PEST MANAGEMENT STRATEGIC PLAN

FOR

CANTALOUPE, HONEYDEW AND MIXED MELON PRODUCTION IN CALIFORNIA

Prepared for the
United States Department of Agriculture and the
U.S. Environmental Protection Agency

By the

California Melon Research Board

and the

California Specialty Crops Council

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Note: This document was revised in 2016 from the 2003 PMSP for Cantaloupe, Honeydew and Mixed Melons produced in California to represent input from and strategy of the California melon industry for 2016 – 2025.

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) is now engaged in the process of registering and re-registering pesticides under the requirements of the Food Quality Protection Act (FQPA). EPA's regulatory focus on the organophosphate (OP), carbamate, and suspected B2 carcinogen pesticides has created uncertainty as to the future availability of these products to growers. In order to facilitate the transition to "reduced risk" pest management, the United States Department of Agriculture (USDA) has requested that all commodity groups develop a Pest Management Strategic Plan (PMSP) to identify the critical research, registration, and educational needs for their specific commodity. Reduced risk is a very broad term used to describe pest management techniques and tools that have low inherent toxicities and those that have a minimal impact on the environment.

On a larger scale, integrated pest management is the basis for the processes discussed herein. IPM is an ecosystem-based strategy that focuses on the long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest-control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

For California melon growers, label registrations of several key crop-care materials are examples of products that have been modified, cancelled or restricted due to FQPA. Due to the loss of these and the possible loss of other valuable crop-protection tools, coupled with widespread reductions in funding and Land Grant University personnel to conduct field research and extension programs, it is imperative that all resources be used in the most efficient manner possible. The objective of this strategic plan is to develop a comprehensive list of critical concerns of the cantaloupe, honeydew and mixed melon industries in California and to recommend means to address these priorities with the most appropriate resources in the areas of research, registration and education.

This strategic plan includes an overview of melon production, cultural practices, seasonal pest occurrences, and management techniques throughout the state. Both current and emerging pest management needs are addressed in this plan. Efficacy ratings of various pest control techniques (chemical and non-chemical) used in melon production have been summarized from input made by growers, Pest Control Advisers (PCAs), researchers, and other experts involved in field activities. As a result of a PMSP review meeting held on October 14, 2015, several critical areas have been identified by the melon industry. The following priority areas, listed in order of importance, must be addressed in order to maintain the long-term viability of this industry.

Research Priorities*:* Finding practical solutions to insect control are of immediate and serious concern to producers of melons in California. Weeds and pathogens are also of concern.

1) Of significant importance is the need to find effective alternatives to Diazinon, a highly efficacious organophosphate insecticide used for leafhopper and soil-borne pest control. This material, along with other chemicals in this class of chemistry, has received intense scrutiny and is under threat to be removed or have the label modified as a crop-protection tool.
2) Preemergence and also postemergence weed control techniques and products are needed for the following broadleaf and sedge species: black nightshade, field bindweed, yellow nutsedge, common purslane and pigweed.
3) Soil-borne disease research is needed that includes pathogen biology and control strategies for *Macrophomina, Phytophthora, Pythium,* and races of *Verticillium* and *Fusarium* that are found in California and for *Monosporascus cannonballus* and any other pathogen associated with vine decline. Also, new root systems are needed which can minimize the impact of soil-borne diseases.
4) Development of resistant varieties for the mosaic virus complex needs to be encouraged, advanced and incorporated into existing seed development research. Plant breeding research should find and develop new melon varieties that are resistant to the many plant diseases and insect pests that are problems for the grower.
5) Development of resistant varieties for the races of *Verticillium* and *Fusarium* that are found in California and that impact on melon production is encouraged.
6) Virus biology research is needed for all viruses that can inflict losses in melon production such as potyviruses and gemini viruses. The understanding of the basic biology of disease/vector relationships is critical to the industry, especially for learning how to avoid and reduce losses from viruses.
7) Melon growers are concerned about effective control of soil pests that damage melons at harvest time, such as darkling beetles, earwigs, pinworms, cucumber beetles and cutworms, in particular strawberry cutworm. Alternatives with very low pre-harvest intervals need to be developed to rotate with other reduced-risk materials.
8) Evaluate the use of manure in terms of potential food safety issues.

Regulatory Priorities: The most important regulatory action that needs to be done involves an enhanced interaction between Cal-EPA and U.S. EPA.

1) Harmonization between Cal-EPA and U.S. EPA needs be encouraged to facilitate and hasten the registration of reduced-risk products. Concurrent registrations of pesticide labels on a federal and state level is getting better, but improvement is still needed. Any delay in getting the federal pesticide label approved for use in California puts our growers at a disadvantage when materials get approved first in other states, such as for Capture LFR, which is already registered in Arizona. The registration process for new chemicals should be looked upon as a means to add alternatives for use in rotation with older products that need to be retained for pesticide resistance management.

In terms of specific registrations, the melon industry also needs:

2) Cost effective new products to rotate in an insect pest resistance program with acetamiprid (Assail) for leafhopper control and soil pests that impact on stand establishment and also at harvest time.
3) New chemistries for powdery mildew control and overall disease resistance management.
4) Language on pesticide labels needs to consistent and easily interpreted for the various melon types.
5) Determine the possibility of IR-4 projects in regard to melons. Consider a project on Capture LFR, a modified bifenthrin product. Also due to funding cuts, the IR-4 center at the UC Desert Research and Extension Center no longer exists, leaving a gap in the needed IR-4 residue research on pesticides applied under low desert conditions. Additional funding is needed for this program.
6) Identify any pollinator issues based on new or future regulations restricting use of chemical materials used for management of white flies and other pests during bloom periods.
7) Identify any Codex International and MRL issues regarding products used on melons that go into the export market.
8) Future regulations should include restrictions on imports that are equivalent to the regulations over U.S.melon producers.

Educational Priorities: The melon industry has been very proactive in providing educational opportunities for growers and PCAs with considerable cooperation from personnel with the University of California (UC) and also USDA researchers. In addition, the California Melon Research Board (CMRB) has been involved with the Pesticide Environmental Stewardship Program (PESP) at the federal level to identify strategies for reducing the risk of pesticides to pesticide applicators. Specific targets for new educational opportunities are:

1) Educate regulators why future regulations should include restrictions on imports that are equivalent to the regulations over U.S. melon producers
2) Regulators and consumer groups must be educated as to how Integrated Pest Management (IPM) practices are used in melon production and how this system optimizes food production while it minimizes risks to workers and the environment. This is especially important as it relates to risk assessments for crop production.
3) The general public needs to understand how IPM is used in agriculture and how changes brought about by the FQPA review impacts on the cost of food.
4) The economic side of replacing low-cost pesticides with newer, but much more expensive, materials needs to be considered in the review process.
5) Resistance management to preserve both new and old pesticide chemistries.
6) Training and demonstration of alternatives to 1,3-dichloropropene (Telone) for soil-borne diseases.
7) Technology transfer on how to use new chemistries with economic thresholds.
8) Continue UC outreach efforts to small-scale melon growers.
9) Use of degree day and crop models for both pest control and plant growth analysis.
10) Finally, the public should be reminded through effective media and websites, social media and media campaigns (e.g., “California Grown” and The Alliance for Food

and Farming type programs) that the consumption of fresh fruits and vegetables, including melons, contributes to a nutritious diet and healthy lifestyle.

The industry has also appreciated efforts made by numerous individuals on field days with EPA, CDPR and USDA representatives to discuss and highlight areas of concern and identify educational opportunities at both federal and state levels.

It is hoped that this strategic plan will serve as a resource for those wanting to learn more about the production of melons in California and especially those issues associated with integrated pest management. A list of key growers, PCAs, industry representatives, and UC research and extension personnel is provided identifying individuals with expertise in particular areas.

This PMSP has been prepared with a time frame of three to 10 years. The melon industry will periodically review, adjust and update priorities to remain current with industry developments and issues. The California cantaloupe, honeydew, and mixed melon industries appreciate the support and assistance of EPA, USDA, CPDR, and the UC system as we seek to find solutions for issues and concerns facing this important industry.

For the sake of all readers, the reference to a pesticide name identified in the body of this report will be shown in both the approved common name and the registered trade name. The American National Standards Institute and the International Standards Organization have approved of common names of pesticides. Please see the Glossary of Pesticide Chemicals listed in the reference section of this report for the latest glossary version (13). Since this is an industry document, all references will identify the chemical in the registered trade name as growers and PCAs are more familiar with the registered trade name. In addition, the scientific name will be identified in the first reference of a specific pest with just the common pest name used for subsequent listings.

Major funding for this updated PMSP was provided by the California Melon Research Board and the California Specialty Crops Council.

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The mention of any specific product in this document does not represent endorsement by any member or organization within the California Melon Work Group.

CALIFORNIA MELON PRODUCTION OVERVIEW

Melons belong to the cucurbit family of plants, known as Cucurbitaceae, which includes cucumbers, gourds, squashes, pumpkins and watermelon. There are several genera within the family and several species within each genera. Cantaloupes (*Cucumis melo* L. var. *cantalupensis*) (7) and honeydews (*Cucumis melo* L. var. *inodorus*) (18) are classified in the same genus. Mixed melons include crenshaw, casaba, Santa Claus, Persian, Juan Canary, piel de sapo, and other melon types. Melons that are commonly cultivated are divided into several groups. The Reticulatus Group, or netted melons, includes cantaloupes, Persian melons, and muskmelons. The Inodorus Group, or winter melons, includes casaba, crenshaw, and honeydew melons. Melons are grown on flat beds with a typical width of 80 inches. Melons are warm-season annuals that are very sensitive to frost.

State reporting systems for pesticide use and also production statistics may vary according to melon type and may include cantaloupes and honeydews in the same category (19). Statistics for the year 2013 from the County Agricultural Commissioner's offices are shown in the appendix (8).

Cantaloupes

- California ranks first in the nation in production of cantaloupes. Acreage plantings for the year 2013 from the USDA National Agricultural Statistics Summary show California ranked number one with 42,500 acres of the total 68,600 planted acres in the United States. This puts the state's production at approximately 62% of all cantaloupes grown in the U.S.(22). Harvested acreage was 42,500 acres. [Note this report (22) has acreage at 42,500 compared to County Agricultural Commissioner's Data, which has it at 28,639 (8).]
- Total production of cantaloupes grown in the U.S.in 2013 was 18,173,000 hundred weight (cwt.) with an average U.S. yield per acre of 265 cwt. (22). This would equate to 662.5 cartons per acre using a 40-pound box. The average yield of cantaloupes in California was 300 cwt., which would equate to an average yield of 750 cartons per acre (8). The harvested acreage total of 42,500 multiplied by the average yield of 300 cwt in California would give a figure of 12,750,000 cwt, which is approximately 62% of the total U.S. yield (23). Cantaloupe growers in California would identify an excellent yield as 800 cartons per acre.
- In 2013, cantaloupes ranked 43rd in gross value among all California agricultural commodities with a total of $172,229,254 (8). Based on data from the offices of the County Agricultural Commissioners in California, the average value per harvested acre was $6,014.
- Cantaloupes grown in California are shipped throughout the U.S. market as shipments to Canada and Mexico have declined in recent years due to the large difference in exchange rates for the dollar. The need for refrigeration (38 degrees F) after harvest has also prevented growers from shipping cantaloupes overseas (18).
- Data indicates that cantaloupes accounted for 64% of the total 14.1 million hundred weight for the state's melon crop in 2013 (8).

Honeydews

- California also ranks first in the nation in production of honeydew melons. The same 2013 summary shows California ranked number one in planted honeydew acreage at 10,500 acres of the total 14,450 planted acres in the U.S. (22). This puts the state's production at approximately 73% of all honeydews grown in the U.S.(22). Harvested acreage was also 10,500 acres.
- Total production of honeydews grown in the U.S. in 2013 was 3,605,000 hundred weight (cwt.) with an average U.S. yield per acre of 249 cwt. This would equate to 830 cartons per acre using a 30-pound box. The average yield of honeydews in California was 260 cwt., which would equate to an average yield of 867 cartons per acre (23). Honeydew growers in California would identify an excellent yield as 1,000 cartons per acre.
- In 2013, honeydew melons ranked 70th in gross value with a total of $42,926,000 (8).
- Based on data from the offices of the County Agricultural Commissioners in California, the average value per harvested acre was $5,764 (8).
- Data indicates that honeydews accounted for 17% of the total 14.1 million hundred weight for the state's melon crop in 2013 (8).

Mixed Melons

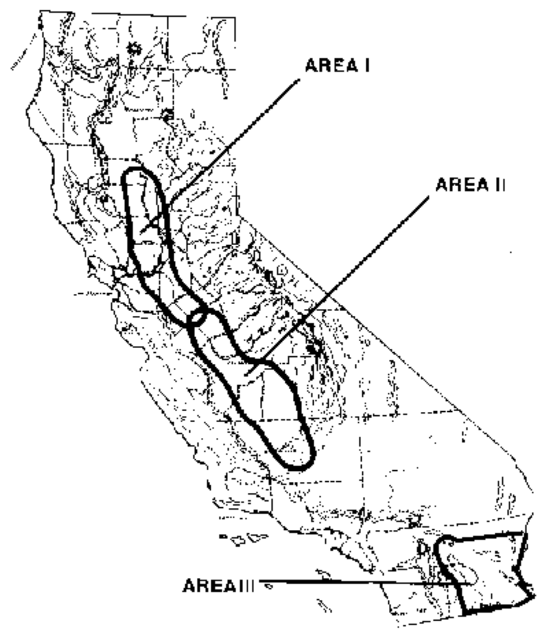
- Mixed melons include numerous different types with Juan Canary, Persian, casaba, crenshaw, Santa Claus, and piel de sapo being the most common (17). Specific production data on each mixed melon type is not available. The estimate on crop acreage of mixed melons is approximately 15% of the state's total melon acreage (19).
- Data indicates that mixed melons accounted for 19% of the total melon crop in the state as identified by total hundred weight (8). Mixed melon production has increased during the past decade. In 2000 mixed melons were at 3% of the total melon crop and in 2013 trending at 19% of the total crop.
- In 2013, mixed melons accounted for a total crop value of $39,659,579 in the state (8).

This strategic plan reports on production of cantaloupes, honeydews, and mixed melons grown in California. No information on watermelons is included. Production statistics for the main melon types can be found in the appendix.

MELON PRODUCTION REGIONS

There are three commonly recognized areas of melon production in California (9) (Figure 1).

Figure 1. Melon Production Regions in California



Area I, located in the northern San Joaquin Valley and lower Sacramento Valley grows approximately 9% of the state's cantaloupes with production focused in Stanislaus County (8, 11). Area I produces 15% of the honeydews with production in Stanislaus, and Sutter counties. Counties are being listed in order of highest planted acreage (8). Area I also produces approximately 16% of the mixed melons in Stanislaus and San Joaquin counties. Planting of melons is from April to early July with harvest from mid-July to mid-October. Rainfall varies from about 26 inches per year in the Sacramento Valley to about 16 inches per year in Modesto in the northern San Joaquin Valley (4). Area I uses flood irrigation to pre-irrigate melon fields then utilizes dryland-farming techniques to force the melon plants to send their root systems downward to a high water table. This allows melon growers to avoid subsequent irrigations via furrows.

Area II, the southern San Joaquin Valley, produces about 68% of the cantaloupes grown in the state (8,11). Production of cantaloupes occurs in Fresno, Merced, and Kern counties (8). Area II produces 68% of the honeydews with production centered in Fresno County. Area II also produces 76% of the mixed melons in Fresno, Merced, and Kern counties. Melons are planted from mid-March to mid-July with a harvest period from late-June into mid-to-late October depending on weather. Fresno receives about 10 inches of rainfall per year while Kern County receives about 6-8 inches per year (4). Subsurface drip irrigation is common in Area II, though there are some growers using furrow irrigation in all three melon types. The growing region in Area II is commonly referred to as the westside district for melons as production occurs along the western part of the valley.

