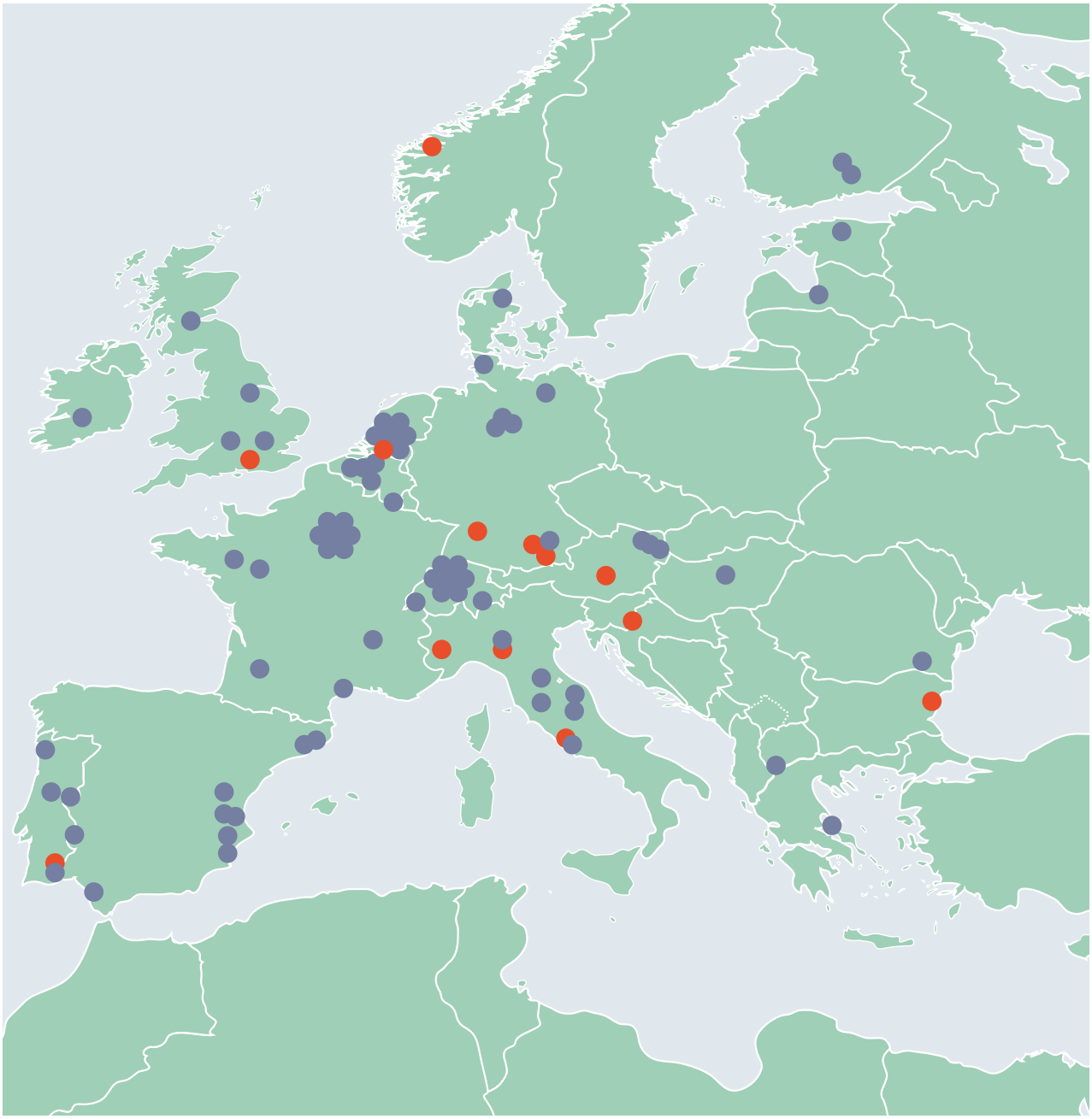
With the development of organic farming, the need for adapted organic breeding developed. Organic breeding has a holistic view, for example, it sees the plant or the animal in relation to the soil, and the rest of its environment. Thus, organic breeding preserves the agrobiodiversity from the past, through the active cultivation of the plants and the keeping of the animals. But it also creates new agrobiodiversity that evolves with the needs and requirements of today's organic agriculture and ensures resilience in a rapidly changing world.



