JUNE 2004
Yuma County Farm Notes
Pest Management Edition

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SANDBUR CONTROL IN ALFALFA

Barry Tickes

Introduction

The three principle mechanisms involved in weed seed dispersal are wind, water and attachment to animals, equipment and people. Various physical characteristics have been developed to utilize these mechanisms. Those that utilize wind include those that have plumed seed (sowthistle), detach and roll (tumbleweed) or have wings (saltbush or many trees such as maple). Those that utilize water have low specific gravity or are flattened (many grasses such as canarygrass), or those that are corky (dock). Those that attach to people, equipment and animals include some of the most insidious seeds around. These include puncturevine, burclover, cocklebur, jimsonweed, desert thornapple, sandbur and many others. Sandbur is one weed that is as dreaded by growers and handlers of alfalfa hay as it is by the animals that consume it.

There are two species of sandbur. Field sandbur (Cenchrus pavciflorus) is the most common of the two. It is native to Arizona and is easily distinguished from southern sandbur. The leaf blade is thin like that of bermudagrass and the burs are yellowish. It grows in a prostrate manner although it is more upright than the other species. It can root at the lower nodes and form a mat. Southern sandbur (Cenchrus echinatus) has a much broader leaf that is red. It grows more prostrate to the ground and also roots at the node and forms a mat. The burs are also reddish and broader than those of field sandbur. Field sandbur burs usually contain 2 seeds while southern usually contain 4 seeds. Southern sandbur is not native and was introduced from South America.

Both field and southern sandbur are appropriately named because they almost always are found in sandy, well drained soil. The reason for this is unclear. Both are described as summer annual weeds although there are almost always some plants that survive even very cold winters. This has an important impact on the ability to control this weed.

Control

Frequent summer cutting and rapid regrowth make alfalfa very competitive with most weeds. This is the case more with broadleaf weeds than grasses which can withstand frequent cutting. Herbicides are needed most during stand establishment and in older, weaker stands but are often required even in second and third year fields during the “summer slump” period between July and September when sandbur is most prolific.

Preplant herbicides

There are two preplant treatments available for alfalfa in Arizona. These are Balan 60DF and Eptam 7E and 20G. Balan is the most active and least selective of the three dinitroaniline herbicides (Triflualin, Prowl) which are commonly used here. It must be mechanically incorporated or unacceptable injury will occur. Injury in the form of crop stunting and stand thinning is not uncommon even when mechanically incorporated although this rarely results in reduced yields. Balan is effective on seedling field and southern sandbur.

Eptam is normally applied after planting in the germination water when the 7EC formulation is used. The 20G formulation can be applied after planting and prior to the first irrigation. Eptam is extremely volatile and should be incorporated with water within 24 hours of application. The 20G is a more efficient means of applying Eptam and no more than 2 lbs. active ingredient per acre whould be applied. Up to 3 lbs. ai/AC of the 7EC can be applied in the germination water although crop injury in the form of stunting and stand thinning is common. Like Balan, this rarely results in yield loss. Eptam is effective on seedling field and southern sandbur.

Preemergent Herbicides

According to Arizona Department of Agriculture L1080 forms approximately 55% of the herbicides used in 2002 were preemergent herbicides. It is always best to control weeds prior to emergence with soil applied herbicides that have residual activity. However, the ability of sandbur to overwinter and regrow in the spring from established crowns greatly reduces the possibility of achieving high levels of preemergent control. Some sandbur plants always survive even very cold winters. Test results are presented here from a test conducted in 1992 to compare the two main preemergent herbicides used in alfalfa, trifluralin 10% granules and Eptam 10% granules. The formulation and availability of Eptam granules have changed although the 7E, active ingredient and rates have remained the same since the 1960's.

This test was conducted on the Yuma mesa and southern sandbur was the species that was present. The test contained four treatments that included 1 lb.ai/A of Trifluralin 10% granules, 2lb.ai/A of Trifluralin granules, 2 lb.ai/A of Eptam 10% granules, 3 lb.ai/A of Eptam 10% granules and an untreated check. The Trifluralin treatments were applied once on February 5. Four applications of both Eptam treatments were made, one on February 5, April 10, June 14 and July 15 for a total of 8 and 12 lbs.ai/A. The herbicides were applied with a valmar airflow ground driven applicator with 4 replications of each treatment.

Table 1

Sandbur control from 4 preemergence herbicide treatments in a first year stand of alfalfa.

Herbicide	Rate (lbs./A)	Number of Applications	Aver. Number of Sandbur Plants Counted per Plot on: 6-19[1]₂	8-1	9-6	Visual Eval. On 9-12 (% control)[2]
Trifluralin 10% Granules	**10**	**1**	**2.5**	**3.8**	**6**	**63 c**
Trifluralin 10% Granules	**20**	**1**	**4.6**	**3.3**	**2**	**73 b**
Eptam 10% Granules	**20**	**4**	**0.5**	**1.3**	**3**	**79 ab**
Eptam 10% Granules	**30**	**4**	**0**	**0.5**	**2.2**	**85 a**
Untreated	**-----**	**------**	**10.3**	**13**	**13**	**0 d**

LSD (0.05)=7.87

[1] Plot size was 33' X 600', subplots were 1/10,000 of an acre or approximately 2 X 2 ft. Eight subplot counts were made per plot. There were 4 replications per treatment for a total of 36 subplot counts per treatment.

[2] Average of 4 replications.

All of the treatments in this test, except for the low rate trifluralin, significantly reduced the sandbur population but were less than completely effective. This was a first year stand of alfalfa although the field had previously contained a heavy infestation of sandbur and some of the plants may not have been destroyed during ground preparation. Normally, when partial control like this occurs it is because some of the sandbur overwintered. Control levels of 70 to 85 percent from preemergent herbicides have been typical in both our tests and grower experience.

Pendimethalin (Prowl, Pendimax) has also been evaluated and found to be highly effective in controlling both sandbur species that are coming from seed and not established crowns that have overwintered. Water-run applications at 1 to 2 pounds active ingredient per acre produce excellent sandbur control. Pendimethalin (Prowl, Pendimax) is not registered for use in alfalfa although efforts are underway to gain this registration.

Postemergence Herbicides

Two grass herbicides are labeled for the postemergence control of sandbur in alfalfa. These are Poast and Select/Prism. Raptor, mainly a broadleaf herbicide with activity on some grasses, also has field sandbur on the label. I have had these and other grass herbicides in tests or sandbur control since the early 1980's when the selective post emergence grass herbicides were first being developed and registered in alfalfa. Some of the other postemergence grass herbicides that have been tested are Fusilade which is registered for use on many crops including vegetables, cotton and soybeans but not alfalfa, and AssureII which is used on cotton, soybeans, sugar beets and other crops but also not registered on alfalfa. Table 2 summarizes the results of three tests conducted in 1994, 1995 and 1997 to evaluate Poast and Select/Prism for sandbur control in alfalfa. Both field and southern sandbur were present in these tests and the control levels reflect the activity on both. Sandbur was from two leaf to heading in these tests.

