

# A Pest Management Strategic Plan for Kiwifruit Production in California



*The California Kiwifruit Commission (CKC)*

*The California Minor Crops Council (CMCC)*

The California Minor Crops Council received major funding for this project from the EPA Region 9 Agricultural Initiative and the USDA Cooperative States Research, Education, and Extension Service (CSREES) Pest Management Alternatives Program (PMAP).

CMCC received additional support from the California Kiwifruit Commission and the Western Regional Pest Management Center at UC Davis. Funding for this project also has been made available by the Governor's *Buy California* initiative, the California Department of Food and Agriculture, and the U.S. Department of Agriculture, through the University of California's Specialty Crops Research Program.

We gratefully acknowledge the contributions of all of these organizations and their participation in this process.

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## EXECUTIVE SUMMARY

California produces virtually the entire United States kiwifruit crop (>98%). In 2002, this commodity generated income of approximately \$23 million from about 3700 acres. Acreage has been steadily declining since the late 1990s due to many pressures on the industry. These include resistance management issues, cancellation of or restrictions on pesticides formerly available (e.g., Ronilan<sup>®</sup>), environmental restrictions on farming and worker practices, declining profitability, urban encroachment, and global competition.

Compared with other commodities, California kiwifruit has relatively few pest problems; as a result, there is very little pesticide usage recorded for this crop. The most important pests are armored scales, omnivorous leaf rollers, soil-borne nematodes and diseases, and post-harvest disease (*Botrytis*). While the number of pests may be relatively low, they can cause significant economic consequences to the grower.

To help transition to "Reduced Risk" pest management in accordance with FQPA and other regulatory activities, the USDA and EPA have requested that all commodities develop Pest Management Strategic Plans (PMSPs) to identify growers' critical research, registration, and educational needs. "Reduced Risk" broadly describes pest management techniques and tools that are safe for consumers, workers, and the environment.

In 2002, several members of the kiwifruit industry met to discuss the long-term issues of insect, mite, disease, weed, and vertebrate control. The work group consisted of growers, packers, shippers, pest control advisers (PCAs), cooperative extension personnel, farm advisors and research scientists, along with representatives from the Environmental Protection Agency Region 9 and the Western Region Integrated Pest Management Center.

The purpose of the industry meeting was to develop a Pest Management Strategic Plan (PMSP) for the issues of greatest concern to kiwifruit growers in California. The input gathered at this meeting provided an important perspective on the pest management products and techniques used in this commodity. Focusing on the pests that have the most significant economic impact on the California kiwifruit industry, the stakeholders identified the critical research, regulatory, and educational needs of California kiwifruit growers.

The PMSP for California kiwifruit comprehensively summarizes the crop production and pest management practices used by this industry in California. The foundation for this document is the *Crop Profile for California Kiwifruit*, at <http://pestdata.ncsu.edu/cropprofiles/docs/cakiwi.html>.

Methyl bromide and Ronilan<sup>®</sup> are examples of products used in kiwifruit production that are being phased out due to FQPA and other regulatory decisions. The loss of these and other valuable crop protection tools and the widespread reductions in funding for Land Grant University research and extension programs require that all resources be used in the most efficient manner possible. The development of a long-term plan to address the needs of the kiwifruit industry will help to maximize efforts made to generate information and solutions for the growers.

This strategic plan includes an overview of kiwifruit production, seasonal pest occurrences, and integrated pest management techniques throughout California. The plan addresses both current and emerging pest management needs; it is a working document that will need to be updated periodically. Efficacy ratings of various pest control techniques (chemical and non-chemical) used in kiwifruit production have been summarized from input made by growers, pest control advisers, and other experts involved in field activities.

The industry experts (growers, pest control advisers, industry representatives, and university research and extension personnel) listed in Appendices 12 and 13 of this PMSP are resources who can provide more detailed information regarding California kiwifruit production.

This strategic plan will receive periodic updates; it serves principally as a guideline to direct future pest management efforts related to California kiwifruit production. Important documents that provide a basis for this strategic plan are UC ANR Publication 3449 (*Integrated Pest Management Guidelines for Kiwifruit*) and the *Crop Profile for California Kiwifruit* (<http://pestdata.ncsu.edu/cropprofiles/docs/cakiwi.html>); these documents provide a complete review of cultural and pest management practices for California kiwifruit.

