Effects of agricultural diversification practices on near-saturated soil hydraulic conductivity assessed with the hood infiltrometer

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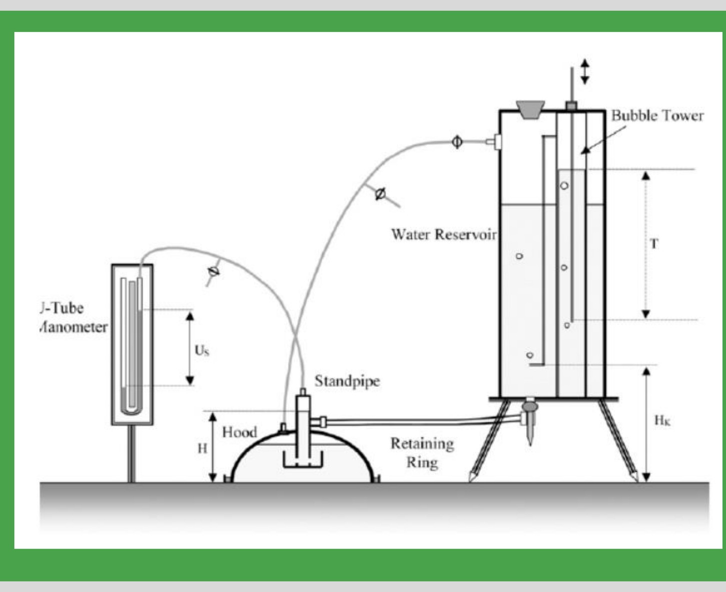
patchCROP



Challenge

- Regional climate change scenarios predict an increase of more frequent water shortages
- Knowledge on in-field variability of infiltration rates due to small-scale soil heterogeneity is limited
- The effect of field management, including crop and soil management practices, on soil hydraulic conductivity is not fully understood

Objective

- Compare the soil surface hydraulic conductivity of patches within a single field (70 ha), which differ in terms of the cultivated crop, soil texture, and management system.