Area III, the desert growing region, covers Coachella, Imperial and Palo Verde Valleys. Area III has both a spring and a fall crop of cantaloupes and honeydews. Planted acreage of cantaloupes and honeydews in Area III is split with about 76% of the acreage in a spring planting and the balance of 24% in a fall crop (17). This region grows about 22% of the state's cantaloupes with production across Imperial and Riverside counties (7). Area III also produces 15% of the honeydews in the same counties. Area III produces 6% of the mixed melons with most of the production in Riverside County and minor acreage in San Diego County. Spring planting starts in mid-December and goes through March with harvests from mid-May into mid-July. Fall melon planting occurs in July and August with a fall harvest period from October into late December (7,9,17). This area produces melons with less than four inches of rainfall per year (4). Furrow irrigation is commonly used though there may occasionally be drip. Area III will be identified as Desert Valleys in tables.

MELON CROP PHENOLOGY

Table 1 shows the typical cantaloupe crop phenology events, shown in days, involved from planting to bloom to fruit development to harvest for the main production regions. Honeydews and mixed melons would be expected to take several days longer in the development period compared to cantaloupes. Melons have optimal germination when the soil temperature is at least 60 degrees Fahrenheit. The longest germination period would occur in early spring when melon seed is planted into cool, wet soils. Melons can germinate in three days if seeds are planted into warm soils during the summer month of July. Hybrid seed varieties have been known to develop faster and with more plant vigor compared to open-pollinated varieties. This phenomenon is commonly referred to as hybrid vigor and technically it is referred to as heterosis (11). This means that progeny that results from genetically different parent lines have an increase in vigor compared to the average parent lines.

Table 1. Melon Crop Phenology in Days

Desert Valleys (Area III)	**Planting to Emergence**	**Emergence to Bloom**	**Bloom**	**Fruit Development**	**Harvest Period**
Average	7	45	30	35	8
Expected Range	5-10	30-60	30-35	30-40	6-10
Sacramento & San Joaquin Valleys (Areas I & II)					
Average	7	30	30	35	10
Expected Range	5-10	21-35	30-35	30-40	7-14

FOUNDATION FOR A PEST MANAGEMENT STRATEGIC PLAN

Members of the California melon industry – representing researchers, growers, packers, shippers, commodity groups, and PCAs – were asked to join a work group with invited representatives from the Western Integrated Pest Management Center. The goal was to update the industry's strategic plan for pest control problems of significant concern to California melon growers and handlers. Their input provided an important viewpoint to the pesticides and alternatives used and to the diversity of IPM practices for the major melon growing regions of the state. Members of this California Melon Work Group and their affiliations are identified with contact information provided at the end of this document.

In order to evaluate pest management strategies, a review of pesticides that were the most commonly used materials in California melons in 2013 was made by searching the CDPR database on pesticide usage (19). These materials are listed in Tables 2 and 3. Not all materials would necessarily be used on a single crop. Pesticides are ranked based on total acreage treated with the highest amount listed first. It should be noted that the term pesticide is a general term that includes insecticides, fungicides, herbicides and other materials used for pest control. The most commonly used insecticides, fungicides, and herbicides are identified with additional information found in the appendix.

Table 2. Most Common Pesticides Used in Cantaloupes, 2014.

Insecticides	Fungicides	Herbicides
Imidacloprid (Admire)	Sulfur	Trifluralin (Treflan)
	Mefenoxam (Ridomil Gold)	Bensulide (Prefar)
Bt (*Bacillus thuringiensis thuringienis*)		Glyphosate (Roundup)
	Trifloxystrobin (Flint)	
Abamectin (AgriMek)	Azoxystrobin (Quadris)	Clethodim (Arrow)
Diazinon (Diazinon)		Halosulfuron-methyl (Sandea)
Carbaryl (Sevin)	Myclobutanil (Rally)	
Chlorantraniliprole (Coragen)	Cyflufenamid (Torino)	Oxyfluorfen (Goal)
	Quinoxyfen (Quintec)	Sethoxydim (Poast)
Flubendiamide (Belt, Vetica)		
	Seed treatment-Thiram (12)	
Pyriproxyfen (Knack)		
Dinotefuran (Venom)		
Methoxyfenozide (Intrepid)		

Table 3. Most Common Pesticides Used in Honeydews, 2014.

Insecticides	Fungicides	Herbicides
Methomyl (Lannate)	Sulfur	Trifluralin (Treflan)
Carbaryl (Sevin)	Trifloxystrobin (Flint)	Glyphosate (Roundup)
Diazinon (Diazinon)	Mefenoxam (Ridomil Gold)	
Esfenvalerate (Asana)	Gold)	Bensulide (Prefar)
Imidacloprid (Admire)	Myclobutanil (Rally)	Clethodim (Arrow) Oxyfluorfen
	Azoxystrobin (Quadris)	Halosulfuron-methyl (Sandea)
Bt *(Bacillus thuringiensis)*	Cyflufenamid (torino)	Sethoxydim (Poast)
Methoxyfenozide (Intrepid) Dinotefuran (Venom) Flubendiamide (Belt, Vetica)	Seed treatment-thiram (12)	

Source for Tables 2-3: California Department of Pesticide Regulation, 2014 Annual Pesticide Use Report Data Indexed by Commodity (19).

Pesticides used in honeydew production would be very similar to those used in mixed melon production.

Insecticides were used on 76% of all cantaloupes grown in California compared to 74% of the total U.S. melon crop in 2000 (1). Insecticides are used on 78% of all honeydews grown in California compared to 80% of the total U.S. honeydews crop (1). Most treatments are applied to the melon foliage after crop emergence with sprays made to protect the crop after fruit has set. The primary pests to all melon types targeted by these foliar treatments include aphids, cucumber beetles, whiteflies, cabbage loopers, mites and leafminers (7, 17). The primary soil-borne pests targeted by insecticide treatments prior to, and at planting, include wireworms, seedcorn maggots, darkling ground beetles, cutworms and flea beetles (9, 20). Please see Tables 11, 13, 18, 19, 26, and 27 for specific information on the most important insecticides used in melon production in California.

Fungicides were used on 52% of the cantaloupes grown in California in 2000 compared to 60% of the total U.S. cantaloupe crop (1). Fungicides were used on 10% of the honeydews grown in California in 2000 compared to 26% of the total U.S. honeydew crop (1). Most fungicide applications are made by foliar treatments. The major disease organism targeted by these treatments is powdery mildew (7, 17). Please see Tables 14, 22, 23, 30, and 31 for specific information on the most important fungicides used in melon production in California.

Herbicides were used for weed control on 42% of the cantaloupes grown in California compared to 43% of the total U.S. crop in 2000 (1). Herbicides are used for weed control on just 3% of the honeydews grown in California compared to 12% of the total U.S. crop (1). Postplant applications of Trifluralin (Treflan) are made to the beds at layby, except for a ten-inch strip centered on the baseline. Layby applications, which target late emerging weeds, are made when melons are in bloom and runners are advancing across the bedtop. This is considered to be the last stage of melon growth when cultivating equipment can still be safely used. After layby, there would be no herbicide applications until after the crop was harvested. Please see Tables 16, 20, 21, 28, and 29 for specific information on the most important herbicides used in melon production in California.

The remainder of this document is an analysis of agronomic practices, pests, and pest management tools used during the major stages of the melon production season. In some cases, certain sections will be divided by area or season to describe regional differences. Timelines of seasonal pest occurrence, pest management field activities, and cultural practices for each production area are provided in the Appendix. A comprehensive overview of melon production practices, pests, and control techniques, have been previously identified in the Crop Profile for Melons in California (9).

The critical issues and concerns of the melon industry in California have been presented in this strategic plan according to the time during the production season in which they occur, such as early season, fruiting, etc. A to-do list has been developed for each issue raised by the working group. In order for the industry to address these topics in the most systematic manner possible, the issues have been listed according to whether they fall into the categories of research, regulatory or educational needs.

LAND PREPARATION TO PLANTING PERIOD

Land preparation is the first step before planting melons. Almost all melons are planted on raised beds in California to facilitate subsequent cultivation and irrigation of the melon crop, as well as to improve drainage, which minimizes root diseases (9). Land preparation consists of several discing operations, chiseling to break up hardpan layers at the bottom of the disc zone, and sub-soiling with heavy machinery such as caterpillars to break up deep compacted layers. The number of discing and chiseling passes needed to prepare a field for melons usually depends on the preceding crop. Triplane leveling, sometimes in two passes across the field, would be used for proper grading for furrow irrigation. Melon beds are most often 80 inches wide (7). Growers in Area II would make sure that the furrows were deep enough for irrigation while growers in Area I would make very shallow rows as they don't need deep irrigations due to their shallow water tables. Organic growers in Area III utilize a modified bed called a Yuma bed to capture more solar radiation in south-sloped beds in early spring in the desert region. This type of bed allows for more heat penetration and absorption of energy (7). After seedling emergence, Yuma beds would then be reshaped to a more traditional flat bed. Yuma beds are not used for the fall plantings in Area III.

Most melons are planted from seed with increasing use of transplants especially for honeydews. Most fields are direct seeded with hybrid seed with precision air planters to insure a good stand. Most melon fields would then be thinned by hand crews several weeks after seedling emergence.

Irrigation is used for all California melons and may be through furrow, sprinkler or drip systems. Furrow irrigation is commonly used in melons grown in the San Joaquin Valley and proper grading is critical for good drainage and for reducing disease levels. Drip irrigation is used in the desert regions in both the spring and fall plantings. Furrow irrigation is used occasionally in the spring plantings in the Imperial and Palo Verde valleys. Sprinkler irrigation can be used to germinate a direct seeded crop, but this type of system is rarely used after fruit set, as the use of sprinklers may increase fruit diseases. Drip irrigation is used on about 50% of the melons grown in California as it provides for good water management and allows hand harvesting at regular intervals. Subsurface drip and furrow irrigation are used in some areas where salt buildup in the soil is a problem.

Weed management is a key component of melon production in California. Practices may be done “in season” or “out of season” and the techniques used vary according to predominant weed species, location, irrigation systems and cost. Weed control may be done with herbicides, cultivation or hoeing. Growers are also concerned about a subsequent crop when in rotation, especially for residual effects and label restrictions of preemergent herbicides. Some organic growers use flaming. The various timings are classified as follows:

- Fall bed treatments – done before weeds emerge and crop is planted
- Fall bed treatments – done after weeds emerge but prior to planting
- Preplant – done before weeds emerge, but shortly before crop is planted
- Layby – after crop is planted but before weeds emerge
- Postplant – after crop is planted and after weeds have emerged

Fallow bed herbicide treatments are sometimes used to prevent winter weed growth and to allow for melon planting in early spring. Growers who plant melons after wheat or barley harvest in the San Joaquin Valley would make melon beds just prior to pre-irrigation and planting and would avoid many winter weed problems encountered with pre-shaped beds.

Soil fumigation has declined with the phase-out of methyl bromide. Effective replacements have not been forthcoming. Another fumigant that may be used after bed preparation but prior to planting would be metam-sodium (Vapam) (19), which would be applied to the seed line under a cap of soil. This material serves as both herbicide and a fungicide. Chloropicrin or 1,3-dichloropropene (Telone) can also be utilized after bed preparation but prior to planting.

EARLY SEASON PESTS – DIRECT SEEDING TO EMERGENCE AND STAND ESTABLISHMENT

Major Insect Pests of Early Season Melons

Pest Control Advisers monitor early season insect pests by examining plants, nearby soil, and associated soil clods shortly after fields are planted or sometimes transplanted. Adjacent fields and vegetation are usually also checked to see if there are pest species migrating into melon fields. Early season pests are a problem during seed germination and seedling emergence and can significantly reduce plant populations and stand establishment. Chemical controls for these insects include organophosphate and carbamate baits and pyrethroids. Additional information on specific insect and mite pests mentioned in the text can be referenced in Tables 9-12 in the appendix.

Variegated Cutworms (*Peridroma saucia*) and Black Cutworms (*Agrotis ipsilon*) are the most common cutworm species found in California melon fields (9,20). Cutworms are serious insect pests of emerging and young melon plants. They are generally night feeders and chew through stems at or near the soil line, reducing the stand. Cutworms are effectively controlled using permethrin (Stiletto, Pounce) bait with most applications made by ground rigs to a small-banded area of about 8-10 inches of the melon beds. Some growers in the Sacramento Valley continue to make band applications of carbaryl (Sevin) bait. The Central Valley is usually planted into pre-irrigated soils and ground rigs may not be able to enter fields. When that happens, aerial applications of bait would be necessary. Permethrin (Stiletto, Pounce) provide fair-to-good control of cutworms. Pyrethroids offer a broad-spectrum control that is a definite plus for pest control in the desert region because soils there don't hold adequate moisture for typical planting and capping operations. Sanitation is a key cultural control practice used to reduce these pests as cutworms are harbored in vegetative trash and weeds. Therefore, cutworm infestations can be avoided by not planting into fields with large amounts of plant residues. Certain crop rotations can also be avoided to stay away from grass crops or pastures that promote cutworm populations. Natural biological control occurs after cultivation as birds eat the exposed larvae in the soil. Cutworms can be a problem in late-planted melon fields grown after barley or wheat crops have been harvested in early June in the San Joaquin Valley. Botanical pyrethroids (Pyganic) offer adequate pest control in organic fields.

Darkling Ground Beetles (*Blapstinus* spp. and others) also feed on young plants near the soil line and usually are most prevalent at the edges of weedy or fallow fields. Darkling beetles can be effectively controlled with carbaryl (Sevin), permethrin (Stiletto, Pounce), bifenthrin (Capture) bait or Diazinon granular applications (9). These beetles can eliminate entire fields if not controlled as large numbers of the pest move around fields in early spring.

Palestriped Flea Beetles (*Systena blanda*) chew holes in leaves and stems, weakening the tender plants. Flea beetles are also effectively controlled with pyrethroids or carbaryl

(Sevin) applications. Esfenvalerate (Asana XL) is effective when run through a solid-set sprinkler system, although this is not a common practice.

Seedcorn Maggots (*Delia platura*) are usually considered early season pests from March through May, and late summer in Area III when producing a late season crop. Cultural control practices include deep plowing to remove or decrease the amount of soil organic matter and the use of crop rotation to avoid following cover crops in early spring plantings. Allow sufficient time (6-8 weeks) for irrigation and plant residue decomposition prior to working the ground in which spring melons will be planted. The pest is attracted to winter annual weeds, which need to be controlled. Diazinon has been effective as an in-furrow application. Bifenthrin (Capture) and zeta-cypermethrin (Mustang) have been effective when used as a seed treatment.

Wireworms (*Limonius* spp. and others) are click beetle larvae that dwell in the soil. The pest has been found in all soil types in the melon production regions. Damage consists of feeding on roots and boring into plant stems. Wireworms are controlled fairly well with chlorantraniliprole (Coragen) and permethrin (Stiletto), especially on adults. Crop rotation can be effective in reducing wireworm infestations in soil and common crops for this include safflower, beans, cotton, tomatoes, and corn.

Aphids can cause feeding damage to melons and can vector viral diseases. Green peach aphid (*Myzus persicae*) can be a problem in early spring. The major concern is the cotton/melon aphid (*Aphis gossypii*) in late plantings. Aphids are controlled very well by imidacloprid (Admire), but good coverage is critical. Growers are also using in rotation thiamethoxam (Actara and Platinum), acetamiprid (Assail) and flonicamid (Beleaf). Pymetrozine (Fulfill) has been reported by PCAs to be very effective and soft on beneficial insects, but it is only registered for ground applications. Pyrethrins (Pyganic) and neem oil (Trilogy) have been reported as control options for organic melons.

