Effect of Organic Soil Fertility and Fungicide Treatments on Yield and Pest Management, Neely-Kinyon-2013

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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 29AR9 soybean aphid-resistant soybeans were planted at the Neely-Kinyon Farm on May 24, 2013, at a rate of 160,000 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 2 and 12, and row cultivations on June 21, 27, and July 2. Soybeans were "walked" on July 17 to remove any remaining weeds. Treatments were applied July 3, 17, August 2, 16, and September 3. Pest and beneficial insect sampling occurred on July 10, 24, August 9, 23, and September 10. Soybeans were 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 2013, averaging 61 bu/acre over all treatments (Table 1), with no significant differences between treatments. Yields were excellent despite the drought.

There also were no significant differences in grain quality among treatments in 2013 (Table 2). Grain quality was excellent for organic soybeans, with an average protein content of 35%, 20% oil, 4.7% fiber, and 23% carbohydrates.

The organic treatments did not affect pest or beneficial insect populations compared to the control (Tables 3-12). The seasonal average aphid population was 13 aphids per 8 sweeps, with peak aphid populations averaging 22 aphids per 8 sweeps on July 24 (Table 4), compared to 337 aphids per 8 sweeps on the non-resistant soybean variety in 2008. These averages were higher than 2012 aphid populations, which averaged less than 1 aphid 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 1 beetle per 8 sweeps on August 9. This compared to an average of 1 beetle per 8 sweeps in 2012. In 2013, thrips averaged 3 thrips per 8 sweeps. Peak populations for thrips occurred on August 9 when populations averaged 5 thrips per 8 sweeps. These numbers were lower than 2012 when thrips averaged 115 thrips per 8 sweeps. Whiteflies averaged 5 whiteflies per 8 sweeps, with a peak of 14 on August 9 (Table 8). Corn rootworms were present in the majority of sweeps throughout the season, but averaged only 2 beetle per 8 sweeps, with no differences among treatments. Higher numerical populations were observed in late August and early September than earlier in the season.

The seasonal average of 4 beneficial insects per 8 sweeps, with the August 23 peak population of 9 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 2 minute pirate bugs per 8 sweeps and peak population was 5 minute pirate bugs per 8 sweeps on August 23. Spiders were also observed in most samplings and averaged less than 1 spider per 8 sweeps overall, with peak populations of 1 per 8 sweeps on July 24. Other beneficial insects included wasps, nabids and green lacewings (Tables 3-12).

No soybean diseases were observed in sufficient quantities to warrant comparisons in 2013, including no signs of soybean rust. Seed staining averaged 0.68% (Table 1), which was similar to 2011 data. Although no significant differences in pest and beneficial insects were found among treatments, it was interesting to note the highest pest numbers were observed for aphids and whiteflies, which are more prominent species in drought months. We will continue this trial in 2014 with new organic-compliant products.

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Table 1. Soybean yield and staining in the Soybean Fertility experiment, Neely-Kinyon Farm, 2013.

Rotation	Yield (bu/acre)	Staining (%)
Control	60.45	0.59
Midwest Bio Ag Compost	62.35	0.76
Safer Soap	58.69	0.64
Regalia	61.43	0.72
$LSD_{0.05}$	NS	NS

Table 2. Soybean grain quality in the Soybean Fertility experiment, Neely-Kinyon Farm, 2013.

Rotation	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)
Control	11.53	34.80	19.65	4.70	22.85
Midwest Bio Ag Compost	11.25	34.76	19.50	4.73	23.03
Safer Soap	11.23	34.73	19.53	4.70	23.05
Regalia	11.40	34.80	19.60	4.70	22.90
$LSD_{0.05}$	NS	NS	NS	NS	NS

Table 3. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-10-2013 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	12.75	0.00	2.50	0.00	0.00	0.00	0.50
Midwest Bio Ag Compost	12.50	0.00	4.50	0.50	0.50	0.75	1.75
Safer Soap	8.50	0.00	4.50	0.00	0.00	0.75	1.50
Regalia	10.00	0.00	4.75	0.00	1.00	0.25	2.00
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS

Table 4. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-10-2013 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished plant bugs	Nabids	Green lacewings	Wasps
Control	3.75	2.00	0.75	6.50	0.00	0.00	0.00	0.50
Midwest Bio Ag Compost	0.00	2.00	3.75	5.50	0.00	0.00	0.00	0.25
Safer Soap	0.25	6.25	3.00	4.25	0.00	0.00	0.00	0.75
Regalia	0.25	2.25	2.50	7.50	0.00	0.00	0.00	0.75
$LSD_{0.05}$	NS	NS	NS	NS	-	-	-	NS

Table 5. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-24-2013 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	21.50	0.00	1.75	0.25	0.25	0.50	2.50
Midwest Bio Ag Compost	20.00	0.00	2.25	0.00	0.00	0.50	1.50
Safer Soap	22.75	0.00	1.25	0.00	0.00	0.75	0.75
Regalia	24.50	0.00	3.00	0.00	0.00	1.50	3.00
$LSD_{0.05}$	NS	-	NS	NS	NS	NS	NS

Table 6. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-24-2013 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished plant bugs	Nabids	Green lacewings	Wasps
Control	0.00	3.00	0.25	0.50	0.00	0.25	0.00	0.50
Midwest Bio Ag Compost	0.25	2.00	0.25	1.75	0.00	0.50	0.00	0.50
Safer Soap	0.00	1.75	0.50	0.50	0.00	0.00	0.00	0.00
Regalia	0.00	3.50	0.75	1.00	0.00	0.00	0.00	0.00
$LSD_{0.05}$	NS	NS	NS	NS	-	NS	-	NS

Table 7. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-9-2013 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	8.75	0.75	4.25	0.75	1.25	0.25	2.50
Midwest Bio Ag Compost	13.75	0.50	4.50	0.75	1.25	0.25	2.00
Safer Soap	10.25	0.25	5.00	0.25	1.25	0.25	2.75
Regalia	11.00	0.50	5.00	0.75	1.00	0.00	2.25
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS

Table 8. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-9-2013 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished Plant bugs	Nabids	Green lacewings	Wasps
Control	0.50	9.75	0.00	0.50	0.00	0.50	0.25	0.00
Midwest Bio Ag Compost	0.00	11.25	0.50	0.75	0.00	0.25	0.00	0.00
Safer Soap	0.25	22.00	0.50	0.00	0.00	0.00	0.25	0.00
Regalia	0.50	13.75	0.50	0.25	0.00	025	0.00	0.00
$LSD_{0.05}$	NS	NS	NS	NS	-	NS	NS	-

Table 9. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-23-2013 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	12.75	0.00	6.50	4.25	6.25	0.50	10.50
Midwest Bio Ag Compost	18.75	0.00	2.50	3.50	5.25	0.25	9.50
Safer Soap	16.00	0.25	4.25	2.50	3.75	0.00	7.50
Regalia	13.50	0.00	2.75	3.00	4.50	0.25	7.50
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS

Table 10. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-23-2013 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished Plant bugs	Nabids	Green lacewings	Wasps
Control	0.50	7.25	0.25	0.75	0.00	0.00	0.75	0.25
Midwest Bio Ag Compost	0.75	6.25	1.00	0.00	0.00	1.00	0.50	0.25
Safer Soap	0.25	7.75	0.50	1.25	0.00	1.00	0.75	0.00
Regalia	0.25	5.75	0.50	0.75	0.00	1.00	0.00	0.50
$LSD_{0.05}$	NS	NS	NS	NS	-	NS	NS	NS

Table 11. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 9-10-2013 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Control	7.67	0.67	0.67	8.33	2.00	0.00	4.33
Midwest Bio Ag Compost	5.00	0.00	0.00	4.33	1.67	0.00	3.33
Safer Soap	3.33	0.67	1.33	1.00	2.33	0.00	5.33
Regalia	0.00	0.50	0.00	2.50	1.00	0.00	5.00
$LSD_{0.05}$	NS	NS	NS	NS	NS	-	NS

Table 12. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 9-10-2013 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished Plant bugs	Nabids	Green lacewings	Wasps
Control	0.00	0.00	1.33	0.33	0.00	0.00	1.00	0.00
Midwest Bio Ag Compost	0.33	0.00	1.33	0.67	0.33	0.33	0.33	0.00
Safer Soap	0.33	0.00	0.00	0.00	0.00	1.00	1.00	0.33
Regalia	0.00	0.00	0.00	0.00	0.00	1.50	0.00	0.00
$LSD_{0.05}$	NS	-	NS	NS	NS	NS	NS	NS