Table 2

Sandbur control in alfalfa with Poast and Select.

Control(%)
Summary of 3 tests
(1994, 1995, 1997)

Herbicide	Rate (lbs.ai/A)	Range	Average
Poast	0.3	10-50	22
Poast	0.5	5-50	30
Select	0.1	10-50	36
Select	0.25	40-75	55

The control levels in these tests are representative of those achieved in other tests and grower experience. Control was poor and far below what would be commercially acceptable. I have seen these herbicides kill seedling sandbur at the 1 to 2 leaf stage. Once these weeds reach the 3 leaf stage they become tolerant. In practice, it is difficult for growers to treat when all of the sandbur is at the 1 to 2 leaf stage because of the multiple emergences of this and other summer annual grasses and the difficulty in treating between frequent summer cuttings and irrigations. Cuttings occur every 28 to 35 days and lay in the field for 5 to 7 days. Irrigations occur every 10 to 14 days. It is difficult to fit herbicide applications into this schedule.

A more recent test was conducted last year to evaluate these older herbicides and some new experimentals. In addition to Poast, Select, Fusilade and AssureII, raptor, Pursuit and a Valent experimental, V-0139 were evaluated. The results are presented in Table 3. Although some differences between treatments were measured, it is clear that none of these herbicides and combinations were effective in controlling field sandbur. These treatments were applied on 8-19-03 when the sandbur was from 2 leaf to heading. The plots measured 20' X 14' and were replicated three times. All the treatments were applied with a CO^2 backpack spray calibrated at 20 gallon per acre. A visual evaluation of control was made on 10-7-03.

Sencor is a broad spectrum herbicide with activity on many grass and broadleaf weeds. It is most effective as a postemergence treatment but causes moderate to severe crop injury if much foliage is present at the time of application. We have evaluated sencor pre and post emergence as a sprayable treatment, impregnated on fertilizer and as a granule. Control was partial and inconsistent.

Table 3

The evaluation of 8 herbicides and herbicide combinations for field sandbur control in alfalfa.

Herbicide*	Rate(oz/A)	Control (%)	
Poast	40	5	cd
Select (high flash)	10	8.3	bcd
Fusilade	12	6.6	cd
AssureII	8	10	abc
AssureII	12	16.6	ab
Pursuit	4	0	d
Pursuit + Select (high flash)	4 + 10	8.3	bcd
Raptor	6	18.3	a
V-10139	10	10	abc
Pursuit + V-10139	4 + 10	11.6	abc
Untreated	-------	0	d

LSD(0.5)=8.3989

*All treatments included 3 lb./AC ammonium sulfate and 2 pts./A crop oil concentrate.

Summary and Conclusions

Sandbur is one of the most dreaded and difficult to control weeds in alfalfa. Fortunately, it is confined almost always to sandy soils. Complete control with both pre and postemergent herbicides is difficult and this weed has continued to be a serious problem for many years. Sandbur has the ability to survive even cold winters and preemergent herbicides typically produce 60 to 85% control. Postemergent herbicides are ineffective once this weed reaches the two leaf stage. It is difficult to apply these herbicides at that stage of growth due to multiple weed emergences and frequent irrigations and cuttings. The best control option currently available is the use of a preemergent herbicide in the spring followed by postemergent herbicide applications as soon as possible after escapes emerge in the summer.

Comparison of Products for Management of Powdery Mildew on Cantaloupe

Michael E. Matheron and Martin Porchas

Abstract

Powdery mildew occurs annually on melons in Arizona. *Podosphaera xanthii (Sphaerotheca fuliginea)* is the plant pathogenic fungus that causes powdery mildew on cucurbits, such as cantaloupe, honeydew, watermelon, cucumber and squash. When environmental conditions are favorable, disease incidence and severity can reach economically significant levels. Development of powdery mildew on melons is favored by moderate temperatures and relative humidity, succulent plant growth and reduced light intensity brought about by a dense plant canopy. Existing products as well as those materials under development were evaluated and compared for efficacy in management of powdery mildew on cantaloupe in a field trial conducted during the spring of 2003 at the Yuma Agricultural Center. A moderately high level of disease had developed by crop maturity (Jun 16-17) on untreated plants. Among treatments, the degree of powdery mildew control ranged from modest to essentially complete control. All treatments significantly reduced the severity of powdery mildew compared to untreated plants. The best performer among all treatments in this trial was Procure at 0.25 lb a.i., which completely inhibited disease development. Several other treatments resulted in a low mean disease severity rating (1 to 5 mildew colonies per leaf), including Quinoxyfen+Actigard, Rally+Actigard, Flint alternated with Bravo, Microthiol Disperss, Bravo, Quinoxyfen, Rally, Flint alternated with Bravo, Flint+Reason+Bond, Topsin M, Quadris+Latron B-1956, Flint+Actigard, Flint, Topsin+Trilogy, Kaligreen+No Foam A, Quadris+Latron B-1956 alternated with Actigard, Quadris+Latron B-1956+Actigard and Pristine. Multiple applications of a single compound are included in these trials to gather information on the relative efficacy of each separate chemistry over a multi-year period. Among tested products, several are registered for use in Arizona for control of powdery mildew on melons. The use of a mixture or rotation among efficacious chemistries with different modes of action will inhibit the development of insensitivity by the pathogen to one or more of these active ingredients.

Introduction

Powdery mildew is an annual concern to melon growers in Arizona. The disease on cantaloupes, caused by the fungus *Podosphaera xanthii* (formerly known as *Sphaerotheca fuliginea*), first appears as small, white, superficial spots on leaves and stems. These spots will enlarge, become powdery in appearance, increase in number and eventually cover stems and both surfaces of leaves. Young infected leaves may turn chlorotic and die. Severely infected leaves turn brown and desiccate. Cantaloupe fruit on severely infected plants may ripen prematurely, be of poor quality and become sunburned due to the reduced plant canopy. Development of powdery mildew is favored by moderate temperatures and relative humidity, dry soil conditions, reduced light intensity and succulent plant growth. These conditions often exist within the plant canopy of an actively growing cantaloupe planting. The same pathogen causes powdery mildew on watermelons, honeydews, squash and other cucurbits.

