

Improving productivity of onions grown on muck with mustard cover crops in Michigan

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In Michigan, onions are usually seeded in April and harvested in September. This long growing season does not provide adequate window to grow cover crops, especially warm season species. Fall-seeded winter cover crops like wheat and cereal rye are the few cover crop species that could easily fit into onion production in Michigan. When these species are used, they are usually killed in the spring by cultivation or by herbicide application, followed by onion planting. However, the large amount of biomass produced and its slow decomposition make those cover crops unsuitable for onion production. In Michigan most of the onion is direct-seeded and requires a well-prepared seedbed for adequate seed emergence and establishment. Cover crops that grow in the spring may limit soil warming and their residues may interfere with onion seeding. Growers are interested in improving their short-term onion rotations with cover crops if they provide benefits and do not interfere with field operations at the time of onion seeding.

Because of the long growing cycle of onions, it is important to develop cover crop strategies that would fit into the entire rotation. The most appropriate time for integrating a cover crop into the production system is the fall that precedes the onion season. Cool season cover crops like brassicas could be effectively integrated into the rotation systems and planted in fall, after harvest of a short cycle crop. Their residues break down easily and do not interfere with field operations the following spring. Several studies showed that brassica species suppressed seed germination, emergence, and seedling growth of many weed species in the laboratory, greenhouse, and field conditions. Brassica cover crops are also known to produce glucosinolates, which upon hydrolysis release biocidal compounds including isothiocyanates with activity on phytophagous insects, nematodes, and fungi. Studies were undertaken by our team to evaluate the potential to integrate several cover crops into onion rotations.

Benefits of cover crops in onion production

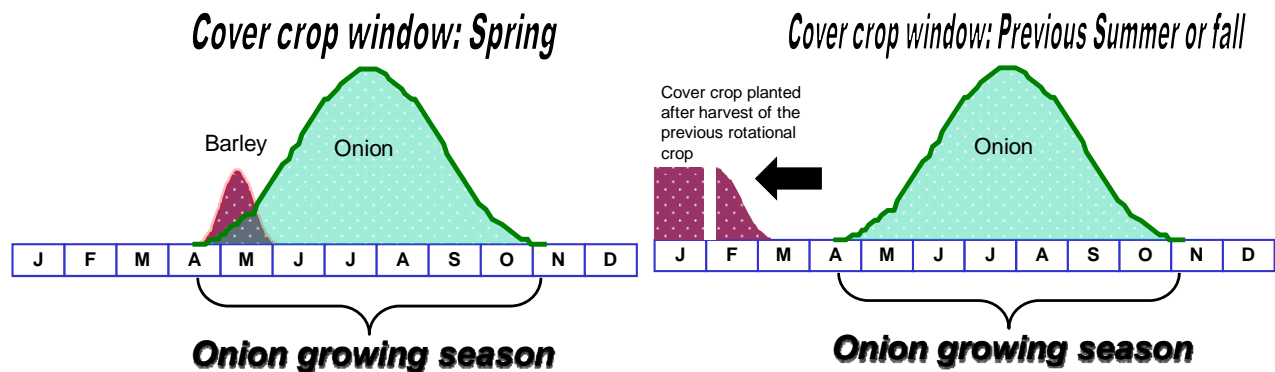
- Protection against wind damage especially on sandy soils
- Erosion control especially wind erosion on muck soil
- Drainage improvement (especially with large taproots of species like oilseed radish)
- Nutrient recycling: uptake of excess nutrient and residues acting as slow release fertilizer
- Nematode and other pest suppression
- Weed suppression early in the spring
- Enhancement of soil mycorrhizal fungi with sorghum sudangrass (note that brassica species do not form mycorrhizae)
- Yield improvement as a result of improved rotation systems

Cover crop options for onion production in Michigan

Cover cropping during onion growing season: Barley has been used successfully in many regions as a living mulch with onions to reduce soil erosion and protect the onions from wind damage. Rye is also used but may present a risk of injuring onions by chemicals produced through its root system. To avoid yield losses Barley should not exceed 8 inches and rye 7 inches when killed with a grass herbicide.

