

# Effect of Organic Soil Fertility and Fungicide Treatments on Yield and Pest Management, Neely-Kinyon-2009

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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<sup>®</sup>, Marrone Bio Innovations, Inc., Davis, CA). Regalia<sup>®</sup> 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 from bean leaf beetle feeding 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, 2009, at a rate of 200,000 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: Twin N<sup>®</sup> (Mapleton Agri-Biotec Pty. Ltd., Mapleton, QLD, Australia) at 2.3 quarts/acre, Soy Soap<sup>®</sup> (Biobased AG, East Bend, NC) applied at 6.8 quarts/acre, and Regalia<sup>®</sup> applied at 4 quarts/acre, and a control (no sprays). Plots were maintained with rotary hoeings on June 11 and 24, and row cultivations on June 23, 30, and July 13. Soybeans were “walked” on July 16 and July 29. Soybean stand and weed counts were taken on July 14. Treatments were applied every 2 weeks from July 17 to August 28. Pest and beneficial insect sampling occurred in alternate weeks from July 24 to September 3. Soybeans were harvested on October 28. The percentage of stained soybeans was determined by counting the number of stained soybeans in a 200-g sample randomly collected from each plot at harvest.

## Results and Discussion

Yields in the organic soybean trial were excellent in 2009, averaging 55 bu/acre over all treatments (Table 1), showing great promise for the new aphid resistant variety. Although yields in all treatments were excellent, the control plots yielded 61 bu/acre, which was not significantly different from the Twin N<sup>®</sup> treatment yields. Twin N<sup>®</sup> yields (56 bu/acre) were not significantly different from the Soy Soap<sup>®</sup> and Regalia<sup>®</sup> yields, which averaged 51 bu/acre.

Plant populations averaged 141,687 plants/acre across all treatments, but Twin N<sup>®</sup> plots averaged 125,750 plants/acre, significantly lower than the control plots (159,750 plants/acre). Weed populations were not significantly different between treatments, averaging 6 broadleaf and 4 grass weeds/sq. meter on July 14.

For the most part, the organic treatments did not affect pest or beneficial insect populations compared to the control (Table 2). The seasonal average aphid population was 11 aphids per 8 sweeps, with peak aphid populations averaging 16 aphids per 8 sweeps, compared to 337 aphids per 8 sweeps on the non-resistant variety in 2008 (Table 2). The seasonal average bean leaf beetle population was 2 aphids per 8 sweeps, with peak bean leaf beetle populations averaging 3 beetles per 8 sweeps, compared to the 2008 peak population of 27 beetles per 8 sweeps (Table 1). There were significantly greater numbers of beetles in the Twin N<sup>®</sup> plots compared to the Soy Soap<sup>®</sup> plots on this sampling date, but because beetle numbers were so low, biological differences were not observed. The seasonal average of 4 beneficial insects per 8 sweeps represented the total number of beneficial insects collected over the season, with peak

beneficial populations averaging 3 per 8 sweeps. The most predominant beneficial insect was the minute pirate bug (MPB), *Orius insidiosus*, which attacks aphids, whiteflies and thrips. The seasonal average was 2 MPB/8 sweeps, with peak numbers averaging 3 MPBs per 8 sweeps. There were greater numbers (5 MPB/8 sweeps) on Regalia<sup>®</sup> plants compared to the 2 MPB/8 sweeps collected in control plots, but differences were biologically small. Spiders were also observed but averaged <1 per 8 sweeps at peak populations.

No soybean diseases were observed in sufficient quantities to warrant comparisons in 2009, including no signs of soybean rust. Seed staining averaged 0.4% in 2009, compared to 23% in 2008 (Table 2), with no differences among treatments. There were no significant differences in grain quality among treatments in 2009 (Table 3). Grain quality was excellent for organic soybeans, with an average protein content of 36.2%, 18.1% oil, 4.7% fiber, and 23.1% carbohydrates. The trial will be continued in 2010 with organic-compliant treatments to examine differences in a much wetter year.

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**Table 1. Stand, weed populations and yield in organic soybean fertility and disease treatment trial, Neely-Kinyon, 2009.**

Treatment	Stand (plants/acre)	Weed populations (weeds/m <sup>2</sup> )		Yield (bu/acre)
		Broadleaves	Grasses	
Control	159,750a	8.75	3.50	60.5a
Twin N®	125,750b	8.25	4.25	56.1ab
Soy Soap®	144,250ab	3.00	4.75	50.8b
Regalia®	137,000ab	3.50	5.25	50.9b
LSD 0.05	32,800	NS	NS	7.2

**Table 2. Insect populations and soybean staining in organic soybean fertility and disease treatment trial, Neely-Kinyon, 2009.**

Treatment	Peak aphid population	Peak BLB population	Peak MPB <sup>1</sup> population	Peak spider population	Peak beneficials population	Seasonal average aphids	Seasonal average BLBs	Seasonal average MPBs	Seasonal average beneficials	Soybean staining (%)
Control	8.3	2.5ab	1.8b	0.5	3.3	5.1	1.7	1.3b	2.3	0.75
Twin N®	9.8	5.8a	2.5ab	0.3	2.5	12.8	2.3	2.0ab	3.3	0.25
Soy Soap®	15.8	1.8b	4.3ab	0.5	2.5	10.8	1.2	2.3ab	5.2	0.15
Regalia®	28.0	3.3ab	5.3a	0.0	3.8	14.4	2.2	2.8a	5.3	0.50
LSD 0.05	NS	3.9	3.2	NS	NS	NS	NS	1.47	NS	NS

<sup>1</sup>MPB = minute pirate bug (predator)**Table 3. Grain quality in organic soybean fertility and disease treatment trial, Neely-Kinyon, 2009.**

Treatment	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)	Moisture (%)
Control	36.12	18.02	4.75	23.10	16.98
Twin N®	36.10	18.05	4.72	23.12	16.72
Soy Soap®	35.98	18.15	4.78	23.12	17.42
Regalia®	36.42	18.00	4.72	22.85	16.75
LSD 0.05	NS	NS	NS	NS	NS