Reducing the Impact of Soybean Aphid on Organic Soybeans Through Multiple Management Tactics

Final Report - SARE Farmer/Rancher Grant
Submitted March, 2012

Objective 1: Evaluate Pyganic® (natural pyrethrum) performance with Air-Assist Sprayer Technology:

Background: Preliminary work in 2009 demonstrated the Pyganic, when applied with an air-assist sprayer, improved the performance of the insecticide and could reduce aphid infestations by 40-60%. This study would expand upon the preliminary work, increasing plot size with the intent of evaluation control at a lower treatment threshold and assessing the impact on yield, seed quality, and beneficial insects.

Procedures:

Aphid colonization: Field scouting for soybean aphids began in late June. Initial efforts were directed at soybean fields that were next to wooded sites that had buckthorn in the understory. Sites were found and soybeans in the field were scouted for a minimum of 20 minutes. Reports indicated whether aphids were found and the size of colony observed.

Production Field Infestations: Once aphids were found in soybean fields, scouting efforts focused on the commercial organic fields owned by the project's farmers. Sixteen fields (Figure 1) were scouted from July 21 to August 19 (R 5 growth stage). Fields were scouted using the "Speed Scouting" procedure developed by U of M researchers. Additional information was recorded, which included estimates of aphids/plant based on count categories. The scouting and aphid/plant estimates were used to document infestation levels and identify fields requiring treatment. Treatments were planned to coincide with populations reaching a population averaging 100-150 aphids per plant, an infestation level below the 250 aphids/plant used for conventional soybean production.

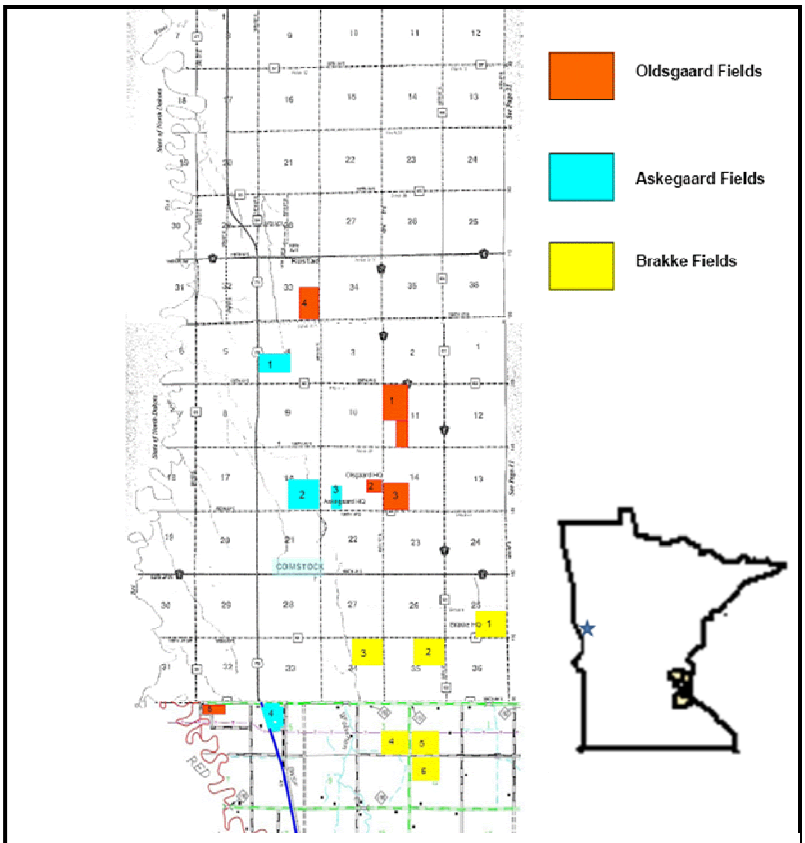
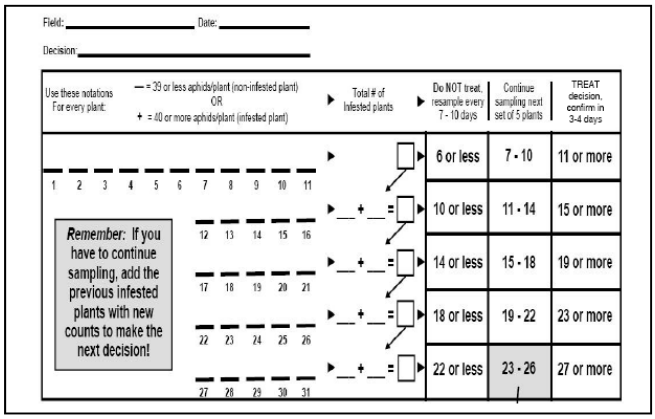
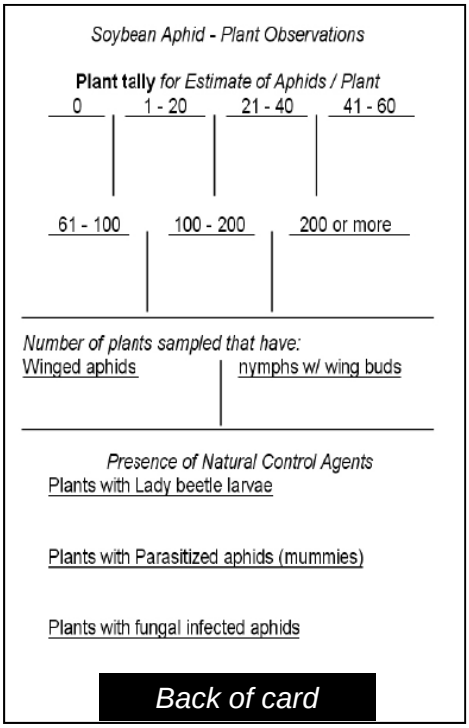


Figure 1. Location of organic soybean fields farmed by the project's farmers in southwestern Clay County, near Comstock, MN. 2010.

"Speed Scouting" procedures are based on the 250 aphid treatment threshold. By following the procedures, fields with significant aphid infestations would be identified. In addition, the aphid per plant estimates were made to graphically illustrate population increases and provide a method of estimating when populations reached an average size of 100—150 aphids per plant, the target treatment threshold for using Pyganic to manage infestations. The two-sided, pocket-sized field card used to record scouting observations is shown in Figure 2.



Front of card



Back of card

Figure 2. Two-sided, pocket-sized card used to record "speed scouting" observations and to record the total number of aphids per plant by the listed categories, the presence of winged aphids, predators, parasitized, and diseased aphids

Pyganic Efficacy Study:

2010

An organic field site in Crookston, MN Polk County) was identified as having significant aphid infestations on August 5, 2010. The air-assist sprayer, Pyganic, and plot designation were set on that day. Treatments were applied on August 6. Post treatment counts were made on August 9 and August 17. Plots to estimate yield were harvested on Sept 27.

2011

Pyganic® and aerial application evaluation:
Pyganic was applied by air using an electrostatic sprayer. Applications were made in the evening (approx 8 to 9 pm) to minimize UV light exposure. Fields were treated when field scouting revealed that plant infestation levels were reaching the 100 aphid per plant range.