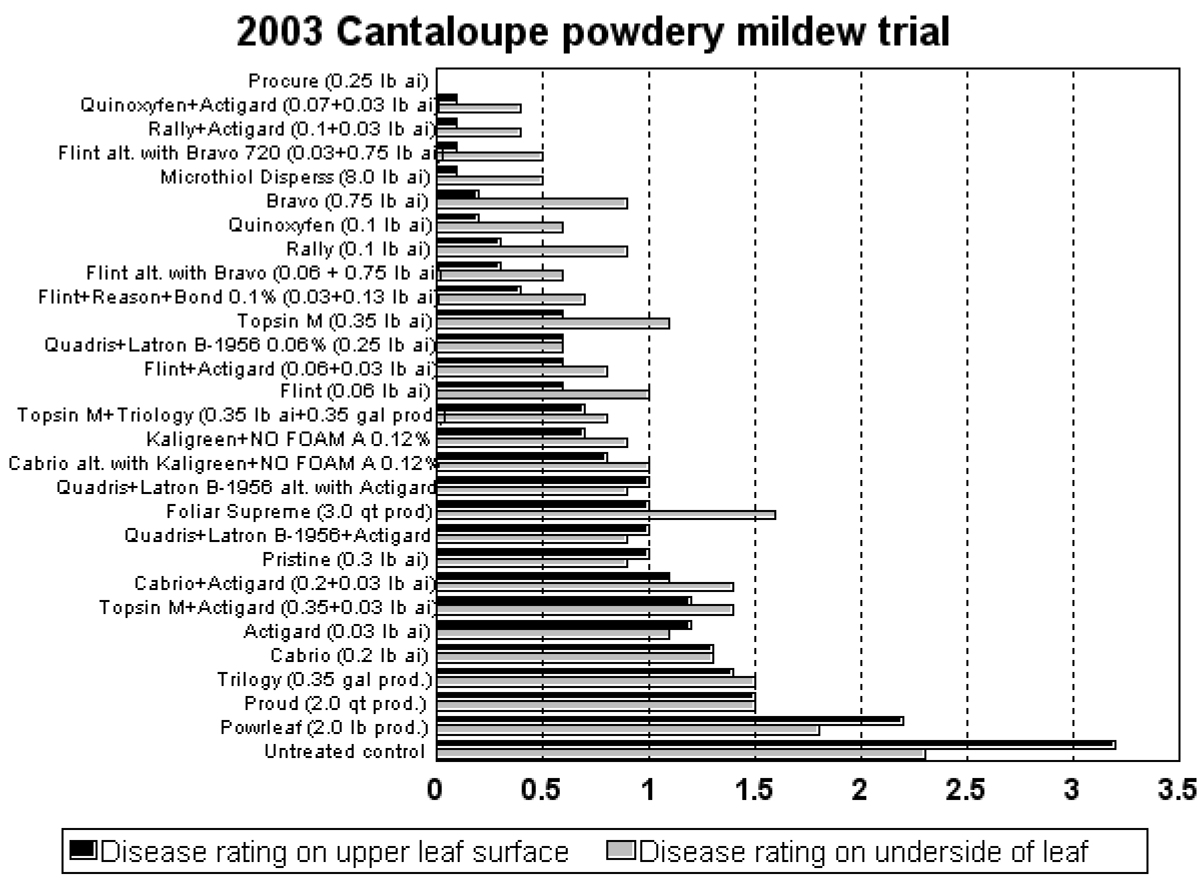
When available, effective control of powdery mildew can be achieved by planting cultivars that are resistant to the pathogen. If susceptible cultivars are grown, it is extremely important to have fungicidal protection in place when environmental conditions become favorable for disease development. The life cycle of the pathogen, going from spore germination on the plant to subsequent release of spores from this infection site, can be as short as 4 to 5 days. By the time initial colonies are visible on plant leaves, numerous additional infection sites are already developing but not yet visible. Sulfur is an excellent powdery mildew fungicide, but can cause serious leaf burn on many melon cultivars in the high temperatures that occur in desert production areas when environmental and cultural conditions favor disease. Other compounds, such as azoxystrobin (Quadris), chlorothalonil (Bravo), myclobutanil (Rally), neem oil (Trilogy), potassium bicarbonate (Armicarb, Kaligreen), thiophanate-methyl (Topsin M), trifloxystrobin (Flint) and triflumizole (Procure) are available for management of powdery mildew on melons as well. A fungicide trial was initiated in the spring of 2003 to compare the efficacy of available fungicides as well as new compounds under development on management of powdery mildew on cantaloupe.

Materials and Methods

This fungicide study was conducted at the Yuma Valley Agricultural Center. The soil was a silty clay loam (7-56-37 sand-silt-clay, pH 7.2, O.M. 0.7%). Cantaloupe 'Topmark' was seeded and watered March 4, 2003 on beds with 80 inches between row centers. Treatments were replicated five times in a randomized complete block design. Each replicate consisted of 25 feet of row with a plant spacing of 12 inches. Treatment beds were separated by single nontreated beds. Each of the five blocks of treatments was bordered by two beds planted to casaba melon 'Golden Beauty.' Fungicide treatments were applied with a tractor-mounted boom sprayer that delivered 50 gal/acre at 100 psi to flat-fan nozzles spaced 12 inches apart. Foliar applications of fungicides were made May 19, May 27, Jun 2, Jun 11. Maximum and minimum ranges of air temperature (°F) were as follows: Mar, 64-90, 38-59; Apr, 70-90, 41-61; May, 75-107, 46-71; Jun 1 to 17, 94-109, 59-70. The only measurable rainfall during this time period occurred in March (0.10 inches). Disease severity was determined at crop maturity on Jun 16 and 17 by collecting 10 leaves at random from each plot and rating the severity of powdery mildew on the upper and lower leaf surfaces using the following rating system: 0=no powdery mildew present; 1=1 to 5 powdery mildew colonies on the leaf surface; 2=6 to 10 powdery mildew colonies on the leaf surface; 3=more than 10 colonies to 25% of the leaf surface covered with powdery mildew; 4=26 to 50% of leaf surface covered with powdery mildew; 5=51 to 100% of leaf surface covered with powdery mildew.

