Control of Codling Moth by Postharvest Application of Ethephon 2SL and Insecticide

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Abstract

In 2007, Ethephon 2SL + Lorsban 4E was sprayed Aug. 4-7 in Sacramento County orchards and in 2008, Ethephon 2SL + insecticide was sprayed about a week later. In the spring of 2008, an average of 25% fewer female CM adults were caught in ethephon-treated plots than in untreated plots and in 2009, 20% fewer females were caught. In 2009, fruit damage was less in the ethephon-treated block in one orchard but not another, and three orchards had no damage. In North Coast orchards in 2008, Ethephon 2SL + insecticide sprays were applied Aug. 22 to Sept. 5. The later spray timing resulted in little or no effect on female CM trap counts and few moths were caught. In both locations, fruit size and weight were reduced with ethephon treatment (2.3% smaller overall and 4.3% lighter). The use of ethephon + insecticide may only be justified immediately after an early harvest in the Sacramento district in orchards with relatively high codling moth pressure.

Introduction

Past research supported by the CPAB and PPMRF has demonstrated that the application of ethephon shortly after harvest will result in rapid maturation and drop of unharvested fruit. CM larvae that infest unharvested fruit treated with ethephon do not complete their larval development. This suppresses the overwintering CM population and thus decreases the CM population the following spring. Ethephon 2SL was registered in 2007 by Makhteshim-Agan as a postharvest application on pears in combination with an insecticide.

In the first year, Ethephon 2SL + Lorsban 4E was sprayed on four 20-acre orchard blocks Aug. 4-9, **2007** in Sacramento County, and on Aug. 14 in Mendocino County (see 2008 Pear Research Reports). These sprayed blocks were compared to adjacent untreated blocks of similar size. Two weeks after the applications, mean fruit pressure of normal fruit in ethephon-treated orchards was significantly reduced in the Sacramento orchards compared to untreated orchards 2 weeks after application, and rattail fruit of ethephon-treated trees had slightly lower pressure than untreated trees. In the Mendocino orchard, average fruit pressures of Ethephon-treated normal fruit were substantially lower than untreated fruit after 2 weeks, and Ethephon-treated rattail fruit in this orchard were reduced after 3 weeks.

After the **2008** postharvest applications (see Methods and Materials), fruit pressures in ethephon-treated normal and rattail fruit in Sacramento County were significantly reduced by week 2 compared to untreated fruit. In the fruit pressure testing that was conducted 2-3 weeks after ethephon application in Lake and Mendocino Counties, there were no differences in pressures on either normal or rattail fruit. Once fruit pressure falls below 6.5 kg/cm^2,CM cannot complete its larval development. In Sacramento orchards, and in the Mendocino orchard in 2007, this point was generally reached in normal fruit 2 weeks after Ethephon treatment, and at 3 weeks in rattail fruit.

In spring 2008, trap counts of female CM moths were reduced an average of 25% in ethephon blocks compared to untreated blocks. Among traps in the center of each block only, 38% fewer female moths were caught in the ethephon blocks. Pheromone traps in ethephon-treated blocks caught an average of 55% fewer male moths. In the Mendocino orchard, the pheromone traps showed that moth populations were far higher in the Ethephon-treated block, due mainly to the choice to use Ethephon on the block with the highest CM pressure.

Numerous harvest measurements in 2008 showed that there is no clear indication that Ethephon affects fruit size or yield.

Methods and Materials

In August 2007, trials were initiated in four commercial pear orchards in Sacramento County and one orchard in Mendocino County following the 2007 harvest. Ethephon 2SL at 4 pts./acre plus 2 pts./acre of Lorsban 4E was applied to 10-20 acres shortly after harvest using a commercial air-blast sprayer. The application dates were Aug. 4-9, 2007 in Sacramento County and on Aug. 14, 2007 in Mendocino County. In each orchard, 10-20 acres of trees adjacent to the treated plots were left untreated with ethephon/Lorsban.

