Comparative Efficacy of Oberon® (spiromesifen) Against *Bemisia* Whiteflies in Spring Cantaloupes

John C. Palumbo

Abstract

Several studies were conducted on spring cantaloupes from 2002-2004 to evaluate a new insecticide, Oberon (spiromesifen) for whitefly control in spring melons. These studies demonstrate that this IGR-like insecticide offers melon growers management alternatives for effectively controlling whiteflies. The results strongly suggest that Oberon has good potential for controlling whiteflies in spring melon crops similar to what can be expected from Courier. Oberon provided 21-28 days of residual control of whiteflies under spring growing conditions when applied early in whitefly population growth. Our studies also indicate that spray timing is important for cost-effective control with both Oberon and Courier. They also suggest that action thresholds based on adult abundance and nymph densities differ for these two compounds depending on whether Admire has been applied at planting.

Introduction

During the past decade, *Bemisia* whiteflies have been relegated to a managed pest in Arizona. This was achieved through the development of management programs in cotton, melons and vegetables which utilized cultural practices, sampling and monitoring plans, and the optimally-timed use of new, selective insecticide chemistries. Growers in all commodities have been quick to adopt and modify these management strategies as new insecticide compounds are made available. The recent registration of several new neonicotinoid compounds on cotton, melons and vegetables has expanded the number of compounds available for whitefly control on these crops. Admire® (imidacloprid), the first compound registered within this class of chemistry, has been used effectively in melons and vegetables for whitefly and aphid control since 1993. The sustained efficacy of Admire over the past 10 years exceeded the expectations of many who speculated that whiteflies would quickly evolve resistance. No field failures have been reported to date, in part because imidacloprid has been used sparingly in cotton. However, the recent registration of Intruder (acetamiprid) and Centic (thiamethxam) in cotton against whiteflies place increased selection pressure on the neonicotinoid chemistry, particularly in multi-cropping communities where these compounds could be applied to a number of successive whitefly generations on neighboring crops throughout the year. Given the tremendous value of these compounds in whitefly control, it is important that new insecticide alternatives be developed and implemented into our varied cropping systems to sustain long-term whitefly management.

Spiromesifen (Oberon®) is a novel non-systemic insecticide belonging to the new chemical class of tetronic acid derivatives discovered at Bayer CropScience during the 1990s. It is especially active against whiteflies (*Bemisia* spp. and *Trialeurodes* spp.) and mites as a foliar spray in many crops such as cotton, vegetables, and ornamentals. Spiromesifen has a new mode of action with IGR like properties that interferes with lipid biosynthesis, resulting in the inability of the younger insect growth stages to develop and affects the fecundity of adults. The active ingredient shows no cross-resistance to any resistant mite or whitefly field population and is therefore a valuable tool for our cross commodity resistance management program. The compound is currently under development and will likely be registered in Arizona within 2-3 years. The objective of these studies was to closely examine and practically define the residual efficacy of Oberon on *Bemisia* whiteflies in spring cantaloupes.

Methods and Materials

Efficacy of Foliar IGR and Soil Neonicotinoid Combinations, 2002.
The objective of this study was to determine the efficacy of two IGRs, Courier® (formally called Applaud; Nichino America) and Oberon® (spiromesifin; Bayer Crop Protection) when applied following applications of a reduced rate of Admire. Cantaloupe plots planted with 'Esteem' were established at the Yuma Agricultural Center on March 27 and managed similarly to local growing practices. Plots consisted of four 80-inch beds, 60 ft long with a 15 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates/treatment. The treatments and rates are shown in figures 1 and 2.

Admire were applied 3" below the seedline prior to seed placement in 22 GPA. The foliar treatments were applied with a hydraulic sprayer delivering 24 GPA at 60 psi, using 5 - TX18 ConeJet nozzles per bed. The IGR treatments were timed to coincide with increases in adult and egg densities and declining Admire soil residual (May 30th). The Courier - Calypso treatment was first sprayed with Courier on May 10, followed by a Calypso spray on May 30. Populations of whitefly adults and immatures were evaluated on 2, 14, 27, May and 12 and 25 June. Populations of whitefly adults and immatures were evaluated at 10-14 day intervals beginning on April 7th and April 30th in the February and April plantings, respectively. We estimated treatment effects on whitefly populations by making whole plant counts. This involved removing the leaves from 3 locations on the primary vine (crown, midvine, and terminal) of 5-8 plants within each replicate. Whitefly densities were counted on 2-cm^2 leaf discs on each leaf using a dissecting microscope. Melon yields and quality were estimated by counting the number of total netted fruit per plot and estimating the amount of sooty mold contamination on individual netted melons.

Efficacy of Oberon against Whiteflies on Spring Melons, 2002
The objective of this study was to determine the residual efficacy of Oberon, a new IGR, against whiteflies on spring melons. Preliminary studies suggest that Oberon is slow acting against sucking pests, but information describing its specific activity against whiteflies is lacking. Cantaloupe plots planted with 'Sol Real' were established at the Yuma Agricultural Center on August 16 and managed similarly to local growing practices. Plots consisted of four 80-inch beds, 75 ft long with a 15 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates/treatment. The treatments and rates are shown in figure 3.

The foliar spray treatments were applied with a hydraulic sprayer delivering 24 GPA at 60 psi, using 5 - TX18 ConeJet nozzles per bed. The IGR treatments were timed to coincide with increases in small and large nymph densities. The first application was sprayed on May 10, followed by a 2nd spray 20 days later on May 30. Populations of whitefly adults and immatures were evaluated on 6, 16, 23, 31 May and 6, 17, and 24 June. The methods for assessing whitefly population densities were similar to methods used in the first study. Yields and quality were not measured in this study.

Efficacy of Oberon against Whiteflies on Spring Melons, 2003
The objective of this study was to determine the residual efficacy of Oberon, a new IGR, against whiteflies on spring melons. Preliminary studies suggest that Oberon is slow acting against sucking pests, similar to what growers can expect with Courier. Cantaloupe plots planted with 'Esteem' were established at the Yuma Agricultural Center on Mar 19 and managed similarly to local growing practices. Plots consisted of four 80-inch beds, 50 ft long with a 15 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates/treatment. The treatments and rates are shown in figures 4 and 5.

The foliar spray treatments were applied with a hydraulic sprayer delivering 25 GPA at 60 psi, using 3 - TX18 ConeJet nozzles per bed. The IGR treatments were timed to coincide with increases in small and large nymph densities. The first application was sprayed on May 13, followed by a 2nd spray on May 30. Populations of whitefly adults and immatures were evaluated on 5, 19, 27 May and 2, 11, and 23 June. The methods for assessing whitefly population densities were similar to methods used in the first study. Yields and quality were measured by harvesting the total number of melons in 30 row ft per treatment every other day over a 2 week period. Quality was assessed by estimating the percentage of melons visibly contaminated with sooty mold.

