Trial: 2003-SBAfoliar

Foliar applied insecticide control of the Soybean Aphid (*Aphis glycines*).

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Background

The soybean aphid (SBA) is a relatively new pest of Minnesota soybeans. It was first identified during the late summer of 2000 in SE MN. SBA subsequently spread throughout the soybean growing areas of MN during the 2001 growing season with localized yield limiting populations in 2002.

This trial was designed to look at aphid control and resultant yield differences between 1) Insecticides and 2) Application timings and the relationship of aphid population to yield.

Site and application information

The trial was placed in a production soybean field with a history of high yields near New Ulm, MN. This field is located near the Minnesota River and numerous wooded areas containing buckthorn, *Rhamnus sp*. This field is in an area where high early season soybean aphid populations, assumed to be locally overwintered, had been had been steadily increasing. Initial aphid populations at the first insecticide timing averaged 127 aphids/plant July 12, on V10-12, R2 soybeans. Soybean aphid populations had increased only slightly (154 aphids/plant) by July 18, when the insecticide comparison treatments were made. Soybean growth, at the onset of the experiment was exceptionally tall and dense, with rows nearly closed and showing no detectable aphid injury.

Yields are at or above average for the growing season with dry late season conditions. *Sclerotinia sclerotiorum* at up to 20% incidence occurred in this trial, which limited yields and may have influenced the results discussed below.

Cooperators: Randall Reinhart, Steve Commerford
County: Nicollet, MN
Nearest town: New Ulm, MN
Soil type: Nicollet clay loam
Fertility: Very High
Tillage: Disk ripped corn stalks fall 2002
1X field cultivator, Spring 2003
Cultivar: Stine 1918-4 *
Weed control: Authority 4.5 oz/acre PRE, followed by Glyphosate 2X POST
Row spacing: 30”
Planting date: May 5, 2003
Design: Randomized complete block with 4 replications

Plot size: 15' x 30' (the center 4 of 6 rows (10') were treated, the center 2 of 6 rows were combined.
Application date(s): 1) Efficacy- July 18, 2003
2) Timing - July 13,18,29,August 4,11
Wind conditions: All applications were made with winds under 5 MPH
Crop stage at application: R2-R5
Crop height at application: 36 inches July 13, taller with subsequent treatments

Insecticide treatments were applied with a CO2 pressurized backpack sprayer, 8002XR flat fan nozzles on 18-inch spacing, 20 gallons/acre, 35 PSI.

* Illustrative of the potential foibles associated with on-farm research, after initial treatments had been applied (R4.5), it was discovered that Agri Pro 1702 seed had been blended in the planter at an increasing rate (up to 12 %) with the Stine variety to the west side of the plot. This did not appear to significantly affect results when analyses with and without mixed seed plots were compared. The results presented are for all plots.

In addition to raw yield, the effects of soybean aphids on seed size were estimated by the weight of 200 seed sub samples for each plot. Bean leaf beetle damage was estimated based on the percentage of seed showing bean pod mottle symptoms in a 200 seed sample. Protein and oil content will also be run from each plot.

Soybean aphid populations were estimated by whole plant aphid counts on 5 plants/plot. SBA densities were initially greatest on the upper canopy but by 7/18 lower canopy leaves, especially those on terminals of developing branches, were being increasingly colonized. Data were transformed to the following 1-10 scale to perform an analysis of variance (ANOVA) and means were separated by Duncan's new multiple range test.

	LOW DENSITY		HIGH DENSITY	
	mimimum	maximum	mimimum	maximum
1	0.0	0.0	0	0
2	0.1	2.5	1	25
3	2.6	5.0	26	50
4	5.1	10.0	51	100
5	10.1	20.0	101	200
6	20.1	40.0	201	400
7	40.1	80.0	401	800
8	80.1	160.0	801	1600
9	160.1	320.0	1601	3200
10	> 320.0		> 3200	

Aphid-days or the number of aphids/plant x number of days aphids present were calculated for each plot to provide an estimate of both intensity and duration of soybean aphid pressure. Aphid days = [(*SBA/plant sample date 1 + SBA/plant sample*

*date 2)/2 * days between samples*]. For example, 25 aphids/plant for 4 day and 50 aphids/plant for 2 days would both equal 100 aphid days.

