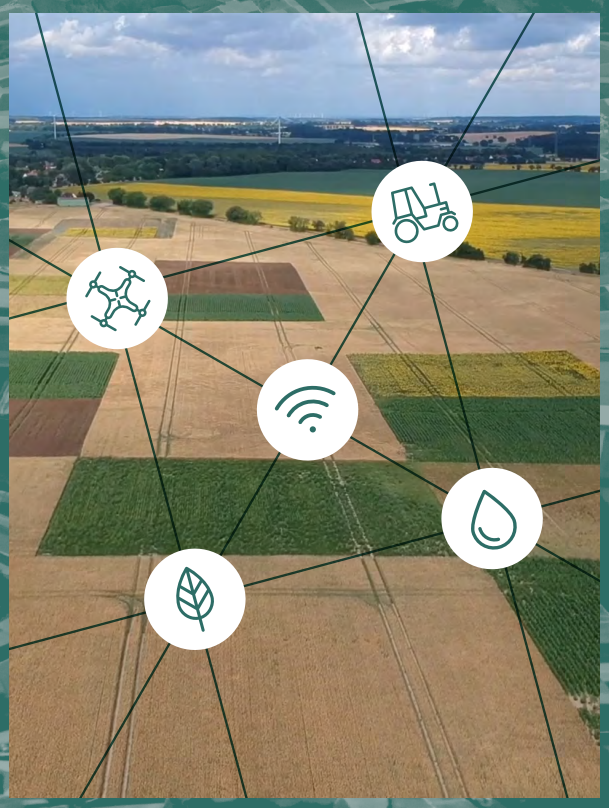
patchCROP

A landscape laboratory for more diversity in agricultural landscapes



LEIBNIZ CENTRE FOR
AGRICULTURAL LANDSCAPE RESEARCH
(ZALF)

THE CHALLENGE

Sustainable agriculture of the future is characterised by innovative, multifunctional cropping systems. Diversification is one of the strategies to save resources and to minimize trade-offs within land uses.

Despite possible negative environmental impacts such as biodiversity loss, the use of chemical-synthetic plant protection products (PPPs) is a common practice in conventional production systems. The regular use of PPPs increases the risk of herbicide-resistant weeds or epidemics of resistant pests. Moreover, the PPPs use in agriculture is confronted with a sinking level of social acceptance and is further being restricted in political and legal terms. Thus, the new EU strategy „From farm to fork" includes among others, the objective to reduce the use of high risk PPPs by 50% until 2030. Additionally, climate change and increases in extreme weather events increases the risk of yield failure and production uncertainties in many locations. More diverse agricultural systems will enable to respond more flexibly to climate change, reduce dependence on external resources and improve the provision of ecosystem services.

By integrating innovative, sensor-controlled technologies and new approaches of design, modelling and simulation, cropping systems can be optimally adapted to the respective site conditions.

However, the vision of multifunctional farming systems can only get adopted if they represent a viable economic alternative to the prevailing agricultural systems. These effects also need to be investigated.

Through a better understanding of interactions at the landscape level, we can use natural mechanisms and processesto reduce resource losses, increase the robustness of crops to weather extremes, pests and diseases and optimize the provision of ecosystem services.

The **patchCROP** project is an experimental approach to design multifunctional and sustainable cropping systems of the future.

It has been designed as a landscape laboratory to serve as a platform for the investigation of abiotic and biotic effects and interactions in newly created small-structured field units and, in particular, site-specific crop rotations and management practices adapted to the heterogeneity of the area.

These effects are investigated by an interdisciplinary team, supported by the use and application of innovative digital technologies and methods of data aquisition and processing and in close cooperation with agricultural practice.

For more information go to:
www.landschaftslabor-patchcrop.de

Prof. Dr. Frank Ewert,
Scientific Director of ZALF

OBJECTIVES OF THE EXPERIMENT

- Reduction in the use of chemical-synthetic plant protection products (PPPs)
- Promotion of biodiversity and ecosystem services
- Increase in resource use efficiency
- Yield stability during extreme weather events
- Integration of innovative, sensor-controlled technologies

The applied PPP reduction strategies are variable and selected dynamically according the occurence of weeds, pests and diseases for the respective crops. This corresponds to the basic principles of agricultural system research.

By the small-scale diversification and the integration of landscape elements, such as flowering strips, positive effects regarding beneficial organism and synergies between environment, crops and soil are expected and will be investigated.