Results and Discussion

The data in the following graph illustrate the degree of control obtained by applications of the various materials tested in this trial. Among treatments, the degree of powdery mildew control ranged from modest to essentially complete. Powdery mildew was not evident at the first application of materials. Initial signs of powdery mildew were not detected until May 27 on the casaba melon plants and 2 to 3 days later on cantaloupe plants. The Golden Beauty casaba melon is very susceptible to powdery mildew and was planted to serve as a nursery for production of powdery mildew fungal spores once these plants became infected. A moderately high level of disease developed by crop maturity on untreated cantaloupe plants. Powdery mildew in this trial was caused by *Podosphaera xanthii* (formerly known as *Sphaerotheca fuliginea*). Disease control observed on the upper leaf surface suggests that tested materials can significantly reduce powdery mildew compared to no treatment when the test compound is applied directly to the leaf surface with relatively good coverage. On the other hand, effective disease control on the underside of leaves, where coverage by the fungicide was not optimal, demonstrates the efficacy of chemistries that can move within the leaf. Due to the late onset of disease, yield differences were not detected.



2003 Cantaloupe powdery mildew trial
Procure (0.25 lb ai)
Quinoxyfen+Actigard (0.07+0.03 lb ai)
Rally+Actigard (0.1+0.03 lb ai)
Flint alt. with Bravo 720 (0.03+0.75 lb ai)
Microthiol Disperss (8.0 lb ai)
Bravo (0.75 lb ai)
Quinoxyfen (0.1 lb ai)
Rally (0.1 lb ai)
Flint alt. with Bravo (0.06 + 0.75 lb ai)
Flint+Reason+Bond 0.1% (0.03+0.13 lb ai)
Topsin M (0.35 lb ai)
Quadris+Latron B-1956 0.06% (0.25 lb ai)
Flint+Actigard (0.06+0.03 lb ai)
Flint (0.06 lb ai)
Topsin M+Triology (0.35 lb ai+0.35 gal prod)
Kaligreen+NO FOAM A 0.12%
Cabrio alt. with Kaligreen+NO FOAM A 0.12%
Quadris+Latron B-1956 alt. with Actigard
Foliar Supreme (3.0 qt prod)
Quadris+Latron B-1956+Actigard
Pristine (0.3 lb ai)
Cabrio+Actigard (0.2+0.03 lb ai)
Topsin M+Actigard (0.35+0.03 lb ai)
Actigard (0.03 lb ai)
Cabrio (0.2 lb ai)
Trilogy (0.35 gal prod.)
Proud (2.0 qt prod.)
Powrleaf (2.0 lb prod.)
Untreated control
0
0.5
1
1.5
2
2.5
3
3.5
Disease rating on upper leaf surface
Disease rating on underside of leaf

INSECT PESTS IN YUMA PRODUCE: A REVIEW OF THE 2003-2004 SEASON

John Palumbo

Introduction

Insect pest populations seemed to be exceptionally abundant on our desert vegetable crops this past growing season. It is difficult to explain why some insect populations occurred in larger numbers this year, but the weather we experienced may have had a significant role. Hot, dry weather in the early fall and spring, coupled with moderate winter temperatures provided ideal conditions for some insect pests. In other cases, pest pressure was down from previous years. Of course there are other biotic and abiotic factors (ie., natural mortality, cropping patterns, growing and pest control practices) that influence pest outbreaks and abundance, and those change from year to year.

Nonetheless, this report is an attempt to review the pest pressures we observed in the Yuma Valley during the 2003-2004 growing season. This was accomplished by summarizing data that we collected annually from untreated head lettuce plots and yellow sticky traps. What you will find in this report is a comparison of the abundance of whiteflies, worms, thrips and aphids this past season with numbers from previous years. Data for the most part is specific for the Yuma Valley and Yuma Ag Center where the studies were conducted, but in general the information should reveal trends and relative differences among insect pests for most Yuma growing areas.

Weather Patterns

Weather plays an important role in the development and regulation of insect populations. In particular, temperatures are the driving force for their biological development and behavior. Insects are poikliothermic (cold blooded), and thus generally develop more rapidly rate when temperatures are at 85-90 ºF. Insect flight, mating and ovipostional activity is generally greatest when temperatures are warm. Conversely, when temperatures are cool (ie., 50 ºF), biological activity is much slower. For example, beet armyworm larvae can complete development from a newly hatched 1st instar larvae to a pupa in about 7 days at temperatures averaging 86ºF, but would require almost 12 days to complete development at 75 ºF. But not all insects are the same. As you know, many of the aphid species that infest lettuce and cole crops are most active during the winter and spring when temperatures are cooler. However, they also have developmental limits that are influenced by a range of temperatures.

Rain and wind also influences insect population dynamics, usually by modifying their environment. Rain can influence the buildup of weeds and other alternate host that harbor large insect populations. Once the plants dry up, insects can disperse directly onto cultivated crops. Rain can also cause direct mortality to some insects that are washed off plants and suffocated in the soil. High winds can limit the insects ability to move or fly. A good example of this is the poor pollination by honeybees that occurs in windy conditions. Consequently, many of the differences in pest pressure we experience each season are determined to some degree by differences in weather conditions.

Figures 1 and 2 show average daily temperatures for the produce growing season during the past 6 years (Data was summarized from AZMET weather station located at the Yuma Ag Center, *http://cals.arizona.edu/azmet/).* Temperatures varied quite a bit from year to year during this period, and in some cases average temperatures varied as much as 15º F. In most cases it is difficult to see clear trends in temperature. However, what is very clear were the 2 extremes in temperatures experienced in 2003-2004. The first occurred during October where average daily temperatures were 10-15º F warmer than observed in the previous years (**Figure 1**). The second extreme occurred at the end of the 2004 growing season where similar differences were observed during much of March (**Figure 2**). As you will recall, both of these extremes had a marked influence on produce crop growth and maturity, and directly influenced the markets. Rainfall appeared to be less than average, where only the 2001-2002 season produced less rain (**Table 1**). This past season was unusual because most of our measurable rainfall occurred during November, which is generally a dry month. Finally, this past season seemed to be windier than normal, but AZMET measurements would suggest that it was not. Interestingly though, winds were light during the two temperature extremes in October and March. The significance of these weather extremes will be speculated upon in the discussions below.

Fig 1. Avg. Daily Temperatures during the 2003-2004 Fall-Winter Growing Season.