Visiting Europe's organic breeders

When looking at organic breeding, one quickly notices that diversity not only plays a special role with plants and animals, but also with people. To get to know this diversity better, we take you on a journey through Europe from north to south, visiting the pioneers of organic plant and animal breeding. With their diverse and unique activities, they are contributing, not only to ecological, but also to societal resilience.

www.biobreeding.org/breeding



Map of organic plant (●) and animal (●) breeding initiatives in Europe.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www.arei.lv

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De Beersche Hoeve
www.debeerschehoeve.nl

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Unser Hausschwein
Research Institute of Organic Agriculture FiBL
www.unserhausschwein.ch

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www.agrologica.dk

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www.saat-gut.org

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Politécnico de Coimbra
www.ipc.pt

Latvia

Selecting plants that are adapted to organic and local environmental conditions

Linda Legzdiņa,
Institute of Agricultural Resources and Economics AREI

Our journey starts in Priekuli, Latvia, at the ***Institute of Agricultural Resources and Economics***. We meet Linda Legzdina*, senior researcher for spring barley breeding. Linda started organic plant breeding about 20 years ago, making her one of the organic pioneers at her institute. Her breeding work focuses on finding pure-line barley varieties which are uniform and robust in their characteristics and suitable both for organic and local environmental conditions. **"I am proud that I can work for farmers applying organic principles, not using synthetic agrochemicals. And I am happy that the main part of my work takes place in fields free of pesticide pollution"**, Linda tells us. What does this mean for organically bred barley in practice?

The main target traits can be seen to the right.

Linda's assertiveness continues to drive organic breeding forward. In her institute, conventional breeding predominates but despite the small investment in organic breeding, Linda is constantly breaking new ground by, for example, small-scale researching and developing heterogeneous populations that are characterised by a high level of diversity. This diversity can be admired in the barley population photo*. The plants differ significantly, for example in their lengths. They also carry different sources of resistance to foliar diseases, and are therefore better able to withstand pathogens. Disease tolerance is based on various genetic factors that would be difficult to combine in a single plant. The more different resistance genes exist in the population, the less likely the pathogens are to overcome the resistance. Whereas a single source of resistance puts pressure on the pathogen, which adapts more quickly through natural selection and overcomes the resistance.

Organic breeding responds to the specific needs of organic farming by focusing on traits that are less important or not accounted for in conventional farming.

Early vigour, i.e. the fast growth of the plants in the first phase after emergence. This improves the crops' competitive ability against the wild plants in the same field that should not be completely eradicated with herbicides but should be kept in quantities that do not cause harm to the crop production.

Resistance or tolerance to diseases in order to limit the use of fungicides.

Nutrient use efficiency in order to limit the need for fertilisation.

Stable yields in order to avoid big fluctuations in productivity.

A glossary of technical terms can be found on page 37.

Denmark

Increasing diversity leads to the promotion of resilience at local and global level

Anders Borgen
Agrologica

Crossing the Baltic Sea, our next stop takes us to Denmark. Anders Borgen welcomes us at *Agrologica*, an organic cereal breeding station in northern Jutland. A wide variety of winter and spring cereal and legume varieties can be found here, from spelt and durum wheat to barley, oats, millet, lentils and lupines.

Anders explains his motivation: **"I like to combine scientific knowledge with practical skills by working outdoors in experimental trials and being close to nature. I like the process of creation and the possibility of making a positive impact. I achieve this in my work as an organic plant breeder by selecting new varieties for sustainable cultivation."**

Anders values the role of diversity in his work. Diversity at all levels is one of the solutions to respond to increasingly extreme environmental changes.

Anders aims to help reverse the loss of genetic diversity by increasing the diversity of genes in the system and conserving genetic resources in situ. He explains that in ***in situ*** conditions, i.e., by planting them in farmers' fields, the variety can adapt to changing environmental conditions, whereas this potential might be lost in ***ex situ*** conditions where the seeds are stored in gene banks and only planted and reproduced every 10 to 20 years.

Anders also points out the trade-offs of diversity. He experienced that while variability in some traits (e.g., resistance to foliar diseases) is positive, too much variability for other traits (e.g., when the date of maturity of the plants is too diverse and they cannot be harvested together) can be critical for the farmer. This shows how difficult it is for farmers and breeders to select varieties that have positive variability on the one hand and maintain uniform traits needed for food production on the other.

The aim is to create different types of varieties (pure-lines, mixtures, populations) that are demanded by organic farmers, millers, and bakers. Anders explains, **"Diversity of choice for the organic food chain is a key issue *Agrologica's* breeding aims to address."** This makes it possible for a diversity of products to sustain healthy diets.

Diversity at variety level – growing several varieties differing in important traits on the same farm or together in the same field.

Diversity at species level – having more crops on one farm or mixing several crops together on one field.

Diversity at food system level – diversity of people involved from farming to food consumption (the value chain).