Results and discussion

By July 29, early treated plots were visually taller than untreated plots. In addition to stunting, after August 8, untreated plots suffered increasing lower leaf loss compared to those where aphids were controlled. Untreated plots also matured earlier compared to those with early aphid control.

1) Insecticide efficacy

This was not designed as a stand-alone insecticide comparison trial. Treatments were limited to a few products and rates were designed to look at residual control as well as initial performance. Aphid control and yield results are presented in Table 1. The 3.2 oz rate of Warrior treatment was also part of the timing trial and was re-sprayed with 6.4 oz of Asana on 8/11/ Aphid control data up to that point can be compared to other products but yield data is shown only as a full season control comparison.

Similar to 2002 results, excellent aphid control was obtained with moderate water volume and pressure in spite of a tall, dense soybean canopy. The design of this experiment should have favored soybean aphid re-colonization of treated plots from untreated rows on either side. At 4 days after treatment (4 DAT), all products, except of the low (1.8 oz.) of Baythroid, significantly reduced aphid populations. The 1 pint rate of Lorsban 4E and the 2.0 and 3.2 oz rates of Warrior provided significantly better initial control (knockdown) than other products. Similar to 2002 results there does appear to be an advantage for higher rates. By 10 DAT, the 3.2 oz rate of Warrior provided better control than the 2.8 oz rate of Baythroid (sampling error?). From 15 –19 DAT no significant differences between treatments were observed with populations increasing in all. The decline was due, in part, to entomopathogenic fungi. By 33 DAT no significant differences between the untreated checks and any insecticide treated plots were observed. In this field, Aphid populations in this trial peaked around 8/08 and began to decline thereafter.

All treatments, with the exception of the low (2.0 oz.) treatment of Warrior, yielded higher than untreated. All insecticides accumulated similar aphid days approximately 20,000 fewer than the untreated check.

2) Insecticide timing

Aphid control by date of insecticide application and respective yields are presented in Table 2. Figures 1 and 2 show aphid populations and accumulated aphid-days by treatment respectively. Note the two population declines (aphid emigration) events in Figure 1. Winged aphids were especially abundant at these times but were present at some level throughout the latter part of the experiment.

Highest yields resulted from treating aphids from 7/18 – 8/04 or R2 – R4 (Figure 3). Delaying treatment until 8/11 or R5 did not maintain yield. This is not surprising since similar aphid pressure as measured by aphid-days occurred in the untreated and 8/11 treated plots.

Surprisingly, the plots that received aphid control early (7/13) yielded less than later applications. The lower yields in the 7/13 and possible the 7/18 treated plots may reflect increased white mold severity in the taller soybeans resulting from early aphid control. After 7/18 the slope of the regression of yield loss on accumulated aphid days is very similar to that observed in other SW Minnesota trials. Very good prediction of maximum yield for this trial was obtained from accumulated aphid days and yield of the untreated check. In addition to the potential impact of *Sclerotinia* on yield these data suggest a hypothesis of the relationship between aphid populations and yield loss. The level of infestation (aphid days or population) after which yield loss occurs may be higher under high yield conditions. In other words, yield loss does not occur until some level of aphid pressure is reached. This point may change with environmental conditions or timing of aphid populations with respect to soybean development.

Bean leaf beetles and their feeding damage were common in this trial. Significant treatment differences in seed symptoms (mottling) of bean pod mottle virus, which is transmitted by the bean leaf beetle did not exist or could not be detected with the sampling method used. Seed size tended to relate to yields. Seed was smaller in untreated or late treated plots, although not significant at the 5% level.

Acknowledgments:
Many thanks to Derek Erickson, Mellisa Olsem, and Mark Anderson for aphid counting assistance. Yield data would not have been possible without the intrepid SWROC mobile plot combining crew of Steve Quiring and Jeff Irlbeck.

