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Leibniz Centre for Agricultural Landscape Research (ZALF)

## Sustainable agriculture in the new "patchCROP" landscape laboratory: **Diversity and cultivation on small areas for more biodiversity and lower pesticide use**

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In the "patchCROP" landscape laboratory of the Leibniz Centre for Agricultural Landscape Research (ZALF), the second season is starting of an experiment that is until now unique in Europe. Working in cooperation with a farm, a research team will be spending the next 10 years testing an innovative cropping system that focuses on high plant diversity on small areas, digitalization and new technologies such as robotics. The aim is to reduce the use of chemical synthetic pesticides and fertilizers in particular. Through this experiment, the researchers want to prove that it is possible to increase soil fertility, yields and biodiversity while at the same time reducing the use of resources. The landscape laboratory is thus leading the way to the sustainable agriculture of the future.

It sounds simple enough: Grow crops where they find the best conditions for growth in the soil. That sums up the research approach of the new "patchCROP" landscape laboratory. The special feature: Instead of taking place in the laboratory or on small experimental fields, the research work takes place under real-life conditions on the agricultural land of the partner farm, the Komturei Lietzen in East Brandenburg. In addition to ZALF and its practice partner, the Julius Kühn Institute (JKI), the "PhenoRob" cluster of excellence, represented by the University of Bonn, and the BMBF-funded project "Digital Knowledge and Information System for Agriculture" (DAKIS) are also part of the project. Technology start-ups from the agricultural robotics industry are involved as well.

"In patchCROP, we have created an innovative platform for an integrated research approach to the development of sustainable agricultural landscapes of the future", explains **Prof. Ewert, Scientific Director of ZALF and Professor of Crop Science at**

**the University of Bonn.** "With the landscape laboratory, we are bridging the gap between basic research and practical implementation. All the experiments are carried out under real conditions in a landscape context. This systems approach is central to solving many of the challenges we currently face in agriculture."

### **A mosaic in the field**

For the experimental setup, a total area of 70 hectares was divided into 30 small squares, called patches, each measuring only half a hectare.

**Dr. Kathrin Grahmann, scientific coordinator of the experiment at ZALF,** explains: "Depending on the soil properties, different crops are grown in each of the squares. This creates a diverse mosaic of arable crops such as rye, sunflowers or lupines. Variegated flowering strips and catch crops complement this diversity." A total of nine types of crops are cultivated at the same time. In addition to the positive effects on the environment, the small-scale, site-adapted cultivation should also make the system more resistant to weather extremes. "By diversifying the crops grown, a farm reduces the risk of losing parts of its harvest during extreme weather events, because each crop species reacts differently to these events", adds Grahmann.

To improve soil health in the long term, the crop rotation, i.e. the sequence of crops grown in the field, has been expanded to include crop types that promote the build-up of humus and nitrogen in the soil. All crop residues are left in the field and are only lightly worked in without plowing. This ensures an accumulation of humus in the topsoil. By planting flowering strips between the squares as a refuge for insects, the researchers hope to improve biodiversity and pollination performance. Beneficial organisms, which find a habitat in the newly created retreats, should also support crop protection.

### **Using new technologies to create the cropping systems of the future**

The experiment is supported by digital measurement technology, 190 soil sensors and drones that are observing each field section. Along with a thorough monitoring of birds and insects, as well as the intensive monitoring of harmful organisms, the impacts of the experiment are being analyzed. In the future, robots will be used to manage the small squares.

Not least of interest to the scientists is the question of whether this type of cropping system, using new digital technologies, can be economically viable, i.e. whether it will in future also deliver the yields needed to cover the high investment costs. They are also investigating the contribution the cropping system will make to the environment, nature and biodiversity and how this should be rewarded. For this reason, the networking aspect of the project is very important. The project team is establishing collaborations with technology companies and start-ups in the

agricultural robotics sector. In cooperation with the participating practice farm, demand-oriented robots as well as associated software are to be tried out on the experimental area and tested under real conditions.

### **Reduce the use of chemical synthetic pesticides**

In order to assess the positive impact of small-scale and diversified cultivation in crop rotations with high levels of biodiversity, experts from the JKI's Institute for Strategies and Technology Assessment regularly monitor the occurrence of harmful organisms in the crops. At the same time, they are investigating how small-scale crop diversification creates synergies that increase crop resilience. "We hope that this experiment will provide insights into how strengthening agro-ecological factors can help stabilize yields and exploit additional reduction potential in integrated crop protection", explains **Silke Dachbrodt-Saaydeh, a plant protection expert at the JKI.**

### **High-tech in the field**

The researchers are already supported by digital tools that monitor the need for crop protection or fertilization for each site in the field. Soil sensors also continuously measure soil moisture and temperature. However, the team is also testing new digital agricultural technology prototypes: Using electronic insect traps, the emergence of pests and beneficial insects is measured and evaluated via app. Drone images already help to regularly monitor the entire area. In the future, additional small autonomous units are to undertake sowing, automatically remove weeds and check the nutrient balance of individual plants. Together with experts from the "PhenoRob" Cluster of Excellence and the "DAKIS" project, a concept for a holistic, digital management solution is to be developed, tested and implemented. In the future, all relevant information and recommendations for action will flow together on an "agricultural dashboard", which will then support the farm in its work as a decision support tool. **Dr. Ixchel Hernandez-Ochoa from the "PhenoRob" Cluster of Excellence,** explains: "The data from 'patchCROP' allows us to simulate how diverse cultivation and different field sizes will impact the soil, yields and the entire ecosystem in the long term."