Germany

Organic breeding respects the living

Barbara Maria Rudolf
Saat:gut e.V.

We cross the border and not far away, we visit Barbara on her farm in Schleswig-Holstein, Germany, the birthplace of ***Saat:gut*** **e.V.** The association, in addition to promoting organic plant breeding, aims to preserve free access to seeds. For ***Saat:gut*** farmers, open-pollinated seeds are nature's tried and tested way to ensure good traits are passed on. Farmers can choose to save seeds from their own crop to plant the following year. They can break the cycle of dependency on seed companies.

The photos show only a glimpse of this diversity. We see rows and rows planted with different carrot* and pak choi plants* from which only the healthiest ones will be selected for further propagation. For Barbara, the genotype and the phenotype are important when she evaluates a plant, because the phenotype results not only from the genes, but also from the influence of environmental factors. After comparing the offspring of different crosses, the plant is brought into the field and observed under organic farming conditions. This means stress for the plant, but it also ensures that plants are selected which can cope with these conditions. **"Our idea is to let the plant deal with the problem itself, and we are grateful for the solution the plant finds. This is the natural way to adapt to new and changing conditions. It is something that nature has been doing all along"**, explains Barbara.

Methods and techniques that are invasive to the cell and the genome do not correspond to organic principles. Barbara never tires, defends her work at every opportunity and promotes the good results of selection conducted with respect for the organic principles.

Organic breeding is based on the four principles of organic agriculture: health, ecology, fairness and care. Following these principles, organic breeding respects the integrity of life, for example by respecting the cell as an indivisible functional entity.

Germany

Respectful and species-appropriate treatment of our “fellow living beings”

Inga Günther
Ökologische Tierzucht

Further south in Germany, in Rhineland-Palatinate, we meet Inga Günther, the founder of the non-profit company Ökologische Tierzucht. At the first organic animal breeding station of our trip, we are greeted by chickens running curiously between our legs.

Inga selects and breeds three chicken breeds, from which hatching eggs, chicks and young birds are produced and distributed. The focus of her work is on dual-purpose chickens, where the hen is used for egg-laying and the rooster for meat production. Most commercial chickens are specialised breeds. This means that the brothers of the highly productive laying hens grow too slowly, and thus, their fattening is considered uneconomical. Until 2021, it was possible to kill male day-old chicks. However, *in-ovo* selection is still practised, also in organic farming. Here, the sex is determined before hatching and the male embryos are discarded in the egg. Inga positions herself against these methods: **“Farmers are not only there to produce cheap food, but agriculture is the basis of us humans here on this planet. If that is to be sustainable, then we simply need to treat plants and animals with respect. This means that breeding should be organised in such a way that the animal is not seen as a waste product, but is raised, regardless of whether it is male or female.”**

Inga's chickens are healthy, robust, and well-adapted to organic farming. What does that mean in practice? Firstly, the chickens are kept under organic housing conditions. Single-animal husbandry that is still common in conventional breeding is not practised. Secondly, the animals are fed with 100% regional and organic feed. This corresponds to the idea of a closed cycle in organic farming, where feed is produced regionally instead of depending on imported feed. Thirdly, artificial insemination and manipulations on beak, spurs or comb are also not practised. In addition to the daily individual animal data collection on eggs, the whole animal is assessed on an individual basis and at regular intervals during the test period. The usually very early assessment of breeding animals purely based on data is not practised.

Generally, the animals are not bred as high-performance animals. According to Inga, high-performance breeding is a model that will phase out in the long term, as it ignores the external costs and carbon footprint caused, for example, by the extremely long feed transports. **“Only small-scale farming that adapts animal husbandry to the available resources in the region is truly sustainable.”** Breeding is carried out in cooperation with farmers. Small-scale, artisanal structures are promoted, and networking is carried out along the value chain from the farmer to the hatcheries, slaughterhouses, butchers, retailers and end customers. With this, *Ökologische Tierzucht* represents an alternative to conventional and globally operating corporate structures.

The Netherlands

Organic breeding reduces the alienation between food and consumer

Abco de Buck
Louis Bolk Instituut

Our journey takes us again a bit up north to Bunnik in the Netherlands. Abco de Buck, who works at the Louis Bolk Institute, takes us to on-farm trial fields, where he is working with nine different varieties of spring wheat. The varieties are planted in different plots and each plot is replicated across the field. In this way, the varieties can be assessed, evaluated and compared without, for example, different soil conditions influencing the trial.*