Residual Efficacy of Oberon on Spring Melons, 2004

The objective of this study was to determine the residual efficacy of Oberon on spring melons. Cantaloupe plots planted with 'Esteem' were established at the Yuma Agricultural Center on February 24 and managed similarly to local growing practices. Plots consisted of two 80-inch beds, 50 ft long with a 15 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates/treatment. The treatments and rates are shown in figure 6. A new formulation of Courier was evaluated (40SC) relative to the 70W that was used in the previous studies.

The foliar spray treatments were applied with a CO_2 backpack sprayer that delivered 20 GPA at 50 psi, using 4 - TX18 ConeJet nozzles per bed. All treatments were timed to coincide with increases in small and large nymph densities. The first application was sprayed on May 4, followed by a 2nd spray 22 days later on May 26. All spray treatments included DyneAmic at 0.06% v/v. Populations of whitefly immatures were evaluated at 7 day intervals after each application (DAT). The methods for assessing whitefly population densities were similar to methods used in the first study, with the exception that 5 plants/plot were samples and 4 leaves were collected from each plant (the 5th , 10th, 15th, and 20th leaves from the terminal on the primary vine). Data shown in figure 6 reflect densities found on the most infested leaf on (based on untreated plants) at each sample date. Yields and quality were not measured.

Spray Timing of Oberon on Spring Melons, 2004

The objective of this study was to examine the effect of Oberon spray timing on whitefly densities based on pre-determined action thresholds both in Admire-treated and untreated spring melons. Cantaloupe plots planted with 'Esteem' were established at the Yuma Agricultural Center on March 19 and managed similarly to local growing practices. Plots consisted of two 80-inch beds, 70 ft long with a 15 buffer between each plot. The study was designed as a split plot design 4 replicates/treatment. The main plots consisted of Admire and untreated plots, and the subplots consisted of the Courier 40SC (13.5 oz) and Oberon 2SC (8.5 oz) treatments applied at both action thresholds. Treatment combinations are show in Table 1.

Admire (16 oz/acre) was applied to the main plots at 3" below the seed line prior to seed placement in 30 GPA. The foliar spray treatments were applied with a CO_2 backpack sprayer that delivered 20 GPA at 50 psi, using 4 - TX18 ConeJet nozzles per bed. All foliar treatments were applied when thresholds were exceeded; either >2 adults per leaf, or >2 large nymphs/2 cm^2. Application dates for the Admire main plots were 24 May for adult threshold and 5 June for the nymph threshold. Dates for the Admire-untreated plots were 24 May for adult threshold, and 8 May and 5 June for the nymph threshold. All spray treatments included DyneAmic at 0.06% v/v. Populations of whitefly adults and immatures were evaluated at 7 day intervals beginning on 29 Apr. The methods for assessing whitefly population densities were similar to methods used in the first 2004 study where 5 plants/plot were sampled and 4 leaves were collected from each plant (the 5th, 10th, 15th, and 20th leaves from the terminal on the primary vine). Data shown in figure 6 reflect densities found on the most infested leaf on (based on untreated plants) at each sample date. Yields and quality were measured by harvesting the total number of melons in 12 row ft per treatment every other day over a 2 week period. Quality was assessed by estimating the percentage of melons visibly contaminated with sooty mold.

Results and Discussion

Efficacy of Foliar IGR and Soil Neonicotinoid Combinations, 2002.

Whitefly pressure was low-moderate for most of the study and increasing near harvest. Significant differences in whitefly control among the spray treatments and the untreated check were not observed until about 3 weeks following the foliar applications just prior to harvest. Both the Appluad+Admire-8 oz and Oberon+Admire-8oz treatments provided similar reduction of whitefly populations and significantly reduced whitefly egg, nymph and pupae densities compared with the control. Admire at 16 oz provided control comparable to both foliar spray treatments (Figure 1). A reduced rate of Admire (8 oz.) alone was included and did not provide adequate control (data not shown). The Courier-Calypso foliar spray treatment provided comparable control to the IGR/Admire treatments, even though no Admire was used at planting. Melon fruit yields were significantly greater in the Admire 16 oz treatment than any other treatment during the early harvest window (Figure 2), but by the end of harvest, all insecticide treatments provided comparable fruit yields and were all significantly greater than the untreated check.

However, fruit quality was best in plots receiving the foliar spray treatments. Although fruit contamination was significantly lower in the Admire 16 oz plots than the untreated check, sootymold/honeydew contamination was overall lowest in the Oberon and Courier/Calypso treatments (Figure 2).

Efficacy of Oberon against Whiteflies on Spring Melons, 2002

Similar to the previous study, whitefly pressure was low-moderate for most of the study, but adult populations developed to large numbers in the untreated check near the end of the study. Following the 1st application, all the spray treatments provided similar levels of residual control of whitefly nymphs for about 21 days (Figure 3). Differences among treatments were observed however following the 2nd application, especially at 25 days after the 2nd spray was made. Egg and small nymph densities were not significantly reduced following a single Oberon spray, but were much lower where Oberon was sprayed twice. In contrast, a single application of Courier did provide reduced egg and nymph deposition compared with the untreated check (Fig 3). Neither a single application of Oberon or Courier significantly reduced large nymphs and eclosed pupae, whereas 2 applications of Oberon appeared to provide good residual control of large nymphs, as did Courier and the Danitol/Thiodan combination. Furthermore, these treatments significantly reduced population development as indicated by the few eclosed pupae that were measured throughout the study.

Efficacy of Oberon against Whiteflies on Spring Melons, 2003

Whitefly pressure was low-moderate for most of the study, but adult populations developed to large numbers in the untreated check near the end of the study. Following the 1st application, all the spray treatments provided similar levels of residual control of whitefly nymphs for about 20 days (Figure 4). Differences among treatments were observed following the 2nd application, especially near harvest. Egg and nymph densities were reduced compared to the check following a single Oberon spray, but were significantly lower where Oberon was sprayed twice. The single application of Courier or Knack did not provide reduced egg and nymph deposition compared with the untreated check (Fig 4). Furthermore, all treatments (with the exception of the Mustang +Thiodan and Courier - 1 spray) significantly reduced population development as indicated by the fewer eclosed pupae that were measured at harvest (Fig 4).

Although greater numbers of early crown-set melons were produced in the Oberon treatment receiving 2 applications, total cumulative melon fruit yields were not significantly different among treatments (Figure 5). However, quality of early melons were significantly better in all spray treatments compared to the untreated check. Following the fourth harvest, the Courier – 1spray, Knack and Mustang+Thiodan plots began to become increasingly contaminated with sooty mold. The Oberon treatments remained nearly contaminant-free until late in the harvest and overall, sootymold/honeydew contamination was lowest in the Oberon and Courier treatments (Figure 5).

Residual Efficacy of Oberon on Spring Melons, 2004

Whitefly pressure was considerably higher in 2004 than in the previous 2 years. Adult populations moved in early and then a large source of adults migrated into the plots again in mid-May. Consequently egg densities were high and probably don't reflect actual population suppression as both Oberon and Courier do not cause direct mortality to adults. Both rates of Oberon did however did have a significant effect on small and large nymphs, maintaining numbers at very low level for 21 days following the first application (Figure 6). After the second application both the Courier and Oberon maintained nymph densities at low levels. Surprisingly Assail did not provide the same level of control, particularly of large nymphs. Although quality yields were not measured, observations of plots at harvest time indicated that all spray treatments provided good protection based on the absence of sooty mold contamination on mature fruit.