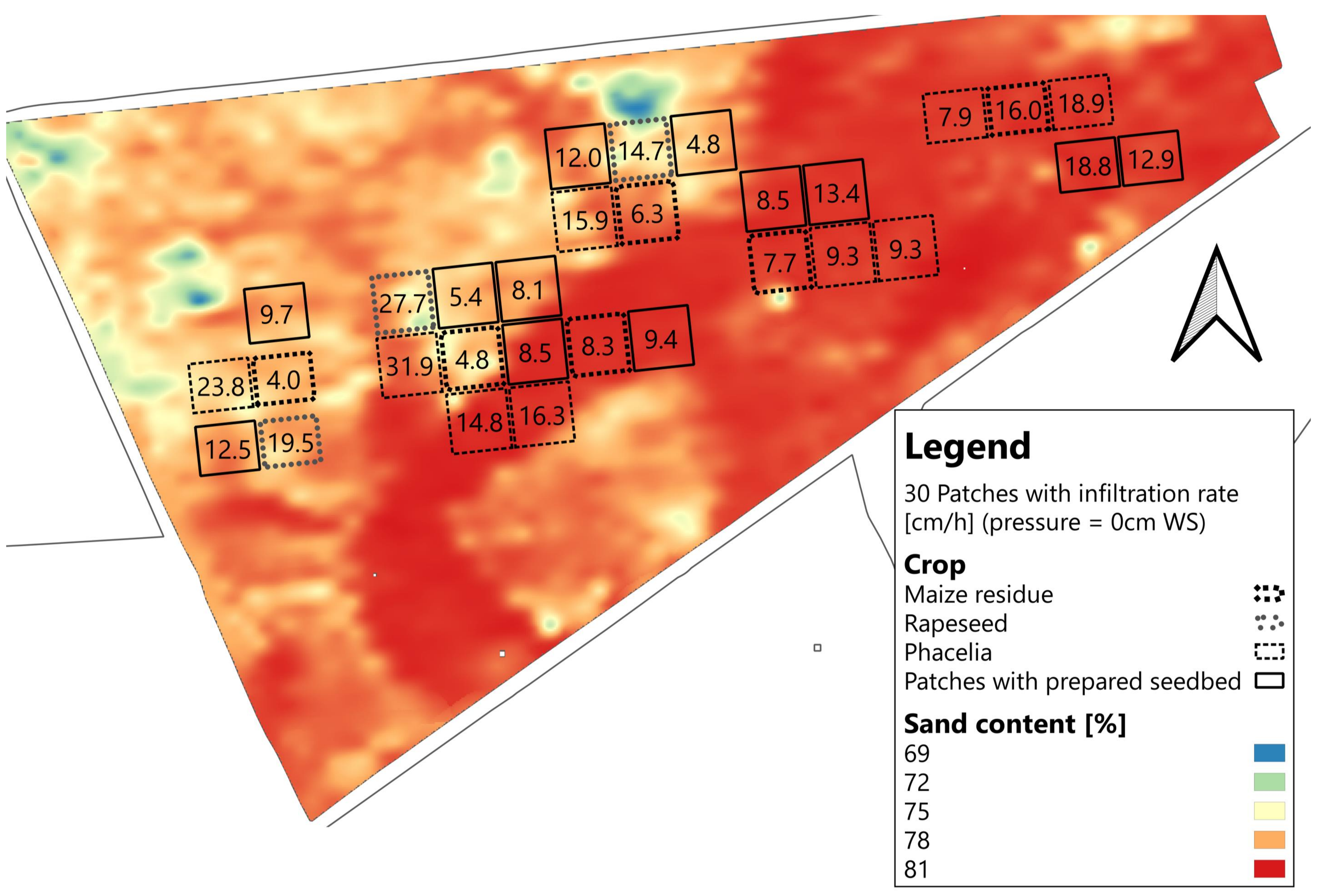


Fig. 1: Infiltration rate per patch in cm/h (head pressure = 0cm WS; n=3) and sand content of the topsoil in % of the patchCROP field (70 ha)

Materials & Methods

- Infiltration measurements in the patchCROP landscape experiment near Müncheberg, Brandenburg, Germany
- The field consists of 30 patches (established in March 2020), with two site-specific, five-year crop rotations that were selected according to the heterogeneous soil conditions (see Fig. 1)
- After harvest of all six summer crops (lupins, phacelia, summer oats, soybeans, sunflower, maze), infiltration rate and hydraulic conductivity were determined with a hood infiltrometer in Oct. and Nov. 2020
- Hood infiltrometer was selected over other infiltrometers
  - no contact layer is required
  - water can infiltrate into the undisturbed soil surface
- Infiltration rates with 3 head pressures :
  0 cm (saturated soil), -2 cm and -5 cm water saturation
- Infiltration took place until steady state infiltration rates were reached
- Calculations of hydraulic conductivity for saturated soil (head pressure = 0cm) and near-saturated soil (head pressure = -2cm) were conducted

Results

Table 1: Arithmetic average hydraulic conductivity in cm/h of different crops and yield potentials at two applied pressure heads, K(h), (cm/h)

Crop	Yield potential	Pressure= 0cm WS	Pressure= -2 cm WS
Maize residue	High	3.3	1.8
	Low	4.9	3.0
Phacelia	High	13.7	8.5
	Low	7.5	5.4
Rapeseed	High	19.1	10.1

- All six maize patches were evaluated directly after harvest
  - highest infiltration rates: in patches with a topsoil texture of ca. 81% sand (saturated infiltration rate: 11.5 cm/h),
  - Lowest infiltration rates: in patches with ca. 77% sand (saturated infiltration rate: 4.0 cm/h) (correlation R^2=0.72)
- Regardless of soil textural differences, relatively high hydraulic conductivity of up to 19.0 cm/h at 0 cm WS in patches where the cover crop phacelia and rapeseed were already established (up to 15 cm plant height)
- Effects on infiltration rates:
  - plant physiological stage (especially root development),
  - soil texture
  - previous tillage activities

