Effect of Organic Soil Fertility and Fungicide Treatments on Yield and Pest Management, Neely-Kinyon-2012

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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 22, 2012, 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 15, 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 1, June 8 and 13, and row cultivations on June 18, 26, 29 and July 13. Soybeans were "walked" on July 24 to remove any weeds. Treatments were applied on June 28, July 14, August 11 and 22. Pest and beneficial insect sampling occurred on July 19, 31 and August 17. Soybeans were harvested on October 8. 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 2012, averaging 51 bu/acre over all treatments (Table 1), with no

significant differences between treatments. Yields were less than 2011 and 2010 yields because of the severe drought. There also were no significant differences in grain quality among treatments in 2012 (Table 2). Grain quality was excellent for organic soybeans, with an average protein content of 35%, 19% oil, 4.7% fiber, and 23% carbohydrates.

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 populations averaging 1 aphid per 8 sweeps on July 19 (Table 3), compared to 337 aphids per 8 sweeps on the non-resistant soybean variety in 2008. These averages were lower than 2010 aphid populations, but the same as 2011 aphid numbers. The seasonal average bean leaf beetle population was 1 beetle per 8 sweeps, and the peak bean leaf beetle population was 2 beetles per 8 sweeps on July 19. This compared to an average of 25 beetles per 8 sweeps in 2011. While the drought did not affect bean leaf beetle populations, thrips increased under dry conditions. In 2012, thrips averaged 115 thrips per 8 sweeps, compared to 24 thrips per 8 sweeps in 2011. Peak populations for thrips occurred on July 31 when populations averaged 293 thrips per 8 sweeps. Corn rootworms were present in the majority of sweeps throughout the season, but averaged only 1 beetle per 8 sweeps, with no differences among treatments. Higher numerical populations were observed in July versus August.

The seasonal average of 7 beneficial insects per 8 sweeps, with the July 31 peak population of 8 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 4 minute pirate bugs per 8 sweeps and peak population was 8 minute pirate bugs per 8 sweeps on July 31. Spiders were also observed every sampling date and averaged 1 per 8 sweeps overall, with peak populations of 2 per 8 sweeps on August 5. Other beneficial insects included wasps, nabids and green lacewings (Tables 3-8).

No soybean diseases were observed in sufficient quantities to warrant comparisons in 2012, including no signs of soybean rust. Although no seed staining was determined in 2012, when BLB populations averaged 10 beetles/8 sweeps in 2011, seed staining was 1.1%, suggesting seed staining would be even less in 2012. 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 thrips and whiteflies, as more prominent species in drought months. We will continue this trial in 2013 with new organic-compliant products.

Acknowledgments
We would like to thank the Leopold Center for Sustainable Agriculture for their support of the Neely-Kinyon organic sites. We also thank the Wallace Foundation for their support. Thanks also go to Grace Wang, Evan Duyvejonck, Jordan Garvey and Justin Kuzila for their help on production, data collection, and analytical aspects of this project. We also thank Blue River Hybrids, Kelly, IA; and Marrone Bio-Innovations, Inc., Davis, CA. Appreciation is expressed to Charles Hurburgh and Glen Rippke of the Grain Quality Lab, ISU.

Table 1. Soybean yield in the Soybean Fertility experiment, Neely-Kinyon Farm, 2012.

Rotation	Yield (bu/acre)
Midwest Bio-Ag fertilizer	52.27
Control	53.21
Regalia	50.40
Safer Soap	47.63
$LSD_{0.05}$	NS

Table 2. Soybean grain quality in the Soybean Fertility experiment, Neely-Kinyon Farm, 2012.

Rotation	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)
Midwest Bio-Ag fertilizer	8.07	35.03	19.33	4.73	22.90
Control	7.96	35.01	19.39	4.73	22.87
Regalia	8.10	35.15	19.33	4.72	22.80
Safer Soap	7.93	35.40	19.18	4.70	22.72
$LSD_{0.05}$	NS	NS	NS	NS	NS

Table 3. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-19-2012 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Midwest Bio-Ag fertilizer	0.00	2.00	17.00	2.25	0.50	0.50	6.00
Control	2.00	2.25	29.00	1.25	1.00	0.25	5.50
Regalia	1.00	1.75	22.50	1.25	0.50	1.25	7.25
Safer Soap	0.75	3.00	20.50	2.50	0.75	1.25	5.25
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS

Table 4. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-19-12 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished plant bugs	Nabids	Green lacewings	Wasps
Midwest Bio-Ag fertilizer	0.75	8.75	0.25	1.25	0.25	0.25	0.00	0.75
Control	0.25	25.25	0.25	4.00	0.50	0.25	0.00	2.50
Regalia	0.00	19.00	0.50	1.50	0.50	1.00	0.00	1.00
Safer Soap	0.25	18.25	0.00	1.00	0.00	0.00	0.25	0.75
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-31-12 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Midwest Bio-Ag fertilizer	1.00	0.75	282.00	1.25	8.50	1.00	7.78
Control	0.25	1.00	160.00	1.00	4.75	1.00	7.33
Regalia	0.50	0.75	269.75	0.75	7.75	1.75	7.88
Safers Soap	0.75	1.00	461.50	1.00	9.75	1.50	7.85
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS

Table 6. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 7-31-12 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished plant bugs	Nabids	Green lacewings	Wasps
Midwest Bio-Ag fertilizer	0.75	106.75	1.25	1.00	0.00	0.75	0.25	2.50
Control	0.25	65.50	0.25	1.50	0.50	0.50	0.25	2.00
Regalia	0.00	79.25	1.00	1.25	0.75	0.50	0.00	2.25
Safer Soap	0.25	37.25	1.00	1.50	1.00	0.75	0.00	0.75
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS	NS

Table 7. Key pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-17-12 (number per 8 sweeps).

Rotation	Aphids	Bean leaf beetles	Thrips	Corn rootworms	Minute pirate bugs	Spiders	Total beneficial insects
Midwest Bio-Ag fertilizer	0.25	0.00	27.25	1.00	4.25	1.00	8.75
Control	0.25	0.00	28.50	0.25	3.75	1.25	7.00
Regalia	0.50	0.50	22.50	1.00	3.75	1.00	6.00
Safer Soap	0.00	0.50	35.50	0.75	4.75	0.25	10.00
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS

Table 8. Other pest and beneficial insects in the Soybean Fertility experiment, Neely-Kinyon Farm, 8-17-12 (number per 8 sweeps).

Rotation	Cater-pillars	Whiteflies	Grass-hoppers	Leaf-hoppers	Tarnished Plant bugs	Nabids	Green lacewings	Wasps
Midwest Bio-Ag fertilizer	0.25	15.00	1.50a	0.00	0.00	0.50	0.75	1.00
Control	0.25	20.00	0.00b	1.25	0.00	0.00	0.50	1.50
Regalia	0.25	12.75	0.75ab	0.75	0.00	0.00	0.50	1.00
Safer Soap	0.00	14.25	0.50b	1.00	0.25	0.50	1.00	2.50
$LSD_{0.05}$	NS	NS	0.97	NS	NS	NS	NS	NS