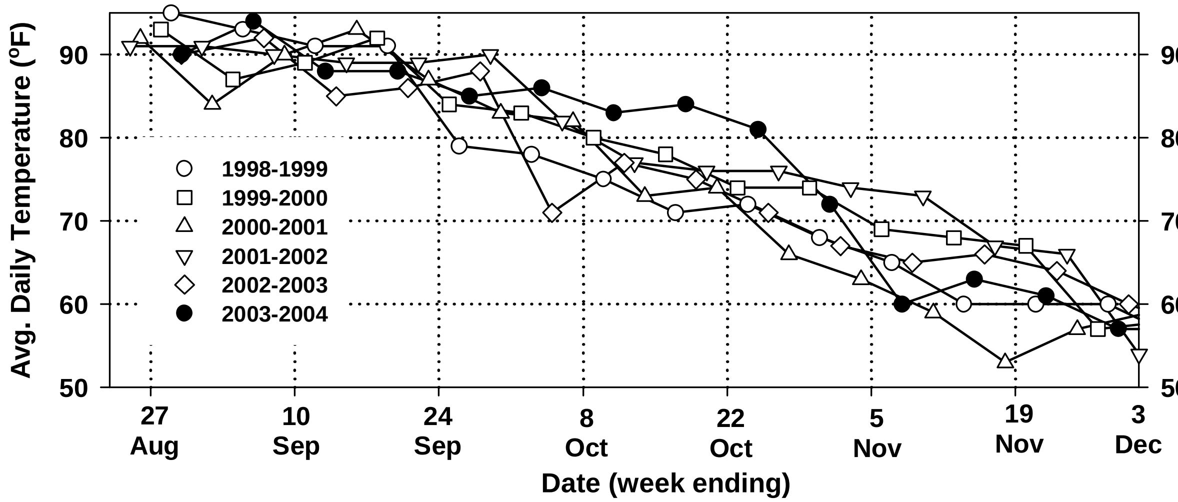


Fig 2. Avg. Daily Temperatures during the 2003-2004 Winter-Spring Growing Season.

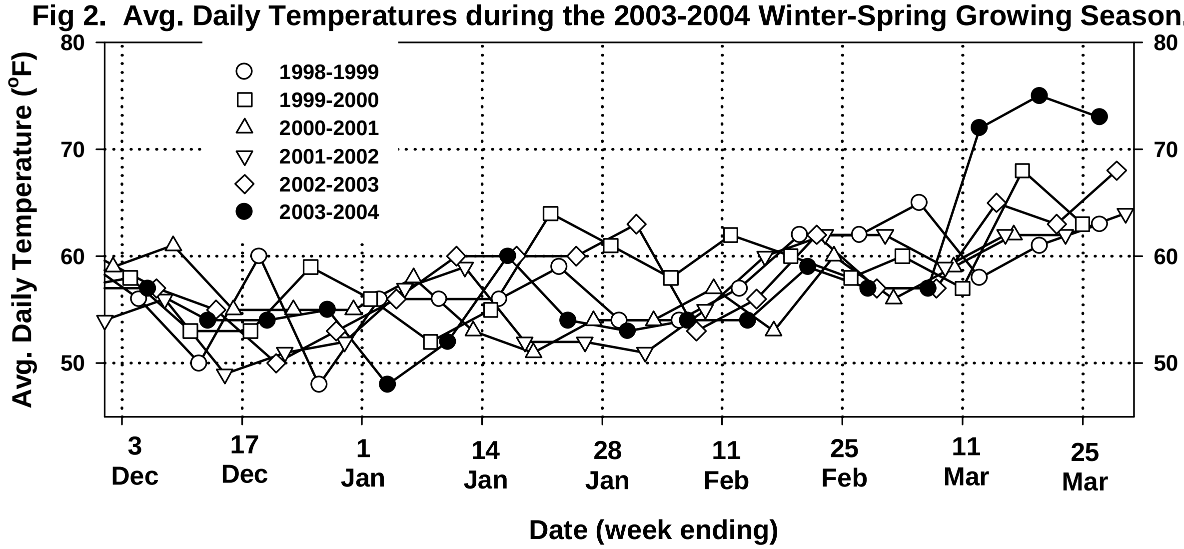


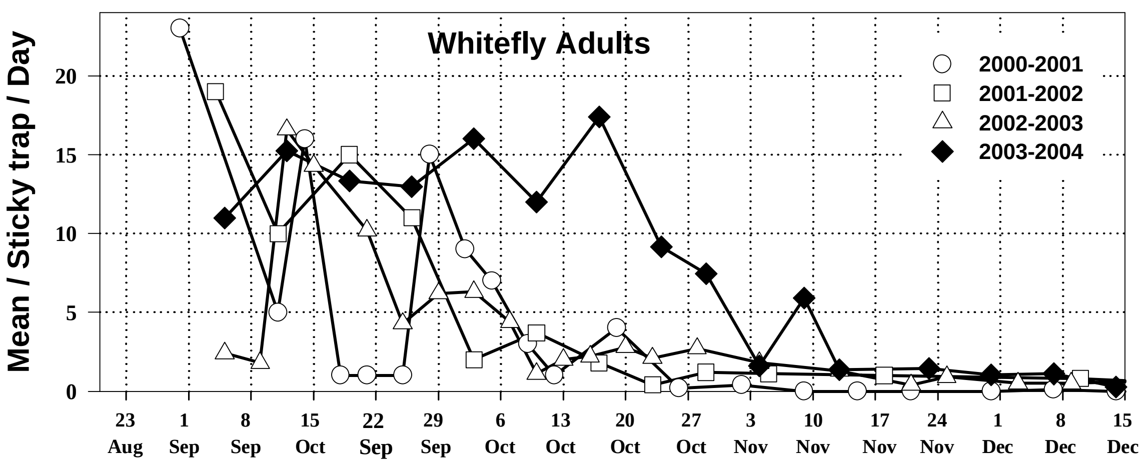
Table 1. Seasonal Avg. rainfall recorded at the Yuma Ag Center.

	Avg Seasonal Rainfall (in.)							
Yr	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Avg.**
98-99	1.01	0	0.26	0.05	0	0.53	0	1.85
99-00	0.80	0	0	0	0	0.05	0.21	1.06
00-01	0.02	0.63	0	0	0.31	0.02	2.54	**3.52**
01-02	0	0.10	0.01	0.01	0	0	0	0.12
02-03	0.02	0	0.02	0	0	0.57	0.64	1.25
03-04	0.05	0	0.40	0	0.10	0.20	0.10	0.85
Avg.	**1.9**	0.73	0.69	0.06	0.41	1.37	**3.49**	

Whiteflies

Based on our experiences over the past decade, whiteflies are most abundant during the fall. This is a result of their numbers building up on cotton and other crops during the summer when temperatures are ideal for biological development. As cotton and other crops are terminated, whiteflies disperse throughout the growing areas in search of suitable host plants like melons and cole crops. For several years we have placed yellow sticky traps in a grid from Gadsden to the North Yuma Valley throughout the season, collecting traps weekly and counting the number of whiteflies, aphids, leafminers and thrips on each trap. **Figure 3** below shows whitefly flight activity during the fall, as determined by sticky traps, over the last 4 years. Historically, we have observed that whiteflies move throughout the area in August and September. We typically experience a considerable decline in movement in October when temperatures begin to decline. However, last fall flight activity extended well into October as illustrated in **Figure 3**. It is probably no coincidence that these extended flights correlate strongly with the higher temperatures we experienced in October **(Figure 1).** These temperatures also allowed for rapid whitefly development on our cole crops and melons where we observed high densities infesting untreated crops. Another factor which may have influenced this movement was the light winds that were associated with the higher temperatures. Winds averaged less than 4 mph during the first 3 weeks in October, compared to previous years when winds consistently averaged over 6 mph (AZMET).