Whiteflies can be a problem throughout the season. Species compositions vary by geography. The sweetpotato whitefly (*Bemisia tabaci*) is the primary whitefly species in the desert production area and increasingly in the San Joaquin Valley, while the greenhouse whitefly (*Trialeurodes vaporariorum*) is the species of concern in the south coastal area. Imidacloprid (Admire) provides excellent early-season control of these pests, although pest populations can build up later in the season and create problems. Insect pest resistance is a big concern for growers in all areas. Growers are also using in rotation dinotefuran (Venom), pyriproxyfen (Knack) and fenpropathrin (Danitol). Whiteflies can transmit viruses that can do more damage than the actual insect feeding. Sweetpotato whitefly is the primary vector for *Cucurbit yellow stunting disorder virus* (CYSDV) (20). Cyantraniliprole (Exirel) used as a soil injection at planting may help delay the onset of CYSDV. Later it can be used as a foliar spray and is an excellent whitefly control insecticide.

Spotted cucumber beetles (*Diabrotica undecimpunctata*) and striped cucumber beetles (*Acalymma trivittatum*) particularly the larval stage, are a problem throughout the northern production regions and especially for organic growers in the San Joaquin Valley. Spotted cucumber beetles are being controlled by bifenthrin (Capture), dinotefuran (Venom) and pyrethroids. Carbaryl (Sevin) is also effective. As overall pesticide use has been reduced through IPM, or changes in use patterns of specific materials have been implemented, the importance of various pest species has shifted. This may be the case with an increase of cucumber beetles as more vegetable crop production has replaced some small grain and cotton acreage. There are no documented cultural control strategies for either species, although avoiding planting next to corn is recommended (20).

Potential/Sporadic Insect Problems in Early Season Melons

Beet leafhopper (*Circulifer tenellus*) can be a pest with some feeding damage done to young melon plants prior to the two true leaf stage but the biggest problem is that beet leafhoppers are the vector for curly top virus. Melons are not considered to be a suitable host for beet leafhoppers as the feeding is usually minimal but long enough to transfer the virus. Fallow-field management is an effective means to manage infestation levels in melon fields close to the foothills of the coastal range, however, there are economic concerns with leaving a field out of production. Methomyl (Lannate) provides good control of leafhoppers, but it has very short residual activity. Malathion is the product effectively used in the state regulatory program for curly top virus control.

Western Flower Thrips (*Frankliniella occidentalis*) can damage melons with their rasping-chewing mouthparts during any stage of plant growth. Thrips are usually considered a minor pest. Growers are using methomyl (Lannate), spinetoram (Radiant) and malathion for control.

Garden symphylans (*Scutigerella immaculata*), commonly referred to as garden centipedes, are an occasional pest that may damage young plants. The pest can be found in the same part of a field each year as the insect infestation slowly spreads to other parts. The pest can be a bigger problem in fields with high amounts of organic matter. Diazinon incorporated into the soil provides fair control. The pest seems to be more of a problem in Area I.

Crickets (Field Cricket in the Gryllid family & Mole Cricket in the Gryllotalpa family) are occasional pests in late spring plantings in Area III and main season plantings from June through September in Areas I and II. Field crickets can damage young seedlings or transplants by feeding upon melon roots. Later in the growing season, crickets can chew deep holes into the fruit and can damage melons by staining fruit with their excrement (9). Mole crickets can damage drip irrigation equipment by chewing on plastic drip lines. Permethrin (Stiletto) is the primary material that controls crickets.

Grasshoppers (Several species including desert locust) can be controlled by permethrin (Stiletto) applications. Grasshoppers may become a problem in dry years when the pest migrates out of the foothills into the valley floor looking for plants on which to feed.

Additional Information on Controls

Cultural Control: Crop rotations, sanitation and the occasional use of plastic mulches can be effectively used. No other new techniques reported.

Biological Control: No commercially acceptable techniques available or reported by the working group.

New Chemistry: Thiamethoxam (Actara) (a neonicotinoid) is not supposed to have cross-resistance with Admire. Thiamethoxam (Cruiser) will have minimal bee problems as a seed treatment. Cyrantraniliprole (Exirel and Verimark) have recently been registered and provide good control of whiteflies.

TO DO List for Management of Early Season Insects in Melons – Seeding to Emergence (listed in order of importance):

Research:
1) Evaluate alternatives for control of leafhoppers and soil-borne pest complex.
2) Evaluate efficacy of Thiamethoxam (Actara, Platinum) for control of cutworms and wireworms.
3) Develop efficacy data for Pyganic, a botanical pyrethroid, and identify pest species controlled. Identify other materials that organic growers can use for insect pest control.

Regulatory:
1) Register alternatives to Diazinon for control of soil-borne pest complex.
2) Allow the continued use of Diazinon and acetamiprid (Assail) by melon growers.

Education:
1) Provide annual list of current registrations on melons.

Weed Management in Early Season Melons

Integrated weed control practices (cultural, hand weeding, chemical, etc.) are used in almost all melon fields. This process begins with field surveys to identify weed species after which appropriate practices and herbicides are selected. Weed control alternatives range from cultural to chemical. Cultural practices include crop rotation, cultivation and hand weeding (hoeing). Water management can be effective in reducing weed germination and this is one reason why drip irrigation is used in melon regions in the state (15). Adjusted planting dates helps to avoid competition from certain weeds (e.g., barnyard grass and dodder). Chemical control practices include the herbicides registered for use in melon crops. The UC has published an excellent herbicide efficacy chart describing the use of these materials in the UC IPM Pest Management Guidelines: Cucurbits (2013).

There are four main timings for melon weed control activities: fall bed treatments, preplant, postplant and layby treatments. Fall bed treatments are often applied to fields in preparation for early season planting (January to March). In these fields, winter rainfall may reduce the opportunity for cultural weed control and thus fall bed treatments help to maintain prepared beds free of weeds and allow melon planting during brief dry periods in early spring. In later plantings (April to July), non-selective herbicides, cultivation and preplant incorporated herbicides can all be used. More costly herbicides are applied as band treatments. Specific information on herbicide use for the years 2011-2014, along with a four-year average, can be seen in Tables 20-21 in the appendix for cantaloupes and in Tables 28-29 for mixed melons.

Fall Bed Treatments - Before Weeds Emerge

Cultivation, cover crops and mulching with plastic are effective ways to manage fall weeds. Oxyfluorfen (Goal) can be applied to the entire bed by ground rig or aerial applications.

Fall Bed Treatments – After Weeds Emerge

Cultivation and hoeing are used as management tactics in the fall after weeds have emerged. Organic growers use flaming as a weed control technique but it can be both labor intensive and costly due to the high cost of propane. Flaming can be used on small weeds but is somewhat ineffective for control of tall grass species.

Chemicals effectively used at this time include paraquat (Gramoxone Extra), glyphosate (Roundup), and a Roundup/Oxyfluorfen (Goal) combination. If Goal herbicide is used, the beds will have to be worked prior to planting because of potential carryover problems in the root zone. Roundup is a systemic herbicide and Goal is a broad-spectrum contact herbicide; and both have activity on several weed species. Roundup, however, is broader spectrum and picks up more of the grass species as compared to Goal, which is a very costly herbicide.

Preplant – Before weeds emerge

Cultivation is done prior to planting. Several herbicides are used at this time for weed control: including trifluralin (Treflan), metam-sodium (Vapam), ethalfluralin (Curbit) and bensulide (Prefar). Halosulfuran-methyl (Sandea) also has preemergence activity, especially on nutsedge.

Postplant – After weeds emerge

Cultivation, soil covering and hoeing are options, as well as flaming. At this time sethoxydim (Poast) is used for grass control. Growers are also using clethodim (Arrow) and halosulfuran-methyl (Sandea).

Layby – After crop established and before weeds emerge

Layby herbicide treatments are done in direct seeded fields and include trifluralin (Treflan), mainly for nutsedge and annual grass control, ethalfluralin (Curbit) and halosulfuran-methyl (Sandea).

Specific Weed Problems in Early Season Melons

Black Nightshade (*Solanum nigrum)* and Hairy Nightshade (*S. sarrachoides*) are two of the most common weeds infesting California melons in Areas I and II, they are not a problem in the desert region. Because nightshades are in the same family as tomato, most tomato herbicides are not effective against these weeds, allowing for population densities to increase. As a consequence, these weeds are troublesome in fields in Area II with regular rotation of tomatoes to melons. Preplant applications of metam-sodium (Vapam) with spray knives provide good nightshade control but are not practical for early season plantings due to the reentry period for planting that keeps crews out for 14 days (10). Cultivation still provides good control of nightshades in California melons. Worth noting, this species has a tuberous root system and infestations can be made worse with certain types of cultivation, discing in particular. This tuberous root also makes it difficult to kill with herbicides, as translocation of sufficient active ingredient to the underground storage system is difficult unless timed correctly.

Field Bindweed (*Convolvulus arvensis),* which is commonly referred to as perennial morning glory, is a troublesome perennial weed with a vining growth habit. Field bindweed infestations can smother melon plants as they out-compete the intended crop. This weed is also only a problem in Areas I and II. Cultivation with straight blading equipment down to a depth of 18-24 inches provides fairly good control but may need to be repeated several times prior to layby. Glyphosate (Roundup) used in early spring or late fall can also provide good control of bindweed. Crop rotation is also used where feasible to control this weed, although this control option is often limited due to water availability. Field bindweed can increase in fallow fields that are left out of production due to water availability.

Yellow nutsedge (*Cyperus esculentus)* and Purple nutsedge (*C. rotundus)* are perennial weeds reproducing primarily from tubers (commonly referred to as nutlets). Nutsedge infestations are very competitive and can substantially reduce all melon crop yields. Cultivation and hand weeding fail to provide lasting control as the weed quickly grows back into the beds. Regional differences occur in weed distribution. Purple nutsedge is primarily limited to the areas south of Madera County in Area II. Yellow nutsedge can be found throughout the state but it is considered to be more of a problem in Area I (15). Vapam can be used in drip irrigation systems, knifed into the beds, or used with flood irrigation and provides good control. It has been reported that Halosulfuron-methyl (Sandea) provides excellent control of both species. Crop rotations can be effective when crops that grow taller than nutsedge are grown to out-compete the weed which is very susceptible to shade. Solarization and fumigation control techniques only provide partial control.

Common purslane (*Portulaca oleracea)* is an annual weed that is often considered a cool-season weed, although can be a common occurrence in irrigated crops. Purslane is considered to be the most widespread weed in vegetable crops. Most herbicides registered for use in melons for other target weeds, such as annual grasses are ineffective and thus, hand labor (with hoeing crews) is also needed to manage this weed. Bensulide (Prefar) and ethalfluralin (Curbit) can be applied preplant as both materials provide good control of purslane.

Pigweed (*Amaranthus* spp.) is generally considered to be a secondary pest as it usually is controlled by the same methods as nightshades. Metam-sodium (Vapam) provides good control, as does glyphosate (Roundup) and trifluralin (Treflan). It should also be noted that there is now glyphosate resistance in certain populations of pigweed.

Dodder (*Cuscuta spp.)* is a parasitic weed that attacks many broadleaf crops and weeds. It germinates in the soil and attaches to the stem of a host. Once attachment occurs, the soil connection is eliminated. Control generally involves cultivation by tractors for removal of the host plant or selective hand weeding by field labor crews. Trifluralin (Treflan) can be used as a spot treatment as it provides excellent control.

Summer annual grasses can be controlled by Roundup applications before the melon crop emerges. Bensulide (Prefar) provides excellent control when applied preplant. Pre-irrigation of melon beds encourages weed germination so that herbicides can be used to control emerging and small weeds. Postplant control is by clethodim (Arrow).

Cheeseweed or Little Mallow *(Malva parviflora)* can become a problem in Area II where preformed 80-inch beds are made in late fall. Repeated cultivations do not eliminate the deep-rooted taproot so the weed grows back after each pass with field equipment. Some growers are trying oxyfluorfen (Goal) for control.

Volunteer Garlic is a problem that occurs when melons follow garlic in crop rotations in the San Joaquin Valley so this problem usually occurs only in Area II. The same type of problem can also occur when melons follow onions and the volunteer onions come up the next year. Numerous passes with cultivation equipment are usually necessary to control volunteer garlic or onions, as fallow bed applications of oxyfluorfen (Goal) herbicide do not provide control. Hand weeding may also be necessary to augment cultivations for adequate control.

Volunteer Sugar Beet is another weed problem in Area III when melons follow sugar beets in crop rotation. Spot treatments of oxyfluorfen (Goal) herbicide and glyphosate (Roundup) are used for control.

Volunteer Melons is another weed problem that can occur when melons occur in successive plantings with no crop rotation. Pre-irrigation is used to germinate the volunteer melon seeds. As the volunteer melons emerge, most herbicides used for other weed control would eliminate the volunteers.

Velvetleaf (*Abutilon theophrasti)* is an annual weed that has been reported to be more common in recent years in Area II. Halosulfuron-methyl (Sandea) has been reported that the material offers good control.

Mustard Family represents numerous weed species that includes mustards, London rocket, and shepherd's-purse. They are all annual weeds that can become a problem in fall and winter plantings. Oxyfluorfen (Goal) applied as a fallow bed treatment provides good control. Mustard can become a problem as it escapes trifluralin (Treflan) applications used for many other problem weeds. Some growers report control with ethalfluralin (Curbit). During the season, hand labor crews would be needed in several passes across a field.

Hand labor crews would also be used for control of minor annual weed pests such as sowthistle, lambsquarters, and ground cherry.

Melon production in Area III uses several different techniques to manage weeds. Growers of spring melons utilize a modified planting method called Yuma beds. After stand establishment, the beds are reworked into a more traditional melon bed. Weeds can be controlled in the final bed formation. Another technique used by growers in the desert region is to use clear, plastic mulch.

Additional Information on Controls

Cultural Control: Better management of irrigation, including drip.

Biological Control: None indicated.

New Technology: Mechanical hoeing (similar to that used in leafy greens) and conservation tillage and precision cultivation with GPS sub-inch technology.

New Chemistry: Need new herbicide materials.

TO DO List for Early Season Weed Management in Melons:

Research:
1) Biology and control options for nightshade, nutsedge, pigweed and velvetleaf.
2) Evaluate rimsulfuron (Matrix) with efficacy and phytotoxicity studies.
3) Evaluate S-metolachlor (Dual Magnum) with efficacy and phytotoxicity studies.
4) Evaluate impact of different cropping systems on weeds.
5) Evaluate new chemical and biological herbicides.
6) Evaluate new mechanical hoeing equipment being used in leafy green crops.

Regulatory:
1) Clarify label language for trifluralin granular (Treflan TR-10) use in melons. (Registered for cucurbits.)

Education:
1) Educate growers on crop and variety tolerances for new herbicides.

Diseases of Early Season Melons

A complex of disease organisms contributes to "damping off," or loss of emerging and very young plants. Organisms responsible for this syndrome include: *Rhizoctonia*, *Phytophthora*, and *Pythium*. In general, cool, damp conditions in combination with poor drainage and compacted soils will predispose a field to infection by these pathogens in Area II in March and April. Acremonium root rot has been reported to damage honeydews more than cantaloupes. Irrigation management and soil drainage play extremely important roles in reducing the threat from the damping off complex.

Verticillium wilt is also a widespread disease that can develop in the early part of the season. Field sanitation, crop rotation and reducing soil movement from adjacent fields into melon fields may reduce the potential for disease development.