Spray Timing of Oberon on Spring Melons, 2004

Similar to the above study, whitefly pressure was quite heavy and adult populations migrated into the plots again in mid-May. This caused our adult threshold treatments to trigger in late May in both the Admire-treated and – untreated main plots (Figure 7). These plots were not retreated. The nymph threshold treatments triggered and received foliar sprays first in the untreated main plots on May 6, and again on 3 Jun (Figure 9). In the Admire treated main plots, the nymph threshold wasn't triggered until about 4 weeks later on June 3.

In the Admire-treated main plots, numbers of immature whiteflies in the spray treatments were significantly lower than the check for most sample dates (Figure 8). Eggs and small nymphs were lower in the Oberon treated plots, regardless of threshold, than in the Courier plots at harvest. Large nymphs were greater in the Courier (adult threshold) and Admire-only plots, than in all other sprayed plots. Numbers of eclosed pupae did not differ among the spray treatments. Similar results were seen for the untreated main plots, where all spray treatments were significantly lower than the untreated plots, with the exception of the Courier plots using the nymph threshold (Figure 9). Differences in nymph densities did not differ among the threshold treatments for either Oberon or Courier. However, colonization (as indicated by the number of eclosed pupae) was significantly lower in the Courier – nymph threshold plots than all other threshold treatments (Figure 9).

Yield estimates showed that total cumulative melon fruit yields were not significantly different among treatments (Table 1). However, differences were observed in fruit quality. All spray treatment combinations contained significantly less sooty mold contamination than the Admire-only and untreated check plots, where 48 and 87% of the melons respectively were contaminated. The Admire treated main plots that were oversprayed with Courier using the nymph threshold had significantly more sooty mold than Courier treatment using the Adult threshold. In untreated main plots, Courier/thresholds treatments did not differ. This was similar for Oberon. However, in the Admire treated main plots oversprayed with Oberon, contamination was significantly lower on melons using the adult threshold.

Conclusions The results of this study strongly suggests that Oberon has good potential for controlling whiteflies in spring melon crops similar to what can be expected from Courier. Previous studies (1998-1999) showed that Courier residual is about 21-28 days under spring conditions, and these studies suggest that Oberon should provide similar residual whitefly control under similar conditions. Oberon is anticipated to be registered in 2-3 years and will bring a new mode of action (inhibition of lipid biosynthesis) to our IPM programs that will serve as a useful tool for sustaining whitefly management in desert cropping systems. Ideally, these two compounds can be used in rotation in years when whitefly populations are heavy or under fall growing conditions. This will ultimately provide a useful tool for sustaining whitefly management in desert cropping systems. Additionally, this study demonstrates that the Danitol/Thiodan combination still provides a solid 14-21 day residual under spring growing conditions and can also be expected to be a rotational partner in a whitefly management program. Our preliminary spray timing study this past spring indicates that spray timing is important for cost-effective control with both Oberon and Courier. They also suggest that action thresholds based on adult abundance and nymph densities differ for these compounds depending on whether Admire has been applied at planting. We plan to further pursue these studies in the next few years.

Acknowledgements

These studies would not have been possible without the funding and support provided by the California Melon Research Board, Bayer CropScience, Nichino America, and Cerexagri. I gratefully acknowledge the excellent assistance from the personnel at the Yuma Agricultural Center including Clay Mullis, Francisco Reyes, Andreas Amaya, Luis Ledesma, Leonardo Chavez, Javier Ruis, Gerardo Villegas and Ron Gaylor.

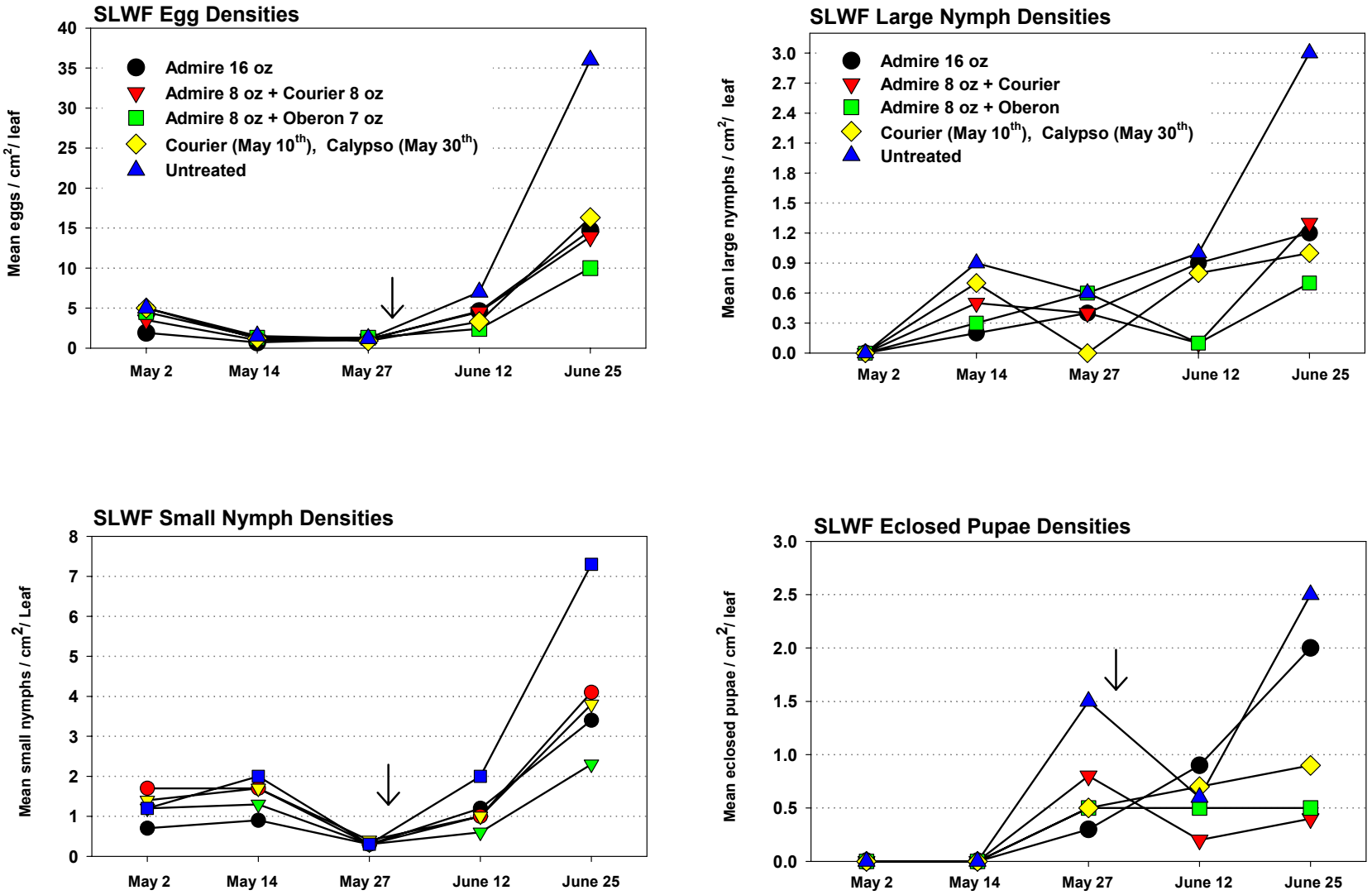
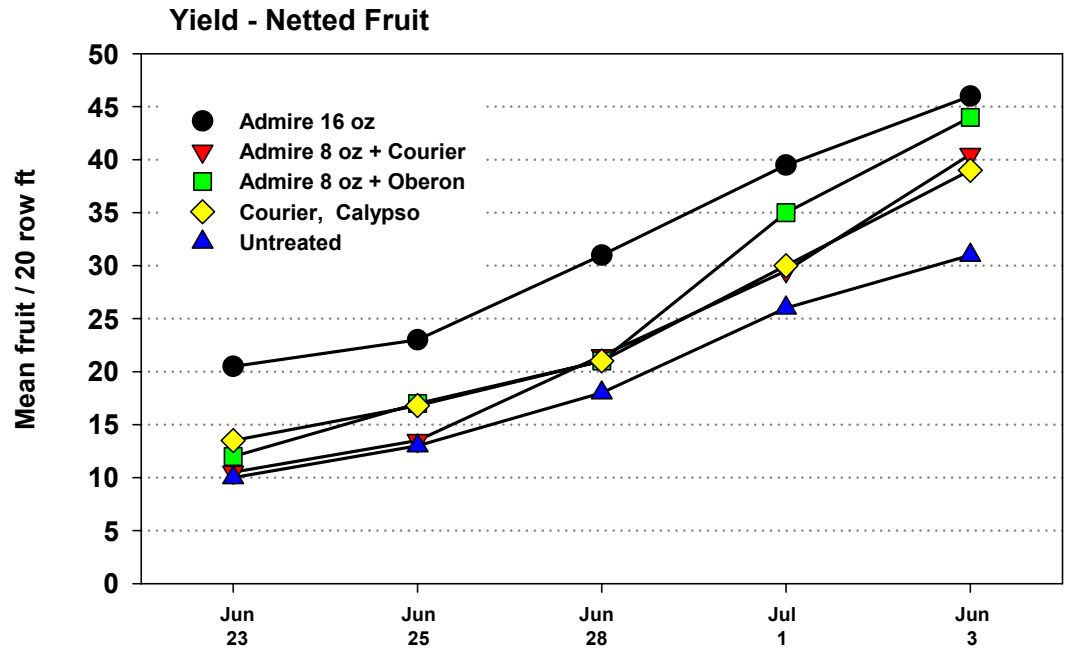