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Table 1. Foliar applied insecticide control (product performance) for Soybean Aphid.
Randall Reinhart farm, Nicollet County, MN, (2003).
B. Potter, U of M

Rated	Estimated Aphids/plant	Estimated Aphids/plant	Estimated Aphids/plant	Estimated Aphids/plant	Estimated Aphids/plant	Estimated aphid days	YIELD (bu/a) 13% moisture	SEED WGHT. g/200 seeds	mottled seed %
Date	7/22/2003	7/29/2003	8/4/2003	8/8/2003	8/21/2003	8/21/2003	9/24/2003	10/24/2003	10/28/2003
Days after treatment	4 DAT	10 DAT	15 DAT	19 DAT	33DAT	33 DAT			
Crop Stage	R3	R4	R4	R5.5	R6.5	R 6.5			
Untreated	142.6 a	712.5 a	393.5 a	1260.3 a	45.1 a	26854.1 a	36.8 b	28.5 a	5.8 a
Warrior-3.2 oz 7/18*[1]	0.7 c-d	2.1 c	26.4 b	346.0 b	11.6 a	6107.0 b	46.2 a	31.7 a	3.5 a
Warrior 2.0 oz 7/18	5.9 c-d	8.4 bc	23.4 b	228.6 b	49.3 a	5289.9 b	41.9 ab	29.4 a	2.1 a
Asana XL 6.4 oz/ 7/18	29.2 b	19.1 bc	23.1 b	271.9 b	26.7 a	5748.8 b	44.5 a	31.9 a	3.0 a
Baythroid 2.8 oz 7/18	31.8 b	97.5 b	35.2 b	267.7 b	47.8 a	6829.9 b	44.5 a	29.4 a	2.1 a
Baythroid 1.8 oz 7/18	54.2 ab	10.0 bc	24.4 b	310.9 b	54.1 a	6511.2 b	43.2 a	30.7 a	4.0 a
Lorsban 4E 1 pt. 7/18	0.1 d	12.1 bc	43.2 b	250.1 b	82.4 a	5939.8 b	43.8 a	31.7 a	2.1 a
LSD (P=.05) *[2]							5.2	N.S	N.S
Standard Deviation	35.1	117.5	105.6	237.4	46.8	4023.7	3.5	1.9	3.3
CV	92.9	95.5	12.9	56.6	103.4	44.5	8.1	6.2	101.0
Grand Mean	37.8	123.1	81.3	419.3	45.3	9040.1	43.0	30.5	3.2
Prob(F)	0.0001	0.0007	0.0001	0.0091	0.1534	0.0001	0.0321	0.1081	0.7353

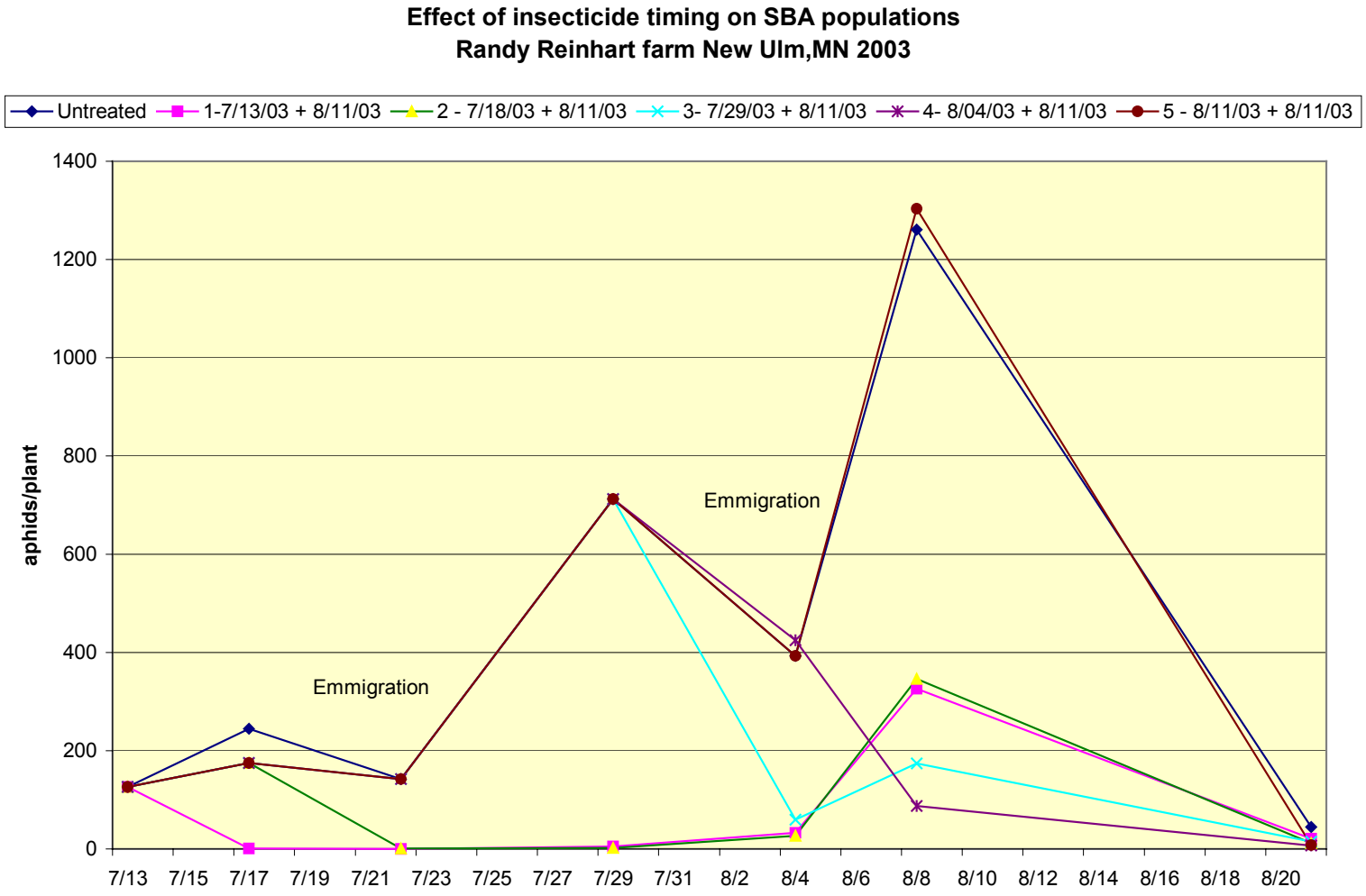
Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
All insecticide applications CO2 Backpack sprayer, 20GPA, 35 PSI
*[1] Respray 08/11/03 with 6.4 oz. Asana XL
*[2] Mean seperation for aphid/plant estimates based on a 1-10 rating scale