In 2008, the same four orchards, along with one additional orchard, were treated in Sacramento County after harvest. Ethephon 2SL at 4 pts./acre was sprayed with the following insecticides in the orchards as shown below (rate shown is per acre):

H: Altacor, 4 oz.; **M**: oil, 0.5%; **T**: Delegate, 6 oz.; **G**: Lorsban, 2 pt.; **L**: oil, 0.5%.

Three orchards in Lake County and two Mendocino County orchards (including the orchard used in 2007) were also used in the study. The application dates of Ethephon 2SL + insecticide were later in 2008: Aug. 12-15 in the Sacramento Delta and on August 22 to September 5 in Lake and Mendocino Counties. Note that these dates are later than the 2007 postharvest spray dates.

CM populations in both regions were monitored during spring 2009 by placing five bait pan traps high in the tree canopy in both the treated and untreated portions of each orchard. A bait mixture was prepared with 3 gal. water, 2.4 lbs. brown sugar, 6 ml terpinyl acetate, and 1.4 ml soap. The bait pan trap is a quart-size container filled with bait mixture. In the Sacramento orchards, one sticky trap with a pheromone lure and one with a combination (pheromone + DA) lure were placed high in the tree canopy about 10 trees away from the central bait pan trap. All traps were monitored weekly from April through June. CM control during the season was the same on both the treated and untreated portions of the orchard and was at the discretion of the grower.

At the end of the first CM generation in Sacramento County, 1,000 fruit were assessed for damage in ethephon and untreated blocks, using 20 trees at 50 fruit per tree (25 high, 25 low).

In all orchards, yields and fruit size were determined in several ways. Randomly selected fruit from each of 1-2 trailers in each block were weighed and fruit diameters were measured. The average number of trees required to fill a bin were determined. In the ethephon and untreated

blocks of one orchard, the number of bins for three uniform, equidistant drive rows (4 harvested rows each) was obtained from the grower.

Results and Discussion

Trap Counts and Fruit Damage

In Sacramento County, more male moths were caught in pheromone trap of one ethephon-treated block only (Table 1). In the traps with combo lures (10X + DA), substantially more males were caught in untreated blocks of two orchards (T and G), and few females were caught in the traps.

In the bait pan traps in four of the Sacramento County orchards, more female moths were trapped in untreated blocks and more males were caught in four untreated blocks as well (Table 1). In North Coast County orchards, the average number of female CM adults caught in bait pan traps between treatments was nearly identical, and slightly more male moths were trapped in untreated orchards.

Evaluation of fruit damage showed that one orchard (G) had more damage in the ethephon-treated block and another orchard (T) had more damage in the untreated block (Table 2).

Yields and Fruit Size

Several methods were used to determine if yields or fruit size were affected by ethephon treatment (Table 3). Randomly selected fruit (n=100) from each of 1-2 trailers were weighed. In both Sacramento and North Coast orchards, ethephon-treated fruit from nearly all blocks sampled were slightly lighter numerically than untreated fruit, but the mean weight of fruit across all orchards in each district was not significantly different. The means were remarkably similar between regions. When values from both regions were combined, ethephon-treated fruit were significantly smaller than untreated fruit. The same trends occurred with fruit diameters, with diameters of ethephon-treated from fruit both regions combined being significantly smaller than untreated fruit. Slightly more trees on average were required to fill a bin in North Coast orchards, but the opposite was true in Sacramento orchards.

In an additional yield measure, a Sacramento County grower provided the total number of bins for three uniform, equidistant rows in the treated and untreated blocks. The average number of bins harvested in the ethephon-treated rows was slightly more than that of the untreated rows, but the variability among rows was large (Table 4).

Conclusions

In 2007, ethephon + Lorsban was sprayed Aug. 4-7 in Sacramento County orchards, but in 2008, ethephon + insecticide was sprayed about a week later. In the spring of 2008, an average of 25% fewer female CM adults were caught in ethephon-treated plots than in untreated plots and in 2009, 20% fewer females were caught. In 2009, fruit damage was less in the ethephon-treated block in one of the two orchards (T) that had any damage. In the other orchard (G), damage was more in the ethephon block, but this area had higher CM pressure than the untreated block and is

why the grower wanted to use ethephon in this portion of the orchard. In North Coast orchards, the later spray timing after harvest in 2008 resulted in no difference in female CM trap counts in the spring of 2009.

