Nutrient Dynamics in Organic Reduced-Till Corn

Hanna Poffenbarger, Steven Mirsky, Ray Weil, John Meisinger, Jude Maul, Michel Cavigelli, John Spargo

The weed control-nutrient supply paradox

Hairy vetch/cereal rye mixture prior to termination in May 2012.

- A cover crop-based organic reduced-till system requires high cover crop biomass and persistent residues to control weeds.
- Legume cover crops, which fix atmospheric nitrogen (N) and release it to the cash crop after termination, produce less biomass than grasses and decompose quickly. Nitrogen may be released prior to crop uptake and stimulate weed growth.
- Grass cover crops produce high biomass and decompose slowly, but do not release much N. Animal manures may be used as a fertility source, but they tend to oversupply phosphorus (P) when applied to meet crop N needs.
- A grass-legume cover crop mixture may produce greater biomass and decompose more gradually than a legume monoculture, improving weed suppression while providing some plant-based N.

Poultry litter subsurface banded at five-leaf growth stage.

What we know

- Hairy vetch/rye mixtures can produce equivalent or greater N than vetch monocultures, but supplemental N is usually needed to meet crop N demands (Clark et al. 1997).
- Subsurface banded poultry litter may reduce ammonia losses by 95% and increase corn yield by ~30 bu/acre relative to broadcast application. Subsurface banding has also been shown to reduce P in run-off, but may increase leaching losses of P (Kleinman 2009).

Research questions

- What are the optimal cover crop mixtures for efficient N delivery and effective weed suppression—are they the same?
- How fast do different cover crop mixtures release N, and how is their decomposition affected by method and rate of poultry litter application?
- What combination of cover crop mixtures and poultry litter rates minimize P overapplication while providing adequate and efficient N delivery?

Approach

- The experiment tests a range of hairy vetch/cereal rye mixtures (6 mixtures from 100% vetch to 100% rye) and subsurface banded poultry litter rates (4 rates from 0 to 6.4 T/A) in a reduced-till corn system. Controls include standard tillage management, broadcast poultry litter application, and mineral fertilizer application.
- Decomposition – Mesh bags are filled with specific mixtures of cover crop residues and collected over time to determine mass loss and N loss of the residues in different poultry litter treatments.
- Nitrogen use efficiency – Corn N uptake and yield are measured at crop maturity to determine how much of applied N was used by the crop.

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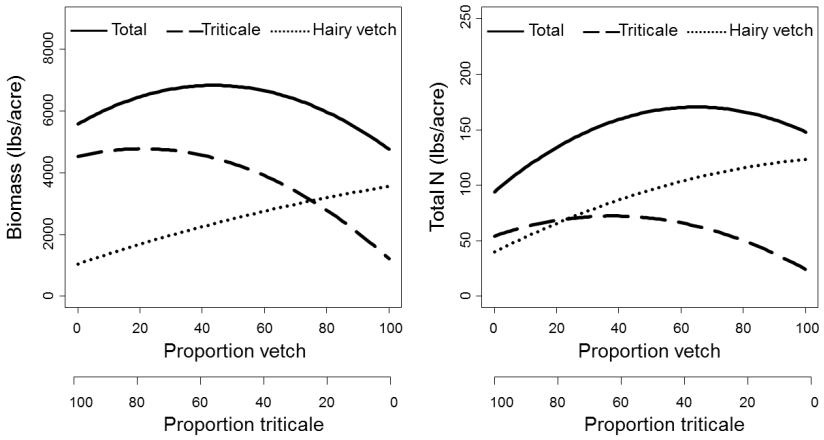
Preliminary findings

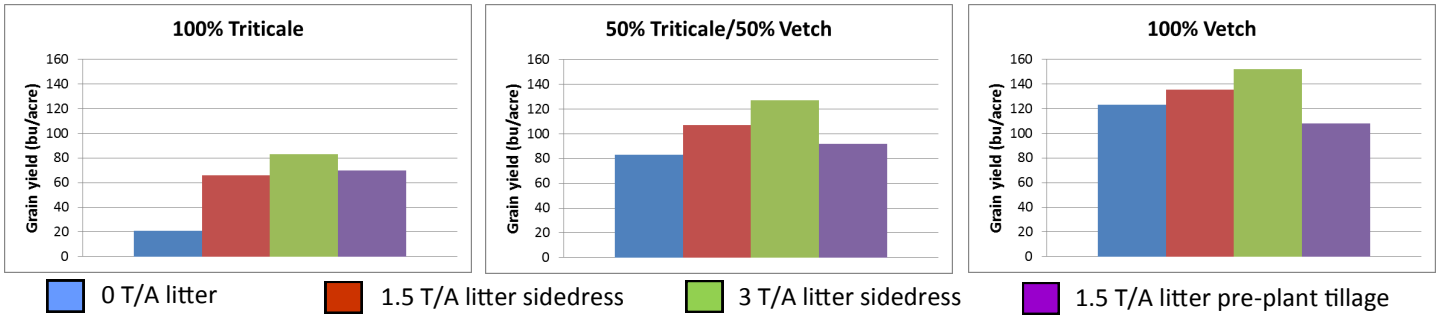
Biomass and N content of triticale/hairy vetch mixtures planted at a range of proportions at BARC in 2010 (right). The 100% seeding rate for triticale was 150 lbs/acre, and the 100% seeding rate for hairy vetch was 30 lbs/acre. Samples were collected prior to termination in spring 2011. Biomass was greatest when planted at 40% vetch/60% triticale, and N content was greatest when planted at 60% vetch/40% triticale.



Residue persistence and N delivery of triticale and hairy vetch at specific litter bag proportions on BARC South Farm in 2011 (below). A 50% triticale/vetch mixture released approximately the same proportion of total N as 100% vetch by sidedress and corn maturity. However, the mixture maintained a residue mulch better than the pure vetch. Incorporating residues through tillage increased the rate of decomposition of the mixture.

Mixture (vetch/triticale)	Estimated % N released before sidedress		Estimated % N released before harvest		Estimated % mass lost before sidedress	
	No till	Tillage	No till	Tillage	No till	Tillage
0/100	4		50		30	
50/50	59	76	80	86	40	87
100/0	58		78		61	

Corn yield in triticale and hairy vetch monocultures and mixture with different sidedress poultry litter rates and tillage-incorporated litter in 2011 (below). Species proportions in titles represent the biomass proportions achieved. Yields were higher with increasing proportion vetch and with increasing poultry litter rate, and slightly lower in tillage vs. no-till plots.



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This project is being conducted by the USDA-Agricultural Research Service, Sustainable Agricultural Systems Lab in Beltsville, MD and is supported by a graduate student grant from Northeast SARE and funding from the NRCS Conservation Innovation Program and Organic Transitions Program.

For more information, contact Hanna Poffenbarger, USDA-ARS Research Technician and University of Maryland Graduate Research Assistant, hpoffenb@gmail.com