Insect Crop Losses and Insecticide Usage for Cantaloupes and Watermelons in Central Arizona: 2004 - 2006

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Abstract

Impact assessment is central to the evolution and evaluation of our IPM programs. Quantifiable metrics on insecticide use patterns, costs, targets, and frequency, crop losses due to all stressors of yield and quality, and other real world economic data (e.g., crop value) are our most objective tools for assessing change in our systems. We recently initiated a project to measure the impact of insect losses and insecticide uses in cantaloupes and watermelons grown in Yuma, AZ and the Bard–Winterhaven area of Imperial County, CA. The data generated in this report is useful for responding to pesticide information requests generated by EPA, and can provide a basis for regulatory processes such as Section 18 or 24c requests, as well as for evaluating the impact of our extension programs on risk reduction to growers. This information also confirms the value of PCAs to the melon industry by showing the importance of cost-effective management of insect pests in desert production.

Introduction

The development of accurate "real world" data on crop insect losses and insecticide usage is important to the assessment of our IPM programs in Arizona. Quantifiable measurements of insecticide use patterns, costs, target pests, and yield/quality losses due to key insect pests are our most objective tools for assessing change in our systems. These data allow us to build relevant databases for measuring user behaviors and adoption of new IPM technologies. This is information important for several reasons. First, specific data on pesticide use patterns and insect losses can be useful for providing information to EPA and other regulatory agencies in submitting Section 18 and 24c requests, as well as support the tolerance of older active ingredients that are critical to the melon industry. In addition, it can directly demonstrate the value of new pest control technologies and IPM tactics. From an academic perspective, these databases help to re-direct the efforts of the College of Agriculture by providing key stakeholder input to our applied research and extension programs. This "real world" input from the industry documents the relevancy of key pest problems and has become mandatory for competing for federal grant funding. Finally, for pest control advisors (PCAs), it can translate their efforts into economic terms for their clientele and confirms their value to the melon industry by showing the importance of key insect pests and their cost-effective management in desert production. This report documents the development of "real world" data on actual insect loss data for cantaloupes and watermelons, and estimates of the level of insecticidal control needed to prevent key insect pests from reducing yield and quality.

Data Collection

The data was developed through the administration of a three-part survey that was conducted in an interactive process with stakeholder input. Growers, PCAs, Extension personnel and industry professionals attended Spring Melon Insect Losses and Impact Assessment Workshops in Phoenix in July of 2005 and 2006 and completed surveys in a guided process. The workshops were conducted in an interactive manner where participants were given a presentation that established the incentives for participation, explained the crop insect loss system, and further walked the participants through the estimation process. The three part survey instrument collected the following information:

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Part I: Information was collected on the actual cantaloupe and watermelon acreage represented by the respondent, estimates of actual yields and potential yields for this acreage (Table 1), and overall percent reductions in yields due to several biological, environmental and management factors (Table 2). In addition, costs associated with aerial and ground applications (Table 3) and insect management fees for scouting (Table 4) were estimated.

Part II. Information was collected on crop insect losses through the description of the percentage of acres where key insect pests were present and insecticide sprays were required to prevent yield reductions in cantaloupes and watermelons. Included with those estimates are the frequency and costs of insecticide applications directed towards those insects. Overall, these costs represent a loss to the grower associated with preventing insects from damaging plants and reducing yields. Finally, actual percent yield losses (heads not harvested due to insect damage or injury) for individual insect species or complexes were estimated (Table 5 and 6).

Part III: Data on insecticide use patterns was collected. These data identify the frequency of use of various chemistries (identified by both product name and IRAC mode-of-action classification) and the percentage of treated cantaloupe and watermelon acres for each product (Table 9).

Results and Discussion

Part I: The Spring Melon Insect Losses Workshops in Phoenix were attended by 15 growers, PCAs, Extension personnel and other stakeholders in 2005, and 8 in 2006. A total of 3 completed surveys collected at the Phoenix meeting in 2006 represented 78% of acreage for spring cantaloupes and 31% of the acreage for watermelons (down from 6 completed surveys in 2005; 85% and 50% representation of cantaloupe and watermelon acreage, respectively) (Table 1). The acreage reported in these data represents melons grown in Maricopa, Pinal, western La Paz and northern Yuma counties. Estimates of yields (both actual and potential) varied between years and melon types, where estimates for yield losses range from 22-30% for both crops. These values are also fairly consistent with the PCA and grower estimates of specific factors responsible for yield losses.

