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Evaluation of Organic Pest Management Treatments for Bean Leaf Beetle and Soybean Aphid

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Abstract
Bean leaf beetles have continued to be a problem for organic tofu soybean producers throughout the Midwest because of the resulting seed staining, which can downgrade the quality of the soybeans at market. Beginning in 2000, we have evaluated organically approved treatments for bean leaf beetle and fungal control.

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Introduction

Bean leaf beetles have continued to be a problem for organic tofu soybean producers throughout the Midwest because of the resulting seed staining, which can downgrade the quality of the soybeans at market. Beginning in 2000, we have evaluated organically approved treatments for bean leaf beetle and fungal control.

The soybean aphid (*Aphis glycines* Matsumura) is native to China and Japan, and was a new pest in Iowa in 2000. Aphid numbers were high in 2001, but in 2002 and 2003, aphids appeared to be less of a problem. This small, yellow aphid has distinct black cornicles (tailpipes) on the tip of the abdomen and develops colonies on soybean plants as winged and wingless forms. Aphids feed through piercing-sucking mouthparts. The winged form has a shiny black head and thorax with a dark green abdomen and black cornicles. The soybean aphid is the only aphid in North America that will reproduce on soybeans. Therefore, any small colony of aphids found on soybeans must be soybean aphids. The aphid may have up to 18 generations/year, beginning with overwintering eggs on the alternate host of buckthorn trees. These eggs hatch into nymphs and two generations of wingless females develop on buckthorn, before the winged generation flies to soybean fields in the spring. Winged generations appear on soybean plants in the case of crowding from wingless colonies, and in the fall, a winged generation migrates back to buckthorn. These females produce a wingless generation that mates with winged males and lay eggs on the buckthorn trees. Soybean aphid populations build and peak during the period between late seedling stage to blooming stage. Usually in late July, the aphids move from the terminal area of the plant to the undersides, making control more difficult. Honeydew and sooty mold (the excrement of the aphid and the resulting black fungus that grows on it) are apparent in August and September. Stunted plants and reduced pods and seeds may result from aphid feeding. Also, soybean aphids can transmit viruses that cause mottling and distortion of the leaves and a reduced seed set. Discolored seeds may also result from this infection.

An economic threshold of 250 aphids/plant if the population is increasing and plants are in the late vegetative or early (R1-R4) reproduction stages has been established. This incorporates a seven-day lead-time before the aphid population would be expected to increase to 1,000 aphids/plant, which is the economic injury level and the population size that would be expected to cause economic damage (i.e., yield loss that exceeds the cost of control). There are several natural enemies that help manage the aphid, including lacewings, Asian lady beetles, and entomopathogens (fungi that infect insects, causing a reddish-brown appearance and death). In 2001, we began to study natural spray treatments that could be used in certified organic production for control of soybean aphid.

Materials and Methods

Pioneer 9305 soybeans were planted at the Neely-Kinyon Farm on May 23, 2006 at 200,000 seeds/acre. Plots measuring 20 ft × 30 ft with a 20 ft cultivated border around each plot were laid out in a randomized complete design. There were four replications of the following treatments: Entrust® (Dow Agrosciences LLC, Indianapolis, IN) at 2 oz/acre, Pyganic®

(McLaughlin Gormely King Corp, Minneapolis, MN) at 1 pt/acre, Hexacide® (EcoSMART Technologies, Inc., Franklin, TN) at 3 pt/acre, and Aphrid™ (TerraMax, Inc., Ham Lake, MN) at 45 grams/acre, which is a biological control (*Paeciliomyces* spp.). All treatments were compared with a control. Treatments were applied every 2 weeks from June 21 to September 1 with the exception of Aphrid™, which is a biological control (*Paeciliomyces* spp.) for aphids. Aphrid™ was applied on August 3 as a one-time application per label recommendations, once aphids reached 10 aphids/plant. Bean leaf beetle, aphid, and other beneficial or pest insect sampling occurred on alternate weeks from June 21 to September 7, by sweeping across plants in each plot 8 times with a 15 in.-diameter sweep net and examining plants for aphids. Insects were placed in zip-lock bags and transported in coolers to Iowa State University. Insects were frozen until enumeration in the laboratory. Plots were rotary hoed on June 1 and 14 and cultivated on June 12 and 27, 2006. Soybeans were harvested on October 31, 2006. The percentage of stained soybeans was determined by counting the number of stained soybeans in a 200-gram sample that was randomly collected from the harvest of each plot.