Table 2. Yield response to timing of soybean aphid control
Randall Reinhart farm, Nicollet County
B. Potter, U of M (2003)

Rating Date Crop Stage	Aphids/plant 8/8/2003 R5.5	Estimated Aphids/plant 8/21/2003 R6.5	YIELD bushels 9/24/2003	SEED WGHT. g/200 seeds 10/24/2003	mottled seed % 10/28/2003
Untreated	1260.25 a	45.05 a	36.80 c	28.51 a	5.80 a
1-7/13/03 + 8/11/03	326.85 ab	21.20 a	42.00 bc	28.89 a	2.60 a
2 - 7/18/03 + 8/11/03	346.00 bc	11.60 a	46.20 ab	31.70 a	3.50 a
3- 7/29/03 + 8/11/03	173.70 cd	14.90 a	49.80 a	29.14 a	7.10 a
4- 8/04/03 + 8/11/03	87.60 d	7.15 a	44.80 ab	28.80 a	2.40 a
5 - 8/11/03 + 8/11/03	1303.70 ab	7.80 a	36.80 c	27.82 a	8.30 a
LSD (P=.05)*2			5.56	N.S.	N.S.
Standard Deviation	274.34	31.42	3.67	1.66	5.22
CV	47.06	175.04	8.58	5.70	105.64
Grand Mean	583.02	17.95	42.74	29.14	4.94
Prob(F)	0.0007	0.9246	0.0009	0.072	0.5098

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
Insecticide 3.2 oz/A Warrior 7/13-8/04, Asana XL 6.4 oz/A 08/11/03
CO2 backpack 20GPA,35 lb PSI
*2 Mean seperation for aphid/plant estimates based on a 1-10 rating scale

Figure 1.


