Leibniz Centre for **Agricultural Landscape Research** (ZALF)

Land Use & Governance

Poster ID:237

Future farming: Can autonomous field robots facilitate the implementation of diversified agroecological landscapes?

Kathrin Grahmann[1*], Felix Erbe[1], Björn G. Wang[1], Thomas Kunze[2]

Objective

Conceptualization: Agricultural diversification was highlighted as one of the most promising strategies to achieve agroecological transformation. Autonomous agricultural robots could play a major role to facilitate the implementation and management of diversified fields.

Study aim: Evaluation of technical performance & process optimization of the autonomous Naio Oz robot for the mechanical weed control in maize in 0.5 ha fields.

Background

Naio Oz: originally developed for vegetable production, electrically powered with 8h battery duration, lightweight of 150 kg, RTK GPS navigation, 1.8 km/h and 0.5 ha per day

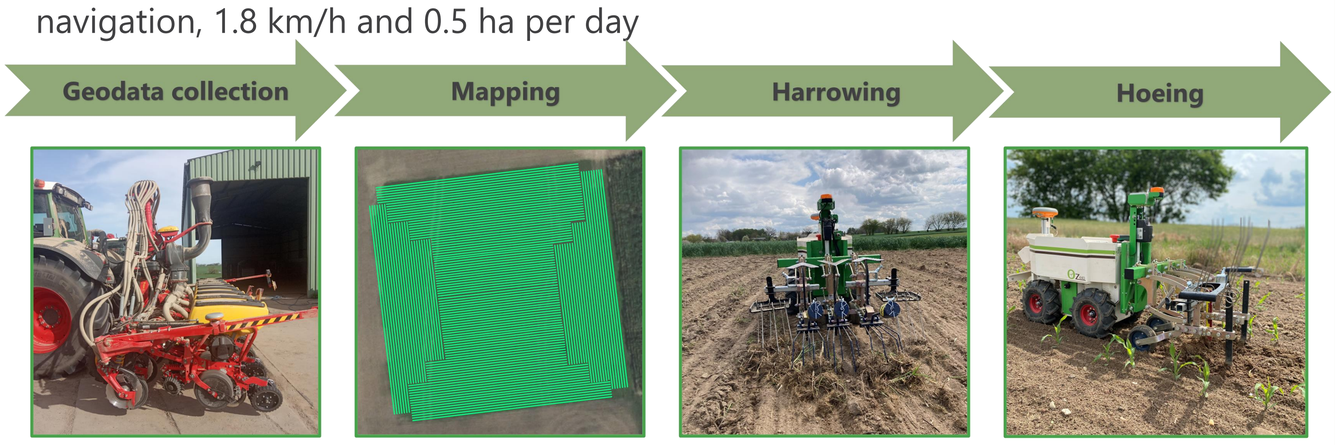


Fig. 1: Stepwise preparation and execution of field tasks

Experimental design

- patchCROP
  - in Brandenburg, Germany with highly heterogenous sandy soils
  - Co-designed landscape experiment on spatial&temporal diversification
- Study design
  - Grain maize planted in 2 yield potential zones (~82 (LYP) vs. ~69 (HYP) % of sand)
  - 3x 0.5ha patches in each zone with mechanical weeding with (*rfs*) and without (*red*) flower strips vs. conventional herbicide application (*con*)
- Data collection in 2022, 2023 and 2024
  - Crop yield: experimental plot harvest
  - Weed density & species: 4 points/patch in 0.5 m x 0.5 m

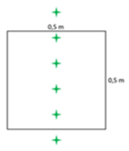
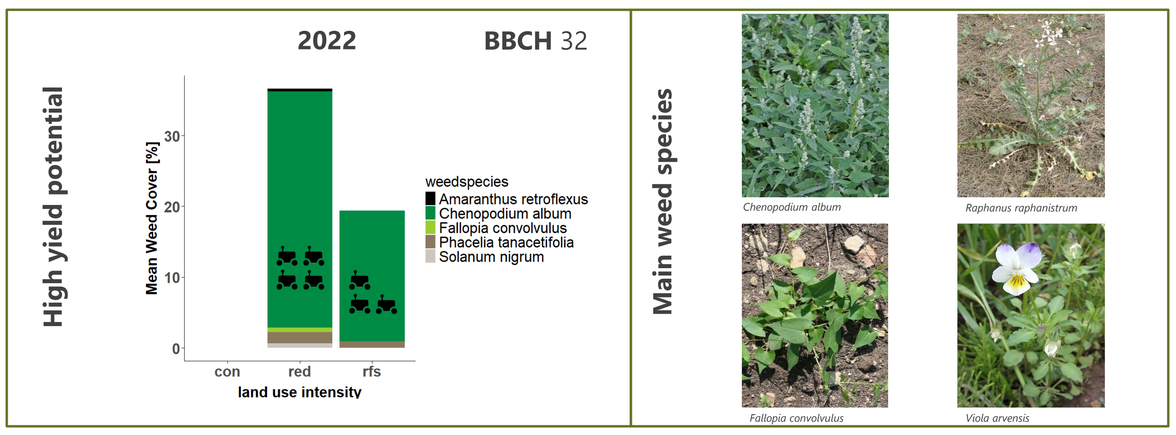