Results and Discussion

Very few insects were found in the 2006 season until July, approximately the same time as the 2004 and 2005 seasons (Figure 1). The peak bean leaf beetle population of the season was found on July 26, 2006, with an average of 17.2 beetles/20 sweeps. Although the beetle populations increased from populations found in 2005, there were no differences in beetle numbers among treatments. Seed staining increased 540% from an average of 1.2% in 2005 to an average of 6.5% in 2006, and did not differ among treatments in 2006 (Table 1). Because staining was less in 2005, soybean companies were willing to accept tan staining in 2006 as opposed to previous years. Soybean aphid populations increased from 2005 populations, but differences between treatments were not significant (Table 1). Beneficial insect populations remained below pest populations, with no differences among treatments. Beneficial insects found in 2006 include lady beetles, lacewings, damsel bugs, parasitic wasps, and assassin bugs. Although not classified as insects, spiders were included in the beneficial insect population counts because of their predatory behavior on insects. Yields were not affected by pest management techniques, with control plots averaging 52.2 bushels/acre, compared with a 52.1-bushel/acre average over all other treatments. There were no differences in grain quality among treatments in 2006 (Table 2). Both yields and grain quality were excellent for organic, tofu-type soybeans, which requires yields of at least 48 bushels/acre and a protein content of at least 37%.

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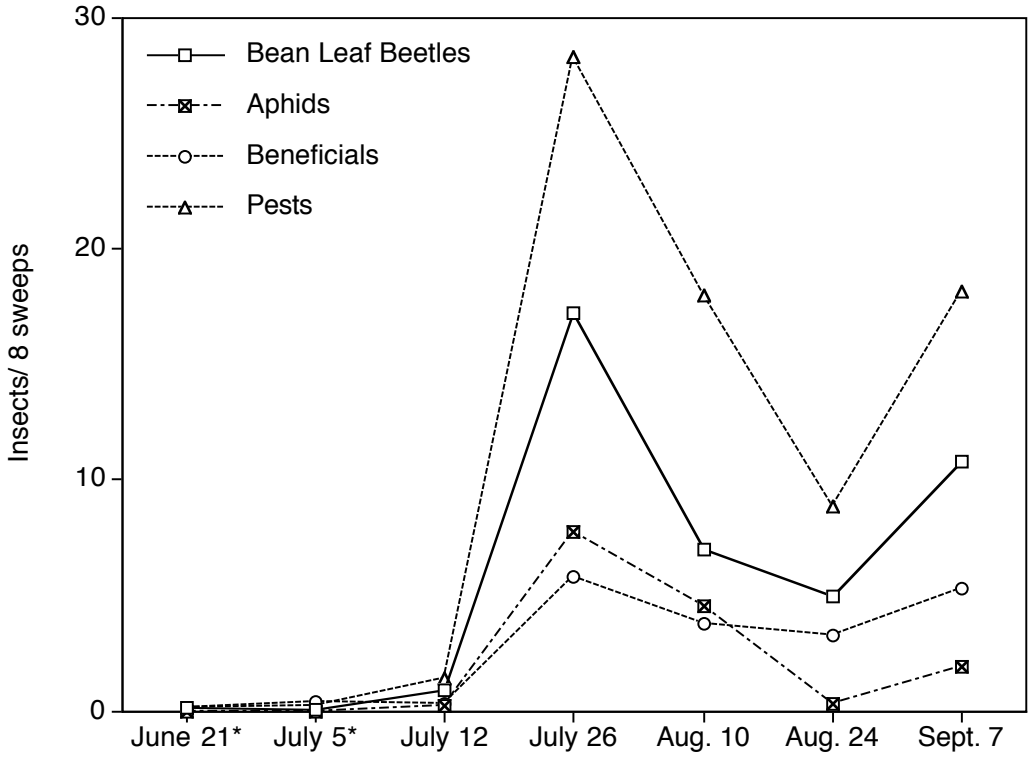
Table 1. Yield, soybean staining, and insect populations in bean leaf beetle and soybean aphid treatments trial, Neely-Kinyon, 2006.

Treatment	Yield (bu/acre)	Staining (%)	Peak beetle population/8 sweeps	Seasonal average insect populations/ 8 sweeps: Bean leaf beetles	All pests	Beneficial insects	Aphids
Control	52.23	5.19	17.75	9.05	16.10	4.40	2.60
Pyganic®	51.32	8.08	14.00	8.10	13.90	3.30	1.75
Aphrid™	52.27	4.80	18.75	8.50	16.70	3.85	3.35
Hexacide®	51.79	7.13	20.50	10.05	17.10	2.80	3.95
Entrust®	52.72	7.42	15.00	5.10	10.80	4.15	3.10
LSD 0.05	NS	NS	NS	NS	NS	NS	NS

Table 2. Grain quality in bean leaf beetle and soybean aphid treatments trial, Neely-Kinyon, 2006.

Treatment	Protein	Oil	Fiber	Carbohydrates	Moisture
Control	37.01	18.23	4.75	22.01	11.49
Pyganic®	37.50	17.75	4.70	22.05	11.45
Aphrid™	36.85	18.30	4.73	22.13	11.48
Hexacide®	37.14	18.36	4.70	21.80	11.51
Entrust®	37.64	17.88	4.70	21.79	11.54
LSD 0.05	NS	NS	NS	NS	NS



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

Figure 1. Bean leaf beetle, aphid, and beneficial and pest insect populations, Neely-Kinyon, 2006.