Root traits of winter annual cover crops as monocultures and mixtures

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Introduction

- Cover crops are invaluable tools for designing sustainable crop rotations that enhance soil health and mitigate nutrient pollution.
- Roots play an important role in building soil organic matter, accessing water and nutrients, and more.
- Cover crop root traits remain poorly studied.
- If farmers are planting cover crops to build soil organic matter, cover crops should be evaluated based on root traits in addition to aboveground traits.

Research Questions

1. How do cover crop species vary in the quantity, quality, and distribution of their root biomass in fall and spring?
2. How are root traits of monocultures expressed in the cover crop mixture?

Methods

- Research was conducted in an on-going (2012-2018) organic maize silage-soybean-winter wheat field experiment in central Pennsylvania.
- Cover crop treatments (see below) were planted after winter wheat in rows spaced 7 inches apart.
- In fall 2016 and spring 2017, belowground biomass was sampled from four cover crop treatments: triticale, crimson clover, canola, and a mixture that contained crimson clover, canola, and triticale.
- In-row and between-row locations were sampled with a 10.3 cm diameter soil core to a depth of 40 cm.
- Each core was split into 0-5 cm, 5-20 cm, and 20-40 cm depth intervals.

Results

- Triticale produced more root biomass at 0-5 cm than crimson clover and the mix in fall 2016.
- Triticale had the highest root:shoot (R:S) ratio in fall.
- In spring 2017, triticale had more root biomass than other cover crop treatments at 5-20 cm, 20-40 cm, and 0-40 cm.
- Triticale exhibited 2-3 times more root biomass in the between-row space than other treatments at all depth intervals (data not shown) in both fall and spring.
- The mixture had more < 2 mm root biomass than canola in spring.
- Triticale had the highest carbon:nitrogen (C:N) ratio for < 2 mm roots in both fall and spring.
- The mixture and canola’s > 2 mm roots C:N ratio were significantly wider in spring than they were in fall.
- The mixture had an intermediate C:N ratio between canola and crimson clover in spring.

Conclusions & Future Directions

- Triticale can have high R:S ratios in fall.
- Triticale, a monocot species, was able to produce more roots in the between-row space than crimson clover, canola, and the mixture.
- Combining monocot and dicot species led to more < 2 mm root biomass than canola.
- Canola’s > 2 mm roots had a wider C:N ratio in spring than in fall.

Artistic Representation of Root Distribution Results

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