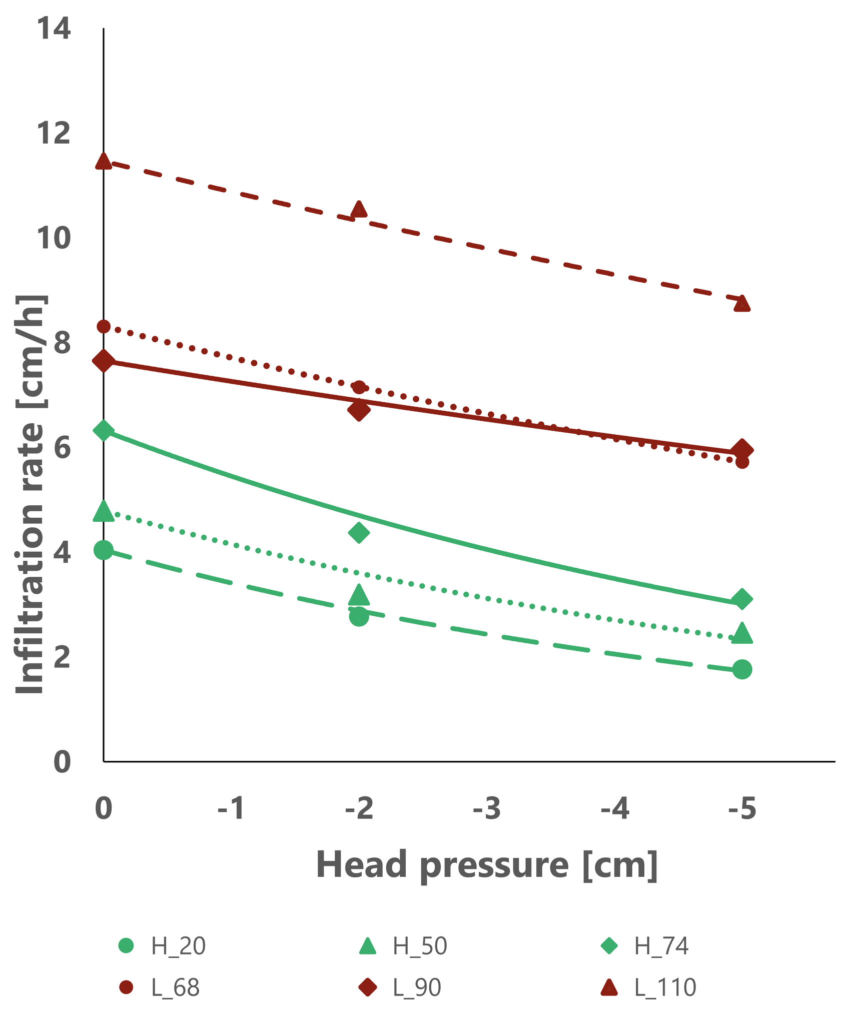


Fig. 2: The infiltration rate of the six maize patches as a function of the applied pressure head at three pressure heads and fitted curves
(green= high yield potential;
red= low yield potential)

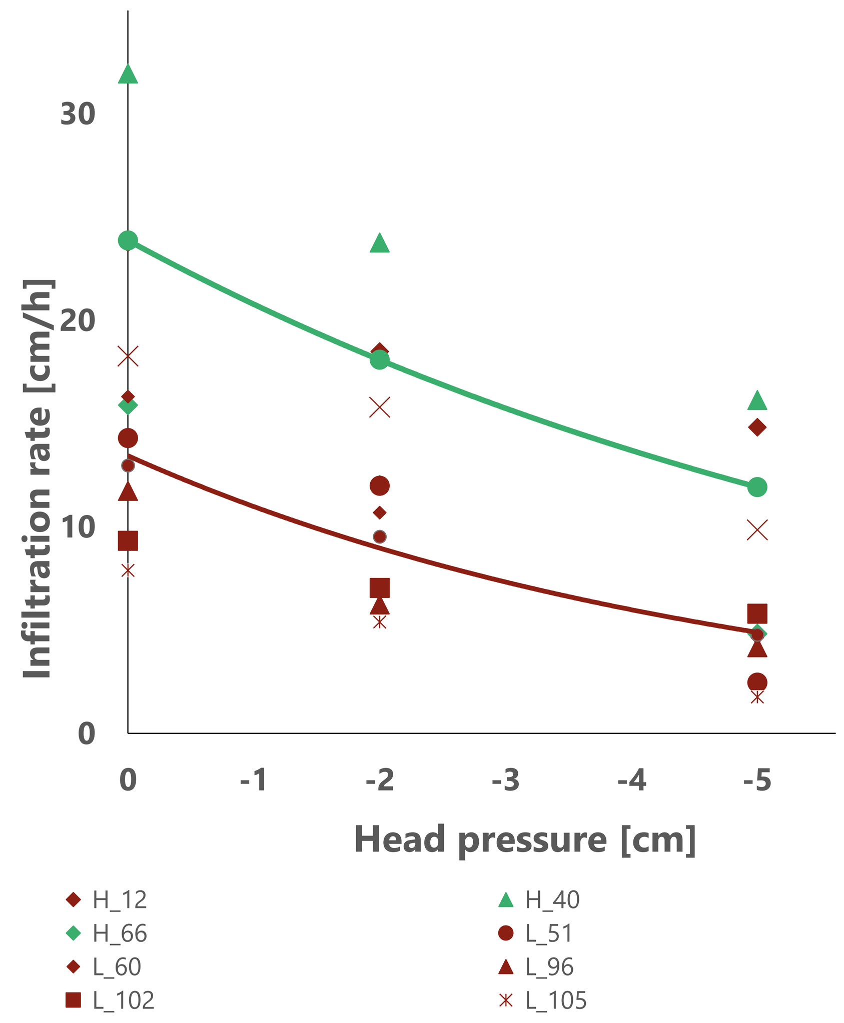


Fig. 3: Comparison of the infiltration rate of the nine phacelia patches with different pressures; the trendlines show exponential trend of the average infiltration rate per yield potential (high YP: n=3; low YP: n=6)
(green= high yield potential;
red= low yield potential)

Conclusion

- Soil hydraulic conductivity on the field scale depends on soil texture, soil management, and crop development
- Future studies should focus more on geostatistical analyses, pedotransfer functions, and geospatial modelling

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www.landschaftslabor-patchcrop.de

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