Results and Discussion

Aphid colonization and Field Infestations:

2010

The results of aphid scouting for the sixteen commercial fields is summarized in the figures on pages 3 - 10. The 2010 season was anticipated as an outbreak year for aphid. However, the scouting reports indicate that no outbreaks occurred in the commercial organic fields monitored.

The scouting report was designed to identify fields that reached infestations of 100-150 aphids per plant as indicated by the proportion of plants shifting to the 100 aphid per plant category. None of the fields shifted significantly to that category. The week of August 9-13 saw a shift to higher numbers on a low percent of the plants. Those numbers had declined by the next week and plants were reaching the R-6 growth stage. These conditions indicate that further risk to aphids was negligible for the year. It also meant that treatments in these fields would not be necessary.

A significant outcome of this effort was the demonstration of the value of weekly scouting to track aphid populations. The program should have identified any field with economic populations instead of treating after numbers exceeded target thresholds.

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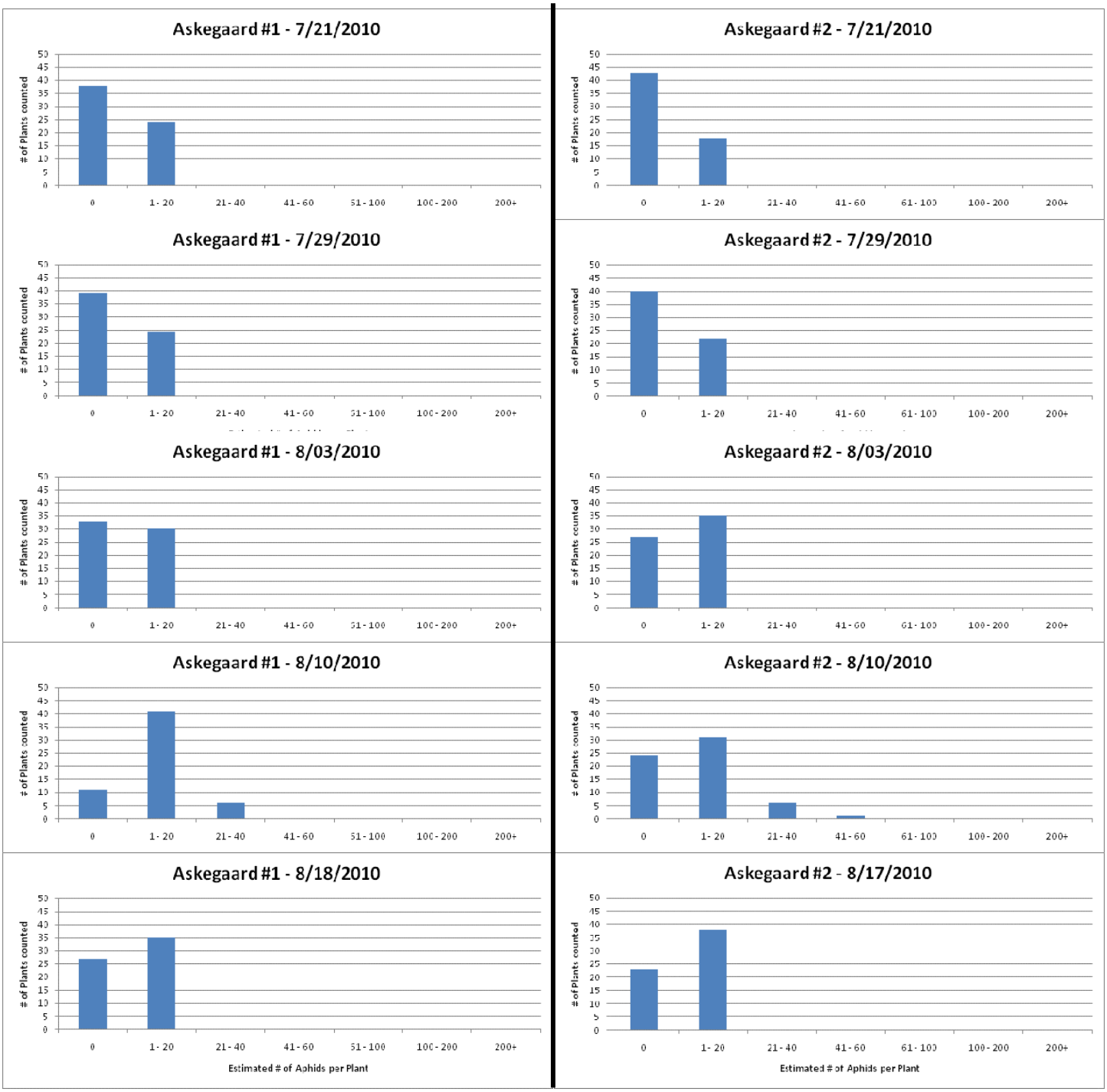
Soybean aphid scouting summary by field (column) and week/date (row) during the 2010 growing season in commercial, organic soybean fields near Comstock, Minnesota.



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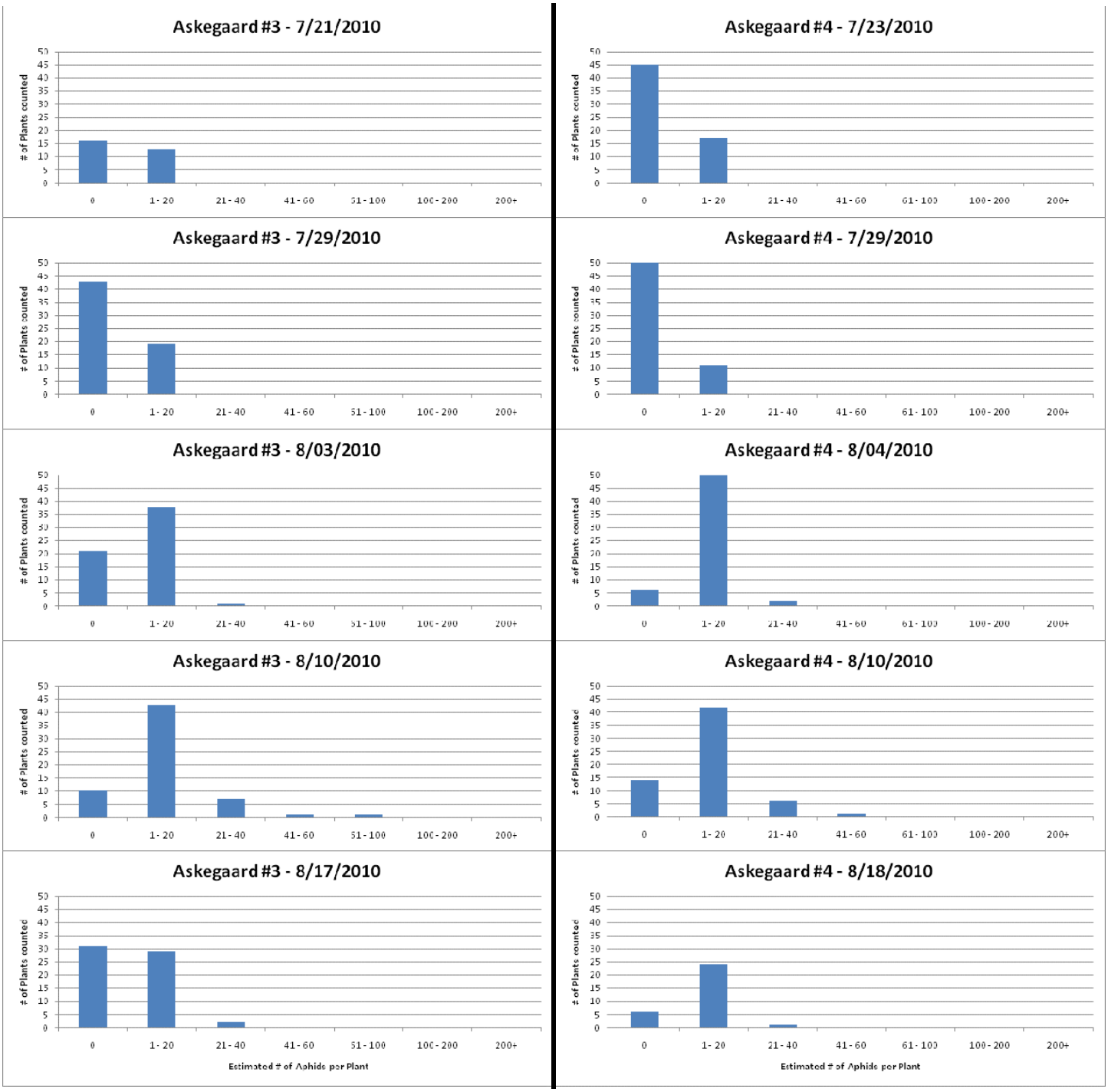