Estimates for specific factors responsible for seasonal yield reduction varied as well (Table 2). Overall, weather and disease constituted the factors that PCAs felt were most responsible for yield reduction. This makes sense since spring melons are planted under cool temperatures and higher amounts of rainfall. Losses for all insects ranged from 0.7-2.6 % and varied between years and melon crops. This is consistent with the unpredictable nature of insect outbreaks that are often influenced by weather and adjacently grown spring crops. Yield reductions due to birds in 2006 was >5.0 % in 2006. PCAs have reported that crop losses due to bird damage have been getting worse each year. Percent reduction in yield by "other" factors was surprisingly high in 2006 and included: salt damage, harvest, poor markets and labor shortages. Collectively, these factors were reported to be responsible from 10.0-11.7 % of the annual crop losses for spring melons in 2006.

Estimates for aerial and ground insecticide applications on spring melons varied between years and crops (Table 3). In cantaloupes, only 12% of the acreage in 2005 was treated by ground and no acres were reported treated by air in 2006. In contrast, nearly 75 % of cantaloupes acres were treated by ground in both years. In 2006, an equal percentage of acres (67%) were treated by air and ground, up from 2005. Application costs increased between years in both crops. Not surprisingly, respondents estimated that 100% of their acres where scouted, monitored and sampled for insect activity (Table 4). The number of field visits per week was fairly consistent between years and crops, averaging more than 2 field visits per week. Estimates for the cost of scouting per acre were comparable for both cantaloupes and watermelons and actually decreased (~5%) between years. It was not documented why these costs decreased. Irregardless, these insect management costs suggest that Arizona melon growers find significant value in the expertise and service provided by their PCAs.

Part II: Insect Crop Losses

<u>Spring Cantaloupes:</u> Insects important at stand establishment such as seedling pests (ground beetles, earwigs, and crickets) and seed corn maggots were the pest most responsible for yield losses in cantaloupes in each year (Table 5). Seedling pests accounted for a 1.0% yield loss in 2005, but were not a economic problem in 2006. Seedcorn maggot was a significant pest in both years where almost 40% and 61% of the acres were treated in 2005 and 2006, respectively. Yield losses ranging from 1.0-1.8 % were reported in both years. Flea beetles were not a pest in either

year, but leafminers required treatment on 15% of the acreage in 2006. Cabbage loopers accounted for marginal control costs in spring cantaloupes in 2005 and caused no yield losses. In 2006, cabbage looper was treated for on 30% of the reported acres and caused 0.3% yield loss. Beet armyworm was not a pest in either year. Whiteflies (sweetpotato whitefly, *Bemisia tabaci* – B biotype) were reported to require foliar sprays on 58% and 41 % of the spring acres in 2005 and 2006 respectively. Control costs were higher in 2005 where yield losses were reported. Admire was applied to 7.8% of the spring acres in 2006, down from 36.1 the previous year (Tables 7). Average costs/acre for Admire was ~15% high in 2006 and could be a result of higher rates used. Since the use of Admire, incidence of aphid-transmitted virus has been almost none existent. However, PCA's reported no control costs or yield losses to aphids in 2005 or 2006 despite the low use of Admire. Thrips and spider mites are rarely found to damage spring cantaloupes and this was evident the past two years by the reported lack of control and yield losses. Darkling beetles can cause problems on spring cantaloupes at harvest by feeding on mature fruit. A significant number of acres were treated for beetles and minor yield losses were reported in both years.

<u>*Watermelons:*</u> In general, insects pest were not important at stand establishment in either year (Table 6). The exception would be seedling pests in 2005, where a small % of acres were treated and marginal yield losses were reported. Seed corn maggot, flea beetle and leafminers were not reported as problems in 2006. Lepidopterous larvae are annual pest of watermelons because of aesthetic damage resulting from feeding on immature fruit. Beet armyworm is generally thought to be more important, but cabbage looper can also be damaging to watermelons. The two pests combined accounted for the highest control costs and yield losses in both years. Similarly, whiteflies were a damaging pest in 2005, causing estimated yield losses of 0.5% and receiving foliar sprays on >65% of the acres. Less yield loss was reported for whiteflies in 2006, but 100% of the acres were treated an average of 1.2 times. This is not surprising considering that none of the acreage in 2006 was treated with Admire (Table 8). Aphids and thrips were not considered pest in either year. Spider mites are frequent pests in watermelons grown in Arizona and a significant number of acres were treated for them in both years.

Part III: Insecticide Usage

The frequency of use and the percentage of treated acres for insecticides applied on spring melons are shown in Table 9. The individual insecticide products are grouped by the IRAC mode-of-action classification (http://www.irac-online.org). This system groups chemistries with a similar mode-of-action with a common number so that users can effectively rotate different chemistries in resistance management programs. We list insecticides by a product name when possible; otherwise the chemical name is listed. Pyrethroids were listed by class because of the numerous products registered in head lettuce.

