

Effect of Organic Soil Fertility and Fungicide Treatments on Yield and Pest Management, Neely-Kinyon Farm-2015

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Introduction

Annual organic soybean [*Glycine max* (L.) Merr.] production in the U.S. has risen to more than 150,000 acres (USDA-ERS, 2005). Critical challenges associated with organic soybean production include weed control, bean leaf beetles (*Cerotoma trifurcata* Förster), soybean aphid (*Aphis glycines* Matsumura), and soybean diseases, including the potential for soybean rust. Bean leaf beetle primarily vectors the seed-staining bean pod mottle virus (BPMV) and for providing sites for other seed-staining fungi such as purple stain [*Cercospora kikuchii* (Mastsumoto & Tomoyasu) M.W. Gardener] and *Fusarium* spp. According to Advisory Committee members, soil fertility could affect insect and disease pest pressure, so a study was established in 2009 to evaluate organic-compliant treatments to improve plant nutritional status and an anti-fungal disease product (Regalia[®], Marrone Bio Innovations, Inc., Davis, CA). Regalia[®] is made with an extract from the plant *Reynoutria sachalinensis* (giant knotweed) which, when sprayed on plants, activates natural plant defenses. This induced diseased resistance is not systemic (i.e., only treated green leaf area is protected), but there is a translaminar effect (i.e., when the product is sprayed on the top of a leaf, the bottom of that leaf also is protected). Reducing the extent of soybean staining was of great economic importance to organic producers who rely on the premiums associated with unstained seed,

and preventing diseases could also increase yields in organic soybeans.

Materials and Methods

Blue River 30C3 organic soybeans were planted at the Neely-Kinyon Farm on June 9, 2015, at a rate of 175,000 seeds/acre. The experimental design consisted of a randomized complete block design of four treatments with four replications of each in plots measuring 20 x 10 feet with a 5-foot border between plots. The following treatments were studied: Midwest Bio-Ag organic fertilizer (50 lb N/acre) applied on July 12, a soap product applied at 2.5 oz. to 1 gal. water (Safer[®] Soap, Wodstream Corp., Lititz, PA), Regalia[®] applied at 4 quarts/acre; and a control (no sprays). Plots were maintained with rotary hoeings on June 19 and 22, and row cultivations on June 29, July 8, and July 14. Soybeans were “walked” on August 2 to remove any weeds above the canopy. Treatments were applied on July 24, August 18, September 1, September 14, and September 28. A visual pest and beneficial insect count was taken on soybean plants in three randomly-selected 10-ft of row per plot on July 16. Pest and beneficial insect sampling occurred by sweeping two 10-ft row of soybeans (8 sweeps total) with a 15-inch diameter net on August 10, August 25, September 9 and September 30. Samples were frozen until identification in the lab. Soybean grain was harvested on October 13. Soybean

grain quality was determined at the ISU Grain Quality Lab (Ames, IA).

Results and Discussion

Yields in the organic soybean trial were excellent in 2015, averaging 63 bu/acre over all treatments (Table 1), with no significant differences between treatments. Yields were less than the average of 79 bu/acre in 2014. There also were no significant differences in grain quality among treatments in 2015 (Table 2). Grain quality was excellent for organic soybeans, with an average protein content of 37%, 19% oil, 4.5% fiber, and 22% carbohydrates.

Overall, the organic treatments did not affect pest or beneficial insect populations compared to the control (Tables 3-11). The visual count taken on July 16 showed an aphid and bean leaf beetle population of less than 1 insect per 10 ft of row (Table 3). The seasonal average aphid population was less than one aphid per 8 sweeps, with peak aphid population averaging 1 aphid per 8 sweeps on August 10 (Table 4), compared to 337 aphids per 8 sweeps on the non-resistant soybean variety, BR 34A7, in 2008. These averages compared to the 2014 average. The seasonal average bean leaf beetle population was 2 beetles per 8 sweeps, and the peak bean leaf beetle population was on September 9 with 8 beetles per 8 sweeps. This is higher than the seasonal average of less than 1 beetle per 8 sweeps in 2014. In 2015, thrips averaged 14 thrips per 8 sweeps. Peak populations for thrips occurred on September 9 when populations averaged 32 thrips per 8 sweeps. This is higher than the 2014 average of 2 thrips per 8 sweeps. Whiteflies averaged 2 whiteflies per 8 sweeps, with peak populations of 4 whiteflies per 8 sweeps on August 25, which was similar to the average of 5

whiteflies per 8 sweeps in 2014. Corn rootworms were present in all sweeps throughout the season, and averaged 1 beetle per 8 sweeps.

