Control of Codling Moth

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Abstract: The implementation of the Food Quality Protection Act of 1996, the Federal Water Pollution Control Act of 1972, aka Clean Water Act and the Occupational Health and Safety Act of 1990 stands to greatly impact established pest management techniques for pears. Changes in the availability and use of current insecticides will require more reduced risk and environmentally benign pest management strategies. Accordingly, trials were conducted in an effort to develop reduced risk control strategies. A single tree crop destruct field trial was conducted to evaluate new experimental insecticides for codling moth (CM) control. This trial showed that GF-1640 and DPX-E2Y45 are two new promising experimental CM products. These products provided significant suppression of CM compared to the untreated check and provided similar or better control compared to the grower standard. GF-1640 also provided some measure of pear psylla (PP) control. However, GF-1640 caused a significant increase in pear rust mite (PRM) compared to the untreated check and grower standard. DPX-E2Y45 did not induce population flare-ups with any of the secondary pests. No phytotoxicity was observed with either of these two experimental insecticides. In addition to the evaluation of new experimental insecticides for CM control, a single tree crop destruct field trial was conducted to evaluate pyrethroid insecticides for CM control. This trial showed that Brigade and Warrior are two new promising pyrethroid products. These products provided similar control compared to the grower standard. Brigade had elevated populations of PP and PRM but reduced populations of European red mite (ERM), while Warrior had elevated populations of PRM and reduced populations of PP. No phytotoxicity was observed with either of these two pyrethroid insecticides. A preliminary study on the pH of growers Imidan spray solution showed that the pH of the spray solution was quite variable when growers used the pH litmus test kit provided by the Gowan Company. Since the pH of the spray solution has a great effect on the half-life of Imidan greater care needs to be taken in determination of the pH of spray solutions. It is recommended that growers or PCAs purchase an inexpensive pH meter.

Introduction: In the summer of 1996, the U.S. Congress unanimously passed and the President signed the Food Quality Protection Act (FQPA). This piece of legislation along with the Federal Water Pollution Control Act of 1972, aka Clean Water Act and the Occupational Health and Safety Act of 1990 has had and will have a significant impact on all pesticides used in the U.S. and particularly on those used on agricultural crops that are consumed by infants and children, e.g. pears and apples. The EPA is reviewing organophosphate (OP) insecticides and has terminated Penncap-M registration and modified the registration of Guthion on pears. As the EPA implements the FQPA, it is anticipated that the EPA will mandate further restrictions on OP insecticides. The termination of Penncap-M and the restrictions on Guthion along with an increase in resistance in codling moth (CM) to most OP insecticides have caused a paradigm shift to occur in pear pest control. Pear pest management now relies on mating disruption for CM control, supplemented with an OP (Guthion or Imidan), pyrethroids (Danitol, Warrior) or reduced risk insecticides (Assail, Dimilin and Intrepid). CM pheromonal control has been demonstrated to be effective through the Pest Management Alliance (PMA) Project. The reduced usage of OP insecticides has caused a substantial decrease in pear psylla (PP) and twospotted spider mite (TSSM) pest pressure that allows for more benign pest control methods. However, despite the efficacy of the pheromonal control of CM, supplemental CM control with OP insecticides is often necessary. Confirm, Intrepid, Esteem, Dimilin or Success are not highly effective substitutes for Guthion in a CM pheromonal control program. It was hoped that Danitol and Assail would provide more effective replacements for OP insecticides. This has not been the case. The identification and continued evaluation of new unregistered insecticides that meet FQPA standards are needed for CM control. Thus, there is a need to implement existing technology while pursuing new, more environmentally and economically sound pest management strategies for the future.

Reported here are the results of our 2005 evaluations of new experimental insecticides and pyrethroid insecticides for CM control and evaluation of water pH in the use of Imidan spray solutions.

1. Evaluation of New Experimental Insecticides for Codling Moth Control

Methods and Materials: This trial was conducted in a commercial 'Bartlett' pear orchard in Fairfield, CA. This orchard was planted on a 25 ft. x 25 ft. spacing (70 trees/ac). Eleven treatments were replicated four times in a randomized complete block (RCB) design. Each replicate was an individual tree. Foliar sprays were applied with a hand-held orchard sprayer operating at 250 psi with a finished spray volume of 200 gal/acre (2.87 gal/tree). Applications were scheduled based on degree-days (DD). DD were calculated with a biofix of 30 March for the first generation and a 24 June biofix for the second generation using a single sine horizontal cutoff model with a lower threshold of 50˚F and an upper threshold of 88˚F. Maximum and minimum air temperatures were obtained from the IMPACT weather station at Cordelia, CA. Flight activity of male CM was monitored with a pheromone trap placed high in the canopy of an untreated tree. The application timings and treatments are shown in Table 1. Control of the CM generations was evaluated at commercial harvest on 26 July by inspecting a maximum of 250 fruit per tree for CM infestation. Control of PP nymphs, TSSM, European red mite (ERM), pear rust mite (PRM) and San Jose scale (SJS) crawlers was evaluated by leaf-brushing 10 exterior and 10 interior leaves collected from each tree weekly from 21 June through 18 July. The plates with the contents from the brushed leaves were counted under magnification (20X) in the laboratory.

Table 1. Treatments and application timings for CM control with experimental insecticides, Fairfield, CA – 2005

Treatment	Rate form/ac	No. appl	Application dates (day-degrees from 1st or 2nd biofix)
1. GF-1640 25WDG	6.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
2. GF-1640 25WDG	7.2 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
3. GF-1640 25WDG	6.0 oz	4	29 April (240 from 1st biofix), 13 May (385 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
4. GF-1640 25WDG	7.2 oz	4	29 April (240 from 1st biofix), 13 May (385 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
5. Success 2SC	6.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
6. DPX-E2Y45 35WG[a]	2.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
7. DPX-E2Y45 35WG[a]	3.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
8. DPX-E2Y45 35WG[a]	4.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
9. Assail 30SG	8.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
10. Imidan 70WP[b]	7.0 lb	1	29 April (240 from 1st biofix)
+ MK-936 0.18 EC	16.0 oz		
Guthion 50WP	3.0 lb	2	31 May (656 from 1st biofix) 7 July (259 from 2nd biofix)
11. Untreated check	——		

[a] Treatments contained 0.25% PureSpray Green oil by volume.