Cover cropping the fall or summer prior to onion growing season: This requires building the practice of cover cropping into the entire rotation system. In tests conducted on muck soils, sorghum sudangrass and

mustard cover crops have provided excellent results when planted late summer or early fall prior to onion growing season. Their residues break down easily and do not interfere with field operations in the spring.



Impact of brassica cover crops on onion stand and growth

In trials conducted in Michigan (Table 1 and 2), onion stand establishment and yield responded positively to brassica (yellow mustard and oilseed radish) cover crops under muck soil conditions. Overall, onion stand was about 13% to 40% greater in the cover crop plots compared with the control without cover crop. The excellent onion stand in the cover crop plot shows that onion seeding rate could be reduced slightly following the cover crops with little effect on total yield.

Table 1. The effects of cover crops on onion stand count and biomass (dry weight) in 2008.

Cover Crop	Stand count*		Biomass evaluation**	
	6 Jun	1 Jul	Plant count	Plant weight (g)
Control	166.1	156.8	11.1	11.6
Oilseed radish	235.2	223.1	14.2	19.9
Yellow mustard	230.0	225.0	13.9	18.8
LSD	10.3	11.9	1.0	4.2

*Stand count on 10-foot section of the bed

** Biomass evaluation was conducted by destructively sampling a 50-cm section of the middle double row outside the area used for yield.

Table 2. The effects of cover crops on onion stand count and biomass (dry weight) in 2009.

Cover Crop	Stand count*	Biomass evaluation**	
	2 July	Plant count	Plant weight (g)
Control	184.4	9.7	3.0
Oilseed radish	210.9	11.2	4.7
Yellow mustard	207.1	11.5	4.3
LSD	10.6	1.5	0.9

*Stand count on 10-foot section of the bed

** Biomass evaluation was conducted by destructively sampling a 50-cm section of the middle double row outside the area used for yield.

Impact of brassica cover crops on onion yield

The cover crops increase onion yield by an overall average of 6 to 8.5% in the 2008 trial (Table 3 and 4). However, the impact of the cover crops varied with plant density. At high onion density, the impact of the cover crops was either negative or minimal because the good stand establishment in the cover crop plots resulted in too many small bulbs. However, as onion plant density decreased, the benefit of using

the cover crops became more evident. This clearly indicates that after the cover crops growers should reduce their onion seeding rate.

The largest benefit of using the cover crops was found at onion density of 172,000 plant/A. At that density the impact of the cover crops was a 15% yield increase. Given the fact that many growers are currently using densities close to 220,000 plants/A it is evident that the cover crops could help reduce onion seed cost.

Table 3. Effects of cover crops on bulb count and weight for 4 grades of onions in 2008*.

Cover Crop	Marketable								Nonmarketable	
	Total		>3 inch		2.5-3 inch		2-2.5 inch		<2 inch	
	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight
Control	155.4	31.7	44.6	13.2	49.7	10.3	61.1	8.2	7.1	0.3
Oilseed Radish	209.3	33.6	15.7	4.3	61.9	12.4	131.8	17.0	17.7	0.9
Yellow Mustard	206.5	34.4	18.7	5.0	64.0	12.6	123.9	16.7	16.9	0.8
LSD	11.8	1.3	5.6	1.6	6.0	1.3	15.6	1.8	3.6	0.2

* Yield and bulb count for a 10-foot section of a bed.

Table 4. Yield change as a result of the use of cover crops in 2008

Cover crop	Yield increase (% of control)*
Control	0.0%
Oilseed Radish	6.0%
Yellow Mustard	8.5%

* Yield change indicates the impact of a cover crop at a given onion density based on total marketable yield.

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