Root traits of winter annual cover crops as monocultures and mixtures

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Introduction

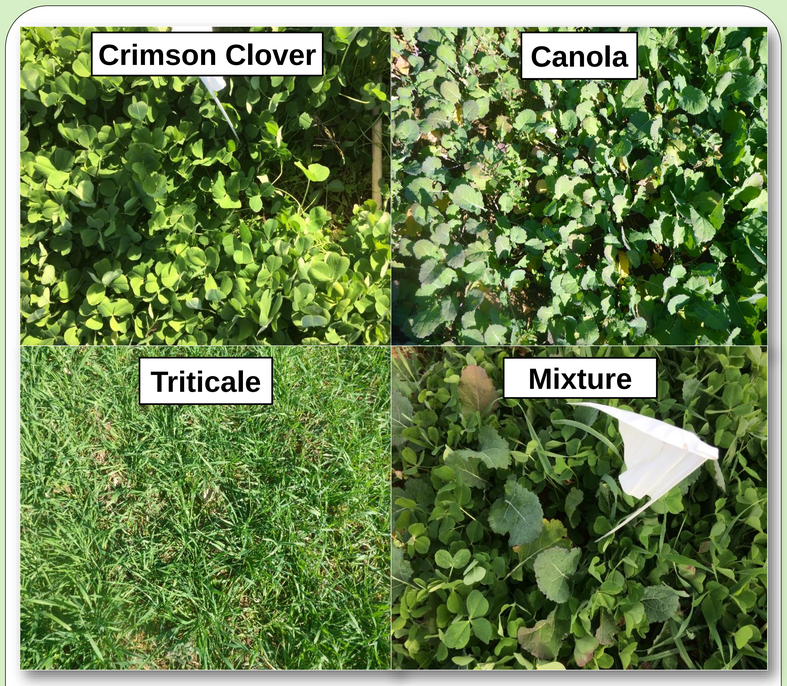
- Cover crops are invaluable tools for designing sustainable crop rotations that enhance soil health and mitigate nutrient pollution.
- Roots play an important role in building soil organic matter, accessing water and nutrients, and more.
- Cover crop root traits remain poorly studied.
- If farmers are 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?**

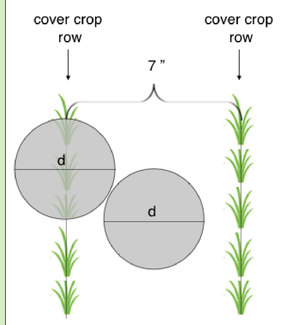
Methods

- 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.



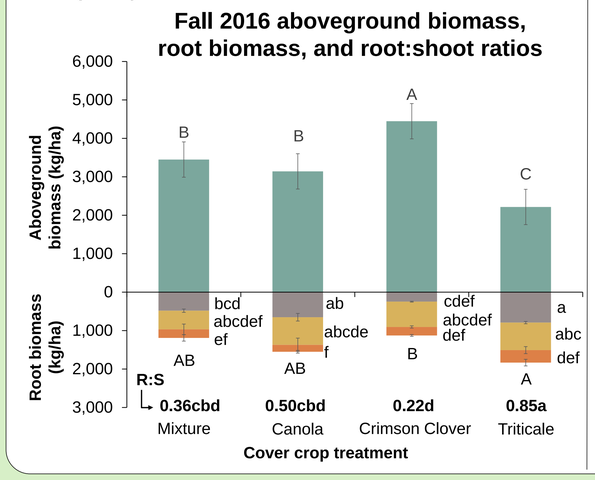
Cover Crop Treatments

Results

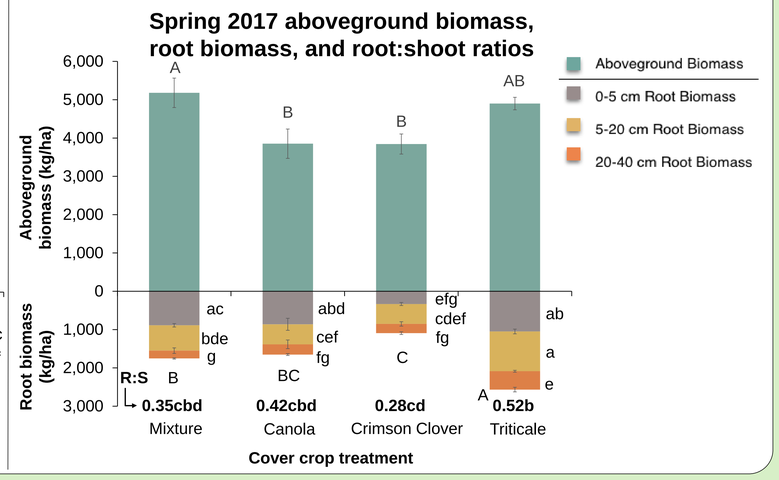


Root biomass reflects the average of in-row and between-row cores.