The mention of specific trade names in this document is not an endorsement of any particular product.

## Stakeholder Recommendations

As a result of the stakeholder input gathered at the meeting held in November 2002 and revisions made to this document in 2003, the Kiwifruit Work Group identified the following research, regulatory, and educational priorities.

### Research Priorities

Finding effective solutions to disease control (especially post-harvest disease control) is the most immediate and serious concern for California kiwifruit growers. Alternatives to using organophosphate insecticides and methyl bromide are also important to continued development of reduced-risk pest management systems for control of insect and nematode pests. Research on soil and plant health management, including vegetation management and pollination, is needed to improve yield and quality of California kiwifruit. The university research and extension programs will remain critical in identifying and adopting new technologies for pest management in California kiwifruit production; there is concern that loss of personnel in these institutions will impede the development of improved horticultural and pest management practices for this commodity.

- Evaluate pre- and post-harvest *Botrytis* management tools
- Evaluate *Phytophthora* management tools
- Evaluate nematode control options
- Evaluate scale control options
- Determine the role of pollination, pruning techniques, thinning, and cane girdling on fruit size
- Evaluate attributes of plant, soil health, and nutrients as these relate to fruit size, quality, and storage

### Regulatory Priorities

The kiwifruit industry needs new post-harvest disease control products registered to replace older chemistries that are being phased out by FQPA, and/or that will not be supported by the registrants. Harmonization among IR-4, Cal/EPA, and US EPA should be encouraged to facilitate timely registration of reduced risk products. In addition, all registrants should ensure that all new product registrations are in compliance with provisions of NAFTA, Codex, and all importing countries.

- Expedite the full Section 3 registration of *Botrytis* materials (especially Elevate®)
- Register an oil that is acceptable for use in organic kiwifruit (for scale control, etc.)
- Expedite registrations for OP alternatives: Seize® and Success®
- Expand the pheromone use season
- Keep kiwifruit on generic pesticide labels
- Harmonize Cal/EPA and US EPA registrations to hasten new product registrations
- Identify potential trade irritants as early as possible in the research and registration process; insure there are no conflicts with provisions of NAFTA or Codex

## Educational Priorities

The public, including regulators and consumer groups, must be educated about the use of Integrated Pest Management (IPM) in California kiwifruit production and how this system optimizes food production while minimizing risks to workers and the environment. Growers and PCAs need to be educated on improved cultural practices and new materials used in kiwifruit production. University programs in the areas of research and education should be enhanced to provide training on reduced risk pest management and best management practices. Finally, the public should be reminded that eating California kiwifruit is an important part of a healthy lifestyle and that this produce is grown under the highest standards of safety and quality in the world.

- Educate growers and PCAs on the use of Elevate<sup>®</sup> for post-harvest disease control
- Educate growers on water management for *Phytophthora* control
- Educate growers on current knowledge of plant and soil health and nutrition, pruning, and cultural practices
- Educate growers on resistance management for new chemistries
- Educate growers on use of PGRs and new PGR chemistries
- Educate growers, PCAs, and commodity members on the use of best management practices to protect and improve water and soil quality
- Educate the public on the nutritional values of California grown kiwifruit and their high level of food safety and quality

The California kiwifruit industry appreciates the support of US EPA, USDA, CDPH, and the University of California Land Grant system throughout the development of this strategic plan. We look forward to the valuable assistance provided by these agencies and institutions as we develop responses to the many issues facing the California kiwifruit industry.

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*November 2003*

# A PEST MANAGEMENT STRATEGIC PLAN FOR CALIFORNIA KIWIFRUIT

## 1. KIWIFRUIT PRODUCTION OVERVIEW

The woody, twining vines of kiwifruit are grown in sunny locations protected from strong winds. The vines' size, vigor, longevity, and heavy crop load require a strong, permanent support structure. The vines also require deep, well-drained, slightly acidic (pH 5 – 6.5) soils; kiwifruit is an appropriate crop wherever citrus, peaches, and almonds are successful. Reaching commercial production in three years, kiwifruit can remain productive for over 50 years.