CO-INNOVATION AND CO-DESIGN

As this is an on-farm experiment in cooperation with the agricultural enterprise Komturei Lietzen, practical requirements can be integrated right from the start. Participatory approaches are implemented to fully integrate farmer´s needs and practical feasibility.

NUMBERS AND DATA

Total area: 70 ha, surrounded by 750 ha of agricultural landscapes

- Two adapted crop rotations in two yield potential zones: A (less sandy soil and higher yields) and B (sandy soil and lower yields)

Year	Crop rotation A	Crop rotation B
1	Rape	Sunflower
2	Winter barley	Winter oats
3	CC-Soybean*	CC-Corn*
4	CC-Corn*	CC-Lupin*
5	Winter wheat	Winter rye

*CC = catch crop

- Three land use intensities:
  1. Crop rotation with conventional PPP application
  2. Crop rotation with reduced PPP application
  3. Crop rotation with reduced PPP application and additional landscape elementes (flower strips) attached to patches

AGRICULTURAL ENTERPRISE: KOMTUREI LIETZEN GMBH

- Modern agricultural enterprise for market fruits in Brandenburg
- 24 employees
- Farm size: 4,840 ha, of which 2,120 ha are arable land, 100 ha are grassland and 2,320 ha are forest, 275 ha are waterbody infrastructure and 25 ha are building area
- all machines with RTK steering systems for Controlled Field Traffic
- all crop residues remain in the field for organic matter formation
- conservation tillage with mulch sowing
- site-specific crop management
- precision farming in liming, green manuring, N-fertilisation, plant protection measures and sowing
- involved in various research projects for over 20 years

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Resources & Infrastructure (status as of December 2022)
- 451 employees
- Total annual budget: approx. 36,5 million € (from which 11.7 million € are third-party funds)
- Core financing by the Brandenburgian Ministry of Science, Research and Culture (MWFK) and the Federal Ministry of Food and Agriculture (BMEL)

- Interdisciplinary research teams
- Involvement in national and international networks
- Transdisciplinary, application-oriented research

- Systematic promotion of young researchers
- Family-oriented personnel management
- Scientific meeting centre

- Research Infrastructure (Joint Lab): AgroScapeLab Quillow
- Platform for openly accessible landscape research data at ZALF: Open Research Data – http://open-research-data.de

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www.zalf.de
www.quer-feld-ein.blog

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patchCROP

CONCEPTUAL APPROACH

- Agricultural system trial at the landscape level
- Creation of patches, i.e. the division of the field into 30 small, structured field units of 0.5 ha each, optimally adapted to the soil properties
- Site-selected crop rotations based on yield potential zone, expert knowledge and crop rotation restrictions
- Innovative, diversified cropping systems replace monoculture
- Possibilities of a stepwise PPP reduction, which can be supported by robotics (especially mechanical weed control and point applications of PPPs through UAVs)
- Increasing amount of scientifically robust and accurate data from multiple disciplines

AVAILABLE TECHNOLOGIES AND MEASUREMENTS

- LoRa multisensor systems (soil moisture, soil temperature and bulk soil electrical conductivity) for Internet of Underground Things
- Continuous recording and monitoring of various parameters across all crops: yield, plant stand, leaf area index, NDVI, plant height and soil nutrients
- Weather stations with LoRa technologies
- UAVs for remote sensing (multispectral and RGB) & Soil scanners for proximal sensing
- Biodiversity monitoring (natural enemies, birds)
- Pest and weed assessment and scoring

SPECIALS FEATURES

- 10 years runtime
- Interdisciplinary research approaches and team structure
- Integration of new technologies for small-scale management and data acquisition (robotics, sensors, drones, machines) and linkage to technological feasibility and the development of field robotics

UNIQUE RESEARCH POSSIBILITIES IN EUROPE

- We cordially invite the scientific community to take action in this interdisciplinary and innovative project and engage the collaboration with research from many disciplines to continue working on the development, support and implementation of new digital technologies in patchCROP. For this purpose, we are looking for partners from the fields of robotics, mechanical engineering, machine learning / artificial intelligence, irrigation systems, pest monitoring as well as weed control and weed removal.
- ZALF also offers bachelor, master and doctoral theses in various research projects taking place in patchCROP.