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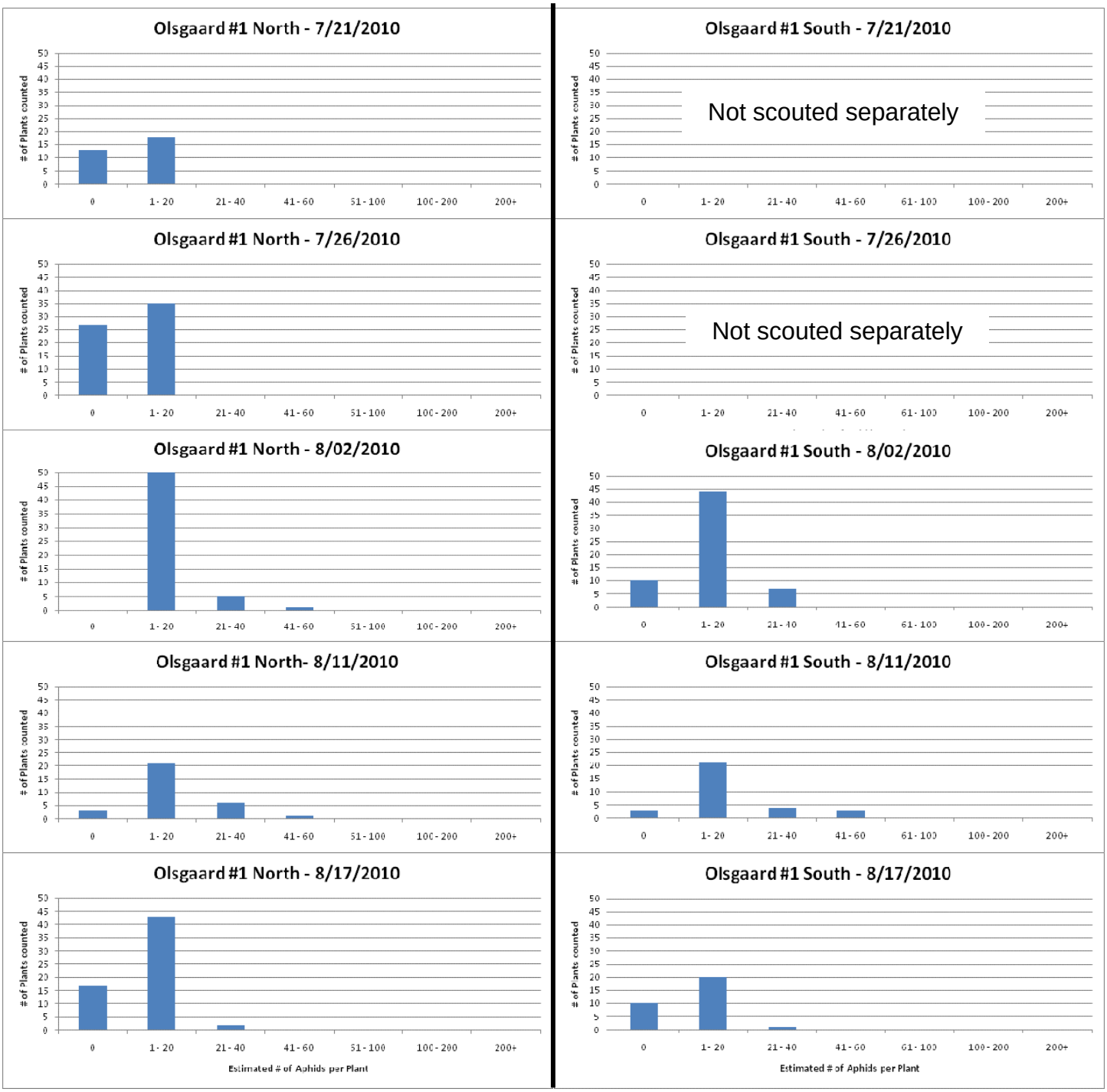