Rhizoctonia, Phytophthora, Pythium, and *Verticillium* are all soil-borne diseases in which the controls are basically the same for all. Good field and water management can significantly reduce problems caused by these pathogens. "Promote" is a beneficial fungus for organic growers that has been suggested as a biological control for soil-borne fungi. Effective chemical controls include metalaxyl (Ridomil) used through the drip system and metam-sodium (Vapam), which varies in efficacy according to proper application technique and soil moisture. Additional research is needed on new chemicals for soil-borne diseases.

Additional Information on Controls

Cultural Control: There are a number of practices that can be used by growers to minimize risk from plant disease, such as using fields with good drainage and planting into high beds. Additional controls include: crop rotation, irrigation management, avoiding use of sprinklers in early spring or after early fruit development, proper fertilization (excessive nitrogen should be avoided), and minimizing soil compaction.

Biological Control: "Promote" and compost teas are reported to be effective.

New Technology: None reported.

New Chemistry: None reported.

TO DO List for Management of Early Season Diseases in Melons:

Research:
1) Capture LFR needs evaluation.
2) Evaluate seed treatments with fludioxonil and thiophanate-methyl (Topsin M).
3) Preplant fungicides for use at planting time are needed.

Regulatory:
1) Registration of Capture LFR.

Education: Nothing at this time.

Nematodes in Early Season Melons

Root knot nematode (*Meloidogyne incognita)* is the major species of nematode of economic importance to melon production in California, although the closely related *M. javanica* may be present in some areas (9). High numbers of nematodes may build up in light texture soils where significant crop loss can be expected in susceptible host plants. Nematodes cause a plant to develop shallow root systems that are unable to meet the great evapotranspiration demands brought on by hot temperatures.

Soil sampling and a knowledge of the history of a particular field will help to determine what preventative treatments need to be made to control this pest. Crop rotation and soil solarization are non-chemical techniques to prevent or reduce high numbers of nematodes in the soil. The use of cover crops and leaving fields fallow can be effective, but these options are not always economically feasible given the cost of land and the price of the commodity. Chitin, a biological method to control nematodes, provides good control but takes a large amount of material and can be costly.

Several nematicides or soil sterilants with a range of efficacy are available for nematode control. Vapam is effective. 1,3-Dichloropropene (Telone) provides good-to-fair control; however, township cap limits on the use of this product might be prohibitive to its use. Oxamyl (Vydate) provides only fair control of rootknot nematodes.

Additional Information on Controls

Cultural Control: Crop rotation, fallowing fields, the use of cover crops and soil solarization have been used in some situations, otherwise, no new techniques have been reported.

Biological Control: No new techniques reported.

New Technology: No new techniques reported.

New Chemistry: No new materials reported.

TO DO List for Early Season Management of Nematodes in Melons:

Research:

1) Identify new materials and their efficacy as compared to standard nematicides.

Regulatory:

1) Request that the 1,3-dichloropropene (Telone) label include drip applications.
2) The current township cap limits for the use of 1,3-dichloropropene (Telone) has been a burden on melon growers, especially in parts of Area II. A regulatory modification is need to make sure that melon producers within the township have equal access to 1,3—dichloropropene (Telone) as do other producers within the township.

Education:

1) Educate growers on the benefit of soil sampling for monitoring with lab analysis of nematode species so that effective control strategies can be implemented.
2) Training on the safe and effective use of alternatives to methyl bromide.

Vertebrate Pests of Early Season Melons

Horned Larks (*Eremophila alpestris*) are one of the most notorious bird species that are known to reduce melon stands when direct seeding is used (9, 11). The birds reduce the plant population by pulling up seedlings as they walk up the planted rows during feeding. The only effective control strategy to reduce horned lark damage to seedlings is to try and protect the crop by a constant patrol of the field, with movement and noise acting as a deterrent to feeding during daytime hours. Once they have established a feeding pattern, horned larks will not be scared away with noisemakers such as propane cannons or even shooting. If they do fly off, it may be only for a short distance. The use of Mylar tape strips attached to solid set sprinkler pipes or risers in the field has had very limited success. Horned larks have become a bigger problem for growers since the introduction of hybrid seed with fewer seeds planted per acre. Growers who need to thin a melon field should delay thinning activities until plants achieve at least two true leaves. Larks are not a problem when transplants are used. Drones may provide temporary relief, but use hands-on time and battery life can be a problem.

Rabbits (*Sylvilagus spp.*) may feed on melon seedlings from early spring through mid-summer. Bait stations with diphacinone baits have been effective in controlling the pest along field borders (9). Damage may be high when fields are located next to almond orchards. They are considered a minor pest as they reduce plant populations along borders where protective cover occurs which minimizes the threat from hawks and owls.

Rabbit fencing can provide good control.

Ground squirrels (*Spermophilus beecheyi*) may damage melon seedlings in early spring planted fields that border almond orchards as they can chew on young plants. Ground squirrels usually do not make their burrows inside melon fields due to all the discing and cultivating activities. Bait stations with diphacinone baits have been effective in controlling the pest along field borders (9). Squirrels have also become a bigger problem in recent years for the same reason as other hybrid seed pests due to the lower plant populations of emerging seedlings (11). Growers are also advised to provide owl boxes around their fields.

Voles (Microtus spp.) are sometimes referred to as meadow mice or field mice. They are considered a pest in Area II where adequate plant cover is present to protect them from owl and hawk predation. Voles damage melon plants early in the growth cycle. They also damage drip lines. Zinc sulfate is used as a bait for control.

Priorities for the various vertebrate pests have been indicated within each pest section above.

PESTS OF ESTABLISHED MELONS (FROM STAND ESTABLISHMENT TO FLOWERING AND FRUIT DEVELOPMENT UP TO HARVEST)

Insects and Mites in Established Melons

The value of melons is entirely dependent upon the quality of the crop and as a consequence of this, very little cosmetic damage can be tolerated, especially with honeydews grown for the export market. Care must also be taken to monitor pests regularly and avoid secondary pest outbreaks, which arise from insecticide treatments.

Insect pests in established melons are controlled with standard pesticides such as organophosphates and carbamates; however, newer chemistries such as imidacloprid have also been shown to be effective for the control of sucking insects. Growers are also having success with other neonicotinoids and pyrethrins. Spinosad (Success) (Entrust for organic production) and spinetoram (Radiant) are reduced-risk compounds that provide good control of Lepidopterous larvae and leafminers (worm pests). *Bacillus thuringiensis* is a widely used microbial insecticide for organic melons and pheromones used as population-monitoring tools are effective tools. Insecticidal soaps used by organic growers have only been moderate in their level of effectiveness that requires excellent spray coverage because it has a contact-only mode of action, it does not have any residual activity after the spray dries and this material is most effective when used on nymphs. Parasites, predators, and naturally occurring viruses have shown limited impact for biological control on high insect densities. Unfortunately, biological control has generally not been shown to be a commercially viable treatment option for many pest species present in melons. Due to the high value of the fruit and the low tolerance of damage by consumers, care must be taken to intensively manage insect damage using an integrated approach. IPM in melons thus incorporates many tactics, with great care given to decisions on which pesticides might be needed, since secondary pests can be very problematic in this crop.

Melon Aphids – (*Aphis gossypii*) Ladybugs and lacewings can be seen at times in great numbers in melon fields, but these beneficial insects usually only get to sufficient densities once significant damage has been sustained by the crop. For this reason, biological control has only been relied upon to a very limited degree in melon production. When a neonicotinoid insecticide is applied as a soil injection at planting or at sidedress, melon aphids will not successfully colonize the melon plants, so no foliar sprays will be required for melon aphid control. Neem oil, a material approved for use in organic systems, provides poor control of aphids as does insecticidal soap (M-Pede) as good coverage is necessary.

Dimethoate works fair to good for aphids. Pymetrozine (Fulfill), Imidacloprid (Admire Pro) work well, but cannot be used late in the season because of PHI issues. Growers report excellent aphid control with flonicamid (Beleaf) and acetamiprid (Assail). Thiamethoxam (Actara) is another product that should provide good control.

Whiteflies (*Bemisia tabaci*) - Imidacloprid (Admire Pro) applied early in the season works very well. As it has PHI issues (21 d PHI), it cannot be used late in the season. Admire Pro used foliarly, can also be effective but it has been reported to be very hard on bees, therefore use during pollination is very limited. Fenpropathrin (Danitol) and methomyl (Lannate) tank mixes and oxamyl (Vydate) only provide fair-to-good control of whitefly pests, while Neem oil is reported to provide poor control of this pest. Pyriproxyfen (Knack) and Buprofezin (Courier) will effect egg viability of dosed female whiteflies and provide good control of nymphs, however, they don't control adult insects. Dinotefuran (Venom) provides control, but should not be used as a foliar spray during bloom. Areawide crop scheduling is extremely important, particularly in desert growing regions where continuous cropping can provide "bridges" to new host material and whitefly buildup has been observed to be extreme.

Leafminers (*Liriomyza trifolii, L. sativa*, and *L. huidobrensis*) are small dipteran flies, which can cause considerable damage to melon leaves by their extensive tunneling into leaf tissue as larvae. These insects have been a problem in the central and northern melon growing regions. Abamectin (Agri-Mek), chlorantranileprole (Coragen) cyantraniliprole (Exirel) and spinetoram (Radiant) provide good to excellent control with low impacts on beneficials; spinosad (Success) provides good-to-fair control. Agromyzid leafminers are a secondary disruption pest in the low deserts resulting from the use of broad spectrum insecticides that kill the more than one dozen different species of parasitic wasps that keep leafminers in check. Neonicotinoids injected in the soil at planting and IRGs applied during the season have preserved the leafminer natural enemies preventing outbreaks of this once devastating pest.

Spider Mite adults have eight legs and therefore are not classified as insects, which have six legs. Two-spotted spider mites (*Tetranychus urticae*), strawberry spider mites (*T. turkestani*), and desert spider mites (*T. desertorum*) are all considered pests of melons. Mites feed on the stems and leaves of melon plants. Mite damage is most severe in hot weather when environmental conditions favor the pest and quicken the pace of the life cycle. Spider mites blow into a melon field from neighboring areas. Fields are monitored for bronzing on lower leaves and treatments are initiated when crop damage begins to spread. If the canopy has not fully developed across the bed, a ground rig could be used with abamectin (Agri-Mek and Reaper). Organic melon growers have also noticed that the use of dusting sulfur had a suppressing effect upon mite colonies.

In the desert area, spider mites are a secondary disruption pest. Use of broad spectrum insecticides not only release spider mites from population suppression by their several natural enemies, but some broad spectrum insecticides like pyrethroids have been documented as egg production stimulants with sub-leathal exposure of female spider mites. These and the carbamate insecticide carbaryl (Sevin) also can cause secondary spider mite outbreaks.

There are several biological control organisms such as predacious mites, small black ladybird beetles, in the genus *Stethorus*, minute pirate bugs, bigeyed bugs and lacewings that are effective predators of spider mites (20). Predatory mite releases are effective when population densities are low to moderate. Continued releases are necessary to keep populations in check. Growers can also control spider mite populations by keeping roadways around fields watered down to limit dust movement onto the plant canopy.

<u>Cabbage Looper</u> (*Trichoplusia ni*) has become an annual problem in established melons. Like control of beet armyworm in melons, methomyl (Lannate), bifenthrin (Capture), permethrin (Pounce), and esfenvalerate (Asana) all provide good to excellent control of cabbage loopers, but may cause leafminer problems if applied early in the season. Bt applications can help to suppress looper populations if applied to small instar larvae. Growers also report success with chlorantraniliprole (Coragen), methoxyfenozide (Intrepid), spinetoram (Radiant) and flubendiamide (Belt, Vetica). Cyantraniliprole (Exirel) used as a soil injection or later as a foliar spray is an excellent looper control material.

<u>Leafhopper</u> (*Empoasca* spp.) can become a significant problem in established melons if large amounts of nymphs are present, as they reduce chlorophyll levels in melon leaves. Methomyl (Lannate) provides good control, but it has very short residual activity. Leafhoppers can be pests throughout the growing season so this species should be monitored the entire season. Foliar sprays of neonicotinoids insecticides, such as acetamiprid (Assail) dinotefuran (Venom), are used. Thiamethoxam (Platinum) and imidacloprid (Admire) are also reported as providing good control but are a risk to pollinators during fruit set. Pyrethroid insecticides such as bifenthrin (Brigade, Capture, Bifenture) zeta-cypermethrin (Mustang), and lambda-cyhalothrinare (Warrior) are efficacious against leafhoppers, but are also a risk to pollinators and may cause secondary pest outbreaks from leafminers and spider mites. Malathion is a product

effectively used in the state regulatory program for beet leafhoppers (*Cirulifer tenellus*), which are not a problem for established melons.

Beet armyworm (*Spodoptera exigua*) – Methomyl (Lannate), permethrin, and esfenvalerate (Asana) all provide good-to-excellent control of beet armyworms but may cause secondary outbreaks of leafminer or spider mites if applied early in the season. Methoxyfenozide (Intrepid), chlorantraniliprole (Coragen), cyantraniliprole (Exirel) spinetoram (Radiant) and flubendiamide (Belt, Vetica) are also good materials for beet armyworm. Bt applications (Xentari) if used at flowering can help to suppress populations. Spinosad (Success) (Entrust for organic production) has been used with fair results and performance does not seem very consistent on this harder-to-control lepidoptera, but this product is still good a good choice in a rotational program to manage resistance. Cyantraniliprole (Exirel) used as a soil injection or later as a foliar spray is an excellent beet armyworm control material.

Western Yellow Striped Armyworm (*Spodoptera praefica* and *S. ornithogalli*) can chew on and gouge out large areas of fruit as melon maturity approaches. Methomyl (Lannate), permethrin (Pounce), and esfenvalerate (Asana) all provide good to excellent control of armyworms but may cause secondary outbreaks of leafminer or spider mites if applied early in the season. Chlorantraniliprole (Coragen), spinetoram (Radiant) and flubendiamide (Belt) are also good materials. Bt applications (such as Xentari) if used at flowering can help to suppress populations of small instar armyworm larvae. Armyworms need to be controlled prior to melon maturity as the pest will attack maturing fruit and a single puncture wound into the melon flesh is enough to force the melon to be culled.

Spotted cucumber beetles (*Diabrotica undecimpunctata*) and striped cucumber beetles (*Acalymma trivittatum*), particularly the adult stage, can be problems for established melons. They rest under the fruit for shade and moisture, take a small bite and when the melon expands in size, so does the bitten area. Bifenthrin (Capture), lambda-cyhalothrin (Warrior) and other pyrethroids can offer some control.

Darkling ground beetles *(Blapstinus* spp. and others) can cause chewing damage to the netting of cantaloupes as the melons approach maturity. Bran bait formulation of Carbaryl (Sevin) is one of the few effective materials, along with pyrethroids such as permethrin (Pounce, Stiletto).

Cutworms, commonly referred to as strawberry cutworms, can attack ripening melons by burrowing into the bottom-sides of cantaloupes as the melons mature. There are several species of cutworms that impact on melon yields in Area II, especially along the Westside District of Los Banos, Firebaugh and Mendota. Cutworms can be significant problems when melons planted in July follow small grain crops such as wheat or barley harvested in June. There are several cutworm species that may need to be controlled, including black cutworm (*Agrotis ipsilon*) and variegated cutworm (*Peridroma saucia*). Permethrin (Stiletto) provides fair to good control, while methomyl (Lannate) and chloratraniliprole (Coragen) provide fair control.

Stink Bugs are a minor threat to melons during fruit development. Consperse stink bug (*Euschistus conspersus*), southern stink bug (*Nezara viridula*), Says stink bug (*Chlorochroa sayi*), and several other species are considered by PCAs to be among the hardest insect species to control. Clothianidin (Belay) provides good control of this migratory pest. Permethrin is registered, however this, like esfenvalerate (Asana) only provides poor control of stinkbugs and tends to flare secondary pests. Potash soap and sanitation only provide poor-to-fair control of this pest.