[b] Treatment pH was adjusted to less than 5.

Results and Discussion:

CM Flight Activity - The overwintering CM flight began prior to 30 March (Fig. 1). Biofix was set on 30 March (Appendix). CM biofix is set when sunset air temperatures meet or exceed 62˚F and there is a sustained moth flight. This temperature is the minimum required for CM oviposition. The overwintering flight was highly bimodal this year. The first peak of the overwintering flight occurred around 21 April at 170 DD. The air temperatures turned cool and unsettled with considerable periods of rain and moth flight decreased. The first peak often occurs at 300 DD after biofix. The second peak of the overwintering flight occurred around 26 May at 579 DD. The second peak often occurs at 650 DD after biofix. The first flight was completed by 23 June at 1,017 DD. The first flight is usually completed by 1,060 DD in early June. Thus this year, the cool spring and early summer temperatures delayed the completion of the first generation. The second biofix was set on 24 June. The first peak of the second CM flight occurred approximately on 5 July at 220 DD while the second peak of the second CM flight occurred after harvest.

Harvest Evaluation:

Codling Moth – The CM infestation in the untreated check was over 80% (Table 2). Thus, this trial provided a stringent test of the experimental treatments. The CM infestation in all of the experimental treatments was significantly lower than in the untreated check. Two new experimental CM products, GF-1640 and DPX-E2Y45, show promise as OP replacement insecticides. In addition to these products, Assail provided nearly equivalent control to the grower standard.

GF-1640 provided control comparable to the grower standard and there was a rate effect between 6.0 oz/ac and 7.2 oz/ac with both the three and four application treatments. The 7.2 oz/ac treatments had numerically lower CM infestation than the grower standard. Only the low rate of GF-1640 applied three times had elevated CM infestation levels. Both rates of GF-1640 at three or four applications had significantly lower infestation compared to Success, the Dow AgroSciences internal standard. GF-1640 provided much better control this year compared to the previous year's studies. In 2004, 5.7 oz of GF-1640 (equivalent amount using GF-968) was applied four times and had unacceptable infestation while this year, 7.2 oz of GF-1640 applied three and four times and 6.0 oz of GF-1640 applied four times provided excellent control. Only 6.0 oz of GF-1640 applied three times had an unacceptable infestation level this year. Thus GF-1640 appears to be highly rate sensitive, particularly under high CM pressure. DPX-E2Y45 also provided excellent control and was comparable to the grower standard. Unfortunately there was not a strong rate effect, with 2.0 oz/ac as effective as 4.0 oz/ac. Both DPX-E2Y45 and GF-1640 were more effective than Assail, the current non-OP grower standard. Both DPX-E2Y45 and GF-1640 are promising new CM control materials which warrants additional evaluations.

External Lepidopterous Larvae – All experimental treatments provided significantly lower damage from external lepidopterous larvae compared to the untreated check. The lepidopterous larvae were a combination of obliquebanded leafroller (OBLR), speckled green fruitworm (GFW) and fruit tree leafroller (FTLR). Fruit surface damage by external lepidopterous larvae occurred early in the spring, about the time of the first application on 29 April.

Pear Rust Mite – All experimental treatments had numerically greater damage from PRM compared to the untreated check. However, only GF-1640 at the low rate had significantly greater damage compared to the untreated check. GF-1640 and Success showed elevated damage levels while DPX-E2Y45 and Assail had damage levels similar to the grower standard. High PRM populations have been associated in the past with pyrethroid and OP insecticide treatments, particularly Asana, Pounce and Guthion. The outbreaks were thought to be the result of the elimination of western predatory mite (WPM) by the pyrethroid/OP insecticides. Thus the high damage in the Success and GF-1640 treatments was surprising. This may implicate western flower thrips (WFT) as an important control agent of PRM since Success and presumably GF-1640, which is a related compound, are known to be effective materials for WFT control. The suppression of WFT by Success and GF-1640 may release PRM from an important biological control factor. Further study is warranted into the causal factors related to the increased PRM damage following applications of Success and GF-1640.

Table 2. Mean percent infested fruit at commercial harvest in Fairfield, CA – 2005

Treatment	Rate form/ac	No. appl	Mean[a] percent infested fruit at commercial harvest: CM	Ext. lep. damage	PRM
1. GF-1640 25WDG	6.0 oz	3	8.7 b	0.4 a	17.0 b
2. GF-1640 25WDG	7.2 oz	3	3.6 a	0.2 a	7.3 ab
3. GF-1640 25WDG	6.0 oz	4	5.9 ab	0.6 a	10.5 ab
4. GF-1640 25WDG	7.2 oz	4	4.1 a	0.3 a	15.0 ab
5. Success 2SC	6.0 oz	3	20.2 c	0.8 a	10.0 ab
6. DPX-E2Y45 35WG[b]	2.0 oz	3	4.5 ab	0.8 a	5.2 ab
7. DPX-E2Y45 35WG[b]	3.0 oz	3	6.5 ab	0.2 a	3.8 ab
8. DPX-E2Y45 35WG[b]	4.0 oz	3	4.5 ab	0.4 a	5.4 ab
9. Assail 30WG	8.0 oz	3	7.1 ab	0.5 a	5.2 ab
10. Imidan 70W[c]	7.0 lb	1	4.8 ab	0.8 a	5.3 ab
+ MK-936 0.18EC[b]	16.0 oz				
Guthion 50WP	3.0 lb	2			
11. Untreated check			82.0 d	3.1 b	2.4 a

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, $P < 0.05$). Percent CM damaged fruit was analyzed using an arcsin transformation.

