Building soil quality with an oilseed radish cover crop—where did the N go?

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There is a great deal of interest in using cover crops to build soil quality. One crop in particular—oilseed radish (OSR)—has received a lot of attention. Some varieties are known for their ability to break up soil compaction while others, such as the variety 'Colonel,' have bioassimilatory properties and are used by sugar beet growers to suppress the sugar beet cyst nematode. Oilseed radish is quick to establish when seeded in late summer and can be an excellent addition to a forage mix for late season grazing. One trait shared by all OSR varieties is the great ability to scavenge and trap nitrogen (N) in the cropping system. If you use cover crops to cycle nitrogen in your cropping system, this recent work in Michigan and Ontario, Canada will interest you.

On-farm strip trials in Michigan

Results from large-scale, on-farm strip trials in Michigan have shown that when swine manure slurry was applied to wheat stubble on a loam soil in early August, and the OSR variety 'Colonel' was sown as a cover crop to trap manure nitrogen, the OSR trapped more than 125 lbs./acre N while producing more than two tons of dry matter per acre. However, very little of that N was available for use by the following corn crop.

The swine slurry was applied using two application methods: 1) low-disturbance placement behind the aeration tines with an AirWay tillage tool and SSD applicator, and 2) low-disturbance injection with a Vetter injection system. Field length strips were sown either with an OSR cover crop (12 lbs./acre, var. Colonel) or with no cover crop. The swine slurry was applied at an agronomic rate to supply the desired level of phosphorus, and after accounting for expected N losses the swine slurry was expected to supply about one-half of the N needed for the following corn crop. The remaining N for corn production was supplied by a commercial N source. The OSR uptake of N in the fall was, in excess of 125 lbs./acre, so we assumed a 40 lbs./acre N credit for the OSR strips and cut the commercial N rate to the corn crop by 40 lbs./acre. An N deficiency in the following corn crop began to show up in plant tissue tests in July as well as in stalk nitrate tests near harvest. The 40 lbs./acre N credit for the OSR cover crop led to a 40 lbs./acre N yield reduction in the following corn crop. Based on the rule-of-thumb of 1 lb./acre N needed for 1 bu./acre corn grain, and the fact that a 40 lbs./acre N credit lead to a 40 lbs./acre yield loss, it appears that very little of the manure N trapped by the OSR was available to feed the following corn crop.

Research results from Ontario, Canada

Similar results were observed on small plot research trials in sweet corn grown on a sandy loam soil at Ridgeway Campus, University of Guelph, Ontario. Drilled in at 12 lbs./acre, common-seed Diakon-type OSR was planted after processing peas; soil and pea residue sampling showed there was a lot of residual N in the field after harvest, which is ideal for OSR growth. By mid-November OSR took up more than 150 lbs./acre N in aboveground shoots. The following year, nitrate in the soil and N taken up by the sweet corn crop were monitored every 2-3 weeks during the growing season. At no time during the sweet corn season was there more N in the OSR plots (in soil + crop) compared to the no cover crop control plots. This suggests that the timing of N release did not match up with sweet corn production. It could be that N from the OSR cover crop was released over the winter or early spring. Measurements taken in April and May before sweet corn planting showed higher N in the soil and cover crop residues on the soil surface compared to the no cover crop. This suggests that N was released before the sweet corn crop could use it.

Importance of timing

This research from Michigan and Ontario illustrates two important processes for efficient nitrogen management with cover crops—N uptake and N release. The cover crop needs to capture the N and then release the N at a time and rate that matches the needs of the following crop. Oilseed radish was an excellent cover crop for trapping N, but it did not appear to be effective at releasing N at a level that provided a significant N credit for the following corn crops.

Based on the lack of synchrony of OSR N release and corn crop N need, a mixture of OSR and cereal rye was evaluated in the same sweet corn trial at Ridgeway Campus, Ontario. The thought was that the cereal rye would be alive and growing in the winter/early spring and taking up N released from the OSR. Unfortunately, similar to OSR alone, the timing or amount of N release with OSR plus rye mix did not meet sweet corn N needs.

More than an N credit

Although there doesn’t appear to be much of an N credit from OSR or OSR plus cereal rye mix, there were slight sweet corn yield boosts. Economic analysis considered revenue from yield at fresh market selling price to the cost of the seed and the cost for custom planting as well as the cost to burn down the cereal rye the following spring. Profit margins were 8-15% higher following the OSR or OSR plus cereal rye mix than without a cover crop. Clearly, bottom-line profits to the farmers are based on more than just these factors, and economics for sweet corn is definitely different than field corn, but profit margins were higher with OSR and the OSR plus rye mix. With higher profit margins, there is room to invest in the soil building properties of a cover crop such as OSR and rye.

Similar results were observed in other research trials at Ridgeway Campus, Ontario with processing tomatoes and machine-harvested cucumber. There was little evidence of an N credit, but profit margins were as high or higher with OSR and plus rye mix compared to having no cover crop. It is not clear why there were slight yield boosts with OSR and OSR plus rye mix but it may be due to healthier soil feeding soil microbes.

Build soil quality with manure and cover crops

Improved N cycling and N credits are potential short-term benefits from incorporating cover crops in your cropping system. Although in this case there was little N available for feeding the following corn crop, there are many additional benefits associated with soil quality improvement that develop with long-term use. Cover crops can alleviate soil compaction, reduce erosion by providing a vegetative cover and improving water infiltration, and stimulate soil-building biological processes. If you are using OSR to trap nitrogen, be conservative in allowing N credits until you confirm how the following corn crop will respond in your soils. Additional research is needed to further understand N cycling with cover crops and cover crop mixtures.

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