The seasonal average of 4 beneficial insects per 8 sweeps, with the September 9 peak population of 7 beneficial insects per 8 sweeps, included numerous species of beneficial insects collected over the season. The most predominant beneficial insect was the minute pirate bug (MPB), *Orius insidiosus*, which attacks aphids, whiteflies and thrips. The seasonal average was 1 minute pirate bug per 8 sweeps and peak population was 3 minute pirate bugs per 8 sweeps on September 9 (Table 8). On that sampling date, these predators were lower in the Midwest Bio Ag and Safer soap treatments compared to the Regalia treatment, but all treatments were not significantly different from the control. Spiders were also observed at every sampling date and averaged 1 per 8 sweeps overall, with peak populations of 2 spiders per 8 sweeps on August 25. Other beneficial insects included wasps, nabids and green lacewings (Tables 4-11).

No soybean diseases were observed in sufficient quantities to warrant comparisons in 2015, including no signs of soybean rust. Seed staining averaged 0.70% (Table 12), which was similar to 2014 data. With few significant differences in pest and beneficial insects found among treatments in 2015, it was interesting to note the low numbers of whiteflies, but higher numbers of thrips, both of which are more prominent species in drought months. We will continue this trial in 2016 with new organic-compliant products.

Acknowledgments

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Table 1. Yields in the Soybean Fertility experiment, Neely-Kinyon Farm, 2015.

Treatment	Bu/acre
Control	61.48
Midwest Bio Ag compost	61.52
Safer soap	67.59
Regalia	62.27
LSD _{0.05}	NS ^z

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 2. Soybean grain quality in the Soybean Fertility experiment, Neely-Kinyon Farm, 11/27/15.

Treatment	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)
Control	9.15	36.75	19.25	4.53	21.48
Midwest Bio Ag Compost	8.98	36.58	19.43	4.53	21.48
Safer's Soap	9.03	36.55	19.45	4.50	21.50
Regalia	8.98	36.40	19.40	4.58	21.63
LSD _{0.05}	NS ^z	NS	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 3. Visual insect counts (numbers per 10 ft of row) in the Soybean Fertility experiment, Neely-Kinyon Farm, 7/16/15.

Treatment	Bean leaf beetles	Cucumber beetles	Aphids
Control	0.00	0.08	0.67
Midwest bio ag compost	0.00	0.00	1.00
Safer soap	0.00	0.00	0.42
Regalia	0.08	0.00	1.50
LSD _{0.05}	NS ^z	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 4. Key soybean pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 8/10/2015 (number per 8 sweeps).

Treatment	Aphids	Bean leaf beetles	Thrips	Corn rootworm	Minute pirate bugs	Spiders	Total beneficial insects
Control	2.00	0.75	1.50	2.75	0.75	0.50	1.50
Midwest Bio Ag compost	0.67	0.67	3.33	1.67	1.67	0.33	2.33
Safer soap	1.75	0.25	0.75	2.50	2.00	0.75	3.75
Regalia	1.00	0.00	2.25	1.00	2.00	0.50	2.75
LSD _{0.05}	NS ^z	NS	NS	NS	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 5. Other pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 8/10/2015 (number per 8 sweeps).

Treatment	Caterpillars	Nabids	Whiteflies	Grasshoppers	Green lacewings	Leafhoppers	Tarnished plant bugs	Wasps
Control	0.25	0.00	2.75	1.00	0.00	0.50	0.25	0.00
Midwest bio ag compost	0.00	0.00	1.00	3.33	0.00	0.33	0.33	0.00
Safer soap	0.50	0.00	1.25	1.25	0.00	0.00	0.00	0.75
Regalia	0.25	0.25	1.75	1.50	0.00	0.50	0.50	0.00
LSD _{0.05}	NS ^z	NS	NS	NS	--	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 6. Key soybean pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 8/25/2015 (number per 8 sweeps).