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Foliar Evaluations:

Twospotted Spider Mite – The summer was exceptionally cool with only one day over 100˚F (July 23) and only nine days above 90˚F recorded at the IMPACT weather station at Cordelia, CA (Appendix). Because of the cool weather, few TSSM were found and there were no significant differences among the treatments and the data was not presented.

European Red Mite – Although the weather did not favor TSSM, it was more favorable for the development of ERM. There was an elevated population level of ERM in the Assail, high rate of GF-1640 and untreated control treatments compared to grower standard with the lowest

ERM population in the mid and high rate of DPX-E2Y45 (Table 3). However, there was no significant difference among the treatments. The grower standard included abamectin (MK-936) for the suppression of ERM, TSSM and PP. Thus it appears that DPX-E2Y45 may have some ERM control potential.

Pear Psylla – In addition to the cooler weather favoring ERM population, the cool weather also favored population increases in PP. PP populations were significantly higher in the middle rate of DPX-E2Y45 and grower standard compared to the untreated check (Table 4). GF-1640 and the high rate of DPX-E2Y45 had numerically lower but not significantly lower PP populations compared to the untreated check. The variable PP numbers in the various rates of DPX-E2Y45 would indicate that there is little or no suppression of PP compared to the untreated check. All four GF-1640 treatments show consistently lower PP populations compared to the untreated check and would indicate that there is some PP control activity with this compound. The lower PP populations with GF-1640 were also observed in 2004.

San Jose Scale – SJS populations were significantly suppressed by all experimental materials compared to the untreated check and there was no significant difference among the experimental treatments (Table 5).

Pear Rust Mite – PRM populations were increased in Success and Assail and all GF-1640 treatments compared to the grower standard or untreated check (Table 6). Both rates and both application timings of GF-1640 had significantly higher PRM compared to the grower standard and untreated check. The DPX-E2Y45 treatments had much reduced numbers of PRM and were comparable to the grower standard and untreated check.

Conclusions: This trial was conducted against a very high CM population with over 80% of the fruit infested at harvest in the untreated check. This trial should be considered a rigorous test of the experimental materials. GF-1640 and DPX-E2Y45 are two new promising experimental CM products. These products provided significant suppression of CM compared to the untreated check and provided similar or better control compared to the grower standard. GF-1640 also provided some measure of PP control. However, GF-1640 caused a significant increase in PRM compared to the untreated check or grower standard. DPX-E2Y45 did not induce population flare-ups with any of the secondary pests. No phytotoxicity was observed with any of the experimental treatments.

2. Evaluation of New Pyrethroid Insecticides for Codling Moth Control

Methods and Materials: This trial was conducted in the same commercial 'Bartlett' pear orchard in Fairfield, CA as the previous trial. The orchard was planted on a 25 ft. x 25 ft. spacing (70 trees/ac). Seven treatments were replicated four times in a RCB design. Each replicate was an individual tree. Foliar sprays were applied with a hand-held orchard sprayer operating at 250 psi with a finished spray volume of 200 gal/acre (2.87 gal/tree). Applications were scheduled based on DD. DD were calculated with a biofix of 30 March for the first generation and a 24 June biofix for the second generation using a single sine horizontal cutoff model with a lower threshold of 50˚F and an upper threshold of 88˚F. Maximum and minimum air temperatures were obtained from the IMPACT weather station at Cordelia, CA. Flight activity of male CM was monitored with a pheromone trap placed high in the canopy of an untreated tree. The application timings and treatments are shown on Table 7. Control of the CM generations was evaluated at commercial harvest on 26 July by inspecting a maximum of 250 fruit per tree for CM infestation. Control of PP nymphs, TSSM, ERM, PRM and SJS crawlers was evaluated by leaf-brushing 10 exterior and 10 interior leaves collected from each tree weekly from 21 June through 18 July. The plates with the contents from the brushed leaves were counted under magnification (20X) in the laboratory.

Table 7. Treatments and application timings for CM control with pyrethroid insecticides, Fairfield, CA – 2005

Treatment	Rate form/ac	No. appl.	Application dates (day-degrees from 1st or 2nd biofix)
1. Warrior 1CS	5.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
2. Brigade 10WP	1.0 lb	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
3. Danitol 2.4EC	21.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
4. Asana XL	12.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
5. Baythroid 2	3.0 oz	3	29 April (240 from 1st biofix), 31 May (656 from 1st biofix) and 7 July (259 from 2nd biofix)
6. Imidan 70WP[a]	7.0 lb	1	29 April (240 from 1st biofix)
+ MK-936 018 EC	16.0 oz		
Guthion 50WP	3.0 lb	2	31 May (656 from 1st biofix) 7 July (259 from 2nd biofix)
7. Untreated check	——		

[a] Treatment pH was adjusted to less than 5.

Results and Discussion:

CM Flight Activity – The overwintering CM flight began prior to 30 March (Fig. 1). Biofix was set on 30 March (Appendix). CM biofix is set when sunset air temperatures meet or exceed 62˚F and there is a sustained moth flight. This temperature is the minimum required for CM oviposition. The overwintering flight was highly bimodal this year. The first peak of the overwintering flight occurred around 21 April at 170 DD. The air temperatures turned cool and unsettled with considerable periods of rain and moth flight decreased. The first peak often occurs at 300 DD after biofix. The second peak of the overwintering flight occurred around 26 May at 579 DD. The second peak often occurs at 650 DD after biofix. The first flight was completed by 23 June at 1,017 DD. The first flight is usually completed by 1,060 DD in early June. Thus this year, the cool spring and early summer temperatures delayed the completion of the first generation. The second biofix was set on 24 June. The first peak of the second CM flight occurred approximately on 5 July at 220 DD while the second peak of the second CM flight occurred after harvest.

Harvest Evaluation:

Codling Moth – The CM infestation in the untreated check was over 80% (Table 8). Thus, this trial provided a stringent test of the experimental treatments. The CM infestation in all of the experimental treatments was significantly lower than in the untreated check. Two new pyrethroid products, Brigade and Warrior, show promise as OP replacement insecticides.