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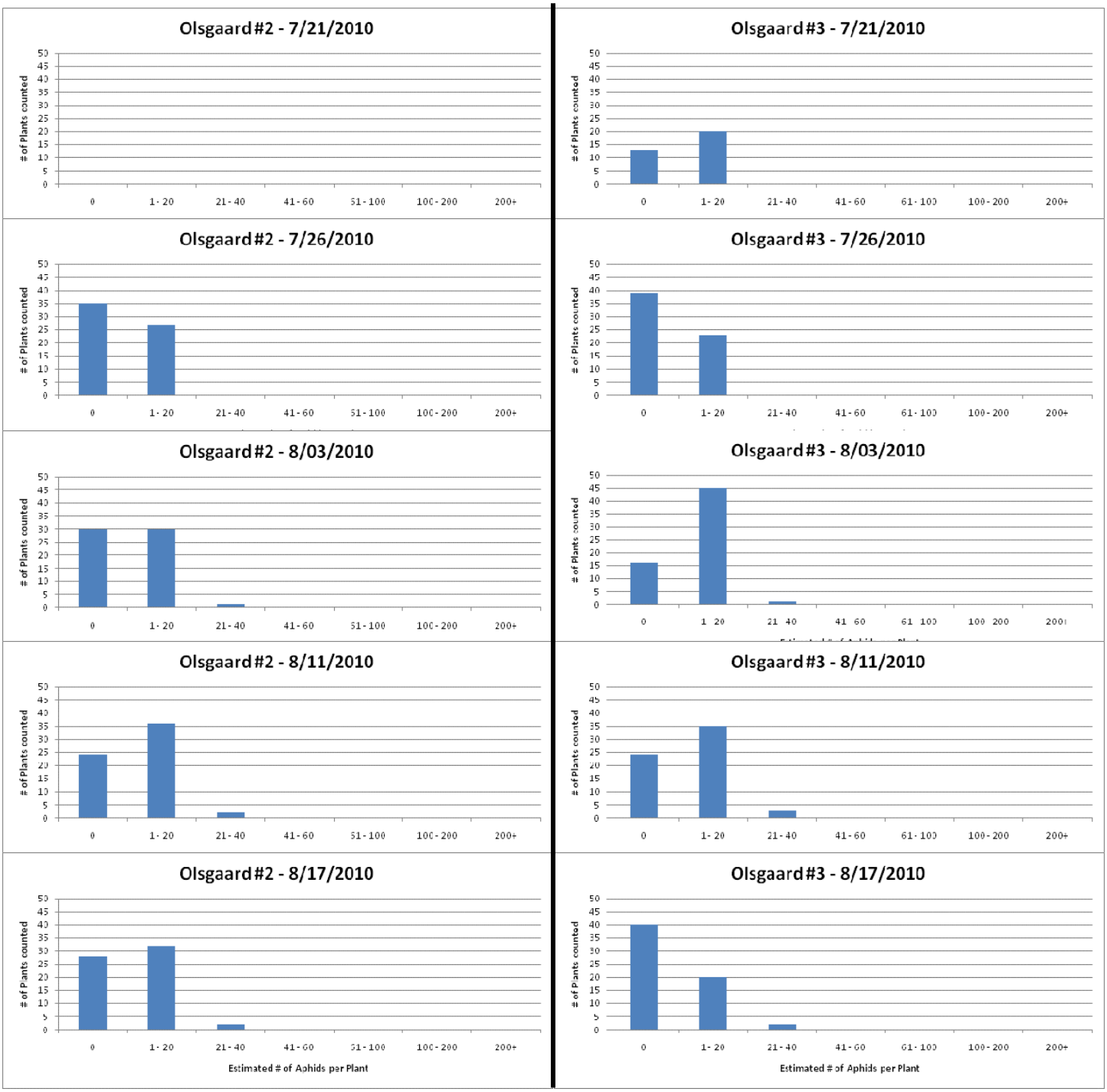

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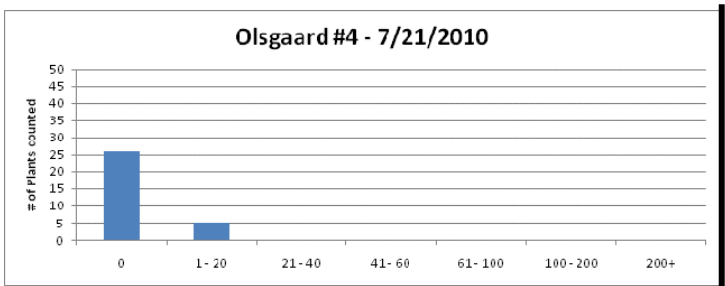
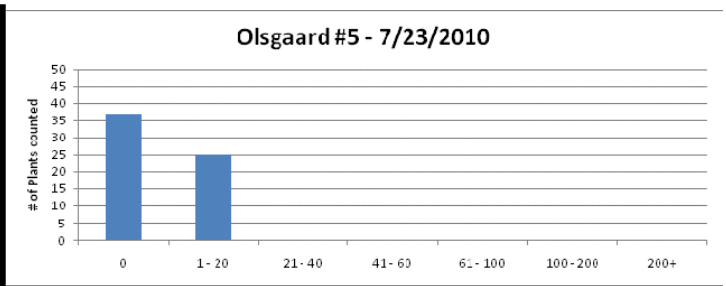
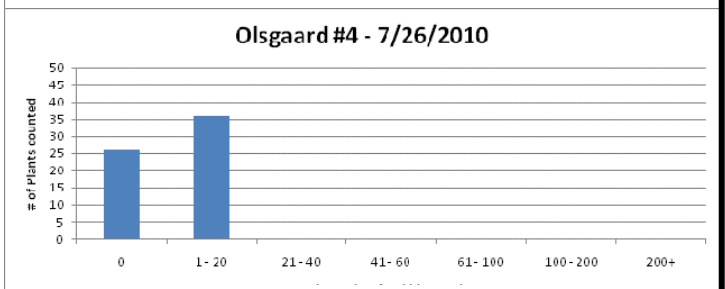
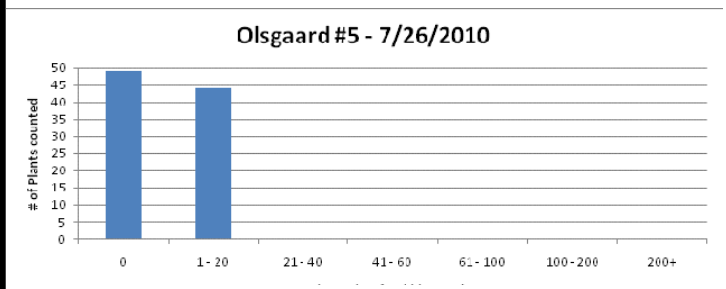
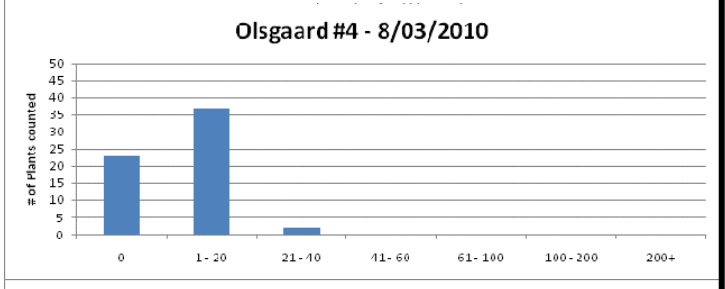
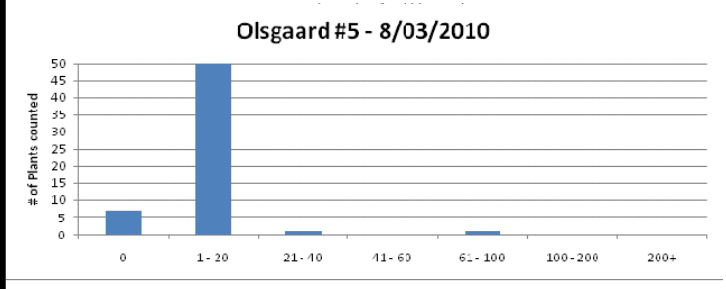