Treatment	Aphids	Bean leaf beetles	Thrips	Corn rootworm	Minute pirate bugs	Spiders	Total beneficial insects
Control	1.75	0.25	16.00	5.00	1.00	2.00	5.25
Midwest bio ag compost	1.00	0.00	16.75	6.50	0.75	1.25	3.75
Safer soap	1.00	0.25	18.50	5.25	1.50	2.00	4.75
Regalia	1.00	0.25	11.75	4.50	1.00	2.25	7.75
LSD _{0.05}	NS ^z	NS	NS	NS	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 7. Other pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 8/25/2015 (number per 8 sweeps).

Treatment	Caterpillars	Nabids	White flies	Grasshoppers	Green lacewings	Leafhoppers	Tarnished plant bugs	Wasps
Control	0.25	0.00	4.50	2.00	0.50	1.00	0.25	1.75
Midwest Bio	0.00	0.00	5.00	2.50	0.00	0.50	1.00	1.25
Ag compost								
Safer soap	0.25	1.00	3.50	1.75	0.25	0.25	0.50	0.50
Regalia	0.25	0.50	4.00	1.00	0.00	1.25	0.00	3.00
LSD _{0.05}	NS ^z	NS	NS	NS	NS	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 8. Key soybean pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 9/9/2015 (number per 8 sweeps).

Treatment	Aphids	Bean leaf beetles	Thrips	Corn rootworm	Minute pirate bugs	Spiders	Total beneficial insects
Control	2.25	9.50	29.00	5.00	2.75ab ^y	1.25	8.25
Midwest Bio Ag	0.50	10.50	34.25	2.75	1.25b	1.50	5.75
compost							
Safer soap	0.50	7.50	28.25	1.50	1.50b	1.00	4.50
Regalia	1.00	5.75	34.50	3.00	5.00a	0.75	9.00
LSD _{0.05}	NS ^z	NS	NS	NS	0.0146	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 9. Other pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 9/9/2015 (number per 8 sweeps).

Treatment	Caterpillars	Nabids	Whiteflies	Grasshoppers	Green lacewings	Leafhoppers	Tarnished plant bugs	Wasps
Control	1.00	2.25	1.75	0.25	1.00	0.50	0.00	0.75
Midwest Bio	0.25	2.50	2.75	0.25	0.50	0.00	0.75	0.00
Ag compost								
Safer soap	0.50	1.50	1.50	0.00	0.25	0.75	0.00	0.00
Regalia	0.50	2.25	2.50	0.00	0.25	0.50	1.00	0.00
LSD _{0.05}	NS ^z	NS	NS	NS	NS	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 10. Key soybean pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 9/30/2015 (number per 8 sweeps).

Treatment	Aphids	Bean leaf beetles	Thrips	Corn rootworm	Minute pirate bugs	Spiders	Total beneficial insects
Control	0.00	0.00	2.00	1.00	0.50	0.75	1.50
Midwest Bio Ag compost	0.00	1.00	11.50	0.25	0.00	1.50	2.25
Safer soap	0.00	0.33	2.00	0.67	0.00	1.00	2.00
Regalia	0.00	0.75	9.00	0.00	0.25	0.50	1.00
LSD _{0.05}	--	NS ^z	NS	NS	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 11. Other pest and beneficial insects in Soybean Fertility experiment, Neely-Kinyon Farm, 9/30/2015 (number per 8 sweeps).

Treatment	Caterpillars	Nabids	White flies	Grasshoppers	Green lacewings	Leafhoppers	Tarnished plant bugs	Wasps
Control	0.25	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Midwest Bio Ag compost	0.00	0.00	2.75	0.00	0.00	0.25	1.00	0.25
Safer soap	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.00
Regalia	0.00	0.00	1.50	0.00	0.00	0.00	0.00	0.00
LSD _{0.05}	NS ^z	--	NS	--	--	NS	NS	NS

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).

Table 12. Soybean staining in the Soybean Fertility experiment, Neely-Kinyon Farm, 8/18/15.

Treatment	Stained soybeans (%)
Control	0.54b ^z
Midwest Bio Ag compost	0.98a
Safer soap	0.66b
Regalia	0.60b
LSD _{0.05}	0.02556

^z Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD Test).