All pyrethroid insecticides had numerically higher CM infestation compared to the grower standard. However, Brigade and Warrior had CM infestations similar to the grower standard with Asana, Danitol and Baythroid having elevated CM infestations compared to the grower standard. Pyrethroid insecticides have historically not provided superior CM control compared to OP insecticides. The comparable control of Brigade and Warrior to the grower standard is encouraging and warrant additional evaluations. This will provide growers additional control tools for CM suppression.

External Lepidopterous Larvae – All experimental treatments provided significantly lower damage from external lepidopterous larvae compared to the untreated check. The lepidopterous larvae were a combination of OBLR, GFW and FTLR. Fruit surface damage by external lepidopterous larvae occurred early in the spring, about the time of the first application on 29 April.

Pear Rust Mite – All experimental treatments had numerically greater damage from PRM compared to the untreated check. However, only Asana had significantly greater damage compared to the untreated check. High PRM populations have been associated in the past with pyrethroid insecticide treatments, particularly Asana and Pounce. The outbreaks were thought to be the result of the elimination of WPM by the pyrethroid insecticides. Thus the low damage in the Warrior treatment was surprising and warrants further study.

Table 8. Mean percent infested fruit inspected at commercial harvest in Fairfield, CA – 2005

Treatment	Rate form/ac	No. appl	Mean[a] percent infested fruit at commercial harvest: CM	Ext. lep. Damage	PRM
1. Warrior 1SC	5.0 oz	3	6.6 a	0.8 a	5.2 ab
2. Brigade 10WP	1.0 lb	3	5.7 a	0.4 a	8.9 ab
3. Danitol 2.4EC	21.0 oz	3	11.9 a	0.6 a	10.4 ab
4. Asana XL	12.0 oz	3	10.2 a	0.6 a	19.7 b
5. Baythroid 2	3.0 oz	3	9.1 a	0.6 a	6.7 ab
6. Imidan 70W[c]	7.0 lb	1	4.8 a	0.8 a	5.3 ab
+ MK-936 0.18EC[b]	16.0 oz				
Guthion 50WP	3.0 lb	2			
7. Untreated check			82.0 b	3.1 b	2.4 a

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, P < 0.05). Percent CM damaged fruit was analyzed using an arcsin transformation.

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Foliar Evaluations:

Twospotted Spider Mite – The summer was exceptionally cool with only one day over 100˚F (July 23) and only nine days above 90˚F recorded at the IMPACT weather station at Cordelia, CA. Because of the cool weather, few TSSM were found and there were no significant differences among the treatments and the data was not presented.

European Red Mite – Although the weather did not favor TSSM, it was more favorable for the development of ERM. There was a significant population increase of ERM in the Baythroid treatment compared to the untreated check or grower standard (Table 9). The increased ERM population in the Baythroid treatment was unusual since other non-miticidal pyrethroid insecticides (Asana and Warrior) did not show this effect. ERM populations in all other experimental treatments were at or below the untreated check. The grower standard included abamectin (MK-936) for the suppression of ERM, TSSM and PP. Thus it appears that Brigade and Danitol have some ERM control potential.

Pear Psylla – In addition to the cooler weather favoring ERM population, the cool weather also favored population increases in PP. PP populations were significantly higher in the Brigade, Danitol and Asana compared to the untreated check (Table 10). Warrior had numerically lower but not significantly lower PP populations compared to the untreated check.

The low PP number in the Warrior treatment is interesting because the other pyrethroid treatments resulted in increased PP populations. Thus additional studies are warranted with PP and Warrior.

San Jose Scale – SJS populations were significantly suppressed by all experimental materials compared to the untreated check and there was no significant difference among the experimental treatments (Table 11).

Pear Rust Mite – PRM populations were significantly increased in the Asana, Baythroid and Brigade treatments compared to the grower standard or untreated check (Table 12). The Warrior and Danitol treatments had elevated numbers of PRM but the numbers were quite variable and the Warrior and Danitol were not significantly different from the untreated check.

Conclusions: This trial was conducted against a very high CM population with over 80% of the fruit infested at harvest in the untreated check. This trial should be considered a rigorous test of the experimental materials. Brigade and Warrior are two new pyrethroid products. These products provided similar or better control compared to the grower standard. Brigade had elevated populations of PP and PRM but reduced populations of ERM while Warrior had elevated populations of PRM and reduced populations of PP. No phytotoxicity was observed with any of the experimental treatments.

3. Modification of water pH for Imidan applications

Methods and Materials: A preliminary study was conducted to determine the pH level of Imidan spray tank solution used by three growers for codling moth control. Two growers were located in the Sacramento Delta and one grower was located in Suisun Valley, CA. The pH level was evaluated using an Oakton Waterproof pHTestr 3+ Double Junction electronic pH meter, laboratory pHydrion pH paper with a pH range of 1-12 and pH paper provided by Gowan Company. The pH level of water was determined prior to adding the Imidan, again after the Imidan was added to the tank mixture at fill-up and again after half of the tank was sprayed on the orchard. The measurements were taken on 25 May from a Sacramento Delta orchard (Delta 1) that used 500 gallons of water mixed with 36 lbs of Imidan and 64 oz of RNA buffer, on 26 June from another Sacramento Delta orchard (Delta 2) that used 500 gallons of water mixed with 25 lbs of Imidan,170 oz of RNA buffer and 80 oz of NuFlim and on 13 July from a Suisun Valley orchard (Suisun) that used 500 gallons of water mixed with 25 lbs of Imidan, 50 oz of Acid pHactant, 88 oz of Liquistik and 20 gallons of Quickmix Oil.