CONTACT

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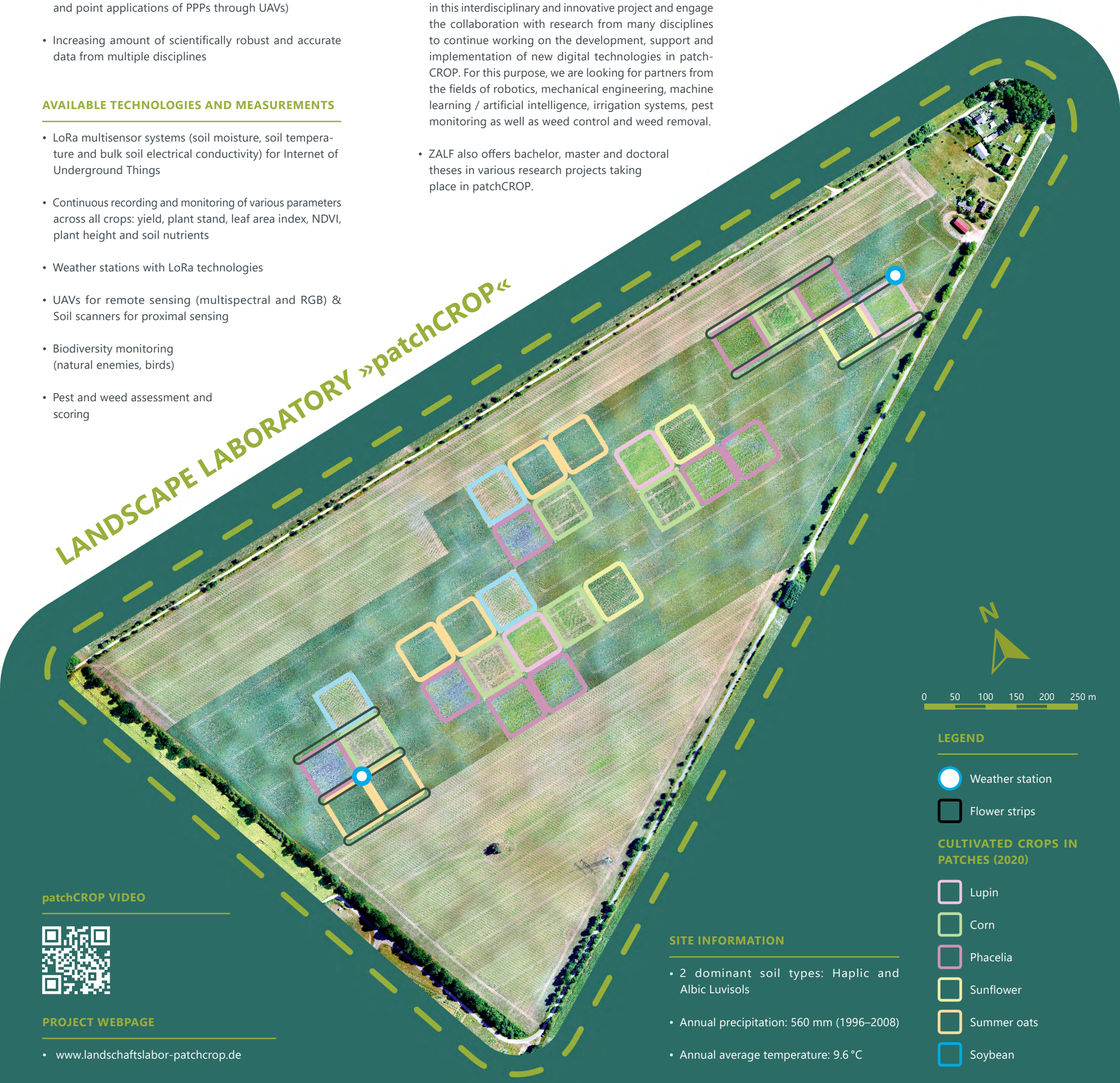

LEGEND

- Weather station
- Flower strips

CULTIVATED CROPS IN PATCHES (2020)

- Lupin
- Corn
- Phacelia
- Sunflower
- Summer oats
- Soybean

patchCROP VIDEO

PROJECT WEBPAGE

- www.landschaftslabor-patchcrop.de

SITE INFORMATION

- 2 dominant soil types: Haplic and Albic Luvisols
- Annual precipitation: 560 mm (1996–2008)
- Annual average temperature: 9.6 °C

PARTNERS

Leibniz Centre for Agricultural Landscape Research (ZALF)

Julius Kühn-Institut, Bundesforschungsinstitut für Kulturpflanzen

PHENOROB

DAKIS Digital Agricultural Knowledge and Information System