Western Flower Thrips (*Frankliniella occidentalis*) can be managed with spinosad (Success), which provides very good control as does imidacloprid (Admire) but Admire has PHI issues. Methomyl (Lannate) and spinetoram (Radiant) are also reported to provide good control. Neemix is reported to only provide fair results for thrips control. Pyrethroids such as esfenvalerate (Asana) can create leafminer flare-ups, so these materials are used judiciously. It is important to manage pesticide resistance when treating for thrips and the use of monitoring fields and adjacent vegetation is important. Weed control around the field is also important in reducing problems brought about by thrips. Early detection and removal of affected plants is effective in certain areas, especially in southern production regions.

Additional Information on Controls

Cultural Control: No new techniques reported.

Biological Control: No new biocontrols reported, use remains limited due to efficacy.

New Technology: Pheromone technology can be effective in pest monitoring.

New Chemistry: New materials are needed.

TO DO List for Management of Insects and Mites in Established Melons:

Research:
1) Evaluate alternatives for control of leafhoppers and stink bugs.
2) Evaluate control strategies for so-called pinworm damage prior to harvest from a complex of insects such as strawberry cutworms, earwigs, and arthropods such as centipedes and millipedes.
3) Plant breeders need to develop melon varieties resistant to whiteflies.

Regulatory:
1) Obtain materials and registrations for control of strawberry cutworms.
2) Maintain California registration for Diazinon for control of flea beetles, leafhoppers, and soil-borne insect pests.

Education:
1) Develop website with photos or link to photos on the UC IPM site of all insect pests identified in this strategic plan via the California Melon Research Board's team.
2) Develop marketing programs with specific retailers to make available so called "ugly fruit" to consumers at a lower price point.

Melon Pollination

All melons require pollination by honeybees in order to produce fruit because the pollen grains are large, sticky, and not moved by the wind (14). In the past, some growers relied on feral bees for pollination of melons. But varroa mites and tracheal mites have decimated the native bee population in the state in recent years. In addition to these mite pests, European honeybees have been competing with the Africanized honeybee in Southern California since 1994 (3). The placement of hives inside fields used to create problems for ground rig applicators and even aerial applicators as a 48-hour notice had to be given to a beekeeper prior to a pesticide application. Now, most beehives are placed outside of the field along the perimeter or even along a nearby road. This lessened the threat to bees from spray drift while also keeping the majority of bees away from where workers are. Beekeepers have also taken an aggressive strategy to replace queen bees with a new queen on a regular basis to promote vigorous colonies.

Bloom begins approximately four weeks after planting and continues until harvest. Most growers have written contracts or verbal agreements with beekeepers to keep hives in a field for a specified time. Beehives are usually held in cantaloupe fields for 30 days and in honeydew and mixed melon fields for 40-45 days. Bees are removed once a harvestable crop has been set. Growers vary the rate of beehives from one-half to one hive per acre based on the melon type and the region. Some growers do not put any beehives in the field and rely bees flying in from other fields.

Potential regulatory actions in the future may focus on restrictions for crop-care materials that might be sprayed during the bloom period. Current strategies, such as spraying at night, will be researched to determine if there is any risk to bees with this practice. Several melon pests do cause damage at bloom time and will need to be managed. Also, all melon growers have been advised to maintain close communications with their beekeepers to minimize any bee kill during bloom periods.

TO DO List for Pollination Management in Melons:

<u>Research</u>:

1) Develop new control strategies for varroa and tracheal mites that impact honeybees.

<u>Regulatory</u>:

1) Work with the bee industry to obtain California registrations for pest control materials for varroa and tracheal mites to rotate with amitraz (Apivar), for which there are reports of resistance.

<u>Education:</u>

1) Focus on hive location in fields.
2) Determine feasibility of placing hives in opposite corners of the field along with making water available at those hive locations.

Weeds in Established Melons

The most difficult weed species to manage in melons are nightshades, field bindweed, nutsedges, and annual grasses (15). Most registered herbicides provide some weed control although, hand labor is regularly required to manage many of these species. The herbicide halosulfuron (Sandea) is showing great promise for nutgrass control in melons. Cultivation is used to control weeds up to the time of “layby.” Layby is considered the stage of melon growth when cultivation equipment cannot be used anymore; melons are growing outward across the beds at layby. At layby, a preemergence herbicide is often applied to the area outside the seedline to control late-emerging weeds.

<u>Black nightshade</u> (*Solanum nigrum*) and <u>hairy nightshade</u> (*S. sarrachoides*) are two weed species of concern to melon growers in Areas I and II. Most melon herbicides are not effective against nightshades. Some growers are checking to see if metam-sodium (Vapam) might provide some control. Hoeing and cultivation are non-chemical options for control of these difficult weeds.

Field bindweed (*Convolvulus arvensis*) and nutsedges (*Cyperus* sp.) – Only cultivation and hoeing are options for these weeds in established melons. Some growers are trying glyphosate (Roundup) applied with a hooded sprayer with some success.

Annual grasses - Hoeing and cultivation are non-chemical options for control of grasses. Irrigation management also is an aid to managing several grass species. Sethoxydim (Poast) and clethodim (Arrow) are effective grass herbicides.

Dodder (*Cuscuta* spp.) – Only hoeing, flaming, or rotating crops provide any control of this parasitic weed. Flaming isn't used very much due to high costs of labor and propane.

Velvetleaf (*Abutilon theophrasti*) – Hoeing, hand removal, and cultivation are non-chemical options for control of velvetleaf.

Purslane (*Portulaca oleracea*) - Cultivation and hoeing are options for these weeds in established melons. Trifluralin (Treflan) used as a layby treatment can offer control.

Puncturevine (*Tribulus terrestris)* – A seed weevil, which is available from some County Agricultural Commissioner's offices is a biological control agent that can be deployed. The spines on the seeds of puncturevine can be very painful if embedded into the flesh of a melon picker's hands.

Groundcherry (*Physalis* spp.) – has a weak tap root with fibrous roots but the weed can grow to a height of over two feet. Oxyfluorfen (Goal) has some contact control and residual activity against the weed. Apply at first water followed by cultivation.

Additional Information on Controls

Cultural Control: No new techniques reported.

Biological Control: No new techniques reported or commercially available.

New Technology: Smart sprayer equipment for precision applications and hooded sprayers are now being tested.

New Chemistry: Alternatives are needed.

TO DO List for Weed Management in Established Melons:

Research:
1) Develop control measures for black and hairy nightshade.
2) Develop control measures for field bindweed.
3) Develop control measures for nutsedge.
4) Develop smart sprayer equipment and hooded sprayers for use with melons.
5) Develop post-emergent materials for control of broadleaf weeds.

Regulatory:
1) Register new alternatives to use in rotation for resistance management.

Education:
1) Demonstrate use of cover crops and organic amendments and their effect on weed populations.

Diseases in Established Melons

The major diseases that occur in established melons include *Verticillium*, *Fusarium*, *Macrophomina, Phytophthora* root rot, *Pythium, Monosporascus* and powdery mildew (20). Viruses, especially cucurbit yellow stunting disorder virus (CYSDV), are now a major problem in many areas and insects such as aphids and whiteflies vector these. Vector control has not been a good strategy to manage disease incidence. Specific viruses of importance include CYSDV, cucumber mosaic virus, watermelon mosaic virus, papaya ringspot, and zucchini yellows mosaic virus (9, 20). Rhizoctonia has been reported to be a late-season problem in the desert region.

Verticillium/Fusarium – The use of aerially applied foliar nutrients helps to maintain plant health and develops plant canopies, thus somewhat reducing the incidence of these diseases. Preplant soil fumigation is sometimes used as a management strategy, as well as resistant varieties.

Powdery mildew was formerly referred to as *Sphaerotheca fuliginea* but recently it has been referred to as *Podosphaera xanthii* (Castagne) U. Braun & N. Shishkoff *comb. nov.* in scientific literature (16). Powdery mildew is a disease that is expressed when the crop is stressed by environmental factors such as high temperature combined with poor soils, salts and irrigation problems. The disease can appear in all melon production regions of California. Disease development is favored by high relative humidity associated with mild air temperatures. High daytime air temperatures favor disease expression and damage. Best growing practices aimed at minimizing plant stress are suggested to reduce impact from the powdery mildew pathogen.

Myclobutanil (Rally) only provided fair preventative control of powdery mildew. Dusting sulfur is fair to good in performance as long as daytime air temperatures remain above 85 degrees Fahrenheit. Rally, Cyflufenamid (Torino) and sulfur are now the most widely used fungicides in all melon types (see previous Tables 2-3). Aerial operators make most applications at nighttime as sulfur has a fire hazard associated with air temperatures above 90 degrees Fahrenheit. Chlorothalonil (Bravo or Echo720) has several labels, which are technically equivalent, and they include powdery mildew control.

Phytophthora / Pythium root rot – These soil-borne pathogens attack roots late in the growing season and their activity is favored by over-watering. Therefore, avoiding over-watering is the best way to manage the onset of this disease in established melons. Preplant soil fumigation has been used as a management strategy.

Cucurbit yellow stunting disorder is primarily a disease of cucurbits (e.g., melons, watermelon and squash) and is caused by a plant virus named Cucurbit Yellow Stunting Disorder Virus (CYSDV); (genus: *Crinivirus* family *Closteroviridae*) (20). The virus was first detected in Southern California and Arizona in the fall of 2006, infecting cantaloupe and honeydew melon, watermelon and various types of squash. Infected cucurbit plants initially show a chlorotic (yellow) spotting, which eventually develops into a striking interveinal chlorosis (yellowing) in which the veins remain more or less green but the rest of the leaf turns bright yellow. Leaves will often roll upward and become brittle. Fruit on infected plants may appear normal but often have reduced levels of sugars; this results in poor marketability and economic loss.

CYSDV is spread from plant-to-plant exclusively by the whitefly vector, *Bemisia tabaci.* Whitefly transmission is entirely responsible for virus spread over short distances. The virus is also spread over long distances through the movement of infected plants, especially cucurbit transplants. As it can take three to four weeks for disease symptoms to develop following infection, infected symptomless plants can be unknowingly transported. Finally, the virus can be maintained in infectious form within whiteflies for up to nine days. Because *B. tebaci* whiteflies can move long distances, especially with high winds, the virus may be transported over long distances in this manner as well. Rapid and precise tests for the virus are available at UC Davis and USDA-ARS in Salinas.

Currently, a number of strategies are recommended to minimize the chance of the virus becoming established or causing significant losses. Before the growing season: While the virus is not seed-transmitted, it is important to use pathogen-free, high quality seeds; and use virus- and whitefly-free transplants; do not import any potential whitefly host material from areas known to have the virus, such as Texas, Florida and Mexico. During the growing season: Plant immediately after any cucurbit-free period; avoid planting new fields near older fields (especially those with plants confirmed to be infected); apply a soil application of a neonicotinoid insecticide, such as imidacloprid (Admire), dinotefuran (Venom) or thiamethoxam (Actara), at transplanting. [Recent research results indicate that dinotefuron may slow the spread and development of the disease, whereas imidacloprid and thiamethoxam may be less effective.] Monitor whitefly populations throughout the growing season and implement insecticide application as needed; rotate insecticides with different modes of action group numbers to minimize development of insecticide resistance; if feasible, cover seedbeds with floating row covers of fine mesh (Agryl or Agribon) in mid-bed trenches of 12-inch depth for fall planting season (row covers need to be removed for pollination, but they prevent early infections); and practice good weed management in and around fields to the extent feasible. After the growing season: Sanitation is very important, remove and destroy old crops and volunteers on a regional basis (plowing or physical removal) and in areas lacking a true winter season implement a voluntary or enforced regional cucurbit-free period to eliminate the virus from the cropping system.

Viral Disease Complex consists of aphid vectored Cucumber Mosaic Virus (CMV), Watermelon Mosaic Virus (WMV), Zucchini Yellow Mosaic Virus (ZYMV), Papaya Ringspot Virus (PRSV), and Cucurbit Aphid-Borne Yellows Virus (CABYV) (9). The complex also includes Squash Mosaic Virus which is vectored by the spotted cucumber beetle (*Diabrotica* spp.). Squash mosaic virus is also seed-borne so cultural control of this disease includes using virus-free seed for elimination of the primary inoculum (20). Currently there are no chemical or biological protection materials that provide any control. Insecticide use for control of insect vectors has not stopped the transmission of viruses into all melon types. When viruses impact on a melon field, symptoms can range from mild to severe depending on the stage of growth. Aphid infestations can vary from year to year and attempts to destroy alternate hosts such as weeds and crops finished with harvest can help in area-wide pest management. Cultural alternatives to the use of pesticides include the use of silver-colored reflective, plastic mulch. The high cost of plastic, installation, removal, and disposal of the plastic mulch has limited its use in large-scale melon production fields. Vector control of aphids and whiteflies has been met with little or no success for reducing virus problems in established melons. No widespread resistances to all viruses have been bred into melon varieties.

Charcoal Rot (*Macrophomina phaseolina*) is another soil-borne pathogen that attacks established melons with heavy fruit loads late in the season. The fungus is favored by environmental conditions with hot air temperatures that force stress on melon plants from a lack of moisture combined with high levels of salinity in the topsoil. It has been suggested that the pathogen occurs more frequently under melons grown with drip irrigation than furrow-irrigated crops. The disease has been reported to be more frequently encountered in fall melons in Area III and summer melons in Area II. Overall there are no chemical controls.

Vine Decline (*Monosporascus cannonballus)* is a destructive root pathogen in established melons, particularly in the desert production regions of Area III. Control strategies include preplant soil fumigation to reduce soil inoculum levels, and post-harvest root destruction strategies to prevent pathogen reproduction on infected roots after crop termination.

Fusarium rot can be a big problem in the spring harvest in Area III, but it can also be a problem in the fall harvest too. Field reports of losses of up to 30% or more of the melon fruit have been reported by PCAs working in the desert region. It has been reported to be a big problem with drip-irrigated fields but it can also impact on furrow-irrigated fields too. Some varietals seem to be more impacted making varietal selection an important detail.

Additional Information on Controls

Cultural Control: Irrigation and fertilizer management may be effective for some diseases.

Biological Control: No new products are commercially available.

New Technology: Systemic Acquired Resistance products such as harpin proteins.

New Chemistry: Strobilurins are new and effective, but resistance management is key. Other new chemistries for disease management are being developed and need to be tested for efficacy.

TO DO List for Disease Management in Established Melons:

Research:

1) Continue study of whitefly transmitted gemini-viruses, especially for CYSDV.
2) Continue to evaluate resistance of *Pythium* to mefenoxam (Ridomil Gold).
3) Develop melon varieties resistant to races of *Verticillium* and all races of *Fusarium* found in California as there has been suggested resistance by seed companies but this has not been confirmed.
4) Identify Fusarium rot control methods.
5) Identify Charcoal Rot control methods.

Regulatory:

1) Register chemical replacements to methyl bromide.
2) The UC Statewide IPM Program states that curly top virus is rare in cucurbits. Based on this information the melon industry needs to petition CDFA that melon producers be released from the curly top virus control program assessment

Education:

1) Help define resistance management strategies for powdery mildew.

Nematodes in Established Melons

Root knot (*Meloidogyne* spp.) nematode is the major species of nematode of economic importance to established melons in California, although the closely related *M. javanica* may be present in some areas. High numbers of nematodes may build up in light texture soils where significant crop loss can be expected in susceptible host plants. Nematodes cause a plant to develop shallow root systems that are unable to meet the great evapotranspiration demands brought on by hot temperatures. Therefore, melon crops can suffer severe damage from nematodes from fruit development up to maturity when the crop is carrying a large amount of fruit.