Fig. 2: patchCROP landscape experiment with patch and reference field selection in 2024

Results



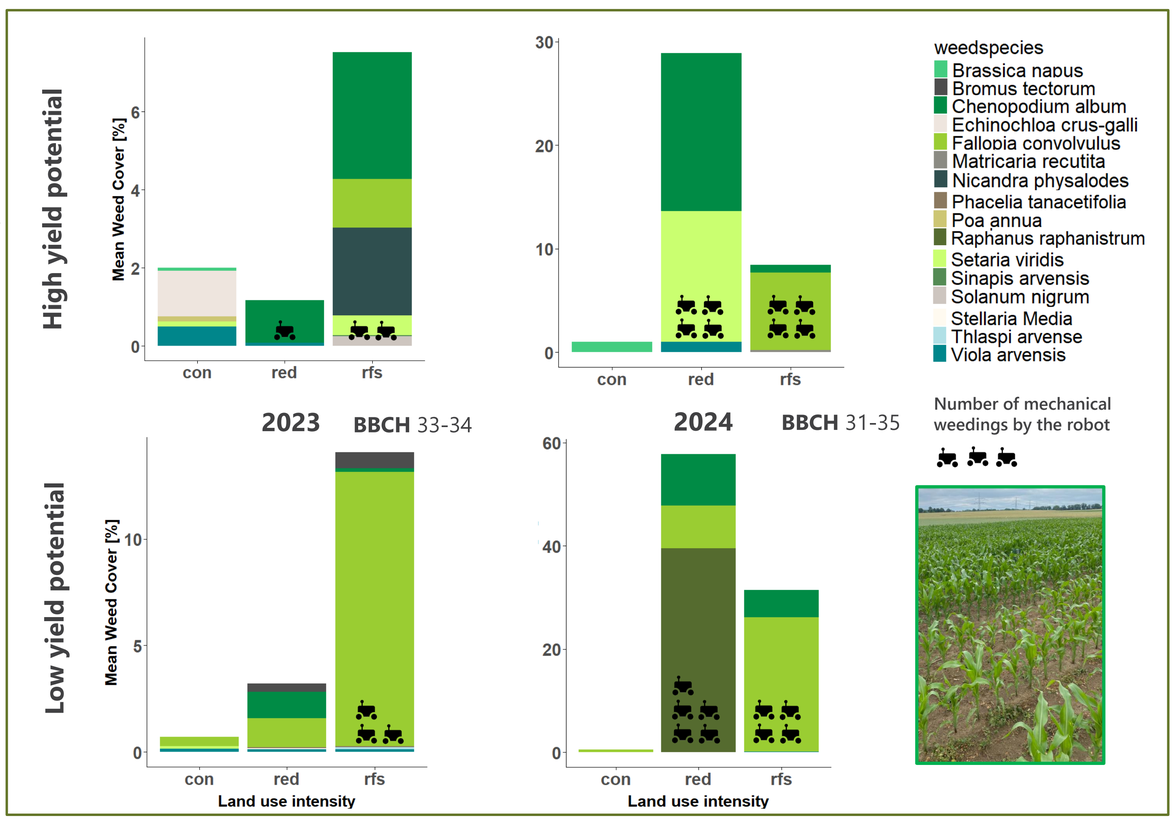


Fig. 3: Weed coverage (%) for three cropping seasons (2022, 2023, 2024) in high and low yield potential maize patches.

- 2023: weather conditions hampered proper timing and field entrance of the robot, facing many rainy days and GPS signal interference
- number of interventions varied between fields and years, making a statistical comparison inappropriate
- Comprehensive supervision was necessary
- Unsuccessful implementation of the planter tool

Table 1: Maize grain yield per patch

t ha^{-1}	HYP		LYP	
2022	con	4.90	con	0.08
	red	0.56	red	0.08
	rfs	3.64	rfs	0.19
2023	con	**10.89**	con	4.07
	red	**10.03**	red	5.96
	rfs	**11.31**	rfs	1.90

- Yield failure in 2022 in LYP
- No yield decrease in HYP 2023
- 2024 not harvested yet

Conclusions & Outlook

- **Potential to support chemical pesticide reduction without yield losses in grain maize when soil water is not limited**
- **Spatial diversification by field-size reduction manageable**
- **Limitations in large-field on-farm conditions (a fleet of robots could increase efficiency)**
- **Limited knowledge on impact of mechanical weeding on plant and soil health**

→ SoilRob Junior Research Group (www.soilrob.de)

patchCROP SoilRob Leibniz Association

[1]Leibniz Centre for Agricultural Landscape Research (ZALF) | Eberswalder Straße 84 | 15374 Müncheberg | Germany
[2]Julius-Kühn Institute (JKI) | Stahnsdorfer Damm 81| 14532 Kleinmachnow| Germany
*Contact: Kathirn.Grahmann@zalf.de

Date: ESA Conference 26 - 30 August 2024

esa EUROPEAN SOCIETY FOR AGRONOMY | L'INSTITUT agro Rennes Angers | INRAE