The carbamate and organophoshphate chemistries are listed within IRAC Group 1 because of their common mode-of-action. Among this group only diazinon was applied to cantaloupes and watermelons. Use was much higher on cantaloupes (42-46% treated acres), and was reportedly used primarily as a chemigation treatment. Endosulfan (Group 2A) was similarly used on a higher % of acres in cantaloupes, decreasing slightly in 2006. Less than 5% of the watermelon acres were treated in 2005, and none reported in 2006. In contrast, pyrethroids (Group 3) were used on only 6% of the cantaloupe acreage in 2005, increasing to 12.8% in 2006. In watermelons, pyrethroids use was higher in both years. A pyrethroid such as bifenthrin or Danitol combined with endosulfan is one of the most efficacious adulticides available for whiteflies and may explain the heavier use in watermelon

Group 4A represents the neonicotinoid chemistry which includes Admire, generic imidacloprid (Alias), Platinum and the newly registered Venom. This class of chemistry represents the most efficacious group of insecticides available for management of whiteflies and aphids in melons. Admire was the only neonicotinoid used in spring melons in either year. Usage was low (7.8 %) on cantaloupes in 2006, decreasing almost 80% from 2005. In contrast, Admire was used on 81% of the watermelon acreage in 2005 and was not applied at all in 2006.

Success (Group 5), Intrepid (18A) and Bt (11B) were used on a significant number of watermelon acres in 2005 and 2006. Use of these products in watermelons is primarily targeted against lepidopterous larvae which are one of the primary pests responsible for yield. Agrimek (6) is an effective insecticide compound for leafminer and mite control, but was reportedly treated on only cantaloupes in 2006. The other products that had significant use reported were Courier and Oberon, two selective insecticides with good whitefly activity. They were used on more watermelons acres, where use for both products increased significantly in 2006. Again this may have been a result of no Admire use.

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Table 1. Number of respondents, and reported acreage and yields for spring melons in the 2005 and 2006 spring growing seasons.

	Cantaloupes			**Watermelons**	
Survey use stats	***2005***	***2006***		***2005***	***2006***
No. of PCA respondents	*6*	*3*		*6*	*3*
Acreage reported for these estimates	7561	6800		2685	1675
Estimated yield /acre (cartons) (tons)	850	817		31.7	30
Potential yield / acre (cartons) (tons)	1030	1117		42.5	41.7

Table 2. Percent reductions in yields due to several biological, environmental and management factors for spring melons in the 2005 and 2006 growing seasons.

	Yield Reduction (%)				
	Cantaloupes			**Watermelons**	
Factor	***2005***	***2006***		***2005***	***2006***
Weather	10.0	7.3		7.8	7.3
Chemical injury	2.0	0.0		0.0	0.0
Weeds	0.0	1.7		3.8	2.7
Disease	4.0	2.7		4.3	2.0
All insects	2.6	0.7		2.0	1.8
Birds	0.4	5.3		0.8	0.0
Other factors	4.0	11.7		6.7	10.0
Avg. Total Losses	22.0	29.4		25.4	23.8
	25.7			24.6	

Table 3. Frequency and costs for aerial and ground applications on spring melons in the 2005 and 2006 growing seasons

Insecticide Applications	**Cantaloupes**			**Watermelons**	
	2005	***2006***		***2005***	***2006***
Aerial application					
% acres treated	12.0	0.0		35.8	67.0
No. applications	1	0		2.3	1
Cost ($) / application	7.00	-		6.30	9.25
Ground application					
% acres treated	73.0	75.0		62.0	67.0
No. applications	2	1.1		2.3	1.8
Cost ($) / application	9.10	10.00		10.60	11.00

Table 4. Insect management costs for spring melons in the 2005 and 2006 growing seasons

Insect Management	**Cantaloupes**			**Watermelons**	
	2005	***2006***		***2005***	***2006***
% acres scouted	100	100		100	100
No. field visits/wk	2.3	2.1		2.3	2.1
Cost ($) / acre	13.00	12.60		13.30	12.60

Table 5. Insect losses and control costs on spring cantaloupes in the 2005 and 2006 growing seasons