> TO DO List for Management of Nematodes in Established Melons:
>
> Research:
> 1) Evaluate fluensulfone (Nimitz) and spirotetramet (Movento) for nematode control after planting.
> 2) Develop new chemistries for management of nematodes.
>
> Regulatory:
> 1) Retain as many existing alternative materials as possible to facilitate a resistance management program for nematodes.
> 2) Register new products once testing confirms effectiveness.
>
> Education: Nothing at this time.

Vertebrate Pests of Established Melons

Pocket Gopher (*Thomomys* spp.) activity should be monitored along field borders, as this is where most gopher damage occurs in melon fields. Gophers can damage melon plants by their burrowing activity and by feeding on roots. They also can damage irrigation canals. Special tractor driven field implements can be used to create artificial gopher tunnels for use with strychnine or anti-coagulant baits prior to planting (9). Providing nesting sites along field borders can encourage predation of gophers by owls but this method of control hasn't been extensively established. Some growers are now trying phostoxin pellets and gas guns for control.

Coyotes (*Canis latrans)* can damage drip irrigation equipment by chewing through lines in order to get to a water source. Damage from coyotes chewing on drip irrigation equipment adds to maintenance and repair costs. Coyotes also do minor damage to all melon types as they chew on fruit close to harvest times. Coyotes are only partially controlled by trapping but this control method is rarely used. No other control options have been employed (9). Some growers are putting up fencing around their fields for food safety purposes.

Crows (*Corvus* spp.) damage melons in the harvest ready stage as the birds peck into the fruit in attempts to get the seeds. When a single puncture wound has been made into the flesh, the melon is unfit for harvest. Once they have established a feeding pattern, crows will not be scared away with noisemakers, such as propane cannons or even shooting (9). If they do fly off, it may be only for a short distance.

Voles (meadow mice), rabbits, and squirrels may cause minor problems to an established melon crop. These pests can do direct damage to the harvestable crop. Poison baits and pellets are registered for some of these pests and can be highly effective but their use would only be outside of fields. Voles were formerly controlled with diphacinone (Ramik Green), which also works on squirrels. Lethal control is also available for gophers (phosphine gas). Bait stations only work fairly well for a number of vertebrate pests including voles, gophers and squirrels.

Additional Information on Vertebrate Control in Established Melons

Cultural Control: No new techniques reported.

Biological Control: Owl predation of gophers can be encouraged by building and providing adequate nesting sites along melon field borders.

New Technology: No new techniques reported.

New Chemistry: No new techniques or products reported.

TO DO List for Vertebrate Control in Established Melons:

Research:
1) Obtain additional funds for vertebrate research, especially in light of potential losses of some of the baits currently being used.

Regulatory:
1) Obtain consistency of issuance of depredation permits.
2) Need to determine status of several formerly used lethal controls.

Education:
1) Provide grower updates on vertebrate pest control options.

PLANT GROWTH REGULATORS

Ethephon (Ethrel) as a plant growth regulator is used as a ripening agent for melons in Area III. Ethephon promotes abscission or slipping of the fruit off the vine. This makes for a more efficient and economical harvesting with fewer passes across the field. The first harvest would be expected at two to six days after application, depending on air temperatures. The higher the air temperatures, the faster the effect of ethephon on cantaloupes. Ground rigs are used to apply ethephon, as aerial applications are not permitted except in the state of Texas. No data on usage patterns was found in a search of the pesticide database but growers and PCAs reported use of ethephon in cantaloupes. Cantaloupe fruit quality for melon flesh color or soluble solids (sugar content) is not improved following ethephon applications.

FRUIT MATURITY AND HARVEST

Harvest of melons has as many variations as growers can think of with modifications to both field packing and shed packing operations. Nowadays, most cantaloupes are harvested by hand crews who pick fruit at full-slip as they follow behind a tractor-pulled packing machine. Cantaloupes detach from the main stem of the plant when they reach full maturity. When fruit maturity approaches, the stem slowly starts to separate from the cantaloupe fruit. When a melon picker picks up a cantaloupe, the melon should easily detach from the stem if it is ripe. When this happens, the stem end of the cantaloupe will have a completely round area that shows that the plant released the melon and thus it had a full-slip. If the melon is not mature, and the picker picks the melon anyways, a portion of the stem would remain in the stem end. Depending on how much stem tissue is still attached at the stem end, the melon would be considered to be at half-slip or quarter-slip stage. Ripe melons at full-slip would easily separate from the vine without any use of cutting knives. Harper type cantaloupes, honeydews and mixed melons do not slip off the vine, they are cut with knives. The pickers would then place the melon onto a wing or belt assembly supported by the main unit as the melons would roll down towards the packer. Most cantaloupe fields are picked once a day with a harvest period commonly across 10-14 days.

Fields are ready for harvest once they have met the approved standards according to an approved maturity index for sugar development. Melon quality is primarily based on uniform shape and the absence of injury or handling defects. Firmness is also a component of quality. Size is not a factor of grade quality, but may strongly influence commercial quality expectations.

POST-HARVEST DISEASES

Forced air cooling is used on almost all cantaloupes. The older packing sheds used to utilize hydro-cooling with cantaloupes dumped into water baths to remove heat from the melons, but this cooling method is no longer used. All of the newer facilities being built for vegetable storage are designed around air cooling with automated computer controls. The air temperature is usually no lower than 38 degrees Fahrenheit (3.3 degrees C) as cantaloupes are typically held for four hours in a cooler. Once the cartons reach the desired temperature, a forklift operator moves the pallets out of the cooler directly into refrigerated trucks ready for transit to their retail customers.

Post-harvest activities involve washing of shed-packed honeydew fruit in wash or dump tanks where Perasan, a sanitizer, is added to water which is slightly warmer in temperature than the product in order to prevent water uptake and also entry of decay-causing organisms. Washing is performed prior to sorting and packing operations. Food grade wax may be applied to export honeydews to replace naturally occurring waxes removed in the washing and cleaning operations. This also improves appearance and reduces water loss. There is no washing of produce in water baths in any melon type that is field packed.

Melons are sensitive to a few environmental and genetic disorders, which may develop during post-harvest ripening or post-harvest storage. Fertilizer and irrigation management, weather conditions, insect feeding injury, asymptomatic virus infection, and unknown agents may all interact to affect post-harvest quality.

The following organisms (disease) may cause post-harvest loss in melons:
- Black Sooty Mold
- Cladosporium (stem decay)

Additional Information on Post-Harvest Disease Control in Melons

Cultural Control: The status of steam as a sanitizer needs to be confirmed.

Biological Control: None available.

New Technology: No new techniques reported.

New Chemistry: No new techniques or products reported.

TO DO List for Post-Harvest Disease Control in Melons:

Research:
1) Need to develop safe and effective post-harvest chemicals and techniques with cost analysis.

Regulatory:
1) The melon industry needs USDA, EPA and CDPR to be aware that California farmers are faced with a threat from Mexican melon growers who are able to use pesticides that are not allowed to be used in production in the state. California melon farmers need regulatory action that would keep a level state of competitiveness for all melon producers in the U.S. without unfair conditions developing because of a lack of registrations in California.

Education:
1) Educate growers on best management practices since this impacts post-harvest quality more than any other thing.

FOOD SAFETY

Prevention of microbial contamination of fresh produce is favored over reliance on corrective actions once contamination has occurred. Microbial contaminants of potential or perceived concern in melon production include *Salmonella* spp*., Escherichia. coli, and Listeria* spp*.* Current techniques and products used to minimize contamination include: prevention, field sanitation, use of proper cooling, worker hygiene, clean packing facilities and transportation. Traceback mechanisms are in place for all packers.

Food-borne illnesses associated with fresh produce consumption have been an increasing occurrence. Produce can be exposed during growing, transportation, cooling, packing, storage and secondary handling.

Produce buyers are now requiring third party audits and certifications that show that melons are free from pesticide residues and post-harvest pathogens. California melons are subject to a state-mandated food safety program.

TO DO List for Food Safety Issues in Melons:

Research:
1) Prevention of pathogens remains the top priority.

Regulatory:
1) The melon industry needs USDA, EPA and CDPR to be aware that California farmers are faced with a threat from Mexican melon growers who are able to use pesticides that are not allowed to be used in production in the state. California melon farmers need regulatory action that would keep a level state of competitiveness for all melon producers in the U.S. without unfair conditions developing because of a lack of registrations in California

Education:
1) Train workers on the value to keeping packing facilities clean.
2) Develop a communications plan to assure consumers that California cantaloupes and other melon types are safe to eat.
3) Develop and recommend a training program for food service handlers, with a special emphasis on cut fruit.

INTERNATIONAL TRADE AND EXPORT ISSUES

California cantaloupes are exported to Canada, Mexico and China. Approximately 20% of California honeydews are exported, with primary destinations being Pacific Rim countries such as Japan and Hong Kong. Future markets include other Pacific Rim countries. While some recent movement towards establishing international tolerances (MRLs = maximum residue levels) for pesticides has been discussed in recent years by the EPA, significant progress towards harmonizing regulatory standards with other countries has not been made. The North America Free Trade Act (NAFTA) Technical Working Group on Pesticides has started to convene on these issues. As world food sources are more globally sourced, our own regulatory agencies, U.S. EPA, USDA, and FDA and their foreign counterparts must address food safety with regard to pesticide residues.

The Codex Alimentarius Commission was created by two United Nations organizations in 1962. The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) serve as the major international mechanisms to encourage trade in food while promoting the health and economic interests of consumers. The U.S.Codex Office is located in the Food Safety and Inspection Service at USDA in Washington, DC.

Presently it takes approximately eight years to obtain an MRL through the Codex system. This is problematic in that while the Food Quality Protection Act of 1996 encourages the U.S. grower community to move towards reduced-risk compounds, an international registration for these materials may lag behind for several years. It is unclear at this point as to how this situation will be handled once a crisis arises, however, commodities which increasingly deal with exports must address this issue as soon as possible.

TO DO List for International and Export Issues in Melons:

Research: No needs reported at this time.

Regulatory:
1) The melon industry needs USDA and EPA to be aware that California farmers are faced with a threat from Mexican melon growers who are able to use pesticides that are not allowed to be used in production in the state. California melon farmers need regulatory action that would keep a level state of competitiveness for all melon producers in the U.S. without unfair conditions developing because of a lack of registrations in California.
2) Ensure that all new pesticides registered for melons are within NAFTA and Codex provisions in advance of trade opportunities.

Education: No needs reported at this time.

CRITICAL PEST MANAGEMENT NEEDS FOR THE CALIFORNIA MELON INDUSTRY

In order of importance, the following list highlights those issues that have been identified as critical to the viability of the cantaloupe, honeydew, and mixed melon industries in California.

Research Priorities: Finding practical solutions to insect control are of immediate and serious concern to producers of melons in California.

1) Vector biology and disease management. (Whiteflies, cucurbit yellow stunting disorder virus (CYSDV), squash vein yellowing virus (SqVYV), leafhoppers, curly top virus (CTV), and aphids/Poly viruses).
2) Development of pest-resistant melon varieties needs to be encouraged, advanced, and incorporated into existing seed development research. Plant breeding research should develop new varieties that are resistant to problem plant diseases and insect pests.
3) Develop alternatives to rotate with organophosphates and carbamates for soil pests.
4) Develop new technologies and techniques to manage field bindweed, nutsedge, and nightshade.

Regulatory Priorities: The most important action that needs to be done involves an enhanced interaction between Cal-EPA and U.S. EPA. Harmonization should be encouraged to facilitate and hasten the concurrent registration of reduced risk products. Concurrent registrations need to be brought into California in a timelier manner to eliminate the disadvantage that occurs when new materials get registered first in other states.

In terms of specific registrations, the melon industry needs:

1) New products registered to use in series rotations for insecticide resistance management in whitefly and strawberry cutworm control. Obtain registration for pyrifluquinazon for use on melons.
2) New chemistries for powdery mildew control and overall disease resistance management,
3) Clarity of label issues for melon types on all pesticides.
4) Future regulations should include restrictions on imports that are equivalent to the regulations over U.S. melon producers.

Educational Priorities:

1) Educate regulators why future regulations should include restrictions on imports that are equivalent to the regulations over U.S. melon producers.
2) Educate regulators and consumer groups on IPM practices for melons, especially as this information relates to risk assessments for crop protection tools.
3) Educate the general public on how IPM is used in agriculture and the impact of FQPA on the cost of food.
4) Continue emphasis on various marketing programs, such as the CA Grown program.

IR-4 PROJECT INFORMATION RELATIVE TO CALIFORNIA MELONS

The following information summarizes the IR-4 status for registration and research issues of importance to the California melon industry. Project requests need to be made to IR-4 through Pesticide Clearance Request (PCR) forms. Only compounds that have been identified by manufacturers to be possible materials for registration have been listed.

IR-4 Crop Group is Cucurbit Vegetables (09A = Melon Sub-Group).

Short term critical needs	Whitefly and strawberry cutworms - alternatives to current chemistries Soil-borne pest controls
Long term needs	**POWDERY MILDEW MATERIALS, HERBICIDES TO CONTROL NUTSEDGE AND PERENNIAL MORNINGGLORY**

TO DO List for Growers/IR-4 in Melons:

Research Needs:
1) New chemistries for whitefly and strawberry cutworm control.

Pesticide Clearance Request Forms Needed from Growers:
1) New chemistries for whitefly and strawberry cutworm control.

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APPENDICES

CALIFORNIA MELON PRODUCTION STATISTICS - 2013

Table 4. Harvested acreage, production (cartons/acre) and crop value (in thousands of dollars) in California

A. Harvested Acreage

County	% of State Total	Cantaloupes	Honeydews	Mixed	Total
Fresno	53.9	15,000	4,540	3,330	22,870
Imperial	15.0	5,890	467	0	6,357
Kern	1.3	560	0	0	560
Merced	12.0	3,590	0	1,500	5,090
Riverside	6.1	957	1,130	477	2,564
San Joaquin	0.4	0	0	150	150
Stanislaus	7.7	2,150	600	489	3,239
Sutter	1.3	0	545	0	545
Sum of Others	2.3	492	165	320	977
STATE TOTALS	100	28,639	7,447	6,266	42,352

B. Production (Cartons/Acre*)

County	Cantaloupes	Honeydews	Mixed	
Fresno	660	1,186	533	
Imperial	403	508	0	
Kern	735	0	661	
Kings	840	0	0	
Merced	535	0	520	
Riverside	545	679	550	
San Joaquin	0	0	565	
Stanislaus	446	610	404	
Sutter	0	506	0	
Yolo	0	556	0	

*Carton Equivalents: Cantaloupe = 40 lb. Honeydew = 29 lb. Mixed=33 lb.