Figure 1. Whitefly densities on spring melons treated with combinations of soil-applied neonicotinoids and foliar IGRs, YAC, spring 2002
Arrow indicates when foliar IGRs were applied to Admire treated plots (May 30th).



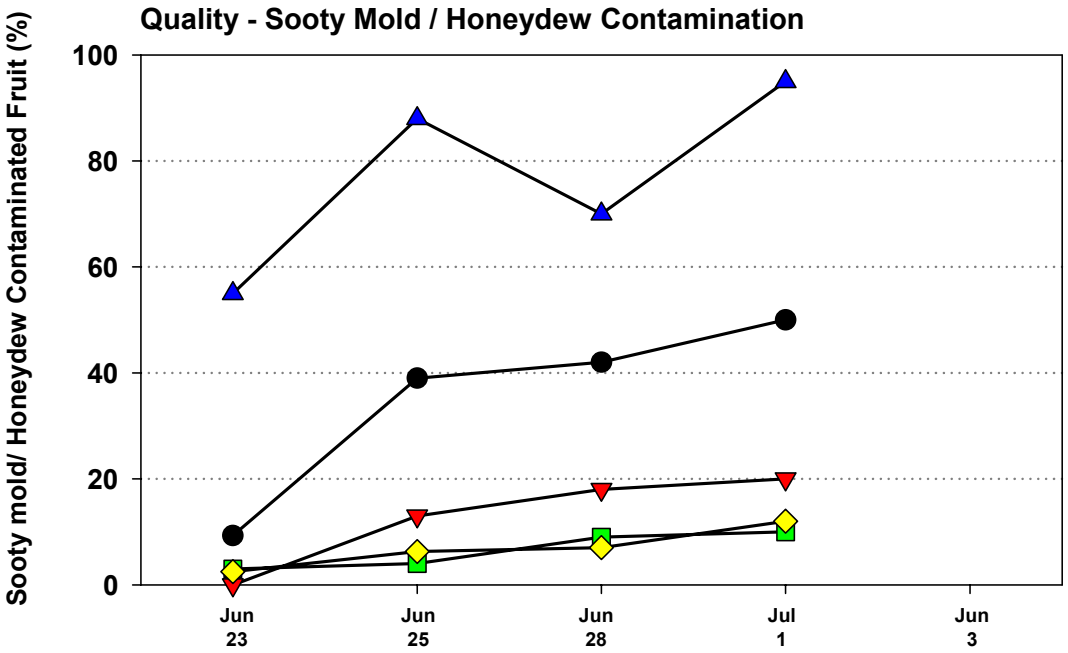


Figure 2. Melon yields and quality as influenced by combinations of soil-applied neonicotinoids and foliar IGRs, YAC, spring 2002

