The Influence of Oilseed Radish Bicultures on Overall Soil Quality and Nutrient Cycling

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INTRODUCTION

Cover crops may have the potential to improve the resilience of corn and soybean rotations in the Corn Belt. The use of oilseed radish (OSR) as a cover crop has increased because its large, deeply penetrating taproot has the ability to biologically till the soil and store large amounts of nutrients such as nitrogen (N) and phosphorus (P) in its tissue. It is hypothesized that rapid decomposition of OSR can lead to early-season leaching of N from the root zone and surface losses of available P before the subsequent crop is able to recover it, and can leave the field susceptible to runoff and erosion. Planting OSR simultaneously (biculture) with a crop containing a higher C:N ratio may allow for slower decomposition of the cover crop, better ability to hold bio-tilled soil and accumulated N and P in place, and an improved ability to cycle N and P back to subsequent crops. Treatments consisting of OSR, OSR + oats, OSR + cereal rye, and no cover crop were established to determine if bicultures improve OSR's influence on soil physical properties, soil conservation, and the cycling of N and P back to subsequent crops.

MATERIALS & METHODS

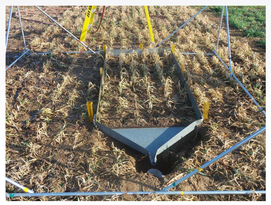
- All treatments were no-till planted into soybean residue on August 28, 2011 at the Purdue Agronomy Diagnostic Training Center (DTC) in West Lafayette, IN
- Treatments were replicated three times with 4.3 x 9.1 m plots arranged in a randomized complete block design
- Soil samples were obtained in August (background) and November (fall) at various row orientations (root zone= <5 cm from OSR tuber, buffer zone= >5 cm from OSR tuber) and soil depths (0-2.5 cm, 2.5-10 cm, 10-20 cm) to observe the movement and accumulation of P and bulk soil samples were taken for N (0-30 cm)
- Fall cover crop samples were collected from 0.25 m^2 frames to measure above- and below-ground biomass and N and P uptake
- Treatments were subjected to simulated rainfalls over 2 m^2 subplots at an intensity of 75 mm hr^{-1} and 30 min of runoff in the spring to measure infiltration and sediment loss
- Penetration resistance was measured in spring

Collecting above- and below-ground OSR and oat biomass from within 0.25 m^2 frames

Harvesting fibrous roots from oats- subsamples of soil were taken to account for fine roots

Washing root samples to measure biomass and analyze for N and P

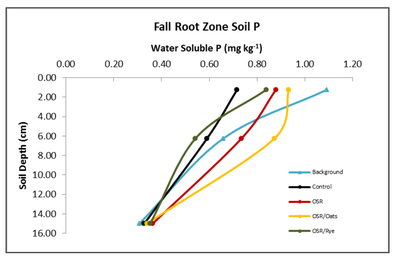
Separating soil samples into depth increments for P analysis

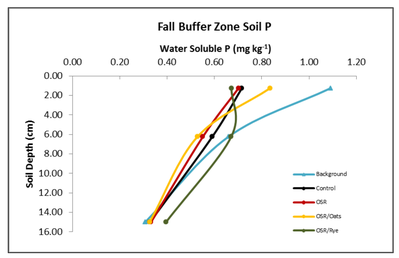


2m^2 subplot set up for rainfall simulation in OSR/Oat biculture

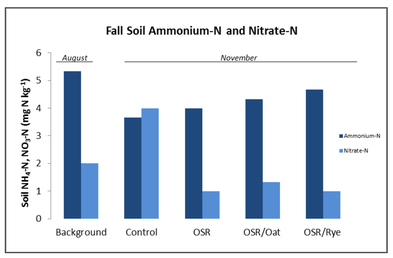
A cone penetrometer was used to measure penetration resistance

RESULTS & DISCUSSION





- Water soluble P concentrations are highest near the OSR tuber (root zone) and at the soil surface
- The increase in root zone water soluble P concentrations at the middle depth for OSR and OSR/Oats as compared to the control and OSR/Rye may reflect their susceptibility to freezing temperatures in which the fine roots could have died and released P



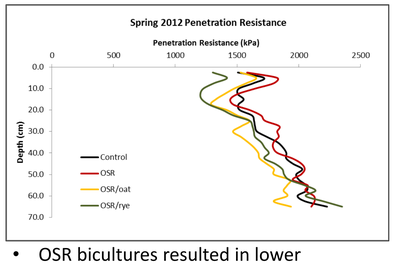
- Cover crops reduced NH_4 and NO_3^- concentrations between Aug. and Nov.
- Actively growing cover crops reduced NO_3-N compared to the control

Fall 2011

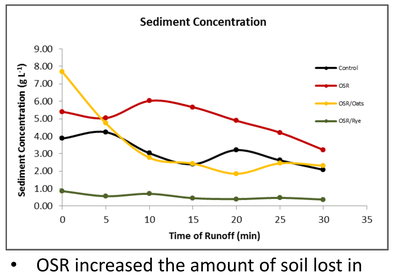
Cover Crop Tubers, Roots, and Shoots

	Biomass	N	P
	(kg ha-1)		
OSR	3863	76.1	14.0
OSR/Oats	3916	62.0	9.3
OSR/Rye	4100	70.6	12.4

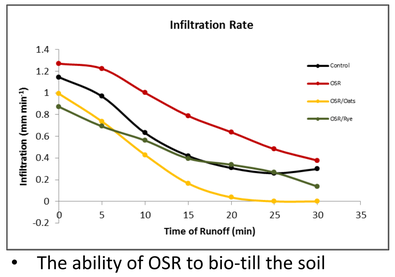
- Cover crops took up a large amount of N and P from the soil between Aug. and Nov.



- OSR bicultures resulted in lower penetration resistance than the control or OSR alone, possibly an effect of the fibrous root systems



- OSR increased the amount of soil lost in runoff as compared to the control, but the presence of oats or cereal rye reversed the negative effect



- The ability of OSR to bio-till the soil resulted in improved infiltration as compared to the control

CONCLUSIONS

- OSR cover crops can maintain higher water soluble P at the soil surface in late fall as compared to a bare soil control
- With large amounts of biomass, cover crops take up large amounts of N and P from the soil
- OSR bicultures can reduce compaction and sediment loss as compared to OSR alone or bare soil
- The bio-tilling action of OSR can improve soil infiltration

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