Evaluation of Organic Pest Management Treatments for Bean Leaf Beetle and Soybean Aphid—Neely-Kinyon Trial, 2007

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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 and bean leaf beetles (*Cerotoma trifurcata* Förster) – primarily as vectors for 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. The beetle has two generations a year in Iowa. Second-generation adults emerge from the soil to feed on seedpods and then hibernate throughout the winter. This generation moves from leaf litter to attack seedling soybeans the following spring. Females of this generation then oviposit eggs in the soil to develop into first-generation beetles that emerge late June and July. First-generation adult populations usually peak in the late vegetative or the early reproductive soybean stages, whereas the second-generation adults peak during the pod-fill stage. The feeding by first-generation beetles on soybean leaves seldom results in economic yield losses, but the second-generation feeding on pods in late summer can be very significant. Both generations can transmit the BPMV, however. Because bean leaf beetle adults overwinter in Iowa, survival is negatively impacted by low winter temperatures. High rainfall during pod can create ideal conditions for the spread of disease.

The majority of organic crops grown in Iowa are soybeans destined for the Japanese and domestic tofu and soymilk market. These soybeans are bred for a specific seed size and protein requirement. In addition, the Japanese market requires a white seed color, which is more of an aesthetic than food quality distinction. Producers became concerned and requested assistance from Land Grant Universities when the rejection rate for stained organic tofu beans began increasing in 2000. The amount of stained soybean seed increased from northeast to southwest Iowa because of warmer winter temperatures in the southern counties of the state. Stained soybean seed is currently rejected for food-grade markets (e.g., tofu), but increasing demand for organic meat and a small premium for organic feed-grade soybean has encouraged producers to continue growing the crop. Reducing the extent of soybean staining was of great economic importance to organic producers who rely on the premiums associated with unstained seed.

Regulations governing organic production require an integrated systems approach to pest management, including biological insect control for managing most insect pests. Natural enemies of the bean leaf beetle include a mite [*Trombidium hyperi* (Acari: Trombidiidae) and the parasitic fly, *Medina* n. sp. (Diptera: Tachinidae).

The use of several organic-compliant pest management treatments was reported by organic farmers to help manage bean leaf beetles and reduce transmission of virus or fungal agents responsible for seed coat staining. Our objectives in this experiment were to examine the effect of organic–compliant pest management treatments

currently in use by organic farmers for management of bean leaf beetle populations and soybean staining. Natural products tested included soil and plant leaf treatments, in addition to insecticidal products. Products tested varied over the years based on recommendations by the Organic Agriculture Advisory Committee who met annually to review results and recommend changes, including new products with reported efficacy against bean leaf beetles. In addition, soybean varieties were evaluated for preference by bean leaf beetles and propensity for staining.

Materials and Methods

In order to be certified organic in 2007, organic seeds were required for all plantings at the Neely-Kinyon Farm. Blue River 34A7 organic soybeans were planted on May 23, at 200,000 seeds/acre. Soybeans were planted in a completely randomized design with four replications of each treatment measuring 20 x 30 feet with a 20-foot border between plots. The following treatments were applied: PyGanic® (McLaughlin Gormely King Corp, Minneapolis, MN) at 1 pt/acre, Hexacide® (EcoSMART Technologies, Inc., Franklin, TN) applied at 3 pt/acre, Entrust® (Dow Agrosciences LLC, Indianapolis, IN) applied at 2 oz/acre, and Aphrid™ (TerraMax, Inc., Ham Lake, MN) at 45 grams/acre. All treatments were compared with a control. Treatments were applied every 2 weeks from June 20 to August 30 with the exception of Aphrid™, which was applied on 1 August. Bean leaf beetle and beneficial insect sampling occurred on alternate weeks from June 27 to September 6. Soybeans were harvested on October 27, 2007. The percentage of stained soybeans was determined by previously described methods.

Results and Discussion

Very few insects were found in the 2007 season until July 13, approximately at the same time as the 2004, 2005 and 2006 seasons. Bean leaf beetle populations averaged 3 beetles per 8 sweeps over the course of the summer (Table 1). The peak bean leaf beetle population of the season was found on July 24, with an average of 12 beetles per 8 sweeps (Table 1 and Fig. 1). Beetle populations were down slightly from 2006, and again, there were no differences in beetle numbers among treatments. Seed staining averaged 10% in 2007 (8% to 12%), and did not differ significantly among treatments in 2007 (Table 1).

Soybean aphid populations averaged 11 aphids/plant, with peak populations of 120 aphids/plant on August 6 (Table 1 and Fig. 1). There were no differences between treatments, however (Table 1). Beneficial insect populations remained below pest populations, with no significant differences among treatments. Beneficial arthropods found in 2007 included lady beetles, lacewings, damsel bugs, parasitic wasps, and assassin bugs, and spiders, and averaged five per plant. Yields were not affected by pest management techniques, averaging 57 bu/acre over all treatments. There were no significant differences in grain quality among treatments in 2007 (Table 2). Both yields and grain quality were excellent for organic, tofu-type soybeans, with a protein content of 34%, 19% oil, and 25% carbohydrates.

