Does Oilseed Radish Provide Nitrogen Credits?

Mike Ballweg, Sheboygan County Extension Agricultural Agent - Crops and Soils, University of Wisconsin-Madison, Division of Extension

Richard Proost, Southesast Regional Agronomist, Nutrient & Pest Management Program, University of Wisconsin-Madison

Matt Ruark, Professor and Extension Soil Fertility Specialist, University of Wisconsin-Madison

Oilseed radish (*Raphanus sativus* L.) is a member of the Brassicaceae or Cruciferae plant family commonly referred to as the mustard family. This plant family includes broccoli, kale, cauliflower and cabbage. There has been considerable interest in growing oilseed radish as a cover crop in Wisconsin due to claimed benefits such as alleviating soil compaction and scavenging excess plant nutrients. ***This research summary specifically addresses the uptake of nitrogen and its availability for the next season's corn crop.***

One concern is that the majority of the radish cover crop research has been conducted in the Mid-Atlantic region of the United States, a region with vastly different agronomic conditions than in the Upper Midwest. Research for this publication summarizes six site-years of data collected in east central Wisconsin and is developed to help growers better understand the limitations and benefits of growing oilseed radish in Wisconsin.

SEEDING RATES AND ESTABLISHMENT

The daikon type of oilseed radish used in this study has a large taproot, which can grow 2 or more inches in diameter and more than a foot in length with adequate growing degree-days and soil fertility. It was planted in mid-August following the harvest of a winter wheat crop. Seeding rates were 10–12 pounds per acre (lb/acre). Oilseed radish is best used in a crop rotation planted after short season crops such as winter wheat, snap beans, peas or other vegetable crops. Planting by mid-August is recommended for oilseed radish in order to produce adequate biomass before the end of the growing season. Oilseed radish will winter kill following several days when temps are below 20°F. Planting in September usually does not result in sufficient plant biomass.

Oilseed radish is drilled, either conventionally or no-tilled, to a depth of ¼ to ½ inch, or broadcast and incorporated with light tillage. With adequate moisture, oilseed radish establishes quickly. Research conducted in Michigan found that seeding rates of 10, 15 and 20 lb/acre all produced similar amounts of biomass. Lower seeding rates resulted in larger individual plants producing larger tubers. Although oilseed radish is often established without the addition of supplemental nitrogen, it may be necessary for adequate growth.

Radish planted in late summer can be overly competitive when established in combination with other cover crop species. Consequently farmers are planting oilseed radish at 1–3 lb/acre in combination with other crops such as barley, oats, berseem, crimson, and/or other clovers.





FALL GROWTH AND NITROGEN UPTAKE

Analysis of whole plant oilseed radish grown as a cover crop clearly shows that large amounts of soil nitrate are captured in the plant biomass. This study found that oilseed radish planted after winter wheat in mid-August showed nitrogen uptake in 2012 of 48 and 120 lb/acre, and 110 and 124 lb/acre in 2013 (Table 1).

At the end of the radish-growing season, radish significantly reduced soil nitrate in the 0–12-inch sampling depth in all six site years, and in four site years in the 12–24 inch sampling depth. At corn planting, radish significantly reduced nitrate in three of the six site years at the 0–12 inch and 12–24 inch sampling depth.

Table 1

		SOIL NITRATE NITROGEN				radish	
		fall sampling		at corn planting			
		0″-12″	12″-24″	0″-12″	12″-24″	biomass	N uptake
		lb N/acre				ton/acre	lb/acre
2011 – 2012	**Sheboygan**						
	no radish	50a*	nc**	29	16	--	--
	radish	11b	nc	39	9	--	--
	Washington						
	no radish	7a	nc	64	21	--	--
	radish	4b	nc	68	22	--	--
2012 – 2013	**Sheboygan**						
	no radish	28a	22a	18a	15a	--	--
	radish	5b	3b	13b	3b	3.1	120
	Washington						
	no radish	35a	17a	nc	nc	--	--
	radish	3b	2b	nc	nc	1.19	48
2013 – 2014	**Sheboygan**						
	no radish	26a	17a	10a	11a	--	--
	radish	6b	3b	7b	4b	2.42	110
	Washington						
	no radish	39a	30a	34a	21a	--	--
	radish	5b	3b	14b	10b	2.78	124

* Means (in columns, within site years) followed by different letters were statistically different (A=0.10)
** nc = not collected

DOES OILSEED RADISH PROVIDE A NITROGEN CREDIT WHEN CORN FOLLOWS RADISH?