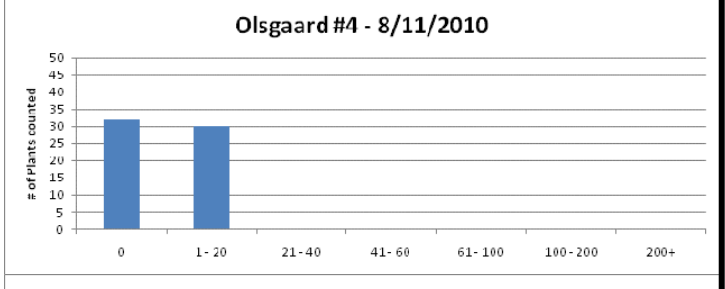


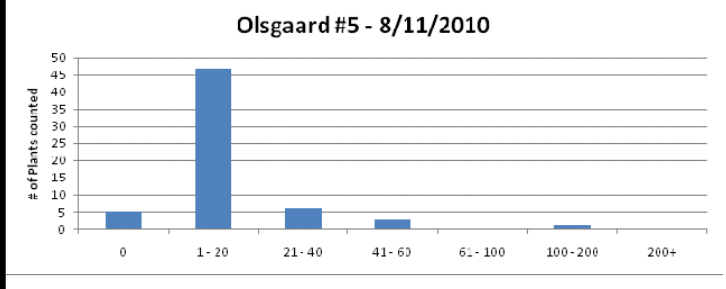


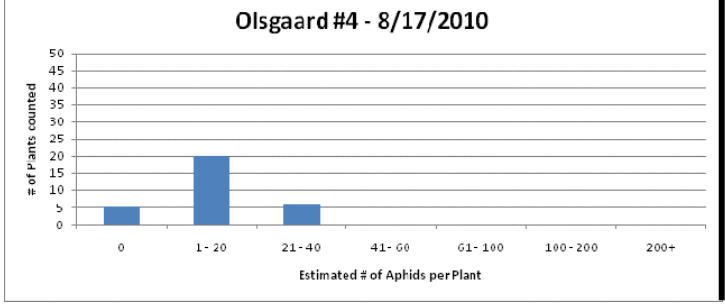


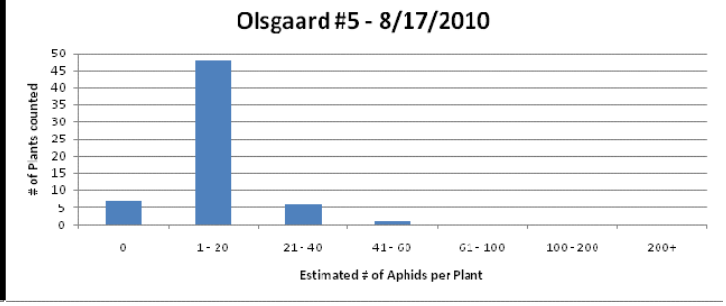




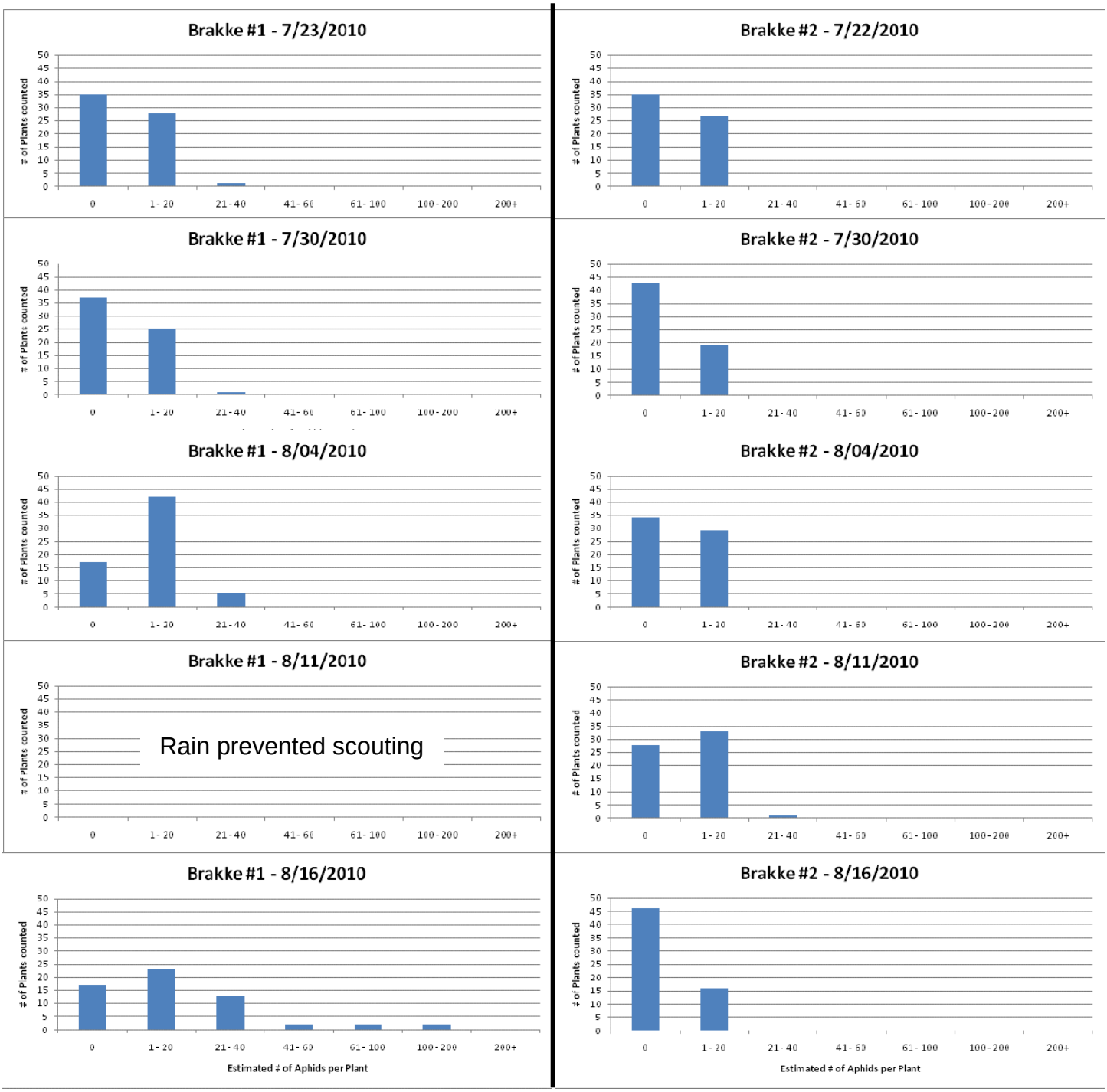








Soybean aphid scouting summary by field (column) and week/date (row) during the 2010 growing season in commercial, organic soybean fields near Comstock, Minnesota.