He explains that the trials were initiated due to the demand from farmers who felt constrained by the limited choice of bread wheat for organic farming. And that is exactly what is so important for Abco: Organic breeding addresses the direct needs of farmers and processors. Artisan bakers, for example, need different dough properties and differences in taste between varieties which are lost in the industrial bakery chain. Another important actor in organic breeding programmes is the end user, us, the food consumers. To increase participation, Abco plans baking and tasting workshops. **"Organic breeding has its principles, that can solve some problems that we have nowadays in society, regarding environmental topics, but also the connection of consumers to the food."**

In addition, Abco mentions the reintroduction of underutilised crops to contribute to diversity. **"Due to the low market volumes, there has been hardly any breeding progress on small crops and some of them have almost disappeared in conventional agriculture. It makes me happy to see that more and more youngsters show interest in diverse and healthy food on their plates."**

Organic breeding rethinks the organisation of food systems. It incorporates all actors along the value chain into selection decisions, from breeders to processors, and consumers.

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The Netherlands

Holistic understanding from seed to human health

Edwin Nuijten
De Beersche Hoeve

After a two-hour train ride, we reach ***De Beersche Hoeve*** in Oostelbeers. ***De Beersche Hoeve*** focuses on biodynamic breeding and seed production. Biodynamic agriculture views the farm as an individual organism with special characteristics. Talking to Edwin reveals this holistic view of the farming system. From seeds to human health, everything is interconnected.

Edwin cites access to seeds as an important factor in his work. **"Seeds represent how society is organised. Who has access to seeds, who does not, and how is this regulated? In our current society, we see developments – such as patents, new techniques of genetic modification – that prevent certain groups of people from having access to seeds."** In organic breeding, on the other hand, the plant retains its natural reproductive ability so that the farmer could reproduce the variety by saving and re-sowing the seeds. Therefore, Edwin works mainly with open-pollinated varieties and populations. Open-pollinated means that the flowers are fertilised by wind, rain or pollinators, like bees and other insects. Self-pollination is also included, however, usually different plants come together, resulting in a higher genetic variability, allowing open-pollinated varieties to better adapt to new environmental conditions over time, compared with hybrids.

Moreover, in biodynamic agriculture, the cooperation of soil and plant is taken into account. Edwin explains that we do not yet know much about the enormous dynamics going on in the soil. However, the plant, through its roots, is in constant interaction with the soil and all life in the soil. In breeding, this means plants that interact well with the soil to get their nutrients and can withstand extreme weather conditions are selected.

"We should not forget the consumers, the citizens. We want to develop varieties that are appreciated by those who eat them and that can contribute to their health. It is important to look at the relationship between nutritional quality and human health", adds Edwin. For Edwin, this does not necessarily mean to only breed for a higher level of nutrients, but to provide a higher diversity of crops, to reintroduce crops that have been cultivated in the past.

The bioverita association recognises and certifies new, robust and efficient crop varieties that are optimally adapted to the conditions of organic agriculture.

There are already more than 150 bioverita certified varieties of vegetable and field crops, including pure lines and population varieties.

bioverita wants to increase the use of these and many other varieties that will be certified in the future and make them better known in cultivation and marketing.

bioverita

www.bioverita.ch/en

Dottenfelderhof · gzpk · Kartoffel Vielfalt · Kultursaat e.V. · Saat Gut · Pomaculta · Reinsaat · saat:gut e.V. Ökologische Pflanzenzüchtung · sativa biosaatgut & pflanzenzüchtung

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Belgium

Bringing diverse actors together through openness and inclusion

Corentin Hecquet
Réseau Meuse-Rhin-Moselle pour les semences paysannes et citoyennes (RMRM)

We cross the border and arrive in Belgium, more precisely in the very south of Wallonia, the Meuse-Rhine Euroregion. Here we meet Corentin Hecquet, coordinator of ***Réseau Meuse-Rhin-Moselle pour les semences paysannes et citoyennes***, a network of actors that are active in the preservation and promotion of cultivated biodiversity. Corentin actually has a background in social sciences and describes his role in organic breeding as a 'gatherer', bringing together people who work with farmers and citizen seeds. These can be farmers and farmers' associations, but also seed artisans, hobby gardeners and researchers. Working with a diverse group of people also means that very different visions may collide. That is why openness and inclusivity are very important to Corentin. **"When you develop a value chain, you must start from where the farmers are today, even if it is conventional, to guide and accompany them into other narratives and other trajectories"**, Corentin explains.

The network works with population varieties of vegetables and cereals. With the new organic regulation, population varieties are classified as organic heterogeneous material and thus have a legal basis. They stand in contrast to the uniform varieties that are mostly found in the fields of our agriculture. Corentin explains that populations are an opportunity in terms of the uncertainty in which we live. The genetic diversity found in heterogeneous material, while not a direct answer to climate change, gives us a chance to adapt to the situation, and thus, reduce the shocks induced by climate change.


