DFG FOR 1320 Crop Sequence and the Nutrient Acquisition from the Subsoil

Precrop-effect of perennial fodder crops on root growth of spring wheat

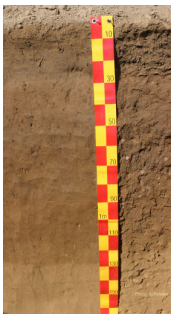
Ute Perkons[a], Daniel Uteau Puschmann[b], Timo Kautz[a], Ulrich Köpke[a]

Introduction

Roots compact the surrounding soil while growing in diameter and leave biopores after their decay. Hypothesis: The size and amount of created pores may depend on the root system and the cropping duration. Biopores influence water infiltration and may be a pathway for roots of following crops to reach deeper soil layers. This might be especially important during dry spells, allowing plants to reach water stored in the subsoil.

Experimental site

- Research station Klein-Altendorf near Bonn, Germany (50°37'N, 6°59'E)
- Mean annual temperature: 9.6 °C
- Mean annual precipitation: 625 mm
- Haplic Luvisol derived from loess (WRB 2006)
  - 0–27, Ap, granular–blocky subangular
  - 27–41, E/B, blocky angular–blocky subangular
  - 41–75, Bt1, blocky angular–prismatic
  - 75–87, Bt2, prismatic–blocky angular
  - 87–115, Bt3, blocky subangular
  - 115–127, Bw, blocky subangular
  - > 127, C, coherent



Field Trial

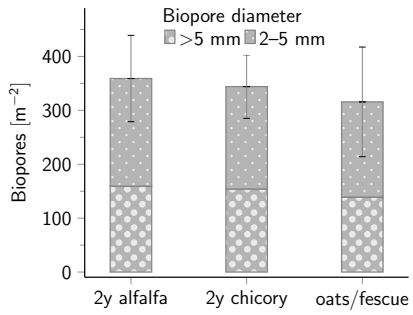
The aim of the investigations was to evaluate effects of perennial fodder crops on soil structure and root growth of subsequent spring wheat (*Triticum aestivum* L.).

Precrops and root architecture:

- 2 years alfalfa (*Medicago sativa* L.), taproot system
- 2 years chicory (*Cichorium intybus* L.), taproot system
- 1 year oats (*Avena sativa* L.)/1 year tall fescue (*Festuca arundinacea* Schreb.), fibrous root systems

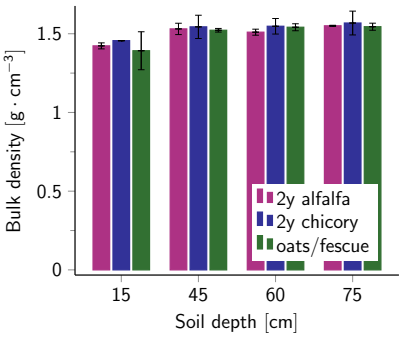
Biopores

Horizontal areas of 50 x 50 cm were excavated in 45 cm soil depth and cleaned from soil particles. Biopores of different diameters were marked on plastic sheets that were placed on the horizontal soil surface or counted directly using a grid.



No significant differences, Tukey-test, $\alpha = 0.05$, Errorbars represent the standard deviation of biopores >2 mm (preliminary data)

Bulk density



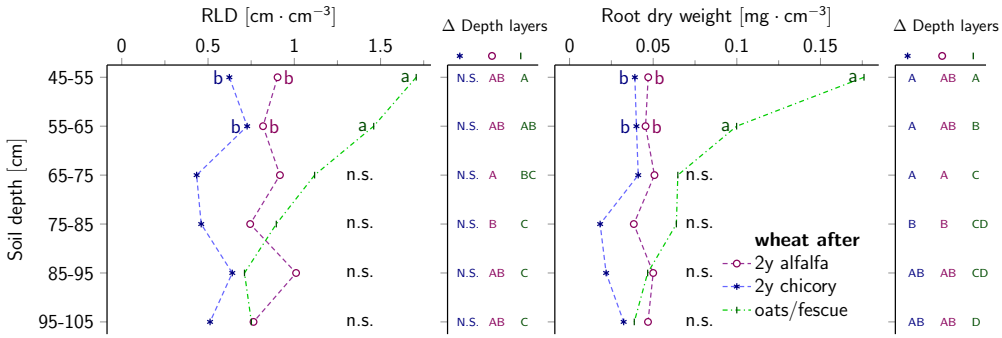
No significant differences, Tukey-test, $\alpha = 0.05$, Errorbars represent the standard deviation

Monolith sampling

- From six soil layers (45-105 cm soil depth), four monoliths of a soil volume of 2.5 l (25 cm x 10 cm x 10 cm) were taken in every 10 cm soil layer

- Roots were:
  - scanned and root-length was analyzed with WinRHIZO software
  - dried to determine the root dry weight

Root-length density (RLD) and root weight



Different letters indicate significant differences: between the treatments (lowercase), between depth layers (uppercase), Tukey-test, $\alpha = 0.05$

Between 45 and 65 cm soil depth RLD and root weight of wheat after oat/tall fescue was higher than after alfalfa and chicory. Beneath 65 cm soil depth no significant differences were detected. Wheat RLD and root weight after tall fescue were continuously decreasing with soil depth whereas there was little change with depth after chicory and alfalfa.

Conclusions

The higher RLD and root weight of wheat after oat/tall fescue may be a result of lower bulk density in the upper soil layers after tall fescue having a dense, fibrous root system. By trend more biopores generated by the taproot systems of alfalfa and chicory may be a reason for the constant RLD und root dry weight of wheat in deeper soil layers. The results support the hypothesis that deep rooting perennial fodder crops can enhance creation of biopores that facilitate root growth of following crops in the subsoil. Nevertheless, these are preliminary results of the first year of our investigations. Future research takes deeper soil layers and a three year cropping duration into account. *The investigations are part of the DFG-funded research unit FOR 1320.*

http://www.for1320.uni-bonn.de

[a] Institute of Organic Agriculture, University of Bonn, Katzenburgweg 3, 53115 Bonn
[b] Institute of Plant Nutrition and Soil Science, University of Kiel, Hermann-Rodewald-Str. 2, 24118 Kiel

iol@uni-bonn.de