Fruit size and weight were smaller with ethephon treated fruit. The values in English system for ethephon-treated vs. untreated fruit were: 6.34 vs. 6.62 oz. (mean fruit weight) and 2.63 vs. 2.69 in. (mean fruit diameter), respectively. Although these values are not large, any practice that reduces fruit size may reduce net profit unless the practice also reduces pest damage and/or input costs.

There seems to be only a moderate reduction in female moth populations as a result of the use of postharvest ethephon + insecticide sprays in Sacramento orchards, and differences in fruit damage were not consistent. As seen in previous small plot work, the most likely beneficial effect may be seen with application immediately after an early harvest, especially late July to early August. Postharvest sprays in the North Coast will likely seldom reduce CM populations or damage due to late harvests. The greatest value in the use of ethephon + insecticide would likely be after an early harvest in the Sacramento district, in orchards with relatively high codling moth pressure.

Table 1. Total first generation CM trap counts (% reduction compares decrease in ethephon vs. untreated block).

Orchard	Pheromone (10X)		Combo (10X + DA)				Bait Pan Traps (Avg. of 5 Traps)			
	Eth.	Untr.	Eth.		Untr.		Eth.	Untr.	Eth.	Untr.
Sacramento	(Males)		M	F	M	F	(Females)		(Males)	
H	6	2	5	0	1	1	3	11	3	8
M	5	1	3	1	3	0	25	25	14	15
T	21	20	3	0	23	0	5	10	2	3
G	40	94	27	5	43	3	106	127	45	78
L	8	0	0	0	0	0	3	5	7	5
Totals	**80**	**117**	**38**	**6**	**70**	**4**	**142**	**178**	**71**	**109**
% Reduction	*32%*		*46% (M)*		*-50% (F)*		*20%*		*35%*	
North Coast							(Females)		(Males)	
L							3	2	3	6
I							0	3	1	3
Z							3	2	3	3
R							14	16	8	10
N							2	0	1	0
Totals							**22**	**23**	**16**	**22**
% Reduction							*4%*		*27.3%*	
Both Regions							**27.3**	**33.5**	**14.5**	**21.8**
% Reduction							*19%*		*33%*	
P Value							*0.08 (NS)*		*0.08 (NS)*	

Table 2. Number of CM-damaged fruit out of 1,000 fruit counted per treatment (20 trees at 50 fruit per tree [25 high, 25 low]) in Sacramento County, 2009.

	Ethephon	**Untreated**
H	0	0
M	0	0
T	2	14
G	22	17
L	0	0
AVERAGE	**6**	**7.8**
P Value (t test)	*0.64 (NS)*	

Table 3. Harvest data from Sacramento and North Coast orchards, 2009.

Location	**Fruit Weight (g)**		**Fruit Diameter (mm)**		**No. of Trees Required to Fill 1 Bin**	
	Ethephon	**Untreated**	**Ethephon**	**Untreated**	**Ethephon**	**Untreated**
Sacramento	179.0	188.2	67.0	68.6	7.6	8.1
P Value[1]	*0.18*		*0.06*		*0.47*	
North Coast	180.4	187.2	66.6	68.1	6.9	5.8
P Value[1]	*0.18*		*0.10*		*0.057*	
Both Regions	179.7	187.7	66.8	68.4	7.3	7.0
P Value[1]	*		*		*0.32*	

[1] T-test to compare means.
*Fruit Weight and Fruit Diameter (Both Regions) sig. different ($P \leq 0.05$).

Table 4. Total number of bins produced from three ethephon-treated drive rows and three untreated drive rows (both picks combined) in one orchard, 2009. Each drive row is 4 rows wide.

Drive Rows	No. of Bins
(Ethephon)	
3	83
5	147
7	136
Avg.	**122**
(Untreated)	
9	136
11	124
13	91
Avg.	**117**

No significant differences ($P \leq 0.05$).