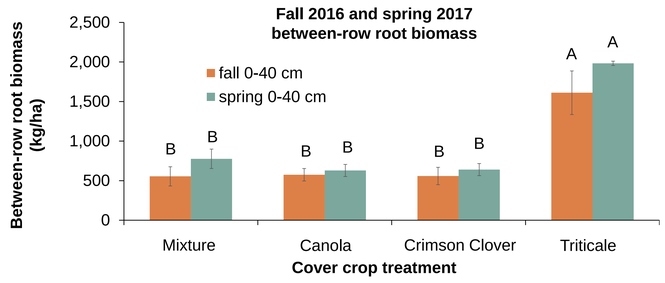
- Triticale produced more root biomass at 0-5 cm than crimson clover and the mix in fall 2016.
- Triticale had the highest root:shoot (R:S) ratio in fall.



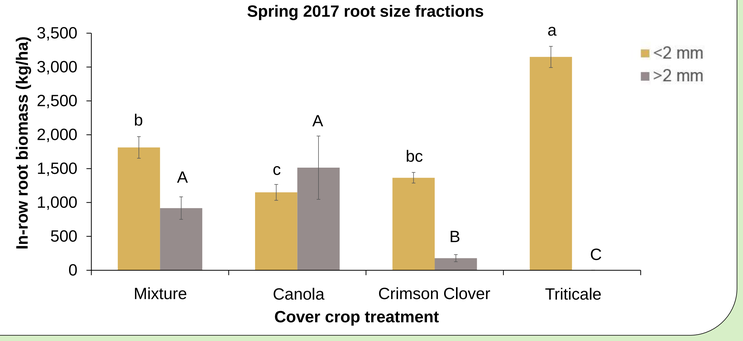
- In spring 2017, triticale had more root biomass than other cover crop treatments at 5-20 cm, 20-40 cm, and 0-40 cm.



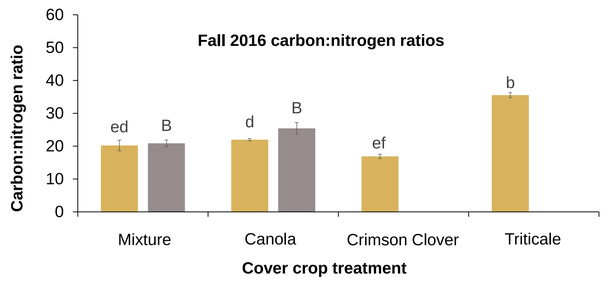
- Triticale exhibited 2-3 times more root biomass in the between-row space than other treatments at all depth intervals (data not shown) in both fall and spring.

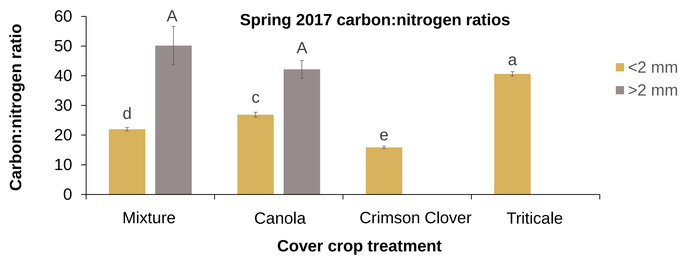


- The mixture had more < 2 mm root biomass than canola in spring.



- 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.

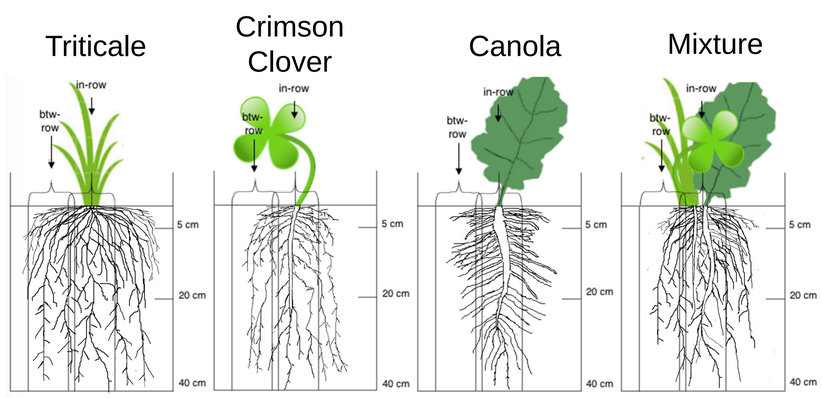




Conclusions & Future Directions

- 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



Acknowledgments

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