

SLURRY ENRICHED MICRO-SITE SEEDING OF BIOSUPPRESSIVE COVER CROPS FOR SUGAR BEET PRODUCTION

Timothy M. Harrigan, Biosystems and Agricultural Engineering
Dale Mutch, Kellogg Biological Station
Sieglinde Snapp, Department of Crop and Soil Sciences

Improving pest management strategies, soil quality, and stand establishment are top priorities of the sugar beet industry. The development of crop management alternatives that reduce tillage intensity and encourage the use of cover crops will improve soil quality by increasing soil organic matter. Manure has been shown to improve soil quality by increasing soil organic matter and hydraulic conductivity, and by decreasing soil bulk density. A lower bulk density allows more extensive root growth and a favorable pore size distribution which increases water infiltration, water holding capacity and soil aeration.

Cover crops are generally grown for soil conservation, but cover crops also improve soil quality by adding organic matter and increasing soil biological activity. In Michigan, growers often use winter cereals as cover crops to protect the soil from wind erosion, but stand establishment costs and the additional management requirements have limited their widespread use. Cover crops in the Brassica (mustard) family may offer benefits beyond soil conservation in sugar beet rotations. Forage radish crops have been used to alleviate compaction in coastal plain soils in Maryland. In Michigan, sugar beet yields increased two tons/acre following an oil seed radish cover crop (Poindexter and Van Sickle, 2004). And, oil seed radish has been shown to suppress soil-borne nematodes in sugar beets. The incorporation of oriental mustard (*Brassica juncea* L., variety Pacific Gold) in the spring before planting potatoes suppressed *Rhizoctonia solani* by 73%, and the cover was highly suppressive of fungal activity by *Pythium ultimum*, and *Fusarium solani* (Snapp, 2004). A similar level of disease suppression may be possible in sugar beets. There is a need to evaluate and better integrate Brassica cover crops in sugar beet rotations.

OBJECTIVES

The objective of this work was to: 1) Evaluate a new and resource efficient seeding method - *slurry enriched micro-site seeding* - for establishing bio-suppressive cover crops in small grain stubble, and 2) quantify effects of treated soil/cover crop combinations on emergence and disease occurrence in sugar beets.

METHODS AND MATERIALS

A replicated trial comparing oil seed radish (*Colonel*, 16.8 kg ha⁻¹ PLS) and oriental mustard variety (*Pacific Gold*, 11.2 kg ha⁻¹ PLS) was established following wheat (August 8, 2005) in a Capac sandy loam soil at the University Farm in East Lansing. Three seedbed tillage were compared: 1) two passes with a Kongskilde Triple-K combination tillage tool in untilled wheat stubble at a depth of 7.5 cm and seeding with a Deere conservation tillage drill, 2) direct-drilling into untilled wheat stubble with a Great Plains no-till drill (disk openers on 19 cm centers), and 3) slurry-enriched micro-site seeding in untilled wheat stubble. The plots were arranged in a randomized complete block with six treatments and four replications. The seedings were made on August 8 and harvested on October 20, 2005.

The slurry seeding treatments were established using a commercially available slurry tanker (3000 gallon capacity) equipped with a rear-mounted Aer-Way SSD low-disturbance soil aeration and slurry distribution system. Swine manure (1.7 % dry matter) was applied at 56,100 L ha⁻¹. The soil aerator gang angle was set at 10° for maximum soil disturbance. The seed was

placed in the spreader tank where bypass flow provided tank agitation and seed mixing. Drop tubes delivered the seed-laden slurry from the chopper/distributor to the loosened soil behind each set of rolling tines. The 56,100 L ha⁻¹ application of swine slurry provided 204 kg ha⁻¹ total N (172 kg ha⁻¹ as NH₄-N), 76 kg ha⁻¹ P as P₂O₅, and 123 kg ha⁻¹ K as K₂O. Because commercial fertilizer is not often used for cover crop establishment, no fertilizer was applied to the non-manure plots.

RESULTS

Above-ground plant mass, root mass, total biomass and plant stand density from the six harvested treatments are listed in Table 1. There were no significant differences in top growth biomass between tillage and seeding methods. There were, however, significant effects on plant stand density. The direct-drilled OSR and OM plant stands were significantly greater than the slurry-seeded OSR and OM plant densities ($p \leq 0.01$). There was a significant *seeder X crop* interaction with the tilled-drilled establishment method. The tilled-drilled OM and direct-drilled OM stand densities were not different ($p = 0.98$), but the tilled-drilled OM stand was significantly greater than the slurry-seeded stand ($p \leq 0.01$). Conversely, the tilled-drilled OSR stand was not different from the slurry-seeded OSR ($p = 0.98$), but the direct-drilled OSR stand density was significantly greater than the tilled-drilled OSR stand ($p \leq 0.01$). There were no significant differences in OSR root biomass or total plant biomass between tillage and planting systems.

Additional work is in progress using greenhouse trials to evaluate and quantify the effects of treated soil/cover crop combinations on emergence and disease occurrence in sugar beets. Cover crop residues were incorporated in the fall and a sugar beet crop will be planted in spring 2006. Effects on disease and pest pressure will be monitored.

Table 1. Stand and yield of Oil Seed Radish and Oriental Mustard sown as cover crops into wheat stubble on a Capac loam soil.

Seed	Drill	Top growth biomass, kg ha ⁻¹	Root biomass, kg ha ⁻¹	Total biomass, kg ha ⁻¹	Plants m ⁻²
Colonel OSR	Till-Drill	4898 a	828 a	5726 a	42 a
Colonel OSR	Slurry	4340 a	1062 a	5402 a	27 a
Colonel OSR	Direct-drill 1	5293 a	670 a	5962 a	153 b
OM	Till-Drill	4540 a	--	--	134 b
OM	Slurry	5283 a	--	--	28 a
OM	Direct-drill	4573 a	--	--	148 b

abc letters indicate values within a column which are not significantly different by Tukey's HSD procedure ($\alpha=0.10$).

CONCLUSIONS

The 2005 biomass yield and stand density measurements showed that the manure slurry enriched micro-site seeding process can provide yields equivalent to conventional seeding methods. A manure application method that effectively incorporates cover crop seeding, manure application and low-disturbance aeration tillage provides considerable labor and machinery efficiencies that will encourage environmentally responsible manure and cover crop use in sugar beet rotations. Reducing tillage intensity and including manure and a biosuppressive cover crop such as oil seed radish in a sugar beet rotation will improve plant stand uniformity by improving soil quality, aid in managing such pests as the sugar beet cyst nematode, and may suppress fungal diseases. Additional work is needed to develop guidelines for this new slurry seeding process and to evaluate potential benefits of Brassica cover crops in sugar beet rotations for pest and disease suppression, soil conservation, and improving soil quality.