SEED

France

Renewal of the crop diversity at all levels, based on on-farm research

Véronique Chable
INRAE Centre Bretagne-Normandie

We arrive in France, at the Centre Brittany-Normandy of the French National Research Institute for Agriculture, Food and Environment. Here we meet Véronique Chable, part of the Cultivated Diversity and Participatory Research team.

Véronique conducts participatory and transdisciplinary research in organic breeding. In other words, farmers, farmer networks and other value chain actors play a central role in plant selection and seed production. In the photos on the right*, you can see how groups gather around the plants, examine, compare and discuss together. As this takes place on-farm, i.e., directly where the plant will grow, the plants can adapt to local contexts and diverse farming practices. She also accompanies organic farmers to try new species in their cropping systems, and to explore species that were not traditionally grown in this region, e.g., safflower and sorghum in Brittany.

According to Véronique, cultivated diversity is a powerful means to enhance organic agricultures' resilience and product quality. Véronique explains, **"My main personal value is the respect for living beings and the diversity of life. Organic plant breeding contributes to a healthy environment by bringing back a wide range of plant species and within each plant species, increasing the number of varieties."**

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France

Adaptability of farmers' seed allows adaptation to local soil and climate conditions

Cécile Morvan
Bio Loire Océan

We want to visit an on-farm breeding initiative to learn first-hand what breeding looks like in practice. Following a tip from Véronique, INRAE, we visit Cécile Morvan, the coordinator of ***Bio Loire Océan***. The association develops population varieties of fruits and vegetables in cooperation with farmers in the Pays de la Loire region. **"We believe and hope that farmers' populations can evolve to adapt to local soil and climate conditions because of their adaptability. We hope that this adaptability will allow our systems to adapt to climate change"**, remarks Cécile.

Cécile explains that farmers are the actors of agrobiodiversity. Bio Loire Océan supports farmers in reclaiming know-how related to breeding and seed production. The association has its own label that encourages the use of farmers' seeds.

Cécile explains the process of developing the carrot variety ***La Nantaise de Grasseval***. Seeds from gene banks are brought back to the field to help increase cultivated diversity. Thus, in 2008, more than a hundred carrot varieties were grown on-farm. Through observation and participatory selection with the farmers, a handful of carrots entered the second phase. In 2013, the process of crossing, selection, and multiplication started, and a new carrot variety was developed in 2021 that displays a good root length, disease tolerance, and, finally, a good taste.

France

Making organic affordable and accessible to all groups of people

Dominique Desclaux
INRAE Centre Occitanie-Montpellier

We travel further south in France and visit Dominique Desclaux at the *Centre Occitanie-Montpellier of the French National Research Institute for Agriculture, Food and Environment*. Dominique is also involved in participatory breeding. She is currently coordinating a project to assess the quality of flours, semolina, breads and pastas in terms of their suitability for gluten-sensitive people. For this purpose, together with organic farmers, 'old' varieties are evaluated and gently processed.

Her aim is to identify wheat varieties that are adapted not only to the specific environmental conditions, but also to the whole system in which the farmer operates, i.e., the economic, social and regulatory conditions. To achieve this, Dominique works with farmers, artisan bakers, millers and pasta makers.

"A participatory breeding project is not only a genetic project but mainly a social project from the beginning. We cannot breed organic varieties just for the farmers if we do not know who will eat the product. We do not want such products to become not accessible because of the price. How can you build an initiative to address the issue of accessibility, and how can you involve citizens with reduced purchasing possibilities from the start?", asks Dominique. To illustrate this, Dominique explains an initiative she worked on 20 years ago, with an organic industrial pasta company. The company was looking for a durum wheat variety with specific characteristics for pasta production but did not recognise the farmers' constraints. Moreover, the company wanted to set a fixed price and was not willing to talk about its profit margin. Discussions were held about profitability and prices. The company was invited to the farms to see how difficult it is to produce high-quality wheat. Likewise, the farmers were able to visit the company to learn about its constraints. Together, a fair price for the pasta was set, for the company, farmers and for the consumers, because pasta should be affordable as a staple food.

Organic breeding takes a holistic approach.

Switzerland

Finding an alternative pig breed for Swiss organic farmers

Anna Jenni
Unser Hausschwein
Research Institute of Organic Agriculture FiBL

Next stop on our Europe tour is Switzerland; more precisely the ***Research Institute for Organic Agriculture FiBL*** in Frick. Here we meet Anna Jenni, the project coordinator of the project ***Unser Hausschwein*** (Our House Pig). The intensification and optimisation of agriculture have not only led to an increase in performance, but also a decline in diversity in livestock farming. The project aims to counteract this development and create a new robust pig breed that is well adapted to Swiss soils and climate.