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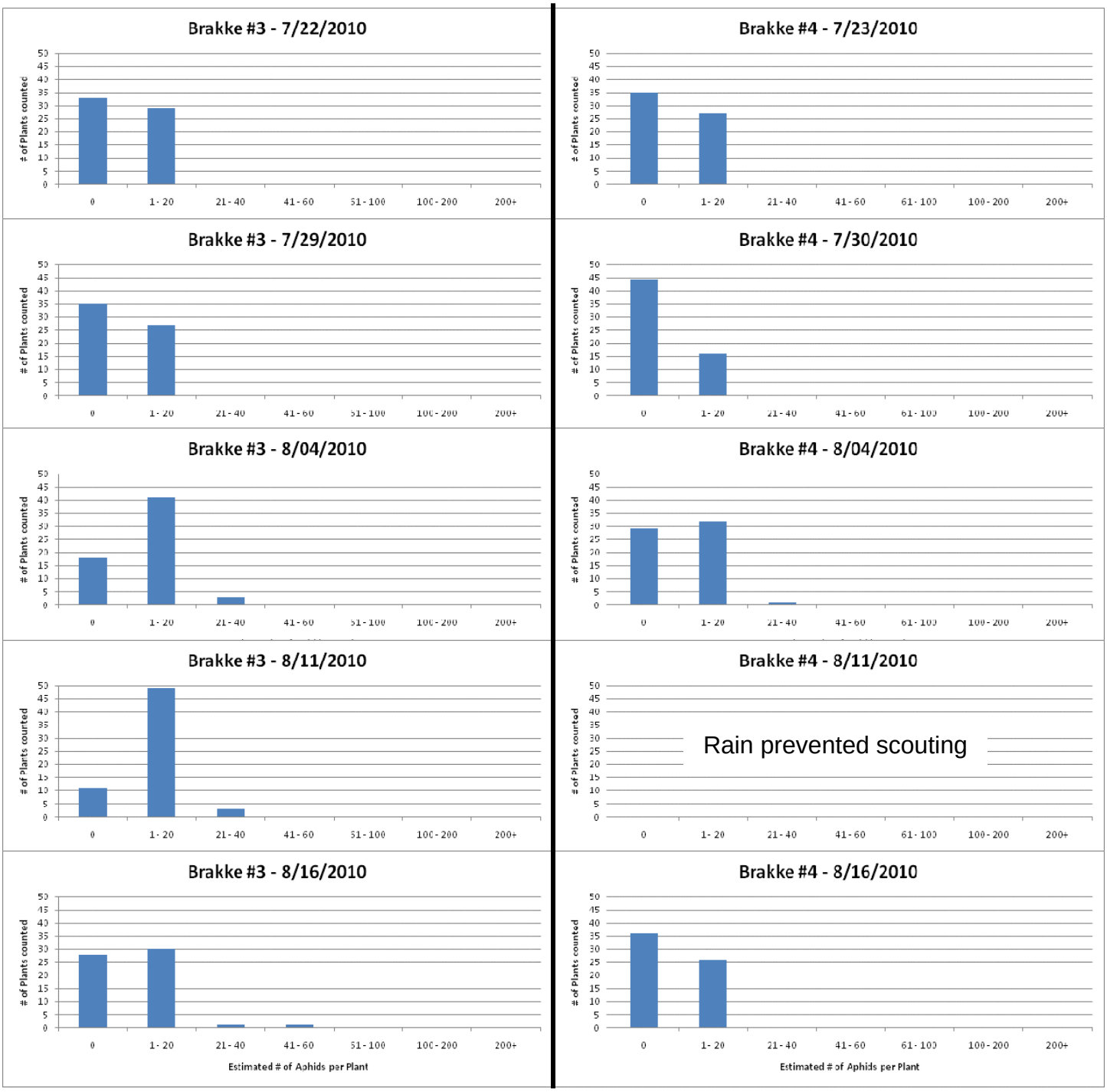

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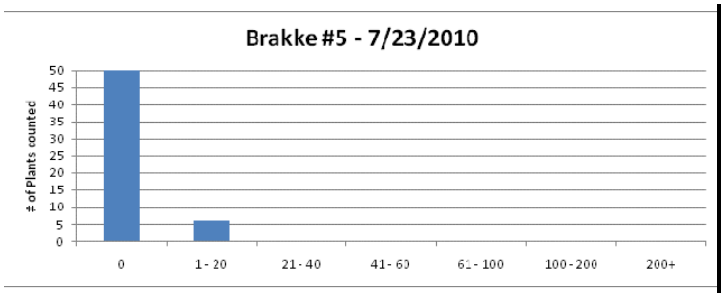