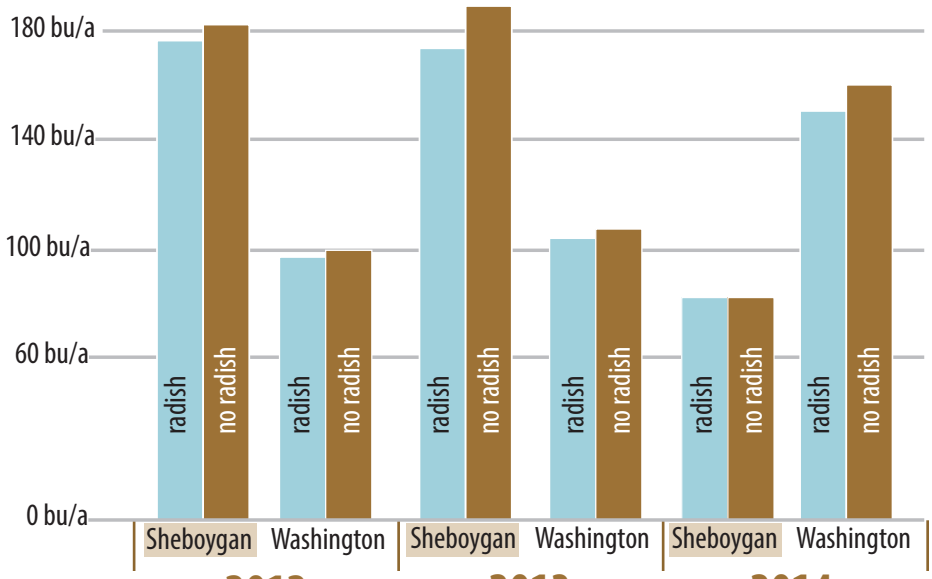
In this study, there was no significant difference in corn yield between radish cover crop and nitrogen rates (data not shown). When corn yield was averaged over all nitrogen rates, significant differences between a radish cover crop and no radish cover crop were found in three of the six site years, and in those cases the no radish cover crop had higher grain yields than the radish cover crop (Figure 1).

The carbon to nitrogen (C:N) ratio of the whole radish plant biomass ranged from 11–19.3, with the above ground biomass ranging from 9.02–16.0 and the below ground biomass ranging from 11.7–25.1 (data not shown). This data was averaged from across all site locations in 2012 and 2013. These C:N





Figure 1



	2012 Treatment	2012 Yield (bu/a)	2013 Treatment	2013 Yield (bu/a)	2014 Treatment	2014 Yield (bu/a)
Sheboygan	radish	177b	radish	175b	radish	83
	no radish	183a*	no radish	190a	no radish	83
Washington	radish	97	radish	105	radish	152b
	no radish	99	no radish	107	no radish	162a

*Means followed by different letters were statistically different (A=0.10)

Material	C:N Ratio
Soil microorganisms	8
Soil organic matter	10
Alfalfa	12
Radish (average)	**12**
Rotted manure	20
Corn residue	60
Grain straw	80
Sawdust	300

ratios would suggest a net nitrogen mineralization rather than a net nitrogen immobilization during the radish decomposition. C:N ratios of 20 or less release nitrogen, whereas C:N ratios greater than 30 tie-up nitrogen (see chart for examples). However, results showed that while the uptake of N by oilseed radish can be substantial, there was no corresponding nitrogen credit.

What is not clear is the fate of the nitrogen released from the decomposing radish biomass. As mentioned, there seems to be a potential N credit based on the amount of N in the whole plant biomass and the favorable C: N ratio for net mineralization. However, this study found no N credit for the next season's crop as determined through nitrogen response curves (data not shown). This research supports radish use as a cover crop to trap fall N. From an environmental perspective, this uptake of nitrogen has the potential to reduce nitrate nitrogen from making its way to the groundwater, however, the release of nitrogen from decomposing radish biomass was not available to a subsequent corn crop as indicated by the corn yield, showing that the fate of this nitrogen is unclear.

NPM

This publication is available from the Nutrient and Pest Management (NPM) Program. (608) 265-2660, npm@hort.wisc.edu or visit our website: ipcm.wisc.edu

Extension
UNIVERSITY OF WISCONSIN–MADISON

An EEO/AA employer, University of Wisconsin-Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act requirements.

References

Chawner, M.M., *Assessing the Benefits of Radish as a Cover Crop*. Thesis: Master of Science (Soil Science and Agroecology) University of Wisconsin-Madison, 2015.

Chawner, M.M., M. Ruark, M. Ballweg, R. Proost, F. Arriaga and J. Stute. *Does cover crop radish supply nitrogen to corn in Wisconsin.*

Jacobs, A.A. 2012. *Plant Guide for oilseed radish (Raphanus sativus L.)*. USDA-Natural Resources Conservation Service.

Ruark, M., K. Shelley and J. Stute. *Radish as a cover crop.* New Horizons in Soil Science. Issue 11-01.

Ngouajio, M. and D.R. Mutch. 2004. *Oilseed Radish: A New cover Crop for Michigan*. Bulletin E 2907. Michigan State University, East Lansing.

Shelley, K., *Cover Crop Options for Winter Wheat in Wisconsin*. Cover Crop in Wisconsin – The Wisconsin Crop Team.