

Effect of Organic Soil Fertility and Fungicide Treatments on Yield and Pest Management, Neely-Kinyon-2014

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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 (*Cerotomatrifurcata* 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 [*Cercosporakikuchii* (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 *Reynoutriasachalinensis* (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 soybean aphid-resistant soybeans were planted at the Neely-Kinyon Farm on May 31, 2014, at a rate of 174,000 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 11 and 13, and row cultivations on June 24, July 9, and July 16. Soybeans were “walked” on August 19 to remove any weeds. Treatments were applied on July 10, 22, and August 10. Pest and beneficial insect sampling occurred on July 17, 29, and August 17. Soybeans were harvested on October 26. 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 2014, averaging 79bu/acre over all treatments (Table 1), with no significant differences between treatments.

Yields were greater than the average of 61 bu/acre in 2013. There also were no significant differences in grain quality among treatments in 2014 (Table 2). Grain quality was excellent for organic soybeans, with an average protein content of 35%, 18% oil, 4.9% fiber, and 24% carbohydrates.

Overall, the organic treatments did not affect pest or beneficial insect populations compared to the control (Tables 3-8). The seasonal average aphid population was less than one aphid per 8 sweeps, with peak aphid population averaging less than 1 aphid per 8 sweeps on July 17 (Table 3), compared to 337 aphids per 8 sweeps on the non-resistant soybean variety, BR 34A7, in 2008. These averages were lower than the 2013 average aphid population of 13 aphids per 8 sweeps. The seasonal average bean leaf beetle population was less than 1 beetle per 8 sweeps, and the peak bean leaf beetle population was on July 29. This compared to similar numbers in 2013. In 2014, thrips averaged 2 thrips per 8 sweeps. Peak populations for thrips occurred on July 29 when populations averaged 2 thrips per 8 sweeps. Whiteflies averaged 5 whiteflies per 8 sweeps, with peak populations of 10 whiteflies per 8 sweeps on July 29, which was similar to the average of 3 whiteflies per 8 sweeps in 2013. Although whitefly populations were low, there was one sampling date, July 17, where there were lower numbers in the Safer Soap™ and the Regalia™ treatments, but these populations were similar to the control, at 2 whiteflies per 8 sweeps. Corn rootworms were present in the majority of sweeps throughout the season, but averaged less than 1 beetle per 8 sweeps, with no differences among treatments. Higher numerical populations were observed in late July.

The seasonal average of 2 beneficial insects per 8 sweeps, with the July 17 peak population of 2 beneficial insects per 8 sweeps, included numerous species of beneficial insects collected over the season. On August 17, beneficial insects were greater in the Safer Soap™ and Midwest Bio-Ag™ compost treatments, averaging 1.5 beneficial insects per 8 sweeps, compared to the control and the Regalia™ treatments, which did not have any beneficial insects at that sampling time. The most predominant beneficial insect was the minute pirate bug (MPB), *Orius insidiosus*, which attacks aphids, whiteflies and thrips. The seasonal average was less than 1 minute pirate bug per 8 sweeps and peak population was 1 minute pirate bug per 8 sweeps on July 29. Spiders were also observed at every sampling date and averaged less than 1 per 8 sweeps overall, with peak populations of 1 spider per 8 sweeps on July 17. Other beneficial insects included wasps, nabids and green lacewings (Tables 3-8).

No soybean diseases were observed in sufficient quantities to warrant comparisons in 2014, including no signs of soybean rust. Seed staining averaged 0.70% (Table 1), which was similar to 2013 data. With few significant differences in pest and beneficial insects found among treatments in 2014, it was interesting to note the low numbers of whiteflies and thrips, which are more prominent species in drought months. We will continue this trial in 2015 with new organic-compliant products.

Acknowledgments

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Table 1. Soybean yield and staining in the Soybean Fertility experiment, Neely-Kinyon Farm, 2014.