C. Crop Value (in Thousands of Dollars)

County	Cantaloupes	Honeydews	Mixed	Total
Fresno	78,660	20,057	4,131	102,848
Imperial	30,714	4,633	0	35,347
Kern	5,054	0	1,733	6,787
Kings	2,968	0	0	2,968
Merced	17,289	0	2,754	20,043
Riverside	12,915	3,181	3,104	19,200
San Joaquin	0	0	1,750	1,750
Stanislaus	8,795	1,207	764	10,766
Sutter	0	8,225	0	8,225
Yolo	0	7,847	0	7,847
Sum of Others	195	381	2,027	2,603
STATE TOTALS	156,590	45,531	16,263	218,384

Source: County Ag Commissioner's Data/ CA Ag Statistics Service

Table 5. Cultural Activities Profile for California Melons: Sacramento & San Joaquin Valleys

	J	F	M	A	M	J	J	A	S	O	N	D
Bed Prep			X	X	X	X			X	X	X	
Weed Control			X	X	X	X	X					
Transplant			X	X								
Seeding/Capping			X	X	X	X	X					
Cap Removal				X	X	X	X					
Pre-thinning Cultivation				X	X	X	X					
Thinning				X	X	X	X					
Fertilization				X	X	X	X	X				
Cultivation				X	X	X	X					
Pollination					X	X	X	X				
Irrigation				X	X	X	X	X	X			
Hand Harvest						X	X	X	X	X		

Table 6. IPM Activities and Plant Monitoring Profile for California Melons: Sacramento & San Joaquin Valleys

	J	F	M	A	M	J	J	A	S	O	N	D
Soil Sampling			X	X				X	X	X		
Irrigation Scheduling				X	X	X	X	X	X	X		
Petiole Sampling					X	X	X	X				
Insecticide App.			X	X	X	X	X	X	X	X		
Herbicide App.				X	X						X	X
Fungicide App.							X	X	X			
Insect Scouting			X	X	X	X	X	X	X	X		
Disease Scouting			X	X	X	X	X	X	X	X		

Note: Information based on grower and Pest Control Adviser experiences.

Table 7. Cultural Activities Profile for California Melons: Desert Valleys

	J	F	M	A	M	J	J	A	S	O	N	D
Bed Prep	X	X	X				X	X	X			X
Transplant	X	X										
Seeding/Capping	X	X	X				X	X				
Cap Removal		X	X					X				
Pre-Thinning Cultivation								X				
Thinning		X	X	X				X	X	X		
Fertilization	X	X	X	X								
Cultivation								X	X			
Pollination			X	X	X				X	X		
Irrigation	X	X	X	X	X			X	X	X		
Hand Harvest				X	X	X	X			X	X	X

Table 8. IPM Activities and Plant Monitoring Profile for California Melons: Desert Valleys

	J	F	M	A	M	J	J	A	S	O	N	D
Soil Sampling	X	X										
Irrigation Scheduling	X	X					X	X	X	X		
Petiole Sampling			X	X				X	X			
Insecticide App.	X	X	X	X	X	X	X	X	X	X		
Herbicide App.	X	X	X				X	X				
Fungicide App.				X	X	X	X		X	X		
Insect Scouting	X	X	X	X	X	X	X	X	X	X		
Disease Scouting	X	X	X	X	X	X	X	X	X	X		

Note: Information based on grower and Pest Control Adviser experiences.

SEASONAL PEST OCCURRENCE TIME LINES

Table 9. Melon Seasonal Pest Occurrence: Sacramento & San Joaquin Valleys

INSECTS/MITES	J	F	M	A	M	J	J	A	S	O	N	D
Sweet Potato Whitefly (biotype B)												
Aphids												
Cabbage Looper												
Armyworms												
Cutworms												
Leafhoppers												
Leafminers												
Spider Mites												
Darkling Ground Beetles												
Seed Corn Maggots												
Wireworms												
Cucumber Beetles												
Grasshoppers												
Crickets												
Dried Fruit Beetles												
DISEASES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Cucurbit Yellow Stunting Disorder												
Mosaic Virus Complex												
Powdery Mildew												
Monosporascus												
Fusarium												
Verticillium												
Damping Off Complex												
Acremonium												
Macrophimina												
WEEDS	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Nightshade												
Field Bindweed												
Nutsedges												
Pigweed												
Purslane												
Dodder												
NEMATODES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Root Knot Nematode												
VERTEBRATES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Horned Larks												
Crows												
Gophers												

Table 10. Seasonal Pest Occurrence in California Melons: Desert Valleys

INSECTS/MITES	J	F	M	A	M	J	J	A	S	O	N	D
Sweetpotato Whitefly (biotype B)												
Aphids												
Cabbage Looper												
Armyworms												
Cutworms												
Leafhoppers												
Leafminers												
Spider Mites												
Darkling Ground Beetles												
Seed Corn Maggot												
Wireworms												
Cucumber Beetles												
Flea Beetles												
Grasshoppers												
Crickets												
DISEASES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Cucurbit yellow stunting disorder virus												
Mosaic Virus Complex[1]												
Powdery Mildew												
Monosporascus												
Damping Off Complex												
Pythium												
Macrophomina												
WEEDS	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Nightshades												
Field Bindweed												
Nutsedges												
Pigweed												
Purslane												
Dodder												
NEMATODES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Root Knot Nematode												
VERTEBRATES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Horned Larks												
Crows												
Gophers												

[1]UC Pest Guidelines state "The occurrence of this virus is erratic and unpredictable; consequently, control of this disease is not attempted."

EFFICACY TABLES

Table 11. Efficacy of Insect/Mite Management Tools Used in California Melons

Product	Trade Name	Sweetpotato Whitefly	Aphids	Cabbage Looper	Armyworms	Cutworms	Leafhoppers	Leafminers	Spider Mites	Seedcorn Maggots	Wireworms	Cucumber Beetles	Crickets	Grasshoppers	Thrips	Dried Fruit Beetle	Darkling Ground Beetles	Flea Beetles
abamectin	Agri-Mek	P	P	P	P		P	E	E	P	P	P	P	P	F	P	P	P
acetamiprid	Assail	E	E	P	P	P	G	P	P	P	P	F		P	P	P	P	G
Bacillus thuringiensis	Bt, Xentari	P	P	G	P	F-G	P	P	P	P	P	P	P	P	P	P	P	P
bifenthrin	Capture	G	F	G	F	G	F	P	F	F		F	G	G	F		P	F
buprofezin		G																
carbaryl	Sevin Bait	P	P	P	P	E	FP	P	P	P	P	E	G	G	P	F	G	F
chlorantraniliprole	Coragen	P	P	E	E	E	P	F	P	P	P	P	P	P	P	P	P	P
cyantraniliprole	Exirel	E	G	E	E	E		G		P	P	P	P	P	F	P	P	G
cyromazine	Trigard	P	P	P	P	P	P	E	P	G	F	P	P	F	P	P	P	G
diazinon	Diazinon	P	G	P	P	P	E	P	P	P	P	P	P	P	P	P	P	G
dimethoate	Dimethoate	P	F	P	P	P	F	P	P	F	F	P	P	P	F	P	P	P
dinotefuran**	Safari, Venom	G	G	P	P	P	G	P	F	P	P	G	P	P	F	P	G	G
esfenvalerate	Asana XL	P	P	F	P	G	F	P						F	F		G	
flubendiamide**	Belt, Vetica	P	P	E	E	E	P	P	P	P	P	P	P	P	P	P	P	P
imidacloprid**	Admire, Provado	G	E	P	P	P	E	P	P	G	G	F	P	P	E		G	
indoxacarb	Avaunt	P	P	E	E	E	P	P	P	P	P	P	P	P	P	P	P	P
insecticidal soap	M-Pede	F	F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
methomyl	Lannate	P	P	F	G	G	G	P		G	G				E		G	G
methoxyfenozide	Intrepid	P	P	E	E	E	P	P	P	P	P	P	P	P	P	P	P	P
oxamyl	Vydate	F	F	P	P	P	F	F	P	G	G				G		G	
permethrin	Pounce	P	P	F	P	G	P	P	P	F	F		F	P	P		P	F
pymetrozine	Fulfill	G	G	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
pyriproxyfen	Knack	G	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
spinosad	Success	P	P	E	E	E	P	P	P	P	P	P	P	P	E	P	P	P
spiromesifen	Oberon	G	P	P	P	P	P	P	G	P	P	P	P	P	P	P	P	P
sulfur	Sulfur	P	P	P	P		P	P	F									
thiamethoxam	Platinum	G																

Data based on collective field observations and experiments by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

Rating System: E = Excellent G = Good F=Fair P=Poor/None R=Known Resistance

**Under review by EPA at publication of this document

Table 12. Efficacy of Non-Chemical Insect Management Tools Used in California Melons

Non-chemical Tools	Sweetpotato Whitefly	Aphids	Cabbage Looper	Armyworms	Cutworms	Leafhoppers	Leafminers	Spider Mites	Seedcorn Maggots	Wireworms	Cucumber Beetles	Crickets	Grasshoppers	Dried Fruit Beetles	Darkling Ground Beetles	Flea Beetles
Cover crops	P		P	P	P		P								P	
Habitat management																
Monitoring/use of action thresholds	G	G	G	G		G	G									
Natural enemies	P	P	P	P/F	P	F	P	P	P	P	P	P	P	P	P	
Nutrition																
Sanitation	F		F	F			F					F		F	F	
Soil/dust management	P		P	P				F/G								
Use of models			F	F	F											
Resistant varieties	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Water management	P	P	P	P	P	P	P	F	P	P	P	P	P	P	P	
Weed control					F					F						
Mulching									F	F						
Trap crops																
Netting	G															
Mating Disruption				E												
Pheromone (monitor)			E	E	E											

Data based on collective field observations and experiments by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

Rating System
E = Excellent G = Good F=Fair P=Poor/None R=Known Resistance

Table 13. Relative Toxicity of Insecticides to Beneficial Organisms in California Melons

Product	Trade Name	Big-eyed Bugs	Damsel Bugs	Green Lacewings	Lady Bird Beetles	Minute Pirate Bugs	Parasites	Spiders	Syrphid Fly Larvae
abamectin	Agri-Mek	S	S	S	O	S	O	U	S
acetamiprid	Assail	U	U	U	U	U	U	U	U
Bacillus thuringiensis	Bt, Xentari & others	O	O	O	O	O	O	O	O
bifenthrin	Capture	H	U	H	H	H	H	U	H
carbaryl	Sevin	H	H	H	H	H	H	H	H
chlorantraniliprole	Coragen	U	U	U	U	U	U	U	U
diazinon	Diazinon	H	H	H	H	H	H	H	H
dimethoate	Dimethoate	H	H	H	H	H	H	H	H
dinotefuran**	Safari, Venom	U	U	U	U	U	U	U	U
esfenvalerate	Asana XL	H	H	H	H	H	H	H	H
flubendiamide**	Belt, Vetica	U	U	U	U	U	U	U	U
imidacloprid**	Admire, Provadp	O	O	O	O	O	O	O	O
insecticidal soap	M-Pede	O	O	O	O	O	O	O	O
methomyl	Lannate	H	H	H	H	H	H	H	H
methoxyfenozide	Intrepid	U	U	U	U	U	U	U	U
oxamyl	Vydate	M	M	M	M	M	M	U	M
permethrin	Pounce	H	H	H	H	H	H	H	H
pymetrozine	Fulfill	O	O	O	O	O	O	O	O
pyriproxyfen	Knack	U	U	U	U	U	U	U	U
spinosad	Success	S	S	S	S	S	S	S	S
spiromesifen	Oberon	U	U	U	U	U	U	U	U

Data based on collective field observations and experiments by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

<u>Rating System</u>
U= Unknown O= No Effect S= Soft M= Moderate H= Harsh
**Under review by EPA at publication of this document

Table 14. Efficacy of Disease-Management Tools Used in California Melons

Product	Trade Name	Mosaic Virus	Powdery Mildew	Monosporascus	Fusarium	Verticillium	Damping Off Complex	Acremonium root rot	Downy Mildew
AQ 10	AQ 10		P						
azoxystrobin	Quadris		F/P						
chlorothalonil	Bravo		F/P						
fludioxanil	Maxim			E					
metam sodium	Vapam			E			E		
mefenoxam	Ridomil Gold							F	G/E
sulfur	Sulfur		E						
thiophanate methyl	Topsin-M		F/G					G	
triflorystrobin	Flint		E						
Non-chemical Tools									
Models (i.e. disease forecasting)									
Irrigation management			G	E	G	F	E	E	
Weed control									
Resistant varieties			G						
Cover crops									
Adjusted planting date									
Post-Harvest Crop Destruct				G		G			
Plant Nutrition									

Data based on collective field observations and experiments by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

Rating System
E = Excellent G = Good F=Fair P=Poor/None

Table 15. Efficacy of Nematode-Management Tools Used in California Melons

Product	Trade Name	Root Knot Nematode
1,3-dichloropropene	Telone	E
Metam sodium	Vapam	E
oxamyl	Vydate	G
Non-chemical Tools		
Fallow		P
Monitoring-soil samples		G
Cover crops		F
Soil/water management		P
Resistant varieties		P
Rotation		G
Soil Solarization		F
Plant Nutrition		F

Data based on collective field observations and experiments by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

Rating System
E = Excellent G = Good F=Fair P=Poor/None

Table 16 . Efficacy of Weed-Management Tools Used in California Melons

Product	Trade Name	Timing*	Nightshades	Nutsedge	Bindweed	Pigweeds	Johnsongrass	Volunteer cereals	Annual Grasses	Velvetleaf	Purslane
bensulide	Prefar	LB	P	P	P	F			E	P	E
clethodim	Arrow		P	P	P	P	G	E	E	P	P
DCPA	Dacthal	LB	P	P	P	E			E		E
ethalfluralin	Curbit	LB	G	P	P	F			E		G
glyphosate	Roundup	PPF	E	F	G	E	F	E	E	E	E
halosulfuron-methyl	Sandea		P	P	P	P	P	P	P	G	P
metam-Sodium	Vapam	PPF	G	F	F	G	F	E	E	E	E
oxyfluorfen	Goal	PP	E	P	F	E	P	P	F	E	E
paraquat	Gramoxone	PPF	E	P	P	E	P	E	E	F	E
sethoxydim	Poast	POE	P	P	P	P	E	E	E	P	P
trifluralin	Treflan	PPI,LB	P	P	P	E	P	P	E	P	E
Non-chemical Tools											
Cultivation			G	P	F	G	P	G	G	F	G
Soil/Water management			F	P	P	F	P	P	F	P	F
Cover crops			P	P	P	P	P	P	P	P	P
Crop Rotation			G	G	G	G	F	F	F	G	G
Pre-irrigation			F	P	P	F	P	G	G	F	G
Subsurface drip irrigation			E	P	P	E	P	F	E	F	E
Hand weeding			E	P	F	E	P	G	G	G	G

Data based on collective field observations and experiments by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

Rating System
E = Excellent G = Good F=Fair P=Poor N=No Control R=Known Resistance

* Timing
LB= Layby PPF= Postplant foliar PP= Preplant PPI= Preplant Incorporated
POE= Postemergence

Table 17. Efficacy of Rodent & Other Vertebrate Controls in California Melons

Technique	Crows	Voles	Gophers	Squirrels	Coyotes-Foxes
Prevention	N	F	N	N	N
Exclusion	N	F	N	N	N
Predators	N	F	P	N	N
Cultural Barriers	N	F	N	N	N
Trapping	N	G	F	N	F
Bait Stations	N	F	F	F-G	N
Lethal Control	L	P	F	G	L
Noise	F	N	N	N	N
Repellent	N	N	N	N	N
Mylar Strips	N	N	N	N	N

Data based on collective field observations by growers, Pest Control Advisers, and University of California Cooperative Extension Farm Advisors.

Rating System
E = Excellent G = Good F=Fair P=Poor N=No Control R=Known Resistance
L= Lethal Control is needed for these vertebrate pests.