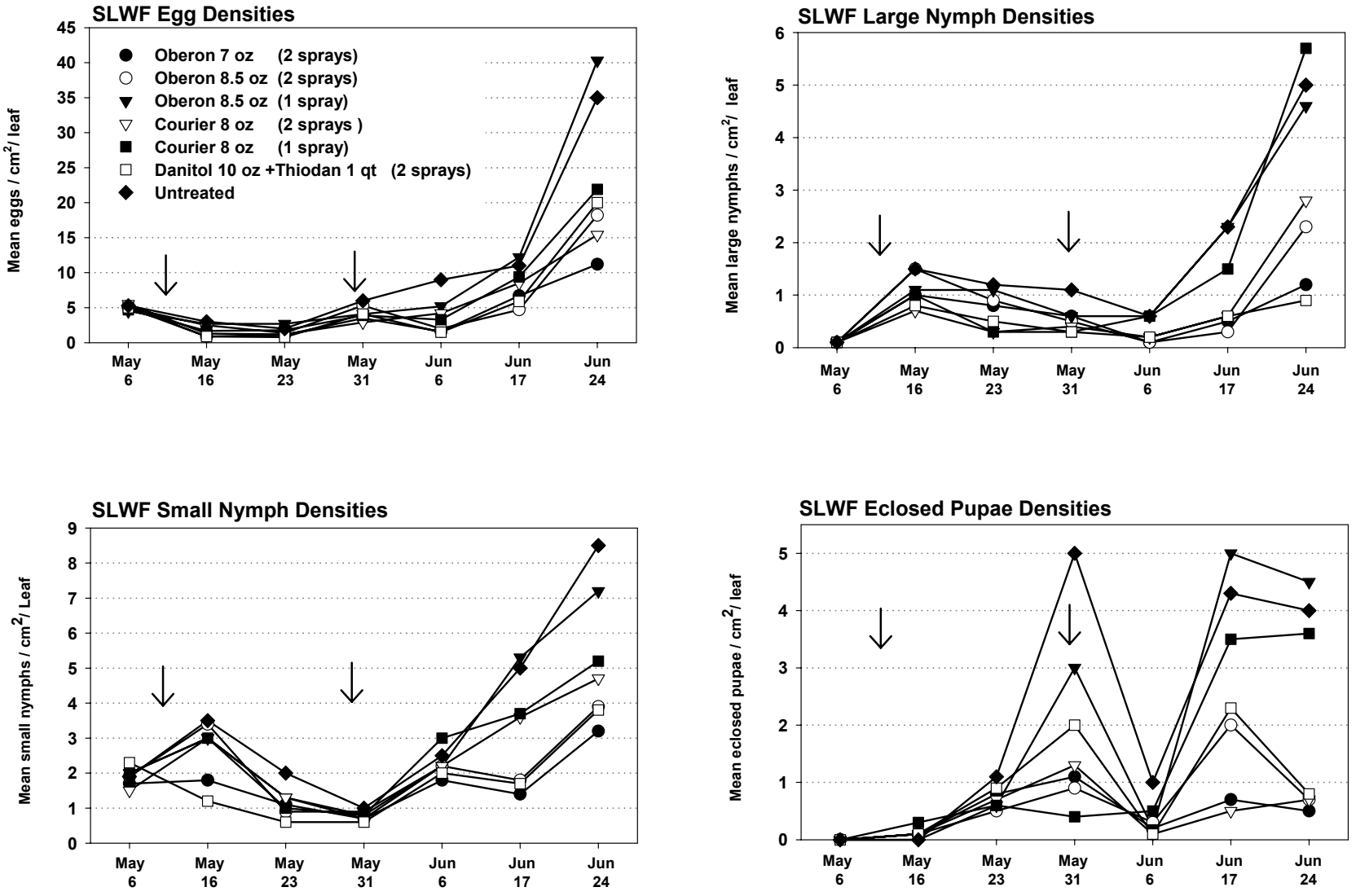


Figure 3. Whitefly densities on spring melons as influenced by rate and frequency of sprays of Oberon and Courier, YAC, spring 2002 . Arrow indicates when foliar sprays were applied to melons (May 10th and 30th) .

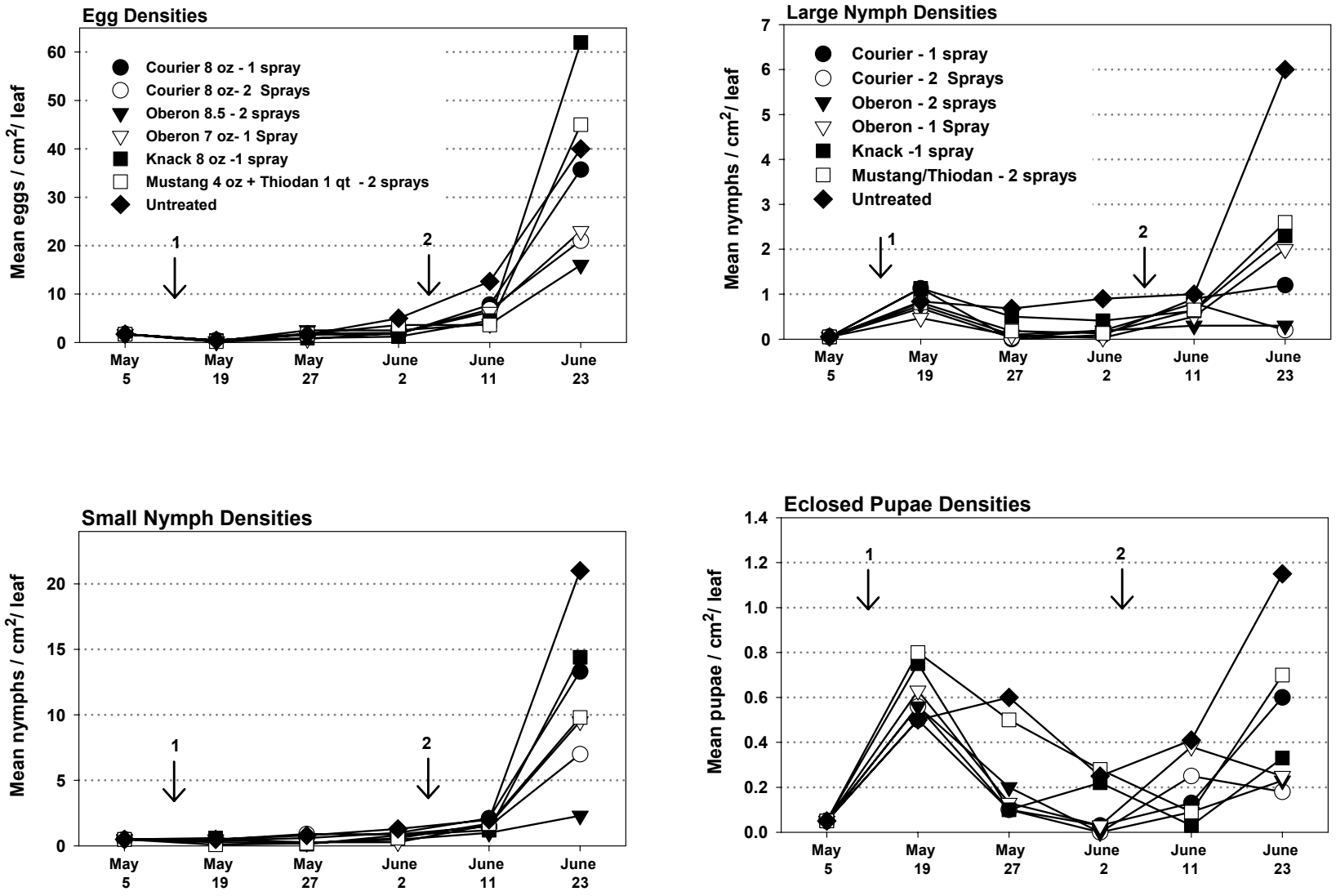
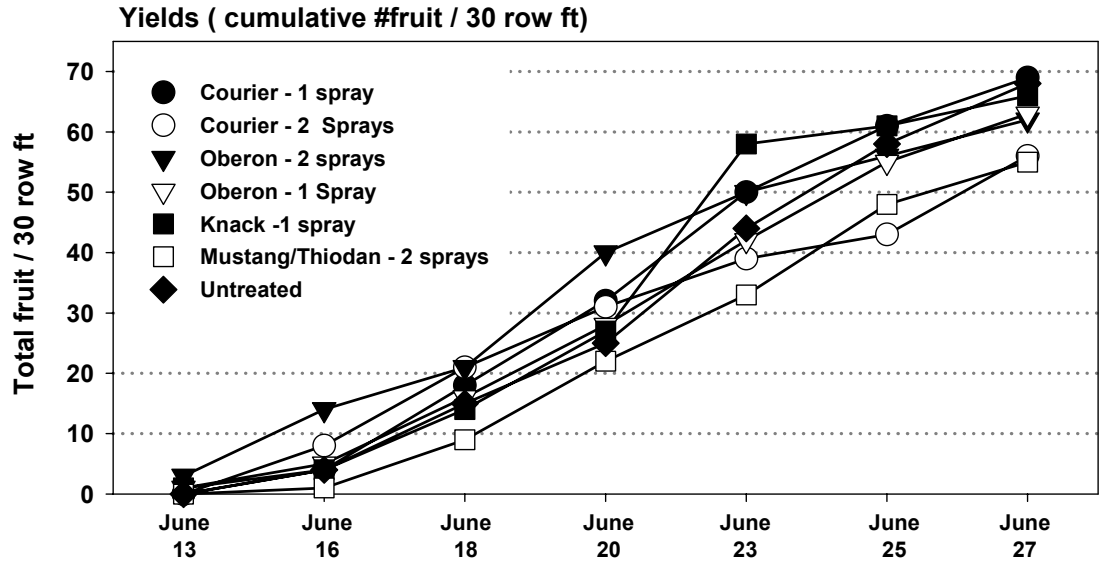