Fig. 3 Whitefly Flight Activity Based on Yellow Sticky Traps Catches, Yuma Valley (2000-2004)



Worms (Beet Armyworm and Cabbage Loopers)

Without a doubt, the fall of 2003 was one of the heaviest worm years that we've seen in quite a while. Anecdotal reports of PCA's spraying insecticides to control beet armyworm (BAW) and/or cabbage loopers (CL) twice a week were common during September and October. There was good reason for this. Historical data generated from the untreated controls of small plot efficacy trials conducted similarly each season from 1997 to 2003 at the Yuma Ag Center shows the large numbers of worms present on lettuce plants in 2003 compared with previous years **(Figure 4).** At their peak, BAW and CL averaged almost 16 larvae / plant. That's a lot of worms. Again, higher than average temperatures (**Figure 1**) likely influenced the buildup of this unusually large abundance of worms. Worm pressure usually subsides during October when the weather breaks. However as shown in **Figure 5** average daily temperatures in 2003 remained at or near 85 ºF during most of October resulting in 3-4 times greater numbers of worms than measured in our 2002 trials. Average daily temperatures differed by as much as 15 ºF during this time. Worm pressure finally declined as temperatures broke in late October. Consequently, we are convinced that the high worm pressure seen on fall produce in 2003-2004 was directly influenced by weather. Temperatures had a significant impact on worm abundance by accelerating larval development on plants. Larvae were able to complete development at a more rapid rate (optimal temperature for development has been shown to be 86 ºF). This resulted in more generations of worms than normally observed. Furthermore, higher night time temperatures likely provided an ideal environment for moth flight and oviposition. This would result in greater egg lays. It was not unusual to see multiple eggs and egg masses on larger plants throughout October. Finally, as discussed above, the light winds probably enhanced moth flight activity.

Fig 4. Worm populations (total larvae / plant) in <u>untreated</u> head lettuce over several experimental trials per season, Yuma Ag Center (1997-2004)

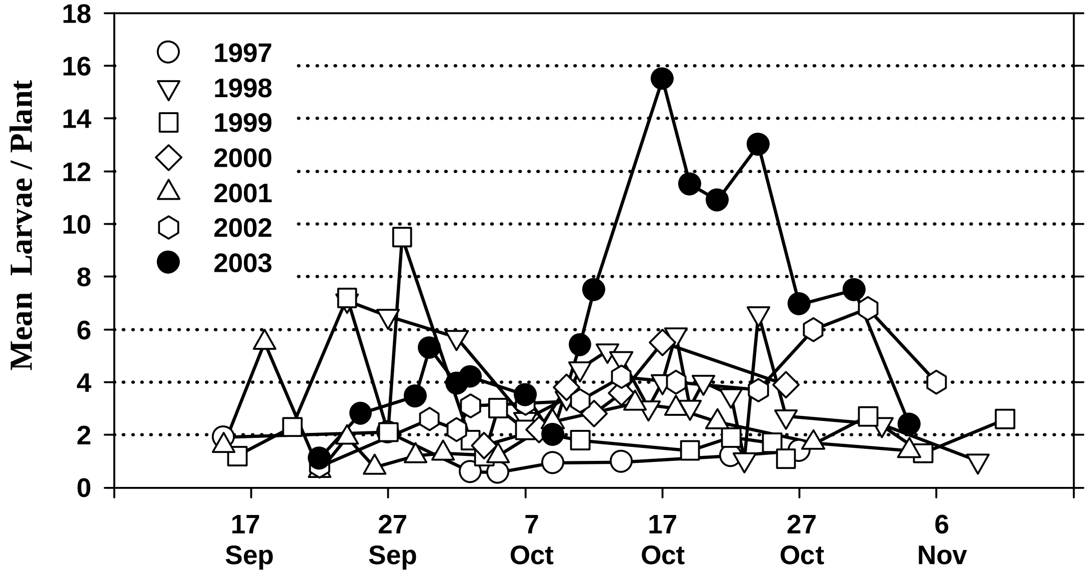
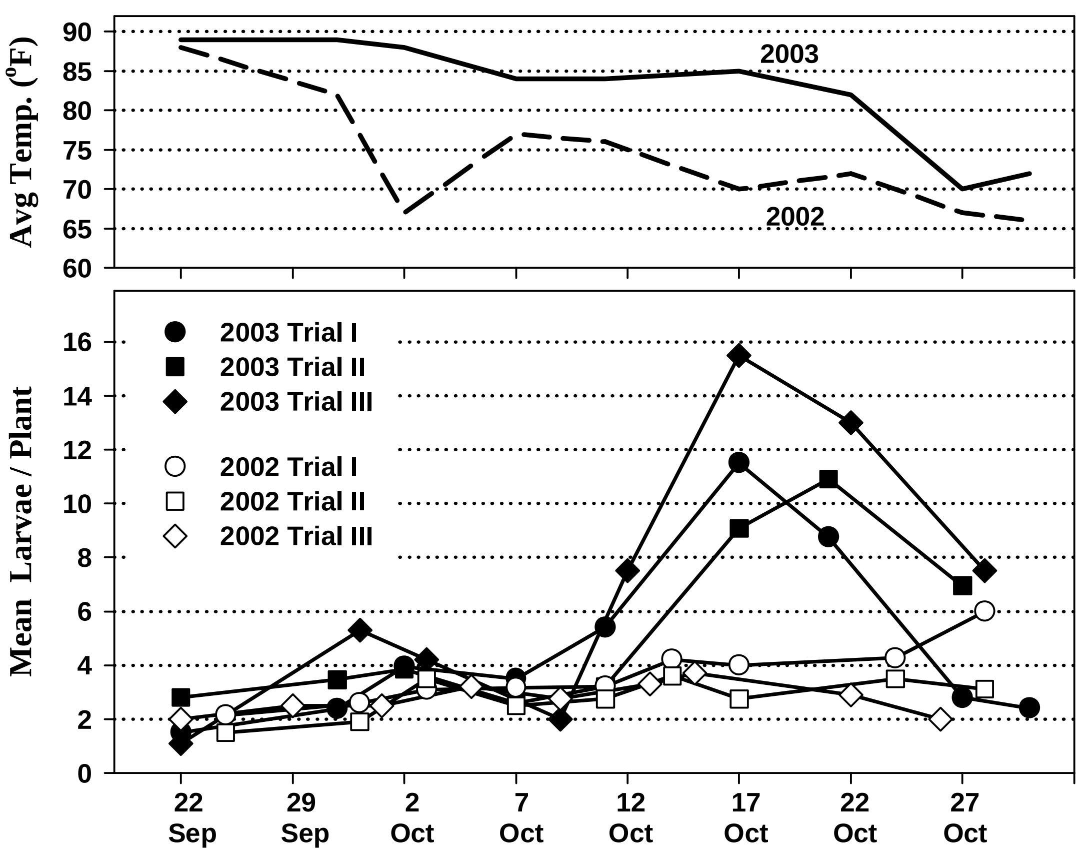


Fig 5. Total worm populations (small and large beet armyworm and cabbage looper larvae) relative to temperatures in <u>untreated</u> head lettuce plots at the Yuma Ag Center, 2002-2003



Western Flower Thrips

Over the past several years western flower thrips has become a common and often serious pest of lettuce. However, thrips abundance in Yuma lettuce during 2003-2004 was lighter than what we have experienced the past several years. We have been conducting trials at the Yuma Ag Center for the past several years to study the influence of planting dates on thrips population growth. **Figure 6** shows the results of those studies to date. Thrips abundance never exceeded greater than 100 thrips /plant last season with the exception of 1 planting (Dec 12 wet date). However, thrips populations exceeded 100/plant in 3 and 4 plantings respectively in 2002 and 2003. Thrips pressure is generally low during Nov, Dec and Jan, the exception occurring during 2002-2003 where populations grew at rapid rates during this period. This can be explained in part to higher temperatures during the winter, particularly in January, 2003 (**Figure 2**). Temperatures may have also influenced thrips flight activity as shown in **Figure 7**. Trap catches of thrips were similar throughout the Yuma Valley for all years until late in the season. This year thrips dispersal at the end of the season was relatively lower than what we've seen in past years. Also, anecdotal reports from PCA's suggest that thrips pressure was lighter this year. This may be due to some extent to high temperatures in March, but was more likely a result of heavy insecticide usage for aphids, and difference in cropping patterns. In general, we feel that thrips abundance and flight activity is generally highest in March as a result of optimal temperatures for development and flight, the rapid harvest of lettuce, and the reduced number of produce acres (**Figures 6 and 7**). Finally, to confirm what most PCA's and growers already believe, our data set suggests that thrips population development in lettuce is generally greatest in late-November and December plantings (**Table 2**).

Aphids

Aphid pressure was heavy for a second consecutive year in 2003-2004. Surprisingly, green peach aphids (GPA) were the predominant species throughout the area, relative to the last few years where it has been almost non-existent. PCA's reported seeing GPA colonizing lettuce and cole crops in early November. Many populations required insecticide treatments to prevent economic infestations. Similar to our work with thrips, we have been conducting trials at the Yuma Ag Center for the past several years to study aphid population development across the season in several lettuce plantings (not treated with insecticide). The results from this work showed that over the past 5 growing seasons GPA populations were greatest last year (**Table 3**), with GPA peaking at over 400 / plant at harvest in our early November planting window (**Figure 8**). GPA continued to be abundant throughout the spring until March when populations quickly crashed due to high temperature (**Figure 2**). We are not certain why GPA was so abundant in 2004, as we are not sure how temperatures influence population growth during the winter. Average daily temperatures ranged between 50-55F for most of Dec, Jan and Feb, but it is more likely that the unusual GPA abundance in 2004 was a result of a complex of both abiotic and biotic factors.

Summaries across years and wet dates show that the seasonal aphid abundance differed by species. Whereas GPA appears to be prevalent in early November plantings, potato aphids are heaviest in late – November to early- December plantings (Table 4). Potato aphids were particularly heavy in 2003 as was lettuce aphid (Table 5) and foxglove aphids (Table 6). Lettuce aphid tends to be most abundant late in the season when temperatures average >60F. Although we only have 3 years for foxglove aphids, our information suggests that this aphid species has the wide range of activity. Compared with the other aphids, foxglove aphid has occurred in large number throughout the November and December plantings. Although we have seen heavy aphid pressure on produce the past 2 seasons, we less certain as to what factors contributed to these outbreaks. As we collect more data, we may be able to associate cropping practices or weather patterns that influence their abundance.

Acknowledgements

The information provided in this report would not have been possible without the funding and support provided by the *Arizona Iceberg Lettuce Research Council* and the cooperative assistance provided by numerous Yuma growers and PCA's.

Fig 6. Seasonal Western Flower Thrips Populations in Several Plantings of Head Lettuce , Yuma Ag Center, 2000-2004