Table 18. Total Pounds Active Ingredients of Insecticides Used in California Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
abamectin	Agri-Mek	164	250	234	268	229
acetamiprid	Assail	198	477	449	692	454
Bacillus thuringiensis	Bt	703	1,433	1,381	1,959	1,369
bifenthrin	Capture	915	1,718	2,322	2,237	1,798
carbaryl	Sevin	4,545	4,753	4,892	2,963	4,288
chlorantraniliprole	Coragen	191	219	224	338	243
diazinon	Diazinon	1,256	202	662	261	595
dimethoate	Dimethoate	23	146	109	169	112
dinotefuran**	Safari, Venom	849	789	1,192	779	902
esfenvalerate	Asana	59	112	150	150	118
flubendiamide**	Belt, Vetica	132	496	717	696	510
imidachloprid**	Admire	3,031	3,679	3,567	4,272	3,637
insecticidal soap	M-Pede			23	136	40
malathion	Malathion	457		392	38	222
methomyl	Lannate	2,258	3,981	2,637	3,267	3,036
methoxyfenozide	Intrepid	2,149	1,756	1,148	869	1,481
oxamyl	Vydate	868	612	914	862	814
permethrin	Pounce	447	1,106	638	1,313	876
pyripoxyfen	Knack	5	47	151	130	83
spinetoram	Radiant	48	89	149	87	93
spinosad	Success, Entrust	213	18	10	12	63
spiromesifen	Oberon	315	349	577	448	422

Source: California Department of Pesticide Regulation Pesticide Use Reports
**Under review by EPA at publication of this document

Table 19. Acres Treated With Insecticides: California Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
abamectin	Agri-Mek	17,188	22,944	17,826	20,360	19,580
azadirachtin	Neemix	1,978	80	117	129	576
Bacillus thuringiensis	Bt	1,298	3,244	1,380	2,248	2,043
bifenthrin	Capture	10,767	20,671	25,642	23,292	20,093
carbaryl	Sevin	7,226	7,839	6,997	5,508	6,893
chlorantraniliprole	Coragen	3,651	4,239	3,935	6,245	4,518
diazinon	Diazinon	5,283	444	2,049	944	2,180
dimethoate	Dimethoate	45	295	220	400	240
esfenvalerate	Asana	1,003	2,579	2,978	3,351	2,478
imidachloprid	Admire Pro	12,613	11,309	10,785	12,009	11,679
insecticidal soap	M-Pede			14	56	18
malathion	Malathion	333		337	58	182
methomyl	Lannate	3,788	6,135	3,375	4,174	4,368
oxamyl	Vydate	1,465	711	944	375	874
permethrin	Pounce	3,083	8,319	5,507	7,626	6,134
pyripoxyfen	Knack	75	403	1,884	1,750	1,028
spinetoram	Radiant	948	2,175	3,505	1,909	2,134
spinosad	Success	1,935	216	269	149	642

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 20. Total Pounds Active Ingredients of Herbicides Used In Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
bensulide	Prefar	13,974	10,929	14,195	16,542	13,910
clethodim	Arrow	88	53	46	31	55
ethalfluralin	Curbit	434		137	29	150
glyphosate	Roundup	9,812	7,706	11,690	5,493	8,675
halosulfuron-methyl	Sandea	16	6	13	2	9
metam sodium	Vapam	4,703	12,625	12,209	3,344	8,220
oxyfluorofen	Goal	161	67	279	355	216
paraquat	Gramoxone	755	534	367	423	520
sethoxydim	Poast	73	17	100	78	67
trifluralin	Treflan	4,669	3,077	2,480	3,538	13,764

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 21. Acres Treated With Herbicides: California Cantaloupes (2011-2014)

Product	Trade Name	2011	20121	2013	2014	Four-Year Average
bensulide	Prefar	4,189	2,916	3,556	2,614	3,319
clethodim	Arrow	891	522	462	261	2,136
ethalfluralin	Curbit	50		128	38	179
glyphosate	Roundup	5,969	3,040	5,005	2,180	4,049
halosulfuron-methyl	Sandea	874	421	608	290	548
metam sodium	Vapam	15	169	179	79	111
oxyfluorofen	Goal	1,372	133	652	746	726
paraquat	Gramoxone	720	569	1,364	784	859
sethoxydim	Poast	428	95	654	394	393
trifluralin	Treflan	7,099	3,950	3,492	5,160	4,925

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 22. Total Pounds Active Ingredients of Fungicides Used In Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
azoxystrobin	Abound, Quadris	591	675	529	39	459
chlorothalonil	Bravo			248	137	96
cyflufenamid	Torino			91	123	54
mancozeb	Dithane	30		50		20
mefenoxam	Ridomil Gold	327	20	1,017	273	409
MYCLOBUTANIL	Rally	904	1,121	399	543	742
QUINOXYFEN	Quintec	389	452	214	409	366
sulfur	Sulfur, Cosavet	63,272	48,665	81,937	72,279	66,538
trifloxystrobin	Flint				4	1

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 23. Acres Treated With Fungicides: California Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
azoxystrobin	Abound, Quadris	4,426	6,700	4,458	2,408	4,498
chlorothalonil	Bravo			218	119	84
cyflufenamid	Torino			4,297	5,516	2,453
mefenoxam	Ridomil Gold	3,534	154	1,715	1,711	1,779
myclobutanil	Rally	7,796	10,959	3,930	5,226	6,978
QUINOXYFEN	Quintec	4,422	5,730	2,830	4,909	4,473
sulfur	Sulfur, Cosavet	6,102	5,958	7,704	8,274	7,010
trifloxystrobin	Flint				58	15

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 24. Total Pounds Active Ingredients of Nematicides Used In Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
1,3-dichloropropene	Telone	14,792	28,428	12,262		13,871
metam sodium	Vapam	4,703	12,625	12,209	3,344	8,220
oxamyl	Vydate	868	692	914	862	834

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 25. Acres Treated With Nematicides: California Cantaloupes (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
1,3-dichloropropene	Telone	333	608	275		304
metam sodium	Vapam	15	169	179	79	111
oxamyl	Vydate	1,465	711	944	375	874

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 26. Total Pounds Active Ingredients of Insecticides Used in California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
abamectin	Agri-Mek	75	104	128	133	110
acetamiprid	Assail	113	287	345	513	315
Bacillus thuringiensis	Bt	1,801	1,178	692	750	1,105
bifenthrin	Capture	775	977	1,134	1,271	1,039
carbaryl	Sevin	2,147	2,335	3,209	1,216	2,227
chlorantraniliprole	Coragen	36	130	153	172	123
diazinon	Diazinon	689	891	488	333	600
dimethoate	Dimethoate	78		143	77	75
dinotefuran**	Safari, Venom	211		297	382	223
endosulfan	Thiodan	84				21
esfenvalerate	Asana	23	12	44	50	32
flubendiamide**	Belt, Vetica	7	117	236	230	148
imidachloprid**	Admire Pro	1,458	1,438	1,321	1,197	1,354
insecticidal soap	M-Pede		1	1	21	6
malathion	Malathion	1		118		30
methomyl	Lannate	787	703	412	609	628
methoxyfenozide	Intrepid	933	728	477	824	741
oxamyl	Vydate	259	61	103	127	138
permethrin	Pounce	86	200	133	218	159
pyripoxyfen	Knack		43	52	75	43
spinetoram	Radiant	54	62	27	45	47
spinosad	Success	104	27	11	54	49
spiromesifen	Oberon	35	147	201	208	148

*Includes: honeydews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons that are not specifically identified in the Pesticide Use Reports and may be entered as just melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports
**Under review by EPA at publication of this document

Table 27. Acres Treated With Insecticides: California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
abamectin	Agri-Mek	7,458	9,660	9,341	10,943	9,351
acetamiprid	Assail	1,287	3,485	4,083	6,226	3,770
azadirachtin	Neemix	67	32		225	81
Bacillus thuringiensis	Bt	2,521	2,428	1,114	1,013	1,769
bifenthrin	Capture	6,125	11,056	12,536	13,830	10,887
carbaryl	Sevin	3,229	3,336	4,352	1,864	3,195
chlorantraniliprole	Coragen	705	2,301	3,048	3,156	2,303
diazinon	Diazinon	1,459	1,520	662	391	1,008
dimethoate	Dimethoate	159		141	210	128
dinotefuran**	Safari, Venom	1,243		2,160	2,836	1,560
endosulfan	Thiodan	188				47
esfenvalerate	Asana	654	254	898	1,101	727
flubendiamide**	Belt, Vetica	416	2,480	4,898	4,831	3,156
imidachloprid**	Admire	5,699	4,786	4,700	4,183	4,842
insecticidal soap	M-Pede		1	1	5	2
malathion	Malathion	2		114		29
methomyl	Lannate	1,200	1,048	560	756	891
methoxyfenozide	Intrepid	6,533	5,457	3,517	6,059	5,392
oxamyl	Vydate	244	116	200	256	204
permethrin	Pounce	847	1,561	1,414	2,111	1,483
pyripoxyfen	Knack		624	757	995	594
spinetoram	Radiant	1,251	1,397	547	812	1,002
spinosad	Success	1,077	364	140	662	561
spiromesifen	Oberon	293	1,275	1,678	1,628	1,219

*Includes: honeydews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports
**Under review by EPA at publication of this document

Table 28. Total Pounds Active Ingredients of Herbicides Used In California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
bensulide	Prefar	3,090	2,341	1,974	1,994	2,350
clethodim	Arrow	15	27	9	2	13
ethalfluralin	Curbit	98	55	102	83	85
glyphosate	Roundup	6,079	5,004	7,176	5,243	5,876
halosulfuron-methyl	Sandea	6	1	3	4	4
metam sodium	Vapam	42,888		2,581	3,058	12,132
oxyfluorofen	Goal	90	24	4		30
paraquat	Gramoxone		39	35	134	52
sethoxydim	Poast	33	53	16	53	39
trifluralin	Treflan	1,047	798	528	2,444	1,204

*Includes: honeydews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 29. Acres Treated With Herbicides: California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
bensulide	Prefar	983	545	595	497	655
clethodim	Arrow	120	214	73	17	106
ethalfluralin	Curbit	446	64	201	111	206
glyphosate	Roundup	3,149	1,790	2,821	1,738	2,375
halosulfuron-methyl	Sandea	136	65	215	238	164
metam sodium	Vapam	696		8	10	179
oxyfluorofen	Goal	380	144	8		133
paraquat	Gramoxone		86	78	127	73
sethoxydim	Poast	164	229	90	288	193
trifluralin	Treflan	1,324	993	548	2,686	1,388

*Includes: cantaloupes, honey dews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 30. Total Pounds Active Ingredients of Fungicides Used In California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
azoxystrobin	Abound, Quadris	176	469	322	130	274
chlorothalonil	Bravo	698	154	294	286	358
cyflufenamid	Torino			78	86	41
mancozeb	Dithane	11	83	79		43
mefenoxam	Ridomil Gold	148	33	79	181	110
myclobutanil	Rally	685	375	287	302	412
quinoxyfen	Quintec	340	69	275	380	266
sulfur	Sulfur, Cosavet	29,282	12,771	12,721	13,839	17,154
trifloxystrobin	Flint	47		10		14

*Includes: cantaloupes, honey dews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Table 31. Acres Treated With Fungicides: California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
azoxystrobin	Abound, Quadris	1,366	3,311	2,060	1,163	1,975
chlorothalonil	Bravo	420	103	251	159	233
cyflufenamid	Torino			3,242	3,613	1,714
mancozeb	Dithane	7	50	35		23
mefenoxam	Ridomil Gold	406	305	604	1,053	592
myclobutanil	Rally	5,314	3,141	2,467	2,706	3,407
quinoxyfen	Quintec	3,950	916	3,576	4,345	3,197
sulfur	Sulfur, Cosavet	3,632	2,851	4,573	6,067	4,281
trifloxystrobin	Flint	755		160		229

*Includes: cantaloupes, honeydews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 32. Total Pounds Active Ingredients of Nematicides Used In California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
1,3-dichloropropene	Telone	37,406	23,855		5,306	16,642
metam sodium	Vapam	41,888		2,581	3,058	11,882
oxamyl	Vydate	259	61	103	127	138

*Includes: cantaloupes, honeydews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports

Table 33. Acres Treated With Nematicides: California Mixed Melons* (2011-2014)

Product	Trade Name	2011	2012	2013	2014	Four-Year Average
1,3-dichloropropene	Telone	841	535		119	374
metam sodium	Vapam	696		8	10	179
oxamyl	Vydate	244	116	200	256	204

*Includes: cantaloupes, honeydews, casaba, Juan Canary, Santa Claus, piel de sapo and other unspecified melons.

Source: California Department of Pesticide Regulation Pesticide Use Reports

WORKER PROTECTION ISSUES IN CALIFORNIA MELONS

The following two tables provide estimates for various cultural practices and pest management activities and the potential for pesticide exposure.

Table 34. San Joaquin Valley: Cultural Activities and Potential Exposure

Activity	Average Times per crop	Minimum to Maximum times	Average acres per day	Average acres per hour	Potential Exposure
Listing/Bed Preparation	6	4-8	50	5	0
Planting	1	1-2	60	6	+
Cap Removal	1	1-2	60	6	0
Pre-thinning Cultivation	2	1-3	40	4	0
Thinning	1	1	40	4	0/+
Fertilization	2	2-3	50	5	+
Cultivation	3	1-4	40	4	+
Pollination	1	1	20	2	++
Irrigation	4	2-5	40	4	+
Harvest	12	9-20	100	10	+
Discing after harvest	2	2-3	50	5	0

0 = No exposure + = Minimal exposure potential
++ = Moderate exposure potential +++ = High exposure potential

Table 35. San Joaquin Valley: Plant and Pest Monitoring Activities and Potential Exposure

Activity	Average Times per crop	Minimum to Maximum times	Average acres per day	Average acres per hour	Potential Exposure
Soil Sampling	1	1	100	10	0
Insect Scouting	15	14-20	80	8	+
Disease Scouting	15	14-20	80	8	+
Petiole Sampling	3	1-4	80	8	+
Irrigation Scheduling	5	5-10	80	8	+
Insecticide Application	3	1-4	40	4	++
Herbicide Application	2	2-3	50	6	+
Fungicide Application	1	1-2	30	3	++

0 = No exposure + = Minimal exposure potential
++ = Moderate exposure potential +++ = High exposure potential

MEMBERS OF THE CALIFORNIA MELON WORK GROUP IN ATTENDANCE – OCTOBER 14, 2015

Commodity Group Representatives & Growers, Packers, and Shippers

1. Milas Russell, Jr., Yuma, AZ
2. Dan McCurdy, Firebaugh, CA
3. Patrick Tucker, Dos Palos, CA
4. Berj Moosekian, Los Banos, CA

Western IPM Center

5. Matt E. Baur, Assoc. Director, Western IPM Center

Other Industry Representatives

6. Jim Langley, Simplot, Fresno, CA
7. Matt Langley, Simplot, Fresno, CA
8. Steve Wilson, Firebaugh, CA
9. Matt Lagorio, Woodland, CA
10. Justin Romero, Ceres, CA

Other Members of the Melon Work Group in Attendance – October, 14, 2015

11. J.D. Allen, CMRB Manager
12. Nathan Sano, CMRB
13. Gary Van Sickle, Executive Director, CA Specialty Crops Council, Visalia, CA

California Melon Strategic Plan Review Team

1. Tim Hartz, Melon Industry Liaison, Department of Plant Science, UC Davis
2. John Palumbo, Research Entomologist, Dept. of Vegetable Crops, University of Arizona, Yuma Agric. Center
3. Eric T. Natwick, Farm Advisor – Entomology, UCCE, Imperial County, Holtville, CA
4. Larry D. Godfrey, Department of Entomology & Nematology, UC Davis
5. Lynn Sosnoskie, Department of Plant Sciences, UC Davis
6. Milt McGiffen, Department of Botany & Plant Sciences, UC Riverside
7. Becky Westerdahl, Department of Entomology and Nematology, UC Davis
8. Bart Fisher, CMRB, Blythe, CA
9. Joe Del Bosque, CMRB, Los Banos, CA
10. Steve Danna, CMRB, Yuba City, CA
11. Stephen Smith, CMRB, Turlock, CA
12. Matt Maring, CMRB, Westley, CA

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