Figure 4. Whitefly densities on spring melons treated with combinations of soil-applied neonicotinoids and foliar IGRs, YAC, spring 2003 arrow indicates when foliar IGRs were applied to Admire and Platinum treated plots.



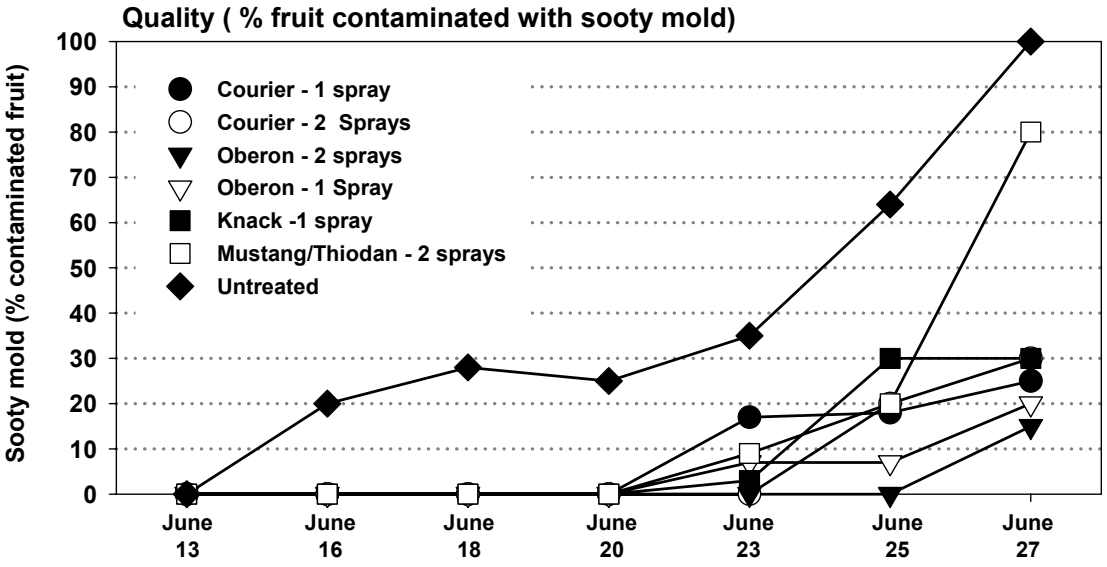


Figure 5. Yield and quality of cantaloupe fruit on spring melons treated with various insecticides, spring 2003

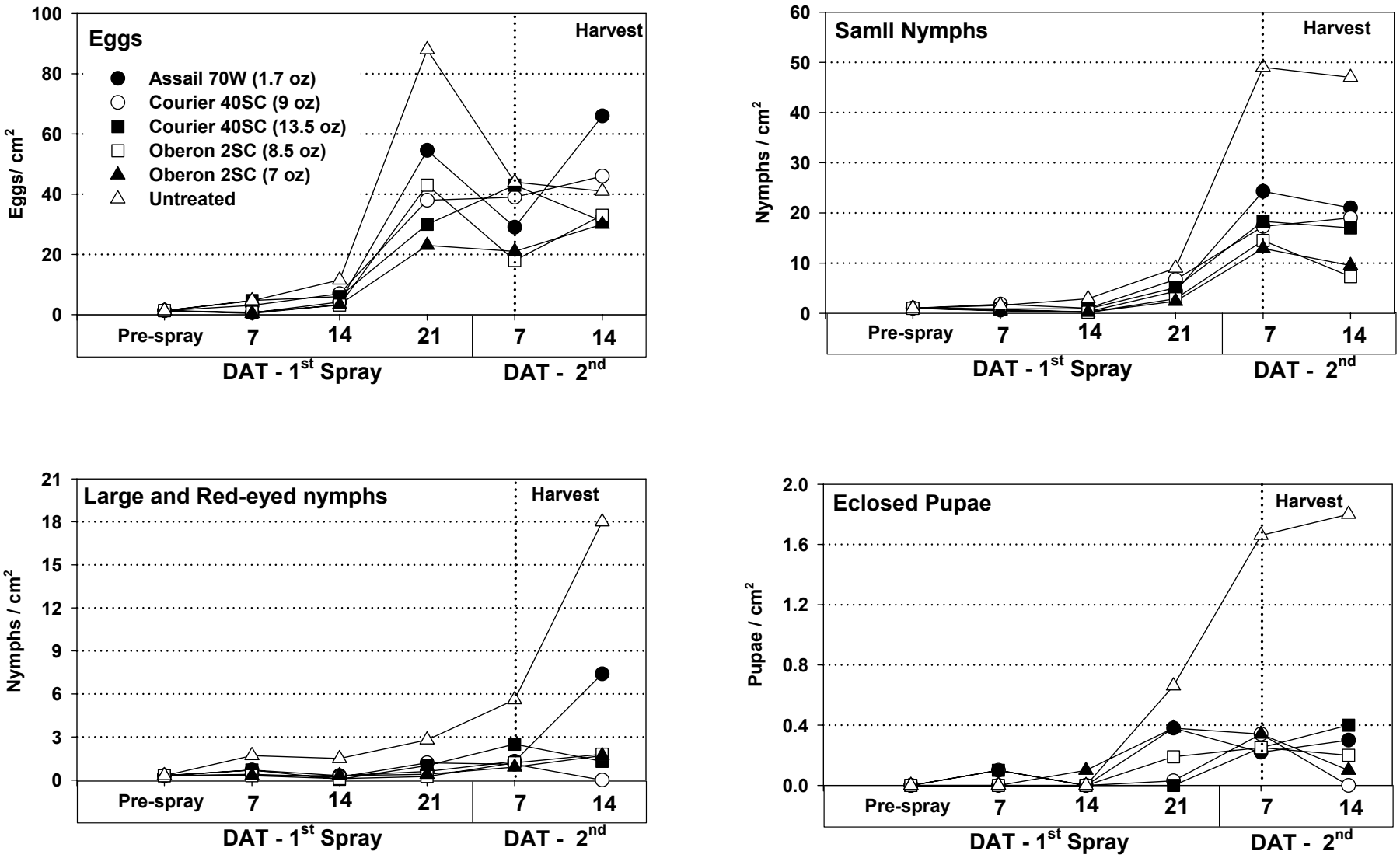


Figure 6. Densities of whiteflies on spring melons (most infested leaf) following application of Oberon and other insecticides, Spring 2004.

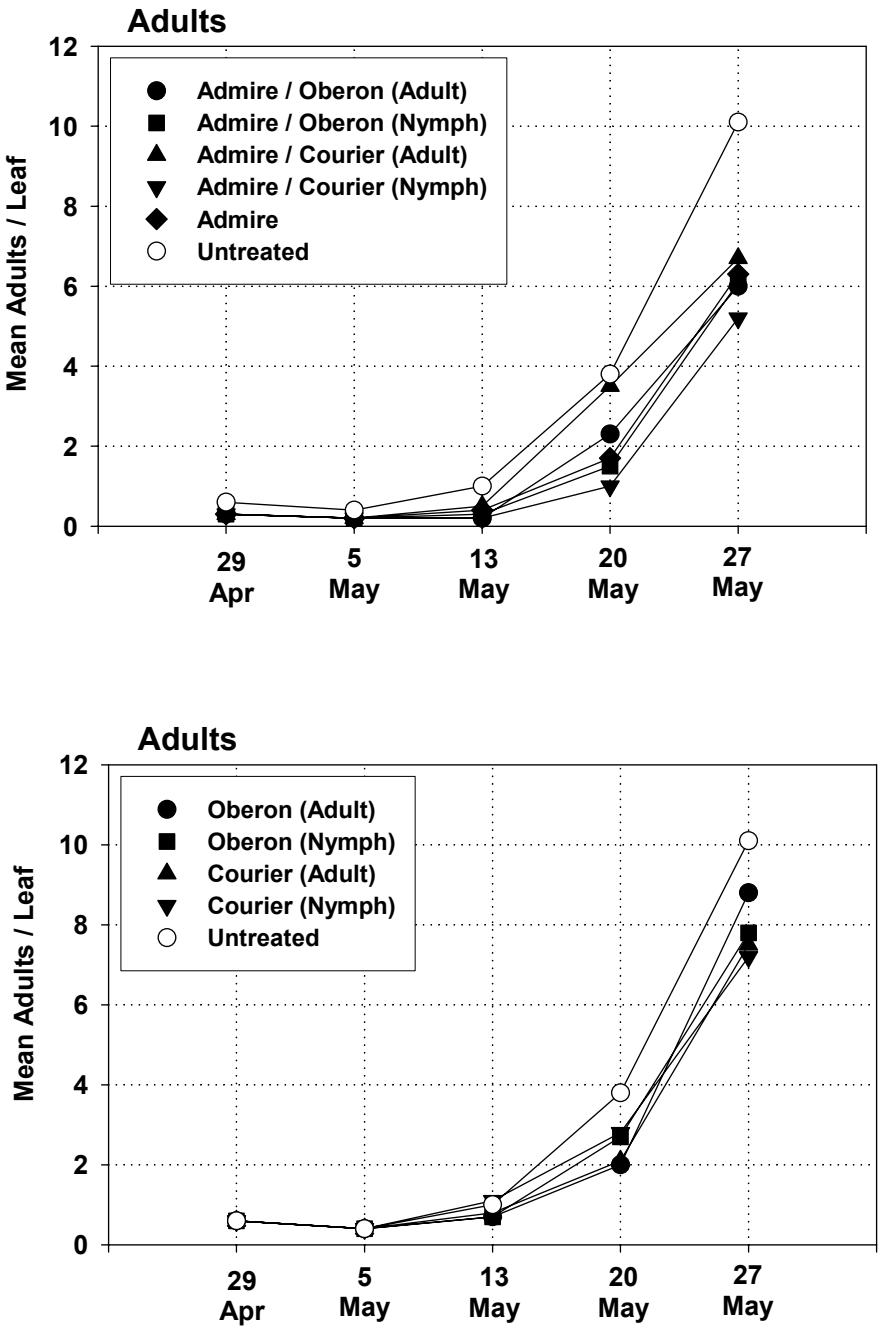


Figure 7. Adult whitefly abundance on cantaloupes treated with Admire and Oberon/Courier treatment combinations, Spring 2004.