Results and Discussion: This preliminary study resulted in widely varying pH levels among the three growers' spray solutions. The pH of Imidan tank mixtures ranged from 4.74 to 6.30 at full tank (Table 12). The desired pH of the Imidan tank mixture is 5.5 or lower based on Gowan Company recommendation. One Sacramento Delta grower (Delta 2) had the correct pH level (4.74). This grower estimated the tank pH using the Gowan pH paper as 4.5. This was lower than the recommended level but the grower felt it was better to err on the conservative side with the pH. The other Sacramento Delta grower (Delta 1) believed that he was using the correct pH based on the pH paper supplied by Gowan Company. The Gowan pH paper incorrectly estimated the solution pH resulting in a tank mixture having a higher pH than the recommended level. The Suisun Valley grower relied on past estimates for the amount of acidifier to add to the Imidan tank mix to obtain the correct pH. This also resulted in a higher pH level than the recommended level. The use of laboratory pH litmus paper did not provide materially better estimates of the pH compared to the Gowan pH litmus paper. However, we have a limited number of observations. Also, it was observed that the pH increased when half of the tank was used. The increase was substantial in the Delta 2 orchard but only marginal in the Suisun orchard. This increase may be the result of more thorough mixing of the solution during application. The tanks were filled by adding about 1/3 to 1/2 the amount of water (150 to 250 gal), then adding buffer/acidifier and other surfactants and then adding the Imidan and filling the tank with the remaining water. The full tanks were mixed before the sample was drawn.

Conclusions: Imidan longevity data provided by Gowan Company shows a dramatic increase in half-life with a decrease in pH of the spray solution from 9.0 to 5.0. The half-life of Imdian at a pH of 9.0 was 5.5 minutes; the half-life of Imdian at a pH of 7.0 was 9.4 hours and the half-life of Imdian at a pH of 5.0 was 7.5 days. Thus, it is critical to maintain an acidic Imidan spray solution to obtain the maximum benefit from the insecticide. This adjustment in the pH of the spray solution is relatively inexpensive compared to the cost of Imidan. Although, this was a limited study with few observations, it does point out that greater care needs to be taken by the growers to properly determine the pH of their spray solutions. It would be cost effective for growers or PCAs to purchase an inexpensive pH meter to better monitor the pH of their Imidan spray tank solution.

Table 12. pH of Imidan spray solutions from grower speed sprayer tanks – 2005

	Water	Imidan full tank mix			Half tank
Orchard	pH meter	pH meter	pH paper*	Gowan pH paper*	pH meter
Delta 1	——	6.30	6.0	5.5	——
Delta 2	7.62	4.74	4.5	4.5	5.04
Suisun	6.98	5.98	6.0	——	6.03

*= Visual estimate

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Appendix - Air temperature and day-degree accumulation for codling moth from the IMPACT weather station at Cordelia, CA – 2005

DATE	Air Temp. (F) Min.	Max.	Daily D.D.	Accum. D.D.	Rain	Timings
Mar 17 2005	47	66	---	---	0.00	
Mar 18 2005	49	58	---	---	0.03	
Mar 19 2005	52	64	---	---	0.06	
Mar 20 2005	46	63	---	---	0.03	
Mar 21 2005	46	62	---	---	0.06	
Mar 22 2005	49	59	---	---	0.37	
Mar 23 2005	45	59	---	---	0.01	
Mar 24 2005	35	63	---	---	0.00	
Mar 25 2005	38	64	---	---	0.00	
Mar 26 2005	41	67	---	---	0.00	
Mar 27 2005	45	68	---	---	0.03	
Mar 28 2005	48	63	---	---	0.00	
Mar 29 2005	45	64	---	---	0.01	
Mar 30 2005	37	69	6.68	6.68	0.00	1st Biofix
Mar 31 2005	36	70	7.00	13.68	0.00	
Apr 01 2005	40	73	8.92	22.59	0.00	
Apr 02 2005	48	66	7.29	29.88	0.00	
Apr 03 2005	44	60	3.63	33.51	0.07	
Apr 04 2005	39	64	4.76	38.26	0.00	
Apr 05 2005	38	68	6.37	44.63	0.00	
Apr 06 2005	43	73	9.47	54.11	0.00	
Apr 07 2005	45	63	5.15	59.26	0.00	
Apr 08 2005	46	62	4.87	64.13	0.04	
Apr 09 2005	42	68	6.95	71.08	0.00	
Apr 10 2005	42	71	8.34	79.42	0.00	
Apr 11 2005	47	68	7.99	87.40	0.00	
Apr 12 2005	37	64	4.55	91.95	0.00	
Apr 13 2005	38	62	3.82	95.77	0.00	
Apr 14 2005	33	69	6.24	102.01	0.00	
Apr 15 2005	41	74	9.55	111.57	0.00	
Apr 16 2005	53	74	13.50	125.07	0.00	
Apr 17 2005	48	69	8.76	133.83	0.00	
Apr 18 2005	44	70	8.25	142.09	0.00	
Apr 19 2005	45	71	8.95	151.04	0.06	
Apr 20 2005	42	69	7.41	158.44	0.00	
Apr 21 2005	44	76	11.12	169.57	0.08	
Apr 22 2005	43	78	11.86	181.43	0.01	

Apr 23 2005	50	62	6.00	187.43	0.04	
Apr 24 2005	46	65	6.30	193.72	0.13	
Apr 25 2005	43	71	8.53	202.25	0.01	
Apr 26 2005	47	75	11.42	213.67	0.10	
Apr 27 2005	51	66	8.50	222.17	0.00	
Apr 28 2005	51	66	8.50	230.67	0.50	
Apr 29 2005	49	70	9.59	240.26	0.00	1A Timing
Apr 30 2005	50	67	8.50	248.76	0.00	
May 01 2005	48	73	10.74	259.51	0.10	
May 02 2005	51	73	12.00	271.51	0.00	
May 03 2005	52	72	12.00	283.51	0.04	
May 04 2005	55	67	11.00	294.51	0.28	
May 05 2005	54	69	11.50	306.01	0.04	
May 06 2005	52	68	10.00	316.01	0.03	
May 07 2005	47	69	8.48	324.48	0.00	
May 08 2005	54	60	7.00	331.48	0.97	
May 09 2005	49	65	7.11	338.59	0.01	
May 10 2005	44	68	7.31	345.90	0.00	
May 11 2005	45	73	9.91	355.81	0.00	
May 12 2005	54	77	15.50	371.31	0.11	
May 13 2005	49	78	13.58	384.89	0.13	1A + 14 days
May 14 2005	56	78	17.00	401.89	0.00	
May 15 2005	59	74	16.50	418.39	0.09	
May 16 2005	52	69	10.50	428.89	0.00	
May 17 2005	49	64	6.61	435.50	0.05	
May 18 2005	55	66	10.50	446.00	0.21	
May 19 2005	55	71	13.00	459.00	0.01	
May 20 2005	48	73	10.74	469.74	0.00	
May 21 2005	47	80	13.89	483.63	0.08	
May 22 2005	55	81	18.00	501.63	0.13	
May 23 2005	53	82	17.50	519.13	0.00	
May 24 2005	56	87	21.50	540.63	0.00	
May 25 2005	57	87	22.00	562.63	0.11	
May 26 2005	55	78	16.50	579.13	0.01	
May 27 2005	53	77	15.00	594.13	0.00	
May 28 2005	53	71	12.00	606.13	0.00	
May 29 2005	51	73	12.00	618.13	0.15	
May 30 2005	56	80	18.00	636.13	0.00	
May 31 2005	57	83	20.00	656.13	0.00	1B Timing
Jun 01 2005	58	84	21.00	677.13	0.00	
Jun 02 2005	56	80	18.00	695.13	0.05	