Effect of insecticide timing on SBA populations
Randy Reinhart farm New Ulm,MN 2003
Untreated
1-7/13/03 + 8/11/03
2 - 7/18/03 + 8/11/03
3- 7/29/03 + 8/11/03
4- 8/04/03 + 8/11/03
5 - 8/11/03 + 8/11/03
aphids/plant
1400
1200
1000
800
600
400
200
0
Emmigration
Emmigration
7/13
7/15
7/17
7/19
7/21
7/23
7/25
7/27
7/29
7/31
8/2
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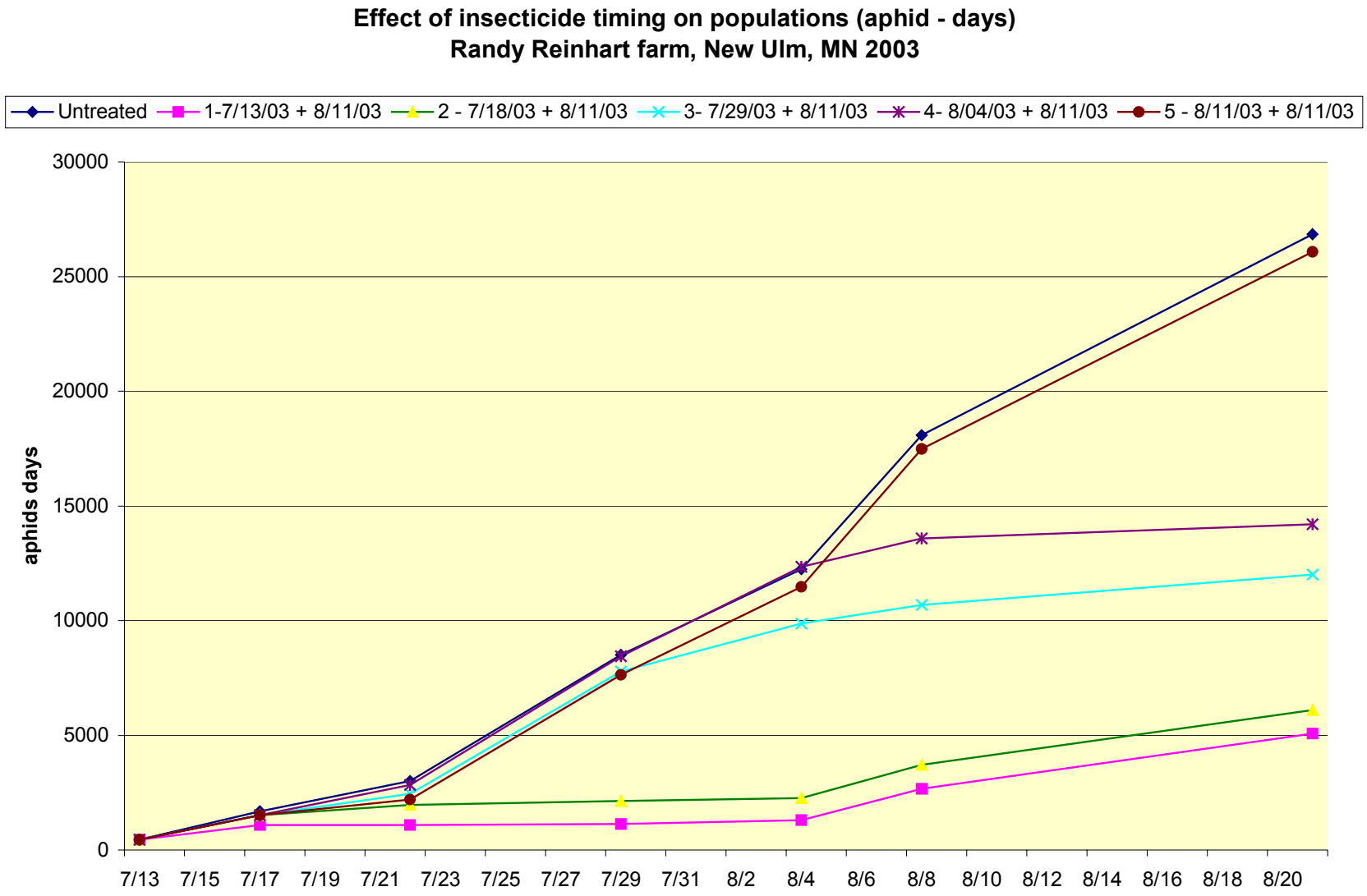
8/12
8/14
8/16
8/18
8/20

Figure 2.


Effect of insecticide timing on populations (aphid - days)
Randy Reinhart farm, New Ulm, MN 2003
Untreated
1-7/13/03 + 8/11/03
2 - 7/18/03 + 8/11/03
3- 7/29/03 + 8/11/03
4- 8/04/03 + 8/11/03
5 - 8/11/03 + 8/11/03
aphids days
30000
25000
20000
15000
10000
5000
0
7/13
7/15
7/17
7/19
7/21
7/23
7/25
7/27
7/29
7/31
8/2
8/4
8/6
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8/18
8/20

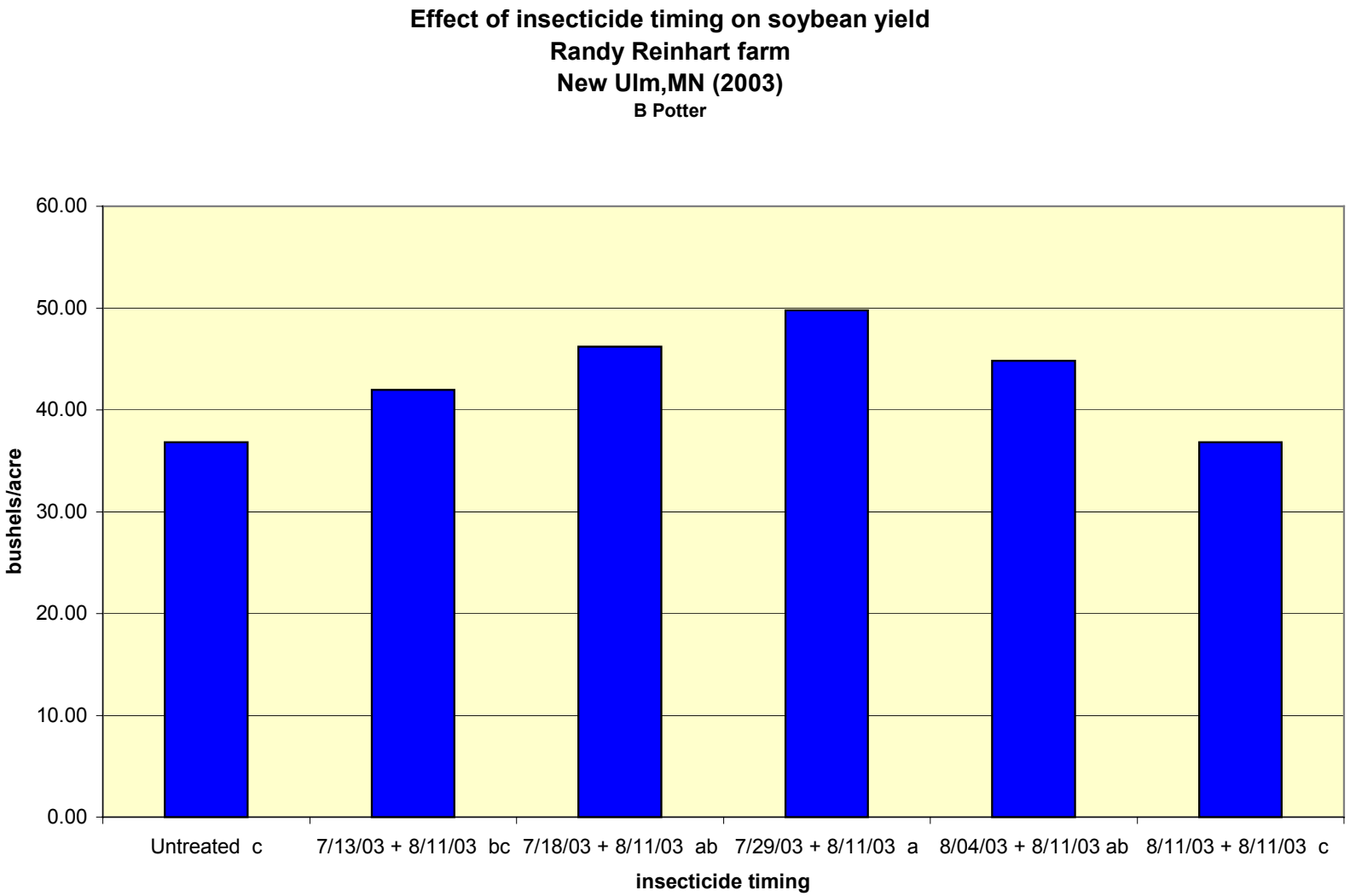
Effect of insecticide timing on soybean yield
Randy Reinhart farm
New Ulm,MN (2003)
B Potter
60.00
50.00
40.00
30.00
20.00
10.00
0.00
bushels/acre
Untreated c
7/13/03 + 8/11/03 bc
7/18/03 + 8/11/03 ab
7/29/03 + 8/11/03 a
8/04/03 + 8/11/03 ab
8/11/03 + 8/11/03 c
insecticide timing

Figure 3.