Kiwifruit require at least 240 frost-free days without late winter or early autumn freezes. While all cultivars need a certain period of winter chilling (600 to 850 chill-hours at or below 45°F), their needs vary dramatically. The most popular cultivar, Hayward, does best with a winter rest of 800 hours of chilling (defined as total hours between 32° and 45°F). In dormancy, mature kiwifruit vines can withstand temperatures to 10°F.

A fully canopied vineyard requires approximately 40 to 48 acre-inches of water per year. On a hot California summer day, water use can peak around 7,000 to 8,000 gallons per acre. The most commonly used irrigation systems are the localized or low-volume drip, or micro-sprinklers.

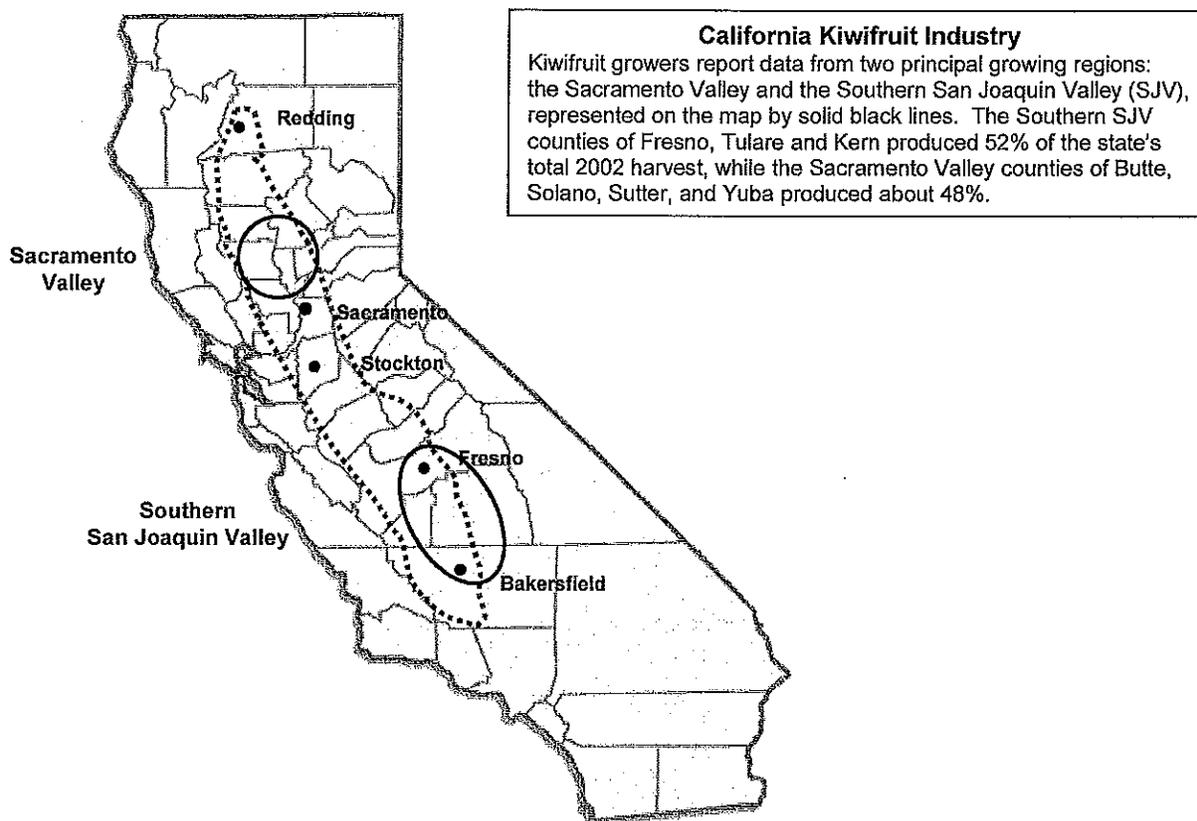
### Production Summary

- California grows about 98% of all kiwifruit produced nationally.
- The U.S. ranks seventh in world production of kiwifruit behind Italy, New Zealand, Chile, France, Japan, and Greece; shipping seasons overlap in some cases.
- California's kiwifruit acreage has declined since 1999 due to high production costs and competition from foreign markets.
- One major variety of kiwifruit grown worldwide is "Hayward," from New Zealand.
- The marketing season for California kiwifruit extends from late September into June.
- Approximately 95% of the kiwifruit harvest is sold fresh; about 5% is processed.
- Kiwifruