Seasonal Abundance and Control of the Lettuce Aphid, *Nasonovia ribisnigri*, on Head Lettuce in Arizona

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Abstract

Small plot studies were conducted in 1999/2000 to examine the population abundance and control of the lettuce aphid on winter and spring head lettuce crops. Seven, 0.25 acre planting of head lettuce were established beginning in October with final harvest occurring in April. Replicated plots within several planting were treated with an Admire treatment at planting, a sidedress application of Platinum post-planting or allowed to remained untreated. Lettuce aphids were first detected in our experimental area on Feb 14 in PD 3 in untreated plants. Temperature had an important influence upon lettuce aphid development based on our field observations. Population appeared to increase in early March when the average daily temperature was about 65 E F. We observed a sharp decline in population abundance in April where daytime highs exceeded 90 E F. We were surprised by the marginal level of lettuce aphid control provided by the systemic insecticides. Lettuce treated with Admire in the early planting dates appeared to prevent lettuce aphids from significantly infesting lettuce heads at harvest. In the later planting dates, both Admire and Platinum contained significantly fewer aphids and infested plants than the untreated control. However, lettuce aphids in the last 3 planting dates were able to colonize plants and infest a larger proportion of heads at levels not considered commercially acceptable. We are hesitant to draw conclusions from our results collected from a single season , and plan to replicate this work next year under different environmental conditions and higher rates of Admire and Platinum.

Introduction

A new aphid species, the currant-lettuce aphid, *Nasonovia ribisnigri* (Mosley), has been creating problems for lettuce growers throughout the western United States. Commonly referred to as the lettuce aphid, the pest was found in Salinas in 1998 causing economic losses to summer head and leaf lettuce crops. Infestations of this species were also reported on lettuce in the Imperial Valley , central Arizona, and Baja California, Mexico in early 1999. The first reported incidence of the lettuce aphid in Yuma was on an untreated head lettuce field in mid- March 1999 in the Gila Valley, and from head lettuce plots at the Yuma Ag Center (Palumbo 1999). Specimens were collected and sent to Tucson, where they we positively identified as *N. ribisnigri*. The lettuce aphid was found again in the Yuma Valley in February of 2000 (Palumbo 2000).

This aphid species is quite different from green peach aphid (GPA) and potato aphid (PA) we commonly find on leafy vegetables in the desert. First, the lettuce aphids deposit their young near the terminal growing points of the plant. The aphids collected from head lettuce in Yuma were found predominantly on the cap leaf and within the head (Palumbo 1999). Furthermore, the aphid looks distinctively different than any other aphid found locally on lettuce. The apterous aphids we observed were orange- pink in color with dark bands across their abdomen and on their legs. Their legs are quite spindly, giving them almost a spider-like appearance. Alate adults were similarly distinct from either GPA or PA.

There is much uncertainty surrounding this new species, and its ability to thrive within our desert growing conditions. Preliminary efficacy studies last year suggest that foliar sprays, when timed properly and with proper

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coverage, can control the lettuce aphid for up to 14 days (Palumbo 1999). However, we don't have enough experience with this species in the desert to really know how effective a foliar spray program will be throughout the season, especially if lettuce aphids migrate into fields late in the season near harvest. Perhaps a more important question is: Will soil applications of systemic insecticides (Admire , Platinum) provide seasonal control of the lettuce aphid? Theoretically, Admire should provide good control of the lettuce aphid, as it does other aphid species. It has been the standard product used for aphid control in desert lettuce for the past 7 years . A single at-planting application usually provides season-long control of green peach and potato aphids (Palumbo et al. 1999). This is achieved by preventing aphid colonization early-mid season when these aphids feed on leaves lower on the plant where Admire has systemically moved to. However, we are not sure of the duration of residual control in lettuce heads treated with Admire or Platinum on spring crops. Therefore, this project was initiated to determine the seasonal abundance of lettuce aphid on head lettuce throughout the growing season, and to assess the residual efficacy of Admire and Platinum soil applications against lettuce aphid populations.

Materials and Methods

Studies to examine lettuce aphid abundance and control were conducted on head lettuce at the Yuma Agricultural Center, Yuma, Arizona. Beginning in mid-October, 0.25 acre plots of head lettuce were planted on about 2 week intervals. Table 1 provides the planting date and lettuce variety for each planting. On each planting date (PD) lettuce was direct seeded into double row beds on 42 inch centers. Each planting was subdivided into plots consisted of 4 beds, 80 feet long. Plots were arranged in a randomized complete block design with five replications with a total of a total of 10 plots established in each planting.

Within each planting date, five plots were randomly selected and imidacloprid (Admire 2F) at 16 oz / acre was applied. The Admire was applied to plots during the bed-shaping operation by injecting the chemical 1.5" below the seed. Plots were furrow irrigated to a stand. The remaining five plots were left untreated at planting. In planting dates 4, 5, and 6, thiamethoxam (Platinum 2SC) was applied post-planting at a rate of 9 oz/acre as a sidedress application to ½ of each untreated plots (2 beds * 80 ft) on 28 Feb. Side dress applications were made by placing the product near the bed shoulder at approximately 3-4 " below the soil. Plots were irrigated 2 days following side dress on March 1. No other insecticide applications were made during the study.

Lettuce aphid populations were assessed by estimating the number of aphids /plant and the percentage of plants infested with whole plant, destructive samples. The dates and plant stages for each sample event is shown in Table 1. On each sampling date, 8 plants were randomly selected from each plot and placed individually into large 4-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of alate and apterous aphids present. At harvest, infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting the number of aphids on frame/wrapper leaves and heads, and separately recording aphid numbers for each location. Data was analyzed using ANOVA and mean differences were estimated using a protected $LSD_{(0.05)}$ or a paired t $test_{(p < 0.05)}$.

Results

The early planted lettuce in PD 1 completed harvested on Jan 24 and was disced under before lettuce aphids were found on the research center. Lettuce aphids were first detected in our experimental area on Feb 14 in PD 3 in untreated plants (Fig 1). This initial population consisted of a single, wingless mature form and 5 newly deposited immatures on a single plant. No alates (winged forms) were observed. The following week, winged and wingless lettuce aphids were found in PD 2 which was just approaching harvest stage. Aphid abundance was very low (<0.6 aphids/plant; <5% infestation level) in heads in both treated and untreated plots. Aphid population numbers were similar in PD 3 at that time, but increased significantly in the untreated plots the following week , when plants had reached harvest maturity (Fig 1). Although not statistically significant, lettuce aphids in the Admire-treated lettuce heads were virtually non-existent compared with heads sampled in the untreated plots (Table 2). Because only 3% of the heads in Admire-treated plots were found to be contaminated, it is questionable whether yield losses would have occurred in commercial fields with similar infestation levels.

In PD 4, lettuce aphids were first detected at about 90 days after planting (DAP) when plants were just beginning to form heads (Fig 2; Table 1). By the next sample date, population abundance had increased in both the untreated and Admire- treated lettuce, and continued to do so until harvest at 113 DAP. The Platinum sidedress did not appear to provide any systemic activity until about 2 weeks post-application. Unfortunately, aphid numbers and infestation levels did not differ significantly among the treated and untreated lettuce treatments. At harvest, mean aphids per head did not differ significantly between the untreated check and Admire treatment (Table 2). Similarly, the Analysis of Variance (ANOVA) showed that aphid abundance in Platinum and Admire plots did not differ from each other (*P>0.5)* on any sample dates or during any planting date. However, both treatments had significantly fewer infested plants than the check, although >63% of the heads were contaminated with lettuce aphids. A similar trend was observed in PD 5, with the exception that lettuce aphids on untreated plants were about 5 times more abundant (Fig 2). Again the Platinum sidedress appeared to require about 2 weeks before aphid efficacy was observed. Although head infestation levels were significantly lower in the treated plots at harvest (Fig 2), head contamination was more than likely not commercially acceptable in any of the treatments.

Lettuce aphids reached their peak abundance in April on plants in PD 6 and 7. Plant sizes were small (<10 leaves/plant) in both plantings at the time aphids were first detected (Fig 2 & 3; Table 1). In PD 6, aphid numbers in all plots remained low until about 66 DAP when the population in the untreated check began to increase. Aphid numbers in the untreated check were significantly greater than both the Admire and Platinum treatments for the next several sample dates, until the stage harvest when aphid populations crashed to almost negligible numbers (Figure 2). Differences in aphid abundance and infestation level did not differ among treatments at harvest (Table 2). Lettuce heads were relatively aphid free at harvest, but were being heavily colonized by several natural enemy species . Naturally occurring predators (lady beetle, lacewing and syrphid fly) averaged over 10 larvae per plant in the untreated check. High temperatures also occurred at this time. Aphid population trends in PD 7 were similar to PD 6, with the exception that the population did not crash to negligible numbers at harvest (Figure 3; Table 2). The presence of natural enemies was not as great either. The plants were primarily colonized with lady beetle larvae at a density of about 3 per plants. However , the temperature extremes were similar to PD 6. Unfortunately, heads in both plantings were probably not commercially acceptable because of the predominance of predator larvae, dead aphids and insect exuviae (PD 6), or high numbers of aphids (PD 7) found infesting a large percentage of heads.

Discussion

In general, our objective for establishing the distinct lettuce plantings was to have plants available for aphid colonization at any time during the growing season. In addition, the experimental design allowed us to begin identifying planting and harvest windows that are susceptible to lettuce aphid in the desert. The Admire and Platinum treatments were obviously included to provide an indication of how well these systemic insecticides could prevent lettuce aphid contamination.

Surprisingly, lettuce aphids occurred earlier and in higher abundant this spring than the previous year (Palumbo 1999). The occurrence of lettuce aphids was about a month earlier than last year. We suspect the population immigrated from the west, near Alogdones, Mexico where we received reports of lettuce aphid attacking organic lettuce about the same time. It is unknown exactly when they first arrived, but based on out intensive sampling, we feel fairly confident it that it was probably within a week from the time we first detected their presence (Feb 14).

Furthermore, it is difficult to conclude based on a single years data the influence that planting date has on the seasonal abundance of lettuce aphids. When the aphids were first detected on the research center, winged forms had the opportunity to preferentially colonize any of the 6 distinctly different ages of lettuce ranging from newly emerged seedlings in PD 7 to nearly mature heads in PD 2. Why they initially chose PD3 is unknown. Peak seasonal population abundance occurred in the later plantings (PD 6 & 7), but these were also the last plantings to be infested. This may suggest that given a choice, lettuce aphids prefer older plants. Further research will be needed to determine how valid this idea is.

We do know that temperature has an important influence upon lettuce aphid development. This is supported to some degree by our field observations. Based on recent laboratory studies by Bill Chaney, University of California in Salinas, the optimal temperature for lettuce aphid biological development appears to be around an average of 66 EF. This is consistent with the average temperatures recorded during late February and March in these studies. Based on AZMET data, the average daily temperature was about 65E F at YAC during this time (Palumbo et al. In Press; see other aphid report in this issue of Vegetable Report).This may explain why the populations did not appear to really increase until early March. A similar response was seen last year in our studies in Romaine lettuce (Palumbo 1999). Interestingly, we observed a sharp decline in population abundance in PD 6 and 7 following extended periods of unseasonably, warm temperatures in April (averaged 73E F), where daytime highs from April 4^{th} to April 14^{th} exceeded 90 E F. We cannot completely attribute these dynamics to temperature because of the high densities of natural enemies associated with heavy aphid colonies on lettuce plants. We feel confident though that the combination of the two factors was responsible for the decline of the lettuce aphid populations during April.

We were surprised by the marginal level of lettuce aphid control provided by the systemic insecticides. Lettuce treated with Admire in the early planting dates (PD 2 and PD 3), appeared to prevent lettuce aphids from significantly infesting lettuce heads at harvest. In the later planting dates (PD 4-7), both Admire and Platinum contained significantly fewer aphids and infested plants than the untreated control. However, lettuce aphids in the last 3 planting dates were able to colonize plants and and infest a larger percentage of heads than would normally be considered commercially acceptable). It is apparent that the Admire provided some residual control, but based on the results of this study, it is difficult to determine the length of effective residual activity Admire has against lettuce aphid.

The results of these trials compel us to ask an important question. Why did Admire provided only marginal control of lettuce aphids when it normally provides season-long control of green peach/potato (GPA/PA) aphid in spring lettuce (Palumbo et al. 1999). We hypothesize that difference in control are because of differences in the feeding behavior of these aphid species. GPA/PA prefer to initially colonize the older leaves found on the lower 1/3 of the lettuce plant. Thus, Admire is capable of preventing GPA/PA colonization early- mid season when these aphids come in contact with insecticide residues on leaves lower of the plant. However, lettuce aphids primarily infest young , terminal growing points within lettuce plants (Palumbo 1999). High levels of lettuce aphid colonization on treated lettuce near harvest suggests that Admire/Platinum residue levels in younger leaf tissue within heads were not adequate enough to provide complete aphid control. Of course factors such as planting date, plant age, lettuce variety, soil types and rate of Admire applied may greatly influence this response. Therefore, we are hesitant to draw conclusions based on a single season, and plan to replicate this work next season with various rates of Admire and Platinum.

We also noted a couple of other behavioral characteristics of the lettuce aphid in these trials. First, compared to other aphid species, lettuce aphids tend to infest a higher % of plants, even when abundance is relatively low (Figure 2). In most cases, the % of infested plants in Admire-treated plots was significantly lower than in untreated plots, but the % remained at very high levels. This will undoubtedly influence commercial acceptability. In addition, regardless of whether lettuce plants were treated or not, a significantly greater number of aphids were found on leaves within heads compared to the surrounding frame and wrapper leaves (Table 2.). Furthermore, a greater percentage of heads were infested than were frame/wrapper leaves. This is a behavior not found in GPA/PA that also infested lettuce in our studies (Palumbo et al., In Press; see other Aphid study found in the 2000 Vegetable Report). These behaviors have been previously reported in the literature and from anecdotal experiences from PCA's and growers in Salinas.

In conclusion, we are still uncertain whether the lettuce aphid can be considered a serious threat to the lettuce industry in the desert. Based on infestations found in Nov and Dec lettuce plantings (PD 2-5), only the Dec 15th planting date sustained high infestation levels in treated lettuce (>10 aphids /plant in about 60% of heads). Although numbers were measurable in the Dec 1st planting (<4 / head), they may have been commercially acceptable. What is certain though is that temperatures will have an influence on seasonal abundance. Temperatures during the 1999/2000 growing season were unseasonably warm and dry. We speculate that lettuce aphid population dynamics may be quite different under more "normal" weather patterns in the winter and spring. This in turn may influence lettuce aphid control with soil systemic treatments. Consequently, we will replicate this work during the 200/2001 growing season and hopefully have a better understanding of what environmental and management factors influence lettuce aphid population dynamics in head lettuce.

Acknowledgments

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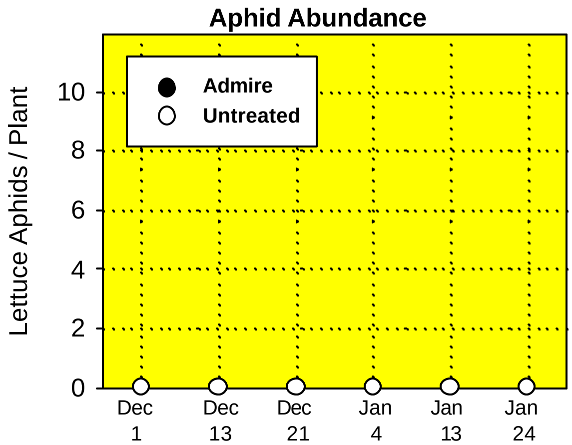
Table 1. Sample dates, plant growth stages and days after planting for seven plantings of head lettuc, Yuma Agricultural Center, 1999-2000.

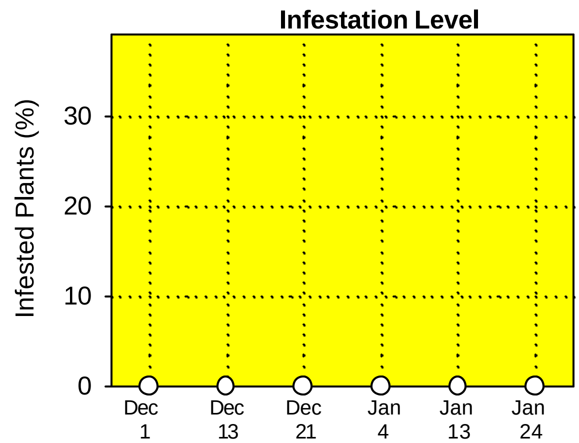
Planting Date (Variety)	Event	1	2	3	4	5	6	7	8	9
1-Oct 11	Sample date	11/11	11/20	12/1	12/13	12/21	1/4	1/13	1/24	
(*Grizzley*)	Plant stage[a]	6-8	10	15-17	16	21-23	23 (2")	25 (4")	Harv	
	DAP[b]	30	39	50	63	71	85	94	105	
2- Nov 1	Sample date	12/1	12/13	12/21	1/5	1/13	1/24	2/2	2/11	2/20
(*Wolverine*)	Plant stage[a]	4	7	9	12-14	14-16	18-20	24(3")	24 (5")	Harv
	DAP[b]	30	43	51	66	74	85	94	102	114
3- Nov 15	Sample date	12/16	12/21	1/4	1/13	1/24	2/2	2/14	2/22	3/1
(*Del Rio*)	Plant stage[a]	2-3	3-4	5-6	8-9	12-14	17	23 (2")	(4")	Harv
	DAP[b]	31	36	53	59	70	79	91	99	106
4 - Dec 1	Sample date	1/13	1/24	2/2	2/14	2/23	3/2	3/8	3/15	3/23
(*Jackel*)	Plant stage[a]	3-4	7	9-10	16-18	20-22	24 (1")	3"	5"	Harv
	DAP[b]	44	55	64	76	85	92	98	105	113
5 - Dec 15	Sample date	1/24	2/2	2/14	2/23	3/2	3/8	3/15	3/23	
(*Diamond*)	Plant stage[a]	4	7-8	12-14	15-17	19-20	22 (2")	4"	Harv	
	DAP[b]	40	49	61	70	77	86	91	98	
6 - Jan 15	Sample date	2/23	3/2	3/8	3/15	3/23	3/29	4/5	4/13	
(*Diamond*)	Plant stage[a]	6-7	8-9	10-11	12-14	15-17	21	22 (3")	Harv	
	DAP[b]	39	46	56	60	66	73	80	88	
7 - Feb 1	Sample date	3/2	3/8	3/15	3/23	3/29	4/5	4/13	4/20	
(*Beacon*)	Plant stage[a]	5	7	9	12	15	18	20 (3")	Harv	
	DAP[b]	31	38	44	50	57	64	72	80	

[a] Estimated avaerage number of frame leaves per plant (head diameter, in).
[b] Days after planting

Fig 1. Lettuce Aphid Seasonal Abundance on Treated and Untreated Head Lettuce,
Yuma Agricultural Center, 1999-2000.

Planting Date 1 (Oct 11)





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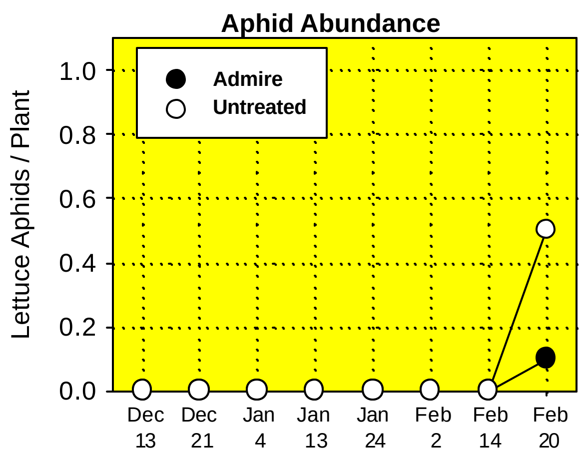
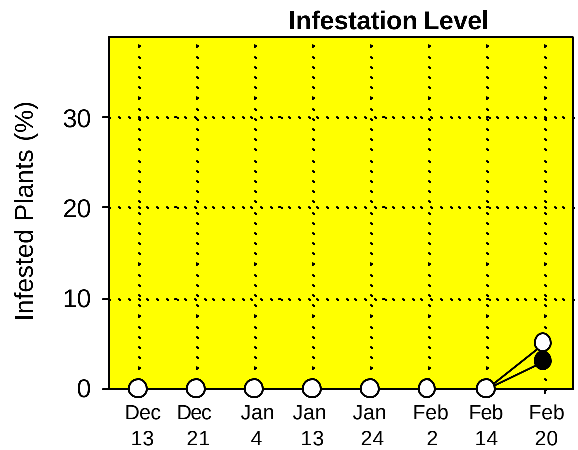
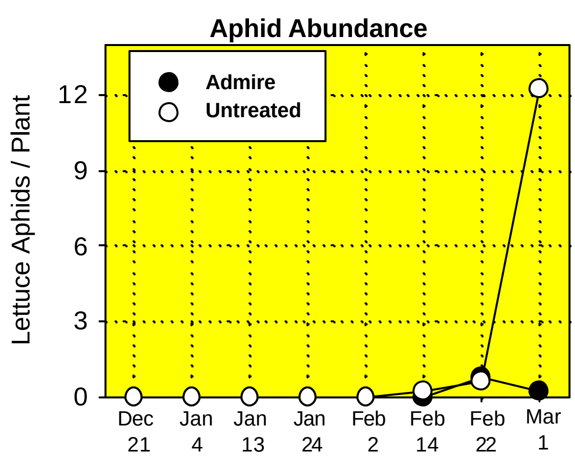




Planting Date 3 (Nov 15)



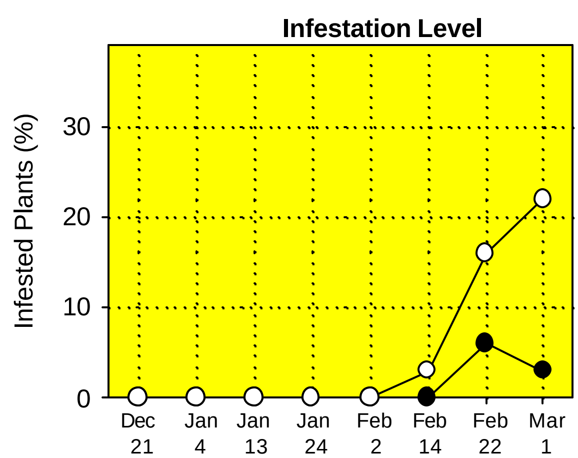
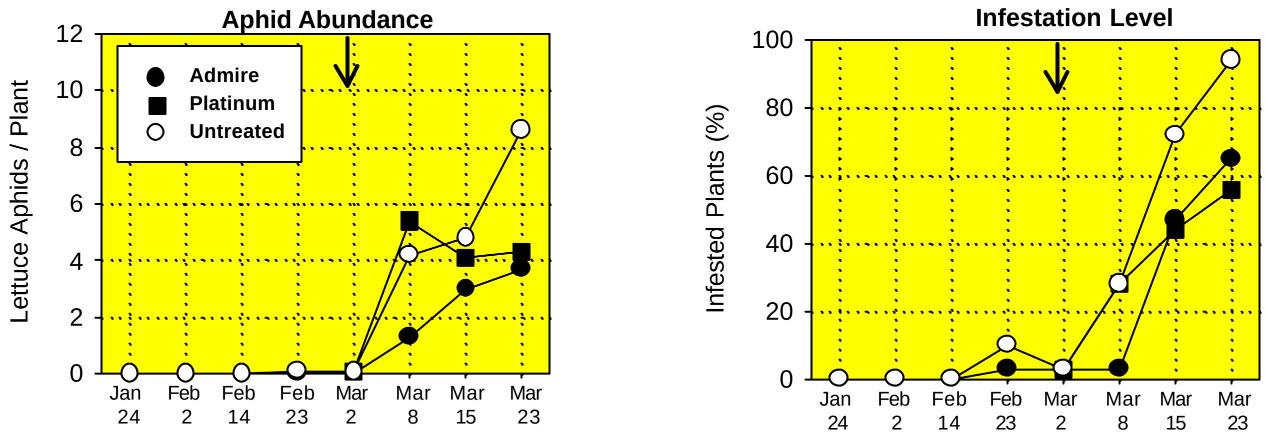
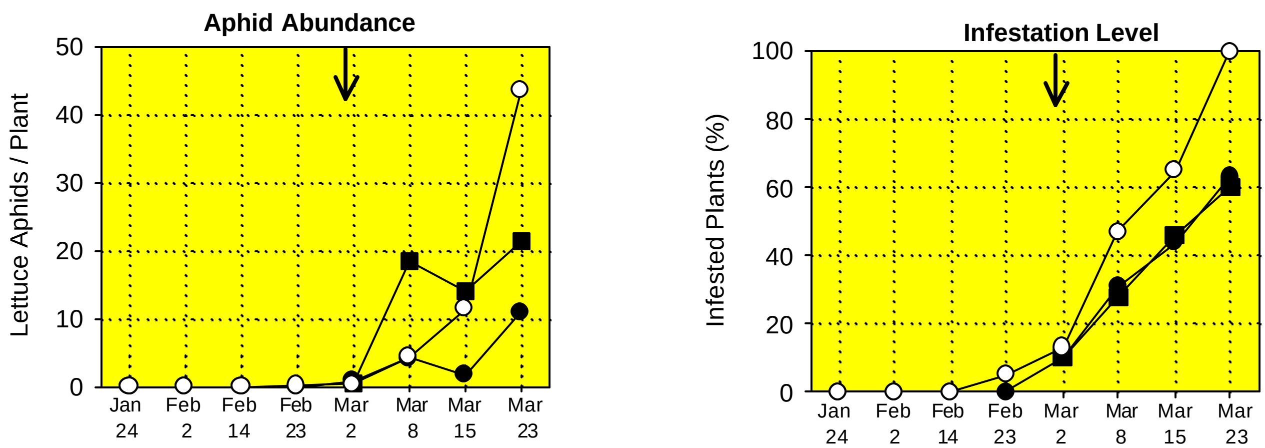


Fig 2. Lettuce Aphid Seasonal Abundance on Treated and Untreated Head Lettuce, Yuma Agric Center, 1999-2000 (Arrrow indicates when Platinum was side dressed and irrigated).

Planting Date 4 (Dec 1)



Planting Date 5 (Dec 15)



Planting Date 6 (Jan 15)

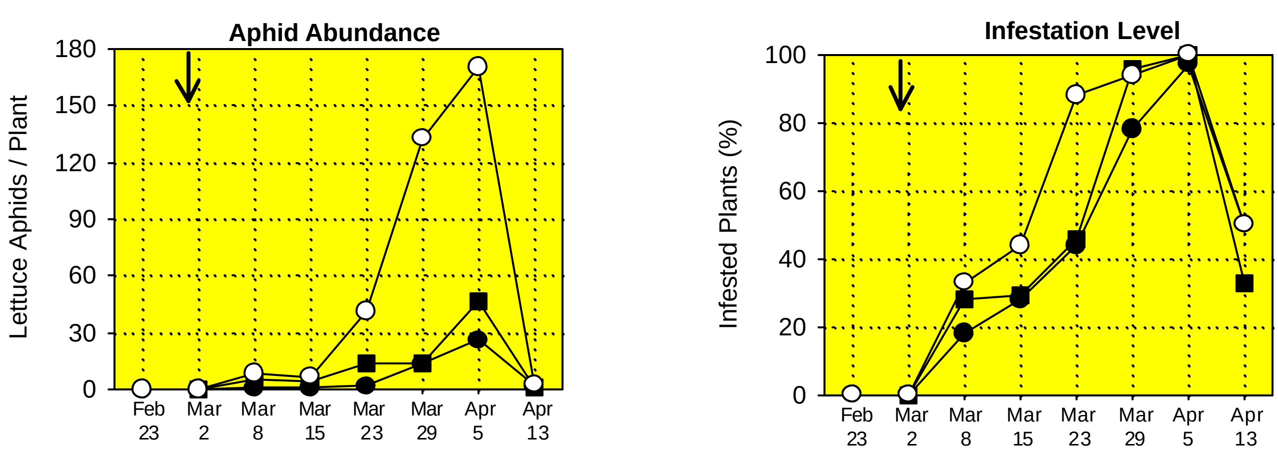


Fig 3. Lettuce Aphid Seasonal Abundance on Treated and Untreated Head Lettuce, Yuma Agricultural Center, 1999-2000.

Planting Date 7 (Feb 1)

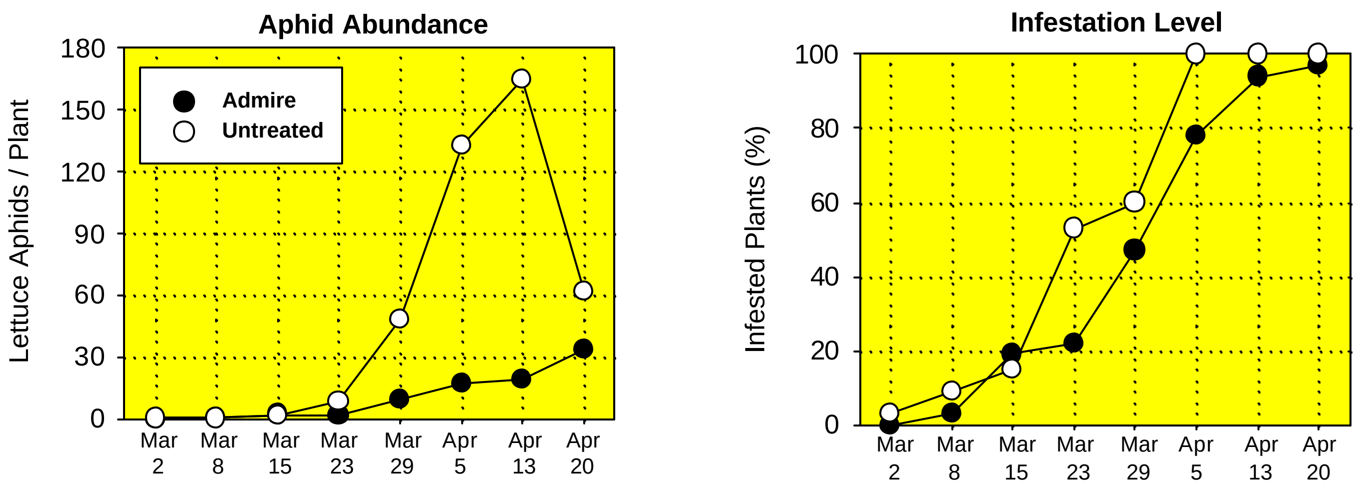


Table 2. Lettuce Aphid Contamination and Infestation Levels on Head Lettuce at Harvest, Yuma Agricultural Center, 1999-2000.

		Mean aphids / plant			Infested plants (%)		
Planting Date	Treatment	Head	Frame leaves	*p > t* [a]	Head	Frame leaves	*p > t* [a]
3	Admire	0.2	0.03	*1.3*	3	3	*1.0*
	Untreated	12.3	0.0	*1.0*	22	6	*1.2*
	p > t [a]	*1.02*	*1.0*		*1.5*	*1.0*	
4	Admire	3.4	0.2	*2.6**	63	13	*4.9***
	Untreated	8.0	0.5	*2.9**	88	25	*5.5***
	p > t [a]	*1.6*	*0.9*		*2.7**	*1.1*	
5	Admire	10.6	0.4	*3.0**	59	19	*2.6**
	Untreated	42.9	0.6	*6.1***	97	22	*6.0***
	p > t [a]	*4.1**	*0.4*		*5.6***	*0.2*	
6	Admire	1.6	0.1	*2.8**	50	9	*3.8***
	Untreated	2.5	0	*3.0**	50	0	*4.9***
	p > t [a]	*0.9*	*1.4*		*0*	*1.6*	
7	Admire	31.9	1.4	*3.0**	97	47	*3.5**
	Untreated	58.4	2.9	*3.2**	97	66	*7.1**
	p > t [a]	*1.3*	*1.7*		*0*	*1.3*	

[a] Significant difference between means as detected by a paired t-test; *, P<0.05; ** p<0.01.