To meet the requirements of more small-scale, organic pig farms, the pig breed must display certain qualities. For instance, the pigs are kept outdoors and fed with agricultural by-products, they should have a calm character and good mothering qualities. In contrast to intensive systems, a moderate reproduction rate is preferred. Anna explains that there is a clear upper limit to the number of pigs per farm. Respecting this upper limit means producing more sustainable pork. **"Animal welfare is very important to me, that the pigs in the project can live a life appropriate to their species. The very resource-intensive pig farming should be reduced and the pig should regain its role as a recycler"**, states Anna.

Farmers' ideas and concerns are at the heart of the project. They are at the beginning of new decisions and have an important influence on all processes. Another part of the project is to raise awareness among consumers. The meat is sold with a story that explains the quality of the meat (slightly more fat, longer lives) and why fewer animals should be consumed in general, while a certain number of animals are important for the organic farming system.

Switzerland

Selecting healthy dairy cows that produce well on grass from pastures and that adapt well to changing natural environments

Anet Spengler Neff
Bio-KB-Stiere
Research Institute of Organic Agriculture FiBL

At the same institute, we meet Anet Spengler Neff, who is involved in Bio-KB-Stiere, a project of FiBL and the Swiss organic farmers' association Bio Suisse, in collaboration with many committed organic breeders and the genetics provider Swissgenetics.

The project is dedicated to cattle breeding and aims to identify good breeding bulls from and for organic farms in Switzerland and to produce semen straws from them. For a good breeding bull, a healthy mother cow is necessary. Very important for Anet is, above all, a mother cow with the ability to feed on roughage, pasture efficiently, and adapt to local and changing feed.

Anet explains that organic farming is based on nutrient cycles. This means, that the animals are ideally fed with what grows on the farm, and their manure is, in turn, used to fertilise the crops. Additionally, the feed should be appropriate for the animal's digestive tract. For ruminants, this means mainly grass, not concentrated feed and cereals. **"Our food systems worldwide can only become sustainable if we stop feeding animals feedstuffs from arable land that could be used for human nutrition, so-called food competing feed. Therefore, we need animals that can feed well on things humans cannot eat, like grass, leaves, even wood, food scraps or food waste"**, Anet explains.

Another important aspect of Anet's work is collaborating with farmers, counteracting the trend where cattle breeding is increasingly being taken over by large organisations. There is an urgent need for breeding to take place on farms and for the competence of selection to remain in the hands of the farmers. Anet believes, **"We cannot use the same breeds everywhere in the world. We need animals that are well adapted to their environment. Therefore, animal breeding and husbandry should be small-scale and site-specific."**

Italy

Finding poultry breeds that meet the needs of organic farmers

Monica Guarino Amato
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

From Switzerland, we cross the border into central Italy, near Rome. Here we meet Monica Guarino Amato at an experimental poultry farm. Monica works at the *Animal Production and Aquaculture Research Centre of the Council of Agricultural Research and Economics (CREA)*. One of her passion projects is TIPIBIO, a project to identify slow-growing poultry breeds for organic farming.

Most breeds used today are highly productive, fast-growing breeds. They have been bred to be bigger, grow faster and therefore be ready for slaughter sooner. Monica explains that when these breeds are then kept in organic conditions, they often develop diseases. Slow-growing breeds, on the other hand, show a more active behaviour and a better welfare status. However, they cannot convert feed into muscle as quickly. It is therefore important to identify those breeds that have both good production performance and high welfare status.

Monica explains that while this is not a full breeding programme, it is more of a performance test to evaluate the adaptability of breeds to organic systems. One step, therefore, is to define basic traits that define adaptability, considering issues of animal welfare, productivity, and meat quality. She went on to say, **"I personally think that adaptability should be the key factor for organic breeds. Choosing the right breed should be a farmer's decision, depending on farm characteristics, type of production, geographical area, etc., and made from a range of breeds that have been tested for adaptability."**

In addition to finding a suitable breed, management, nutrition and housing are also important. Therefore, Monica is, for example, investigating various alternative protein feeds that are environmentally friendly and do not compete with human diets.

Italy

Creating resilience in a changing world

Matteo Petitti
Rete Semi Rurali

We arrive in Scandicci, near to Firenze in Italy to meet Matteo Petitti. He is the action-research coordinator at ***Rete Semi Rurali***, an umbrella organisation that promotes collective management of agrobiodiversity. The focus is on decentralised, participatory plant breeding. Matteo explains that organic plant breeding is a service to organic farmers and the value chains that surround them, and that field research should be useful to the community.

In participatory breeding, the breeding programme is developed in discussion with farmers and other value chain actors. According to Matteo, protocols and methods should be chosen according to what the needs and means of the actors are. **"With participatory organic breeding, we want to achieve a paradigm shift, where seeds become the centre of food systems that are local and in the hands of the actors"**, Matteo explains.

Matteo works with the evolution of populations of cereals, particularly bread wheat. That means, he disseminates a population in small packages to as many farmers as possible. Then he investigates how the same population evolves differently in different climates. Due to their level of diversity, evolutionary populations can adapt to climatic trends and produce stable yields, thus, offering a way to adapt to climate change. But Matteo also encourages the farmers themselves to observe what they are growing, to save their own seed, and to take care of the seed quality aspects. He thinks this work, **"disseminates and disperses biodiversity in farmers' and seed networks, but also empowers the farmers to maintain this diversity and spread it even further – to foster local-based seed systems in terms of more local adapted varieties and biodiversity."**

According to Matteo, local seed systems are the basis of local food chains. **"There are no better seeds than those that grow under your feet. There is not a more sustainable food system than a food system that includes seeds."**

Organic breeding contributes to the collective management of climate change.

Portugal

Conserving the tradition of maize cultivation and the culinary tradition of maize breadmaking

Pedro Mendes Moreira
Politécnico de Coimbra

In Portugal, at the ***Politécnico de Coimbra***, we meet Pedro Mendes Moreira. While learning about his maize breeding project, we are tasting maize bread made from different maize varieties mixed with rye flour. The maize project started in 1984 with the aim to identify maize varieties and develop maize populations with high adaptability to the region. Additionally, the project aims to preserve culture and local traditions. This is particularly close to Pedro's heart. For many years, Portuguese farmers have selected, and thus, adapted maize varieties to their locations. However, this tradition is being lost and replaced by buying seeds every year.

Pedro mentions the importance of not only preserving farmers' knowledge and the tradition of maize cultivation, but also preserving the culinary tradition of maize breadmaking. **"In seeds, in a way, there is the past, the tradition, a genetic history. However, they also contain the future, the potential of adaptability to new conditions"**, Pedro explains.

The maize selection is done in a participatory manner. Pedro stresses the importance of involving the farmer, the community, and the value chain in the breeding process. Pedro is shown in the photo at a meeting with farmers.* Discussions are taking place about which selection criteria are important, such as the number of kernels and the size of the ear, while maintaining the diversity of the population. In this way, through a mutual learning process, science and practice join forces. Pedro believes, **"You should have the vision of a farmer and the head of a breeder."** The outcome is resilient populations that might yield less than modern varieties but ensure the farmer a stable yield.

Some breeding steps are conducted on-station, as farmers are generally less interested in more technical procedures such as inbreeding or regeneration of material. For sensory qualities, Pedro explains that the best laboratory is your stomach and we do agree.

Organic breeding contributes to the collective management of climate change.

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Why do we need organic breeding?

Organic breeding takes place under the conditions of organic farming. This means that plants or animals develop in co-evolution with the living environment. A high degree of agrobiodiversity and decentralised selection, in which farmers grow the crops in their own fields and make selection decisions themselves, achieves a high degree of adaptability to local conditions.

Organic breeding respects the variety and the breed as cultural heritage, which must be both preserved and adapted to new conditions. Therefore, organic breeding renounces patents and stands for free access to seeds and farm animals. Organic breeding strives for a fair price along the value chain, for farmers, breeders and consumers.

Organic breeding benefits the entire food system by producing a wide range of adapted, robust varieties and animal breeds. But organic breeding is a long-term activity. Ten to fifteen years are needed before a breeding process is completed and the product ends up on our plates. Thus, enabling breeders and farmers to maintain and develop diversity for us all requires cooperation in the value chain, including us consumers.

For more information about breeding goals, background principles, breeding techniques:

European Consortium for Organic Plant Breeding (ECO-PB)
www.eco-pb.org

European Consortium for Organic Animal Breeding (ECO-AB)
www.eco-ab.org

Research Institute of Organic Research FiBL
www.fibl.org

Engagement.Biobreeding
www.biobreeding.org

Organic breeding for healthy, tasty and diverse food

https://youtu.be/MxjFIadRwBo

Glossary

Agrobiodiversity: Agricultural biodiversity describes the variability of animals, plants, microorganisms and other species that contribute directly or indirectly to food and agriculture.

Allogamous species: Cross-pollinators, as they have self-incompatibility mechanisms to prevent self-fertilisation. Plant species for which the pollen from one plant is needed to fertilise the flower of another plant.

Artificial insemination: Sperm is taken from a male animal and inserted into the reproductive tract of a fertile female animal.

Autogamous species: Self-pollinator species. Plant species in which ovules are (predominantly) fertilised by pollen from the same flower.

Biodiversity: Biological diversity describes the variability of all living organisms, habitats and ecosystems.

Biodynamic agriculture: Great similarities with organic farming, but it also takes into account the rhythms of nature. Methods unique to the biodynamic approach include its treatment of animals, crops and soil as a single system.

Cross-breeding: Process of producing offspring, especially by the planned mating of two individuals of different breeds or varieties.

Cross-pollination: Pollination of a plant with the pollen of another plant.

Decentralised selection: Farmers grow the plants on their own fields and make selection decisions on-farm.

Ex situ conservation: Preservation of plant seed or animal semen outside their natural habitats, e.g. in gene banks.

Gene: The basic unit of heredity. Each consists of a nucleotides sequence. Most genes are responsible for a particular characteristic or function.

Genome: All genetic information of a specific plant or animal species.

Genotype: All genes of a specific individual, like a genetic fingerprint.

Hybrid: Plants or animals produced by the cross-breeding of two genetically different varieties or species. To maintain performance, crosses need to be made each generation.

Inbreeding: Pairing of relatively close relatives. In plant breeding, it means particularly self-pollination, usually over several generations.

In-ovo selection: Sex of the embryo in the incubated eggs can be determined on the ninth day. Eggs with male embryos are sorted out so that only laying hen chicks are born.

In situ conservation: Preservation of plant seed or animal breeds in their natural habitats.

Open-pollination: Pollination is carried out by insects, birds, wind, humans or other natural mechanisms.

Organic heterogeneous material: Defined in the new organic regulation (EU) 2018/848 as a plant grouping characterised by a high level of genetic and phenotypic diversity.

Participatory breeding: Breeding programme that is developed in collaboration with farmers and other value chain actors.

Phenotype: All traits and characteristics of a specific individual plant or animal (e.g., height, colour).

Pollination: Pollen is transferred to the female floral organ resulting in in-vivo fertilisation.

Population varieties: Plant grouping composed of plants that are genetically different, but the population can still be distinguished from other populations by its characteristics.

Pure-line varieties: Plant grouping composed of plants that are almost genetically identical.

Self-pollination: Pollen from one plant fertilises the female floral organ of the same plant.

Semen straw: Preservation and packaging of bovine semen for future artificial insemination.

Varieties: The term ‘variety’ is used within this brochure as a general term for officially released varieties, landraces, heterogeneous populations, niche varieties, farmers' selections, etc.

Imprint

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This brochure is published by the Research Institute of Organic Agriculture FiBL on behalf of Engagement.Biobreeding Europe.

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Photo credits: Linda Legzdiņa (AREI): page 7; Anders Borgen (Agrologica): p. 9; Barbara Maria Rudolf (Saat:gut e.V.): p. 10, 11; YOOL GmbH for Demeter e.V. & Ökologische Tierzucht GmbH: p. 12, 13; Ulrike Behrendt (Kultursaat e.V.), Boki Luske (LBI), Harm Reindsen & Abco de Buck (LBI): p. 14, 15; Edwin Nuijten (De Beersche Hoeve): p. 16, 17; Corentin Hecquet (RMRM): p. 18, 19; V. Chable (INRAE): p. 20, 21; Bio Loire Océan: p. 22, 23; Dominique Desclaux (INRAE): p. 24, 25; Marion Nitsch: p. 26; Anna Jenni (FiBL): p. 27; Anet Spengler (FiBL): p. 28; Thomas Alföldi (FiBL): p. 29; Christoph Metz (Demeter Bayern): p. 29 (top); Monica Guarino Amato (CREA): p. 30, 31; Matteo Petitti (RSR): p. 32, 33; Pedro Mendes Moreira (IPC): p. 34, 35.

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FiBL publication No. 1422

DOI: 10.5281/zenodo.6726833

This publication is available for free download at shop.fibl.org and www.biobreeding.org > Communication

Disclaimer: This brochure was made thanks to the project Engagement.Biobreeding Europe. The project aims to increase the awareness about organic breeding. Engagment. Biobreeding Europe is not directly involved and/or does not fund the initiatives mentioned in this brochure.
The breeders presented in this brochure represent only small selection of the initiatives involved in organic breeding mapped by our project. A large but not complete list of initiatives across Europe is available at (www.biobreeding.org). Please contact us (mariateresa.lazzaro@fibl.org) if your organisation is missing or not correctly displayed.

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