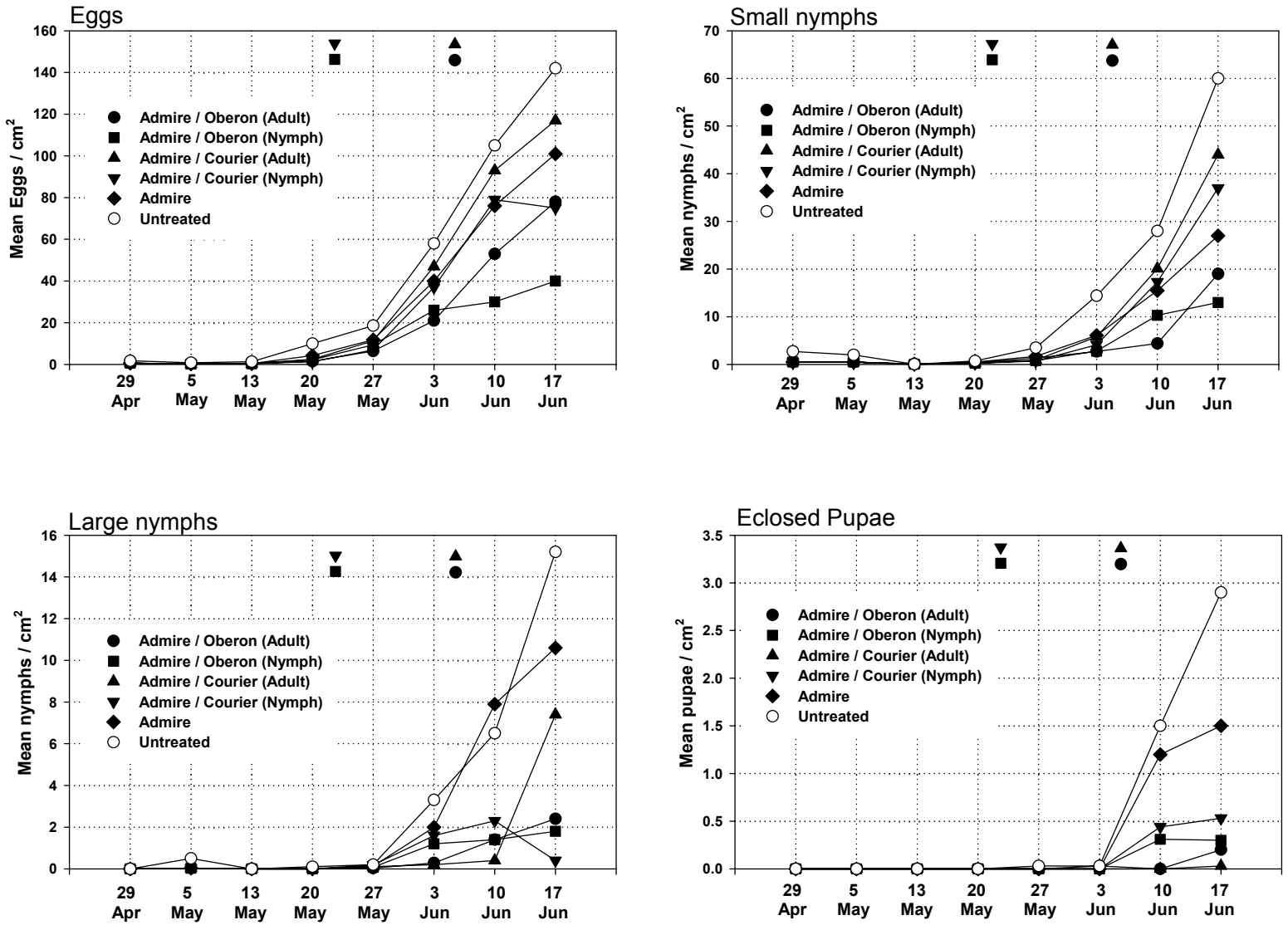


Figure 8. Whitefly densities on cantaloupes treated with Admire and Oberon/Courier treatment combinations, Spring 2004. Symbols at top of graphs indicate foliar spray timing.

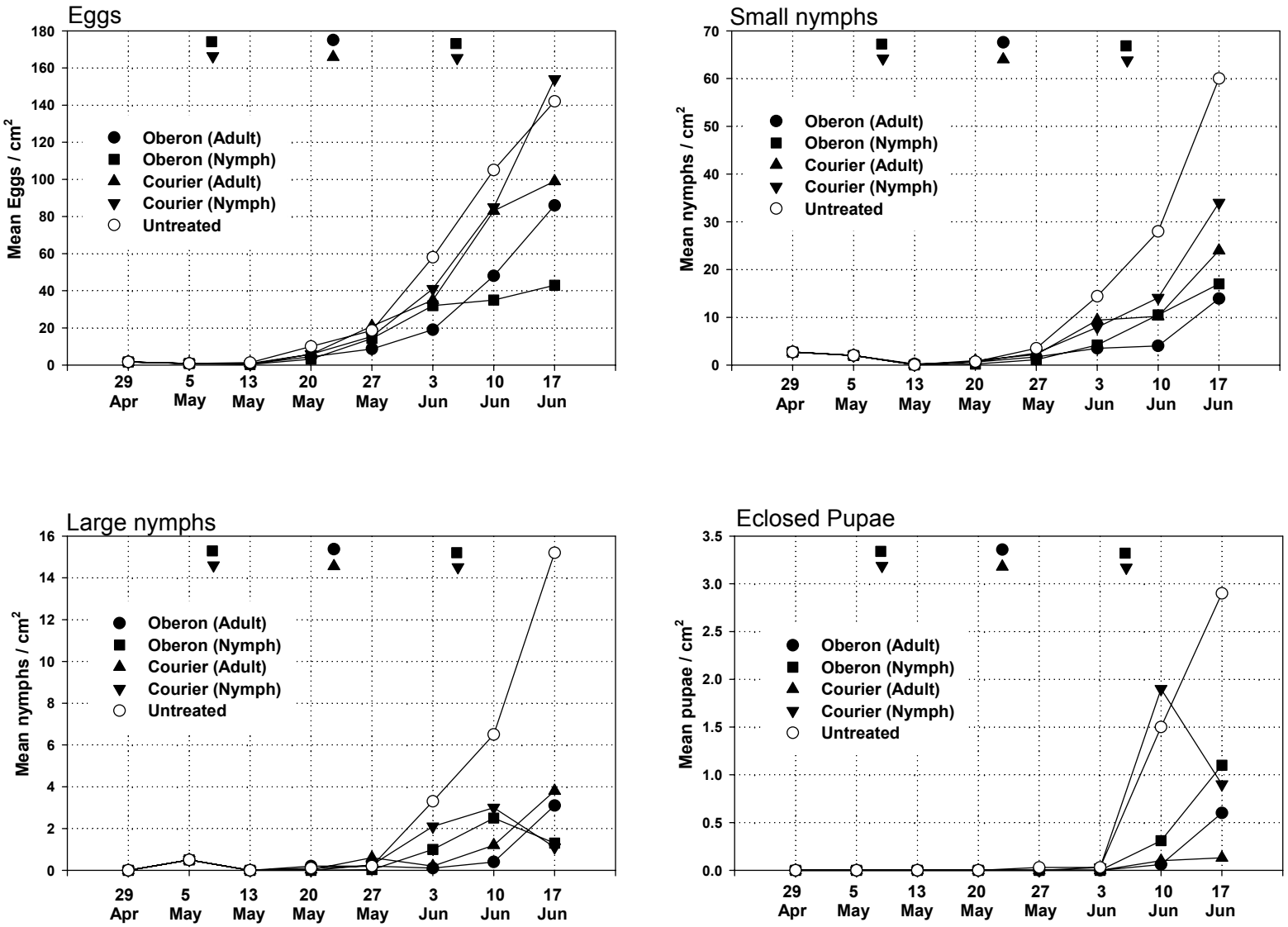


Figure 9. Whitefly densities on cantaloupes treated with Oberon/Courier, Spring 2004. Symbols at top of graphs indicate foliar spray timing.

Table 1. Average total yields and quality for Admire –Oberon/Courier treatment combinations on cantaloupes, spring 2004.

Soil treatment	Foliar treatment	Action Threshold	Avg. no. melons per 12 row ft	Contaminated melons (% sooty mold)
Admire	Oberon	>2 adults	26.3 a	0.0 e
Admire	Oberon	0.5 nymph	30.6 a	9.5 d
Admire	Courier	>2 adults	28.6 a	5.0 de
Admire	Courier	0.5 nymph	29.2 a	20.3 c
Admire	Untreated		30.9 a	48.0 b
Untreated	Oberon	>2 adults	26.8 a	0.0 e
Untreated	Oberon	0.5 nymph	26.6 a	2.2 de
Untreated	Courier	>2 adults	24.9 a	8.3 de
Untreated	Courier	0.5 nymph	25.3 a	3.0 de
Untreated	Untreated		30.6 a	87.0 a