Acknowledgments

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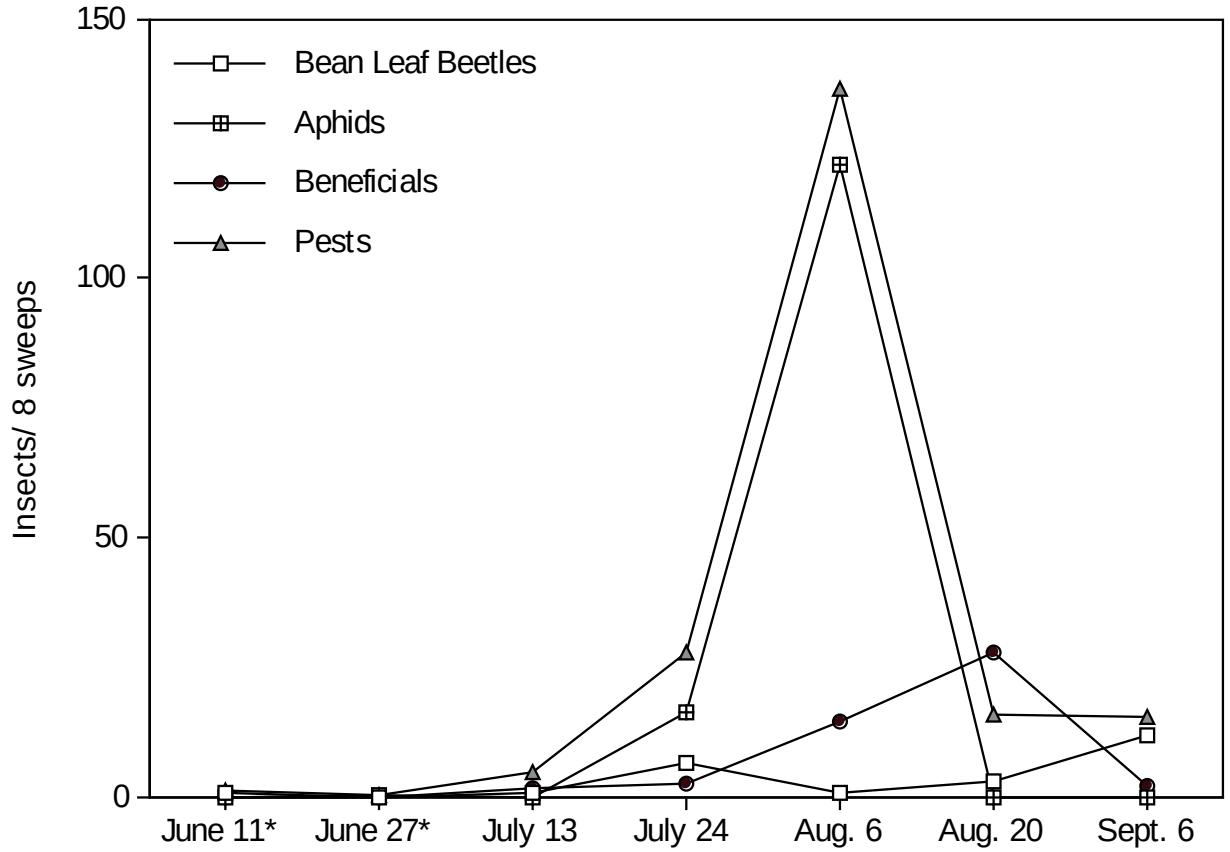
Table 1. Insect populations, soybean staining, and yield, Neely-Kinyon, 2007.

Treatment	Peak Aphid Population /8 sweeps	Peak Beetle Population /8 sweeps	Seasonal average				Staining (%)	Yield (bu/acre)
			Bean leaf beetle population /8 sweeps	Aphid population /8 sweeps	Pest insect population /8 sweeps	Beneficial insect population /8 sweeps		
Control	183.00	12.25	3.00	24.92	33.57	5.54	8.4	54.70
Pyganic®	139.25	19.00	4.06	16.77	24.38	4.91	10.3	60.79
Aphrid™	61.75	11.25	2.22	15.28	21.81	5.08	9.1	53.72
Hexacide®	55.25	9.25	2.75	6.17	13.44	5.58	11.8	57.07
Entrust®	165.00	6.50	1.69	14.14	19.60	5.83	8.5	60.41
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Grain quality analyses, Neely-Kinyon, 2007.

Treatment	Protein (%)	Oil (%)	Saturated Fats (%)	Carbohydrates (%)	Linolenic (%)	Moisture (%)
Control	33.84	18.82	15.24	24.85	7.87	14.07
Pyganic®	33.80	18.74	15.47	24.97	7.94	14.41
Aphrid™	34.17	18.71	15.32	24.62	7.88	14.23
Hexacide®	33.95	18.74	15.26	24.81	7.78	14.16
Entrust®	34.09	18.89	15.03	24.52	7.67	14.20
LSD 0.05	NS	NS	NS	NS	NS	NS

Figure 1. Insect populations across the 2007-growing season.



* Insect populations were censused on plants in 10 feet of row.