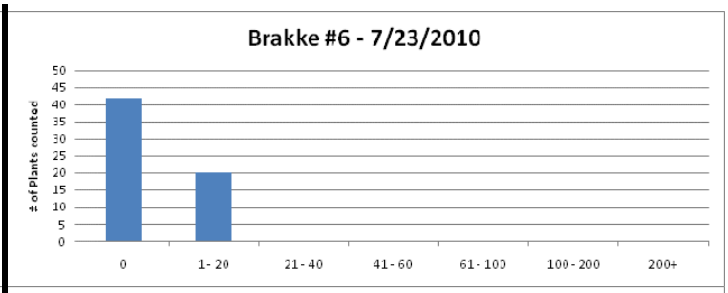

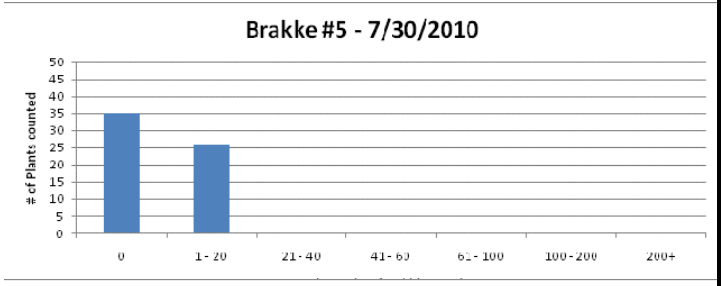

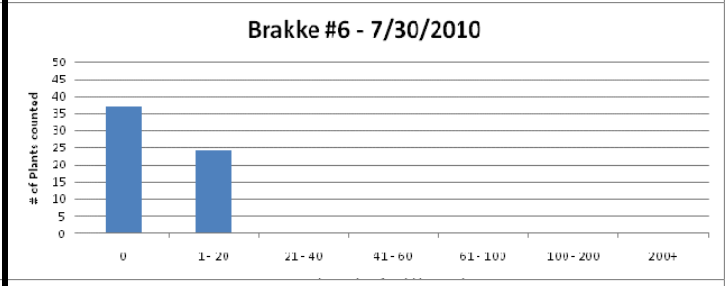

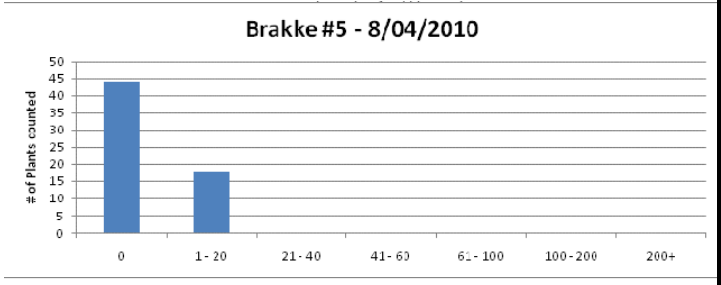

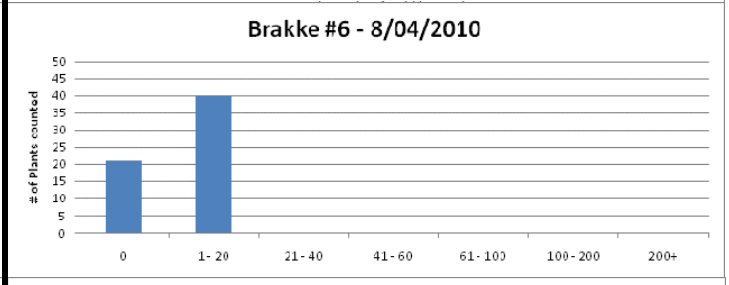

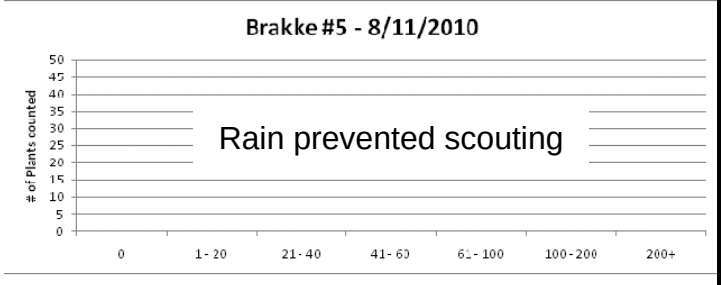

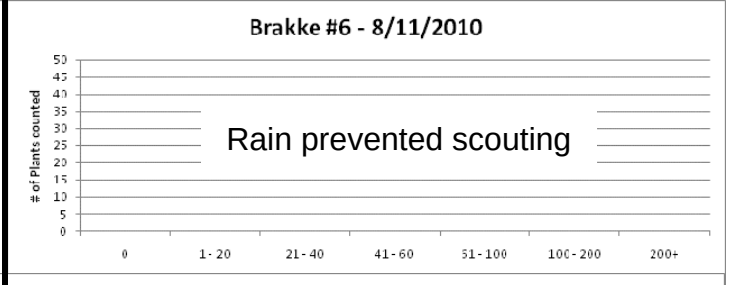

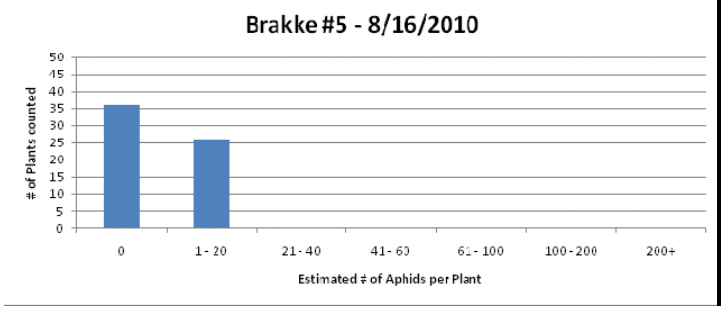

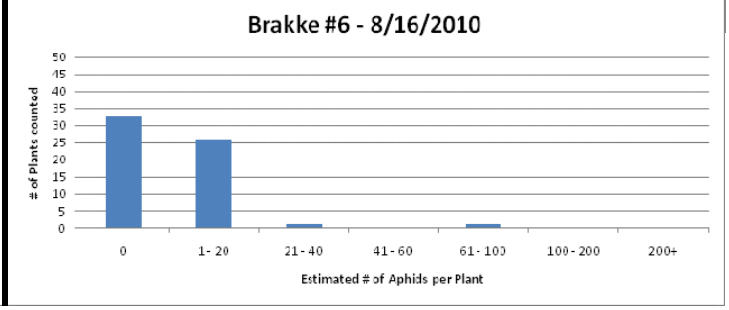

Objective 1 continued from page 2

The scouting protocol will be evaluated and likely amended for 2011. The categories for aphids/ plant will likely be adjusted for a little more balance in the range covered to allow a better definition of an “average” plant infestation.

Pyganic Efficacy Study:

2010

None of the scouted fields reached threshold levels in the Comstock, MN area. One organic soybean field near Crookston, MN was reported to have a significant aphid infestation. After scouting and determining infestation levels, individual plants were flagged and sampled to estimate aphid/plant numbers. Blocks where plants were located were randomly assigned as treated *vs.* untreated. Speed scouting was conducted to evaluate proportional breakdown of infestation levels (Figure 1) and the procedures treatment decision.

After treatment was made, follow-up counts were taken to assess the impact on the infestation levels. In October, 20 row feet were harvested within each treated and untreated block to compare yield and quality.

Five acres of the field were treated one time on August 6 at a rate of 0.35lbs AI/acre (Pyganic EC 1.4®=32 fl oz/acre) using the air-assist sprayer. Individual plants by treated vs. untreated were flagged to obtain aphid counts /plant to determine impact of Pyganic®. For the field as a whole, aphid numbers were greater than the target threshold of 100-150 aphids/plant.

Results from the treated site in Crookston, MN found treatment reduced aphid populations by an average of 56% (140 aphids/plant reduced to 78); untreated plots had an average increase of 50% (158 aphids/plant increased to 237) (Figure 2).

Average yield from treated plots was 19% grater than from untreated plots, however, the yields were not statistically different (Table 1).
In general, 67% of treated plants had decreased aphid numbers; 70% of the untreated plants had increased numbers.

The level of aphid control observed was similar to 2009. No significant yield response in this study was most likely due to treatment delays well beyond the 250 aphid/plant threshold. We still strongly feel that a spray threshold of 100-150 aphids/plant is a better target. Pyganic® at the applied rates suppresses populations but does not reduce them comparably to synthetic insecticides used by conventional farmers. Allowing populations to exceed the 250 aphid/plant threshold prior to treatment appears to create a big challenge for Pyganic® at these rates to overcome aphid population survival and subsequent increase.

2011

Figure 3 highlights the scouting approach and how decisions were made for lower threshold use, and the impact after treatment. Rain showers two days after the first application prompted the second, as numbers did not decline as hoped. Additional fields were treated and similar results were obtained.

Another field was treated where aphid numbers increased beyond threshold, similar to circumstances as earlier years. The field was scouted, population estimates by aphids/ plant were made (Figure 4). Aerial application of Pyganic was made on 8/13. After 48 hours, populations were reduced by 32% compared to three areas tarped as untreated checks. The "white dwarf" form of the SBA were prevalent in both pre and post counts. The post counts observed by P Glogoza were shifted predominately to the white dwarf form and very low numbers of the green, normal form were present. Colonies in the upper parts of the plant were severely depleted, leaving mostly white dwarves surviving on the lower, older, and "leathery" leaves of plants.

Modified “Speed Scouting” for SBA decisions in organic soybean:

A modified scouting procedure was tested in 2010. It provided a very good look at weekly aphid populations. The “speed scouting” method,

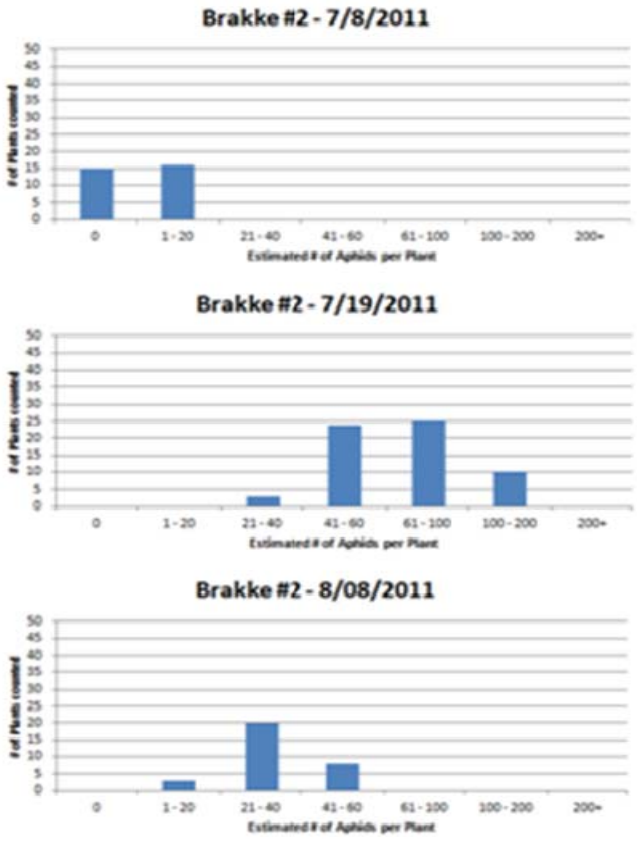

Figure 1. Soybean plants (N) observed by aphid count range. Field was treated 7/21 and 7/28. Comstock, MN. 2011.