The "DAKIS" project, currently one of the largest research projects for the development of a digital, knowledge-based agriculture of the future in Europe, also uses data from the "patchCROP" experiment. The **"DAKIS" coordinator, Prof. Sonoko Bellingrath-Kimura,** explains: "The objective of 'DAKIS' is to develop a software system that digitally supports farmers in their everyday decision-making. This decision support system provides information on site-specific requirements for ecosystem services, biodiversity and resource efficiency. In this way, the services that agriculture can provide in addition to production, such as clean drinking water, the pollination performance of insects or attractiveness for tourists, can be

recorded. This is the basis for us to be able to reward farmers appropriately for this in the future."

The practice partner of "patchCROP", the Komturei Lietzen, is an agricultural food crop producer in Brandenburg. The experiment is being carried out as a landscape laboratory as part of the daily operations on the Komturei's land. **Felix Gerlach, managing director of Komturei Lietzen**, sees opportunities in this cooperation: "In the 'patchCROP' landscape laboratory, we can support research into sustainable cultivation systems with our experience and integrate the results directly into practice."

In 2020, the first management year, extensive measurement and management plans laid the initial groundwork for the experiment. In addition to measuring soil properties, there will be ongoing monitoring of which species of wild plants, birds, insects and soil organisms are present in the field and in flowering strips. Based on this, researchers will be able to determine in the next few years whether diversity in the field is having the expected positive impact on the soil, biodiversity and yields. The "Agricultural Mosaic" is now entering its second season.

#### Project Partners:

- Leibniz Centre for Agricultural Landscape Research (ZALF), Müncheberg (project coordination)
- Julius Kühn Institute, Institute for Strategies and Technology Assessment, Kleinmachnow
- "PhenoRob" Cluster of Excellence - Robotics and Phenotyping for Sustainable Crop Production, University of Bonn
- "DAKIS" – Digital Knowledge and Information System for Agriculture, coordination at ZALF

#### Further information:

Website of the "patchCROP" landscape laboratory:

<https://comm.zalf.de/sites/patchcrop/SitePages/Homepage.aspx>

Image film of the "patchCROP" landscape laboratory:

<https://www.youtube.com/watch?v=LSdcBL6TsvE>

Podcasts issued by the "patchCROP" landscape laboratory:

<https://www.quer-feld-ein.blog/episodes/querfeldein-podcast-folge-4-mosaik-acker-statt-monokultur-ist-kleinteilige-landwirtschaft-die-zukunft/>

<https://www.quer-feld-ein.blog/episodes/fruchtfolgen-folge-4-hightech-auf-dem-acker/>



Small field sizes, varied crops and flowering strips should ensure more biodiversity and stable yields. At ZALF's "patchCROP" landscape laboratory in Brandenburg, research is being conducted on a sustainable cropping system in cooperation with a practice-based farm. | The image is released for editorial purposes, provided the source is given: © Hendrik Schneider / ZALF | Image source in color and print quality: <http://www.zalf.de/de/aktuelles>



Felix Gerlach (left) is the managing director of Komturei Lietzen, the partner farm of the "patchCROP" landscape laboratory. The scientist Dr. Kathrin Grahmann (right) is coordinating the project at ZALF. | The image is released for editorial purposes, provided the source is given: © Kristina Backhaus / ZALF | Image source in color and print quality: <http://www.zalf.de/de/aktuelles>

Press contact:

Hendrik Schneider

Head of Press and  
Public Relations

Telephone: + 49 (0) 33432 82-242

Fax: +49 (0) 33432 82-223

E-mail: [public.relations@zalf.de](mailto:public.relations@zalf.de)

Specialist contact:

Dr. Kathrin Grahmann

Scientific coordination of the ZALF  
"patchCROP" landscape laboratory

Telephone: + 49 (0) 33432 82-142

Fax: +49 (0) 33432 82-308

E-mail: [kathrin.grahmann@zalf.de](mailto:kathrin.grahmann@zalf.de)

**About the Leibniz Centre for Agricultural Landscape Research (ZALF) in  
Müncheberg, one of the institutes of the Leibniz Association:**

ZALF conducts research on the economically, ecologically and socially sustainable agriculture of the future – together with stakeholders from science, politics and practice.

As a contribution to addressing global societal challenges such as climate change, food security, biodiversity conservation and resource scarcity, we develop and design cropping systems in a landscape context that combine the need for crop production with sustainability. To do this, we combine complex landscape data with a unique set of experimental methods, new technologies, computer-based models and socio-economic approaches.

ZALF research is systems research: from processes in soils, plants and water, to interrelationships at the field and landscape level, to global impacts and the consideration of complex interactions between landscape, society and economy.  
[www.zalf.de](http://www.zalf.de)