Rotation	Yield (bu/acre)	Staining (%)
Control	79.33	0.61
Safer Soap	79.44	0.67
Midwest Bio Ag Compost	78.50	0.59
Regalia	77.63	0.84
LSD _{0.05}	NS	NS

Table 2. Soybean grain quality in the Soybean Fertility experiment, Neely-Kinyon Farm, 2014.

Rotation	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)
Control	11.58	35.15	18.14	4.86	23.86
Safer Soap	11.70	35.54	17.86	4.84	23.76
Midwest Bio Ag Compost	11.53	35.13	18.13	4.86	23.89
Regalia	11.55	35.30	18.13	4.84	23.74
LSD _{0.05}	NS	NS	NS	NS	NS

Table 3. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-17-2014(number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	0.50	0.00	2.50	0.00	0.25	1.00	2.25
Safer Soap	0.00	0.00	1.00	0.75	0.50	0.50	1.75
Midwest Bio Ag Compost	0.50	0.00	1.00	0.25	0.25	1.75	2.25
Regalia	0.25	0.00	0.75	0.50	1.00	0.75	2.25
LSD _{0.05}	NS	-	NS	NS	NS	NS	NS

Table 4. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-17-14 (number per 8 sweeps).

Rotation	Caterpillars	Whiteflies	Grasshoppers	Leafhoppers	Tarnished plant bugs	Nabids	Green lacewings	Wasps
Control	0.00	1.75±0.69ab	1.00	0.50	0.00	0.00	0.75	0.00
Safer Soap	0.00	1.00±0.69b	0.50	0.25	0.00	0.00	0.75	0.00
Midwest Bio Ag Compost	0.00	3.50±0.69a	1.25	0.50	0.00	0.00	0.25	0.00
Regalia	0.00	0.50±0.69b	1.75	0.00	0.00	0.00	0.50	0.00
LSD _{0.05}	-	0.3787	NS	NS	-	-	NS	NS

Table 5. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-29-14 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	0.75	0.25	3.50	0.50	1.25	1.00	2.75
Safer Soap	0.00	0.25	2.25	0.25	0.25	0.00	0.25
Midwest Bio Ag Compost	0.25	0.00	0.75	0.25	0.50	0.50	1.25
Regalia	0.00	0.25	1.25	1.25	1.50	1.25	2.75
LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS

Table 6. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-29-14 (number per 8 sweeps).

Rotation	Caterpillars	Whiteflies	Grasshoppers	Leafhoppers	Tarnished plant bugs	Nabids	Green lacewings	Wasps
Control	0.00	13.75	1.00	1.00	1.00	0.00	0.50	0.00
Safer Soap	0.00	7.75	1.25	1.25	0.00	0.00	0.00	0.00
Midwest Bio Ag Compost	0.25	10.75	1.25	1.50	0.75	0.00	0.25	0.00
Regalia	0.50	9.50	1.00	0.50	0.50	0.00	0.00	0.25
LSD _{0.05}	NS	NS	NS	NS	NS	-	NS	NS

Table 7. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-17-14 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	0.00	0.00	1.50	1.00	0.25	0.00	0.00±0.24b
Safer Soap	0.00	0.00	0.50	0.25	0.75	0.00	1.50±0.24a
Midwest Bio Ag Compost	0.00	0.00	1.25	0.25	1.00	0.50	1.50±0.24a
Regalia	0.25	0.00	2.00	0.25	0.00	0.00	0.00±0.24b
LSD _{0.05}	NS	-	NS	NS	NS	NS	0.2421

Table 8. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-17-14 (number per 8 sweeps).

Rotation	Caterpillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished Plant bugs	Nabids	Green lacewings	Wasps
Control	0.00	2.75	0.00	0.00	0.00	0.00	0.00	0.00
Safer Soap	0.00	2.50	0.50	0.00	0.00	0.25	0.25	0.00
Midwest Bio Ag Compost	0.00	1.25	0.75	0.00	0.00	0.00	0.00	0.00
Regalia	0.00	1.75	0.25	0.00	0.00	0.00	0.00	0.00
LSD _{0.05}	-	NS	NS	-	-	NS	NS	-