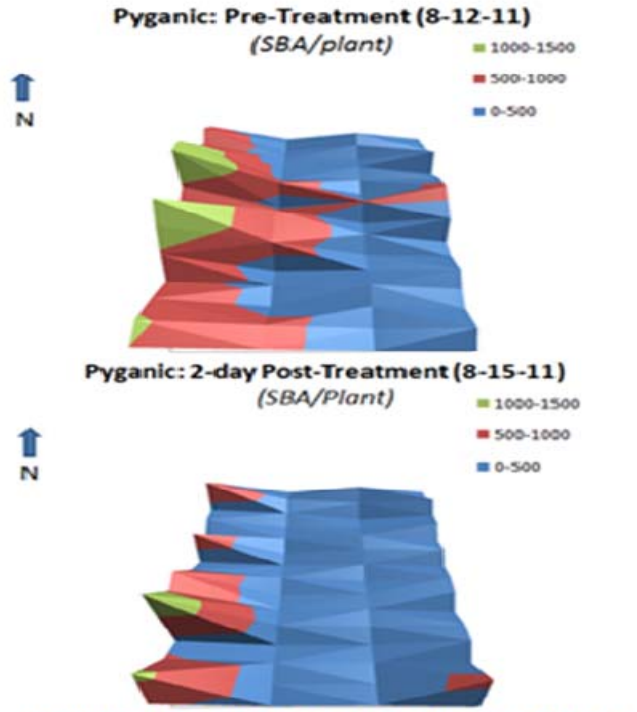

Figure 2. Soybean aphids per plant, pre- and post-treatment with Pyganic. Comstock, MN. 2011

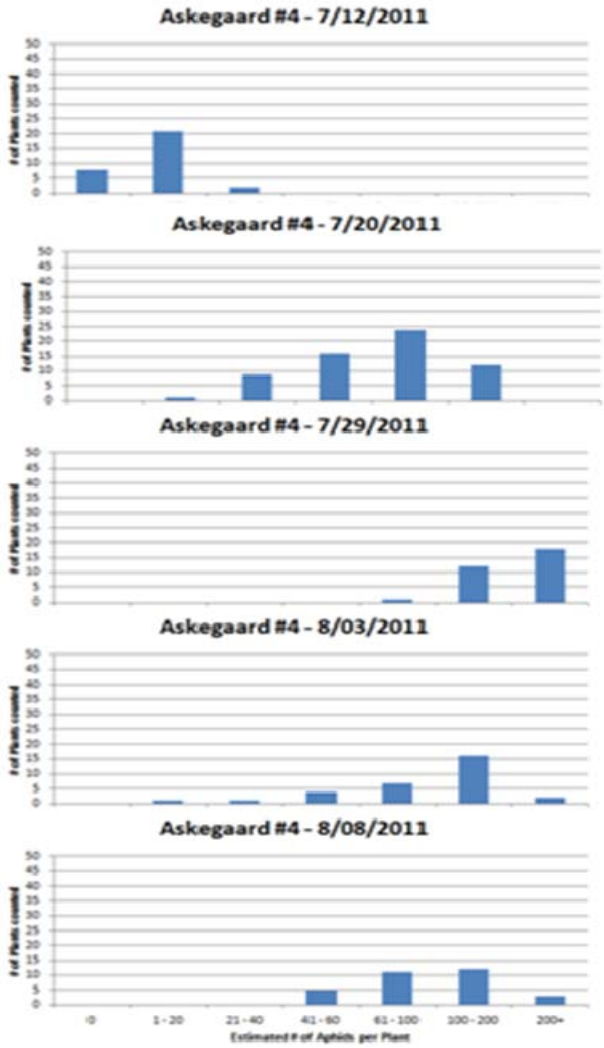

Figure 3. Soybean aphids per plant, and progression of infestions based on modified "speed scouting". Comstock, MN. 2011

combined with estimating plant populations and assigning to a category allowed us to see when per plant infestations were increasing based on the number of plants moving to the higher categories (Figure 1 and 3). Our target for treating is when the majority of plants shift into the "61-100" and "100-200" category. We will probably change these categories a little for 2011 so the range of values are more equal and should give a more reliable way to calculate an average.

Objective 2
Delaying Aphid Colonization with Reduced risk OMRI Approved Insecticide:

2010
The Oldsgaard #5 (second column, page 7) site had some of the greater aphid counts from the production fields being monitored. One end of the field was selected for the suppressive study, spraying insecticidal soap (M-Pede®) to evaluate the effect the product would have on aphid populations, predators, and yield. Soap treatments were begun on July 26. Individual plants were flagged in designated treated vs. untreated areas of the field. Aphid counts per plant were stopped on August 16 when plants reached the R-6 growth stage and aphid populations in the region were generally declining. Due to low and similar aphid populations in treated and untreated, no yields were taken.

2011
A spray trial to evaluate insecticidal soap as an aphid suppressant was set up as RCB design with 3 replications (Untreated check, soap at 2% v/v, and soap at 4% v/v). Treatments were applied 7/18, 7/25, 8/1 and 8/8. There were no significant differences in the average number of aphids by date (Table1). Aphids did not increase to population levels observed in neighboring fields, either.

Table 1. Mean number of soybean aphids per plant by treatment on the corresponding dates. Comstock, MN. 2011.

Treatment	20-Jul	25-Jul	5-Aug	11-Aug	15-Aug
UTC	59	32	54	51	53
2% v/v	68	27	48	55	60
4% v/v	54	23	34	34	37
	NS	*NS*	*NS*	*NS*	*NS*

Objective 3
Planting Date and Relative Maturity (RM):

2010
Plots at two sites, originally designed for a Planting Date x Relative Maturity interaction, were planted as a single planting date with subplots/ split-plots for weed management and aphid threshold. Weed-free and grower practices were compared based on weeds per row feet. Weed-free plots were manually hoed. Split plots were set up for different aphid thresholds. Lack of significant aphid numbers prevented any work on comparing aphid management outcomes. Late-May plantings had similar weed pressure between weed-free and grower's practice.

Weed-free and grower practices were compared based on weeds per row feet. Weed-free plots were manually hoed. Split plots were set up for different aphid thresholds. Lack of significant aphid numbers prevented any work on comparing aphid management outcomes. Late-May plantings had similar weed pressure between weed-free and grower's practice. Due to similarity of all blocks; no yields were taken.

2011
Due to the wet spring and delays in planting, this objective was not addressed in 2011.