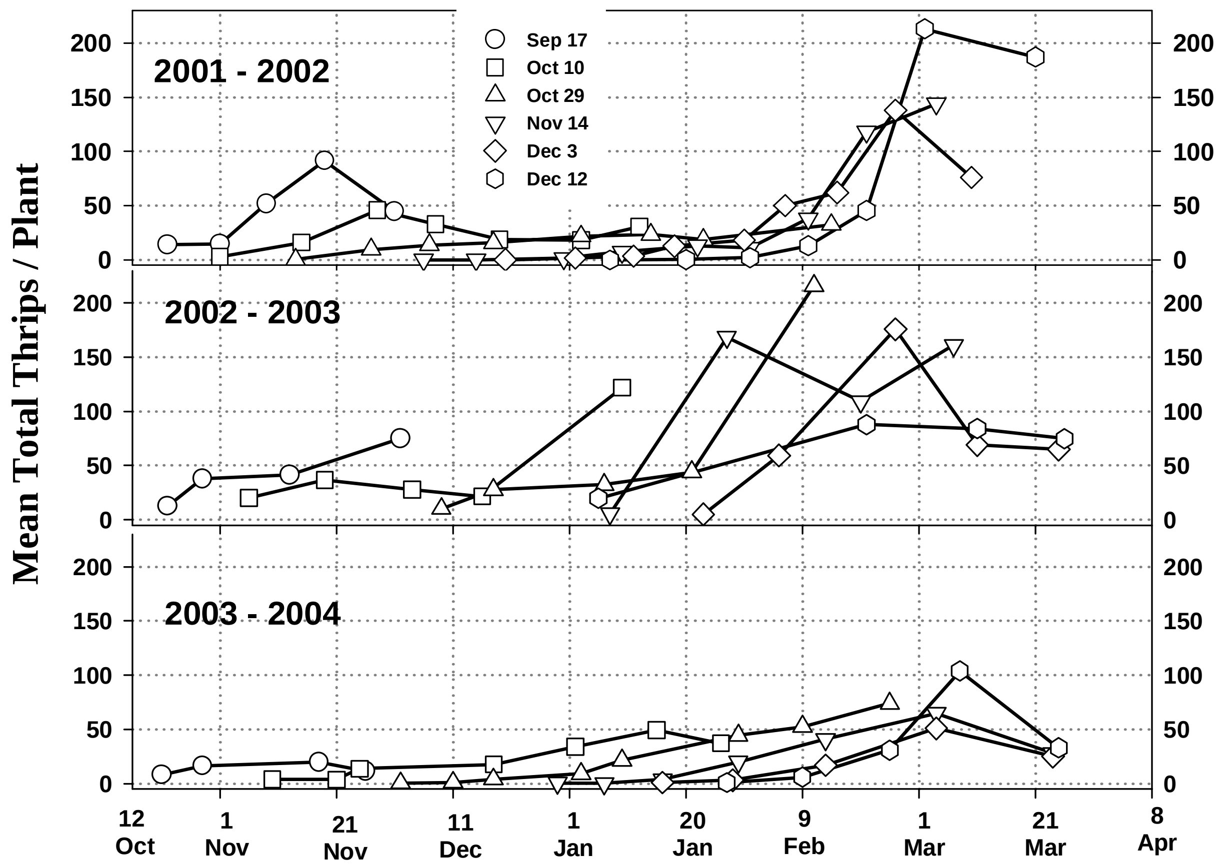


Fig 7. Thrips Flight Activity Based on Yellow Sticky Trap Catches, Yuma Valley 1998-2004

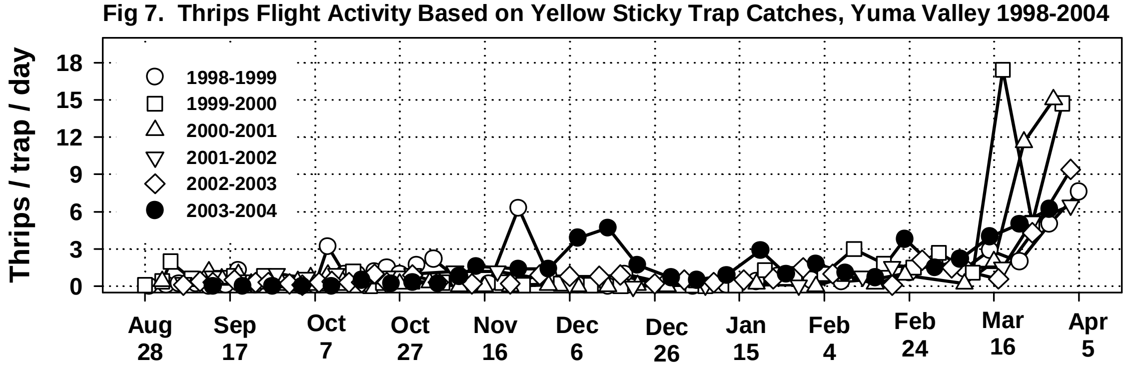


Table 2. Seasonal Western Flower Thrips (mean/plant) on untreated lettuce, YAC

Season	Wet date						Avg
	17-Sep	10-Oct	30-Oct	15-Nov	2-Dec	15-Dec	
2001-2002	43.3	23.6	16.9	37.0	40.2	65.9	37.8
2002-2003	41.7	45.7	66.2	111.8	75.9	66.8	**68.0**
2003-2004	14.1	22.8	25.9	22.7	19.5	35.0	23.3
Avg	33.0	30.7	36.3	**57.2**	45.2	**55.9**	

Table 3. Seasonal Avg. Green Peach Aphids / Plant, YAC, 1999-2004

Season	Wet date					Avg
	11-Oct	2-Nov	15-Nov	3-Dec	15-Dec	
1999-2000	0.0	0.1	0.1	0.3	0.2	0.1
2000-2001	5.5	20.4	12.6	4.7	5.7	9.8
2001-2002	0.0	1.0	0.7	0.2	0.1	0.4
2002-2003	0.0	0.8	1.8	0.0	0.3	0.6
2003-2004	15.8	117.0	23.0	10.6	12.0	**35.7**
Avg	4.3	**27.9**	7.6	3.2	3.7	

Table 4. Seasonal Avg. Potato Aphids[a] / Plant, YAC, 1999-2004

Season	Wet date					Avg
	11-Oct	2-Nov	15-Nov	3-Dec	15-Dec	
1999-2000	0.0	0.1	2.5	3.5	1.0	1.8
2000-2001	1.3	6.7	4.6	1.6	2.7	3.4
2001-2002	0.2	0.4	1.5	0.8	5.6	1.7
2002-2003	2.3	1.4	72.2	94.2	60.1	**46.0**
2003-2004	0.0	0.1	0.0	0.0	0.0	0.1
Avg	0.8	2.2	16.2	**20.0**	13.9	

[a] includes *Acrythosiphum lactucae* populations

Table 5. Seasonal Avg. Lettuce Aphids / Plant, YAC, 1999-2004

Season	Wet date					Avg
	11-Oct	2-Nov	15-Nov	3-Dec	15-Dec	
1999-2000	0.0	0.1	1.6	1.2	4.4	1.8
2000-2001	0.0	1.0	1.2	3.1	9.1	2.9
2001-2002	0.0	0.0	0.9	0.2	0.7	0.4
2002-2003	0.0	0.1	5.1	32.8	40.2	**15.6**
2003-2004	0.0	0.0	0.0	0.9	0.5	0.14
Avg	0.0	0.3	1.8	7.5	**11.0**	

Table 6. Seasonal Avg. Foxglove Aphids[b] / Plant, YAC, 1999-2004

Season	Wet date					Avg
	11-Oct	2-Nov	15-Nov	3-Dec	15-Dec	
1999-2000	-	-	-	-	-	
2000-2001	-	-	-	-	-	
2001-2002	0.0	0.1	1.2	14.6	1.5	3.5
2002-2003	1.1	16.3	32.6	67.1	37.2	**30.9**
2003-2004	1.4	25.1	49.8	5.6	5.7	17.5
Avg	0.8	13.8	**27.9**	**29.1**	14.8	

[b] foxglove aphids not detected in Yuma lettuce prior to the 2001-2002 season

Fig 8. Seasonal population trends for Green Peach Aphids in untreated head lettuce for three planting windows over a five year period, YAC