	Cantaloupes							
	2005				2006			
Pest	**Treated Acres** *(%)*	**Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*	**Treated Acres** *(%)*	**Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*
Seedling Pests	66.8%	1	$8.50	1.0%	0.0%	0	$0.00	0
Seedcorn Maggot	39.0%	1	$10.70	1.0%	60.8%	1	$10.00	1.8%
Flea beetles	0%	0	$0.00	0%	0%	0	$0.00	0
Leafminers	1.7%	1	$15.00	0%	15%	1	$42	0
Beet armyworm	0%	0	$0.00	0.0%	0%	0	$0.00	0
Cabbage looper	2.9%	2	$19.50	0.0%	30.0%	1	$30.00	0.3%
Whiteflies	58.5%	1	$34.80	0.7%	41.6%	1	$25.00	0
Aphids	0%	0	$0.00	0%	0%	0	$0	0
Thrips	0%	0	$0.00	0%	0%	0	$0	0
Spider Mites	0%	0	$0.00	0%	0%	0	$0	0
Trash bugs	0%	0	$0.00	0%	0%	0	$0	0
Darkling Beetles	37.6%	1	$12.00	0.4%	58.8%	1	$10	0.7%

Table 6. Insect losses and control costs on spring watermelons in the 2005 and 2006 growing seasons

	Watermelons								
	2005					2006			
Pest	**Treated Acres** *(%)*	**Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*		**Treated Acres** *(%)*	**Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*
Seedling Pests	12%	0	$0.00	0.1%		0%	0	$0	0
Seedcorn Maggot	0%	0	$0.00	0%		0%	0	$0	0
Flea beetles	0%	0	$0.00	0%		0%	0	$0	0
Leafminers	0%	0	$0.00	0%		0%	0	$0.00	0
Beet armyworm	32.1%	2.5	$27.40	0.7%		37.3%	1.5	$25.00	0.5%
Cabbage looper	32.4%	2	$17.70	0.1%		58.2%	1.8	$25.00	0.2%
Whiteflies	65.2%	1	$24.30	0.5%		100%	1.2	$28.50	0.1%
Aphids	0%	0	$0.00	0%		0%	0	$0.00	0
Thrips	0%	0	$0.00	0%		0%	0	$0	0
Spider Mites	29.1%	1.1	$28.70	0.6%		26.9%	1	$35.00	0
Trash bugs	0.9%	1	$8.00	0.3%		0%	0	$0	0
Darkling Beetles	12.1%	1	$13.50	0.1%		0%	0	$0	0

Table 7. Frequency and costs of chemigation and soil-applied insecticides at stand establishment on spring cantaloupes in the 2005 and 2006 growing seasons.

	Cantaloupes			
	% Treated acres		Cost $ of one application/acre	
Treatment	2005	2006	2005	2006
Chemigation treatments used at stand establishment	54.9	50.0	9.30	8.00
Soil applied insecticide used (Admire, generic imidacloprid, Platinum, or Venom)	36.1	7.8	50.00	60.00

Table 8. Frequency and costs of chemigation and soil-applied insecticides at stand establishment on spring watermelons in the 2005 and 2006 growing seasons.

	Watermelons			
	% Treated acres		Cost $ of one application/acre	
Treatment	2005	2006	2005	2006
Chemigation treatments used at stand establishment	0	0	0	0
Soil applied insecticide used (Admire, generic imidacloprid, Platinum, or Venom)	81.4	0	45.25	0

Table 9. Insecticide usage on spring cantaloupes and watermelons in the 2005 and 2006 growing seasons

IRAC MOA Group	Product	Cantaloupes 2005 Treated acres (%)	Cantaloupes 2005 No. times applied (No./ac)	Cantaloupes 2006 Treated acres (%)	Cantaloupes 2006 No. times applied (No./ac)	Watermelons 2005 Treated acres (%)	Watermelons 2005 No. times applied (No./ac)	Watermelons 2006 Treated acres (%)	Watermelons 2006 No. times applied (No./ac)
1A	Lannate	0.0	0	0	0	0	0	0	
1A	Vydate	0.0	0	0	0	0	0	0	
1B	Diazinon	42.7	1	45.6	1	6.0	1	0	
1B	Dimethoate	0.0	0	0	0	0	0	0	
1B	Metasystox -R	0.0	0	0	0	0	0	0	
2A	Endosulfan	35.6	1	29.2	1	4.8	1	0	
3	Pyrethroids	6.0	1	12.8	1	26.1	3	27.0	2
4A	Admire	36.1	1	7.8	1	81.4	1	0	
4A	Generic imidacloprid	0	0	0	0	0	0	0	
4A	Platinum	0	0	0	0	0	0	0	
4A	Venom	0	0	0	0	0	0	0	
5	Success	0	0	22.8	1	38.2	1.5	26.9	1
6	Agrimek	0	0	18.4	1	0	0	0	0
9B	Fulfill	0	0	0	0	0	0	0	0
11B	Bt (ie. Dipel/Javelin)	0	0	0	0	15.8	1.5	41.8	1
16	Courier	19.4	1	33.2	1	13.0	1	73.1	1
18A	Intrepid	0	0	0	0	26.1	1	0	0
23	Oberon	0	0	0	0	11.2	1	43.6	1