Jun 03 2005	57	81	19.00	714.13	0.04	
Jun 04 2005	54	79	16.50	730.63	0.00	
Jun 05 2005	50	74	12.00	742.63	0.05	
Jun 06 2005	52	80	16.00	758.63	0.00	
Jun 07 2005	45	72	9.43	768.06	0.00	
Jun 08 2005	55	67	11.00	779.06	0.00	
Jun 09 2005	58	76	17.00	796.06	0.00	
Jun 10 2005	56	79	17.50	813.56	0.00	
Jun 11 2005	55	80	17.50	831.06	0.00	
Jun 12 2005	56	87	21.50	852.56	0.00	
Jun 13 2005	51	80	15.50	868.06	0.00	
Jun 14 2005	57	84	20.50	888.56	0.00	
Jun 15 2005	54	81	17.50	906.06	0.00	
Jun 16 2005	54	64	9.00	915.06	0.00	
Jun 17 2005	49	70	9.59	924.65	0.00	
Jun 18 2005	55	72	13.50	938.15	0.00	
Jun 19 2005	53	76	14.50	952.65	0.00	
Jun 20 2005	53	79	16.00	968.65	0.00	
Jun 21 2005	54	76	15.00	983.65	0.00	
Jun 22 2005	55	82	18.50	1002.15	0.00	
Jun 23 2005	56	74	15.00	1017.15	0.00	
Jun 24 2005	57	76	16.50	16.50	0.00	2nd Biofix
Jun 25 2005	55	72	13.50	30.00	0.00	
Jun 26 2005	56	73	14.50	44.50	0.00	
Jun 27 2005	55	75	15.00	59.50	0.00	
Jun 28 2005	56	77	16.50	76.00	0.00	
Jun 29 2005	55	90	22.30	98.30	0.00	
Jun 30 2005	59	91	24.61	122.90	0.00	
Jul 01 2005	58	86	22.00	144.90	0.00	
Jul 02 2005	56	79	17.50	162.40	0.00	
Jul 03 2005	56	83	19.50	181.90	0.00	
Jul 04 2005	58	88	23.00	204.90	0.00	
Jul 05 2005	55	76	15.50	220.40	0.00	
Jul 06 2005	57	85	21.00	241.40	0.00	
Jul 07 2005	56	79	17.50	258.90	0.00	2A Timing
Jul 08 2005	55	81	18.00	276.90	0.00	
Jul 09 2005	58	77	17.50	294.40	0.00	
Jul 10 2005	57	83	20.00	314.40	0.00	
Jul 11 2005	62	89	25.42	339.82	0.00	
Jul 12 2005	61	96	26.84	366.66	0.00	
Jul 13 2005	56	86	21.00	387.66	0.00	

Jul 14 2005	62	95	27.10	414.76	0.00
Jul 15 2005	59	96	25.88	440.64	0.00
Jul 16 2005	59	97	26.09	466.74	0.00
Jul 17 2005	61	95	26.62	493.36	0.00
Jul 18 2005	57	83	20.00	513.36	0.00
Jul 19 2005	58	85	21.50	534.86	0.00
Jul 20 2005	56	86	21.00	555.86	0.00
Jul 21 2005	58	78	18.00	573.86	0.00
Jul 22 2005	57	85	21.00	594.86	0.00
Jul 23 2005	59	101	26.82	621.68	0.00
Jul 24 2005	61	89	24.92	646.60	0.00
Jul 25 2005	60	90	24.78	671.38	0.00
Jul 26 2005	58	92	24.41	695.79	0.00

Table 3. Mean number of European red mite per 20 leaves in Fairfield, CA. – 2005.

Treatment	Rate form/ac	No. appl	Mean[a] no. European red mite per 20 leaves					
			6/21	6/27	7/5	7/11	7/18	Total
1. GF-1640 25WDG	6.0 oz	3	1.0 b	0.0 a	0.3 a	0.4 a	0.3 a	2.3 a
2. GF-1640 25WDG	7.2 oz	3	0.5 ab	1.8 ab	1.0 ab	4.0 a	4.8 a	12.0 a
3. GF-1640 25WDG	6.0 oz	4	0.0 a	0.0 a	0.3 a	0.3 a	5.5 a	6.0 a
4. GF-1640 25WDG	7.2 oz	4	0.0 a	0.5 ab	0.3 a	1.0 a	5.3 a	7.0 a
5. Success 2SC	6.0 oz	3	0.0 a	0.5 ab	0.3 a	2.5 a	1.3 a	4.5 a
6. DPX-E2Y45 35WG[b]	2.0 oz	3	0.0 a	0.8 ab	0.3 a	6.3 a	1.0 a	8.3 a
7. DPX-E2Y45 35WG[b]	3.0 oz	3	0.0 a	0.0 a	0.5 a	0.5 a	0.3 a	1.3 a
8. DPX-E2Y45 35WG[b]	4.0 oz	3	0.0 a	0.3 ab	0.0 a	0.5 a	0.5 a	1.3 a
9. Assail 30WG	8.0 oz	3	0.0 a	0.0 a	2.0 b	3.5 a	4.8 a	10.3 a
10. Imidan 70W[c] + MK-936 0.18EC[b] Guthion 50WP	7.0 lb 16.0 oz 2.0 lb	1 2	0.0 a	2.5 ab	0.0 a	0.3 a	0.0 a	2.8 a
11. Untreated Check			0.0 a	6.3 b	0.3 a	2.5 a	2.3 a	11.25 a

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, $P < 0.05$).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 4. Mean number of pear psylla per 20 leaves in Fairfield, CA. – 2005.

Treatment		Rate form/ac	No. appl	Mean[a] no. pear psylla per 20 leaves					
				6/21	6/27	7/5	7/11	7/18	Total
1.	GF-1640 25WDG	6.0 oz	3	9.3 a	9.0 abc	14.5 ab	13.3 a	14.5 a	60.5 a
2.	GF-1640 25WDG	7.2 oz	3	8.5 a	13.5 abcde	20.5 ab	22.3 ab	22.3 ab	87.0 abc
3.	GF-1640 25WDG	6.0 oz	4	7.8 a	7.3 ab	14.5 ab	13.0 a	22.8 ab	65.3 ab
4.	GF-1640 25WDG	7.2 oz	4	8.5 a	3.3 a	11.3 a	14.0 a	28.5 abc	65.5 ab
5.	Success 2SC	6.0 oz	3	17.5 ab	27.8 e	35.3 ab	34.8 ab	38.5 abc	153.8 cd
6.	DPX-E2Y45 35WG[b]	2.0 oz	3	17.5 ab	24.3 de	21.3 ab	33.5 ab	36.8 abc	133.3 abcd
7.	DPX-E2Y45 35WG[b]	3.0 oz	3	26.3 bc	22.5 cde	35.3 ab	66.8 c	58.0 cd	208.8 de
8.	DPX-E2Y45 35WG[b]	4.0 oz	3	13.8 ab	11.0 abcd	14.5 ab	25.3 ab	31.8 abc	96.3 abc
9.	Assail 30WG	8.0 oz	3	21.5 abc	21.0 bcde	37.8 b	26.5 ab	47.8 bc	154.5 cd
10.	Imidan 70W[c]	7.0 lb	1	34.3 c	26.0 e	34.5 ab	70.8 c	80.5 d	246.0 e
	+ MK-936 0.18EC[b]	16.0 oz							
	Guthion 50WP	2.0 lb	2						
11.	Untreated check			15.0 ab	18.8 bcde	13.8 ab	43.0 bc	27.0 ab	117.5 abc

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, P < 0.05).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 5. Mean number of San Jose scale per 20 leaves in Fairfield, CA. – 2005.

Treatment	Rate form/ac	No. appl	Mean[a] no. scale per 20 leaves 6/21	6/27	7/5	7/11	7/18	Total
1. GF-1640 25WDG	6.0 oz	3	6.3 a	5.8 a	1.8 a	4.8 a	5.3 ab	23.8 a
2. GF-1640 25WDG	7.2 oz	3	2.0 a	3.8 a	2.0 a	5.3 a	2.3 ab	15.3 a
3. GF-1640 25WDG	6.0 oz	4	4.8 a	2.8 a	3.0 a	1.5 a	4.3 ab	16.3 a
4. GF-1640 25WDG	7.2 oz	4	5.3 a	5.0 a	3.0 a	1.8 a	1.5 a	16.5 a
5. Success 2SC	6.0 oz	3	2.8 a	2.8 a	2.0 a	4.0 a	4.0 ab	15.5 a
6. DPX-E2Y45 35WG[b]	2.0 oz	3	1.5 a	2.0 a	1.8 a	5.3 a	0.5 a	11.0 a
7. DPX-E2Y45 35WG[b]	3.0 oz	3	5.0 a	2.3 a	4.0 ab	6.5 a	1.5 a	19.3 a
8. DPX-E2Y45 35WG[b]	4.0 oz	3	0.8 a	3.0 a	2.3 a	1.8 a	1.8 a	9.5 a
9. Assail 30WG	8.0 oz	3	5.8 a	3.0 a	1.8 a	2.5 a	1.8 a	14.8 a
10. Imidan 70W[c]	7.0 lb	1	2.5 a	1.0 a	1.3 a	5.5 a	17.3 c	27.5 a
+ MK-936 0.18EC[b]	16.0 oz							
Guthion 50WP	2.0 lb	2						
11. Untreated check			34.5 b	25.0 b	9.5 b	14.0 b	11.0 bc	94.0 b

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, P < 0.05).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 6. Mean number of pear rust mite per 20 leaves in Fairfield, CA. – 2005.

Treatment		Rate form/ac	No. Appl	Mean[a] no. pear rust mite per 20 leaves 6/21	6/27	7/5	7/11	7/18	Total
1.	GF-1640 25WDG	6.0 oz	3	676 ab	817 a	1629 b	1462 b	1530 bc	6114 c
2.	GF-1640 25WDG	7.2 oz	3	229 ab	461 a	1115 ab	1137 b	1401 bc	4343 bc
3.	GF-1640 25WDG	6.0 oz	4	648 ab	872 a	1384 b	1127 b	1452 bc	5482 bc
4.	GF-1640 25WDG	7.2 oz	4	843 b	982 a	657 ab	1238 b	1995 c	5715 bc
5.	Success 2SC	6.0 oz	3	379 ab	690 a	1057 ab	706 ab	620 ab	3452 abc
6.	DPX-E2Y45 35WG[b]	2.0 oz	3	26 a	36 a	52 a	130 a	158 a	402 a
7.	DPX-E2Y45 35WG[b]	3.0 oz	3	95 ab	97 a	67 a	146 a	248 a	652 a
8.	DPX-E2Y45 35WG[b]	4.0 oz	3	12 a	51 a	48 a	86 a	72 a	269 a
9.	Assail 30WG	8.0 oz	3	105 ab	374 a	688 ab	727 ab	863 ab	2757 ab
10.	Imidan 70W[c]	7.0 lb	1	18 a	37 a	33 a	41 a	108 a	237 a
	+ MK-936 0.18EC[b]	16.0 oz							
	Guthion 50WP	2.0 lb	2						
11.	Untreated Check			4 a	158 a	71 a	166 a	164 a	563 a

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, P < 0.05).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 9. Mean number of European red mite per 20 leaves in Fairfield, CA. – 2005.

Treatment		Rate form/ac	No. appl	Mean[a] no. European red mite per 20 leaves					
				6/21	6/27	7/5	7/11	7/18	Total
1.	Warrior 1SC	5.0 oz	3	0.0 a	0.0 a	1.0 a	0.5 a	3.0 a	4.5 a
2.	Brigade 10WP	1.0 lb	3	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	0.3 a
3.	Danitol 2.4EC	21.0 oz	3	0.0 a	0.0 a	0.3 a	0.8 a	0.0 a	1.0 a
4.	Asana XL	12.0 oz	3	0.0 a	0.0 a	0.3 a	0.5 a	0.8 a	1.5 a
5.	Baythroid 2	3.0 oz	3	9.8 b	38.5 b	13.0 b	8.5 b	34.3 b	104.0 b
6.	Imidan 70W[c] + MK-936 0.18EC[b]	7.0 lb 16.0 oz	1	0.0 a	2.5 a	0.0 a	0.3 a	0.0 a	2.8 a
	Guthion 50WP	2.0 lb	2						
7.	Untreated Check			0.0 a	6.3 a	0.3 a	2.5 ab	2.3 a	11.3 a

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, P < 0.05).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 10. Mean number of pear psylla per 20 leaves in Fairfield, CA. – 2005.

Treatment		Rate form/ac	No. appl	Mean[a] no. pear psylla per 20 leaves					
				6/21	6/27	7/5	7/11	7/18	Total
1.	Warrior 1SC	5.0 oz	3	9.3 a	15.8 ab	10.3 a	15.3 a	29.0 a	79.5 a
2.	Brigade 10WP	1.0 lb	3	50.3 d	31.0 c	72.5 d	147.0 c	114.8 c	415.5 c
3.	Danitol 2.4EC	21.0 oz	3	23.3 abc	23.5 abc	56.0 cd	55.5 ab	101.3 c	259.5 b
4.	Asana XL	12.0 oz	3	26.3 bc	32.8 c	38.3 bc	81.0 b	82.0 bc	260.3 b
5.	Baythroid 2	3.0 oz	3	20.0 abc	10.3 a	22.0 ab	37.3 ab	50.3 ab	139.8 a
6.	Imidan 70W[c]	7.0 lb	1	34.3 c	26.0 bc	34.5 abc	70.8 b	80.5 bc	246.0 b
	+ MK-936 0.18EC[b]	16.0 oz							
	Guthion 50WP	2.0 lb	2						
7.	Untreated Check			15.0 ab	18.8 abc	13.8 ab	43.0 ab	27.0 a	117.5 a

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, $P < 0.05$).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 11. Mean number of San Jose scale per 20 leaves in Fairfield, CA. – 2005.

		Rate	No.	Mean[a] no. San Jose scale per 20 leaves					
Treatment		form/ac	appl	6/21	6/27	7/5	7/11	7/18	Total
1.	Warrior 1SC	5.0 oz	3	2.8 a	2.5 a	0.8 a	2.5 a	0.8 a	9.3 a
2.	Brigade 10WP	1.0 lb	3	0.0 a	4.8 a	1.0 a	0.5 a	3.3 a	9.5 a
3.	Danitol 2.4EC	21.0 oz	3	2.5 a	4.8 a	1.5 a	1.0 a	1.5 a	11.3 a
4.	Asana XL	12.0 oz	3	2.5 a	2.0 a	1.3 a	2.0 a	1.0 a	8.8 a
5.	Baythroid 2	3.0 oz	3	0.5 a	1.8 a	1.8 a	0.3 a	2.0 a	6.3 a
6.	Imidan 70W[c]	7.0 lb	1	2.5 a	1.0 a	1.3 a	5.5 a	17.3 b	27.5 a
	+ MK-936 0.18EC[b]	16.0 oz							
	Guthion 50WP	2.0 lb	2						
7.	Untreated Check			34.5 b	25.0 b	9.5 b	14.0 b	11.0 ab	94.0 b

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, $P < 0.05$).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.

Table 12. Mean number of pear rust mite per 20 leaves in Fairfield, CA. – 2005.

Treatment		Rate form/ac	No. appl	Mean[a] no. pear rust mite per 20 leaves 6/21	6/27	7/5	7/11	7/18	Total
1.	Warrior 1SC	5.0 oz	3	15 a	266 ab	326 abc	497 ab	623 a	1727 bc
2.	Brigade 10WP	1.0 lb	3	122 a	488 abc	613 c	342 ab	572 a	2137 c
3.	Danitol 2.4EC	21.0 oz	3	18 a	398 ab	524 bc	309 ab	538 a	1787 bc
4.	Asana XL	12.0 oz	3	704 b	1344 b	740 c	1135 c	630 a	4553 d
5.	Baythroid 2	3.0 oz	3	124 a	313 ab	527 bc	747 bc	1191 b	2902 c
6.	Imidan 70W[c]	7.0 lb	1	18 a	37 a	33 a	41 a	108 a	237 a
	+ MK-936 0.18EC[b]	16.0 oz							
	Guthion 50WP	2.0 lb	2						
7.	Untreated Check			4 a	158 ab	71 ab	166 a	164 a	563 ab

[a] Means followed by the same letter within a column are not significantly different (Fisher's protected LSD, $P < 0.05$).

[b] Treatments contained 0.25% PureSpray Green horticultural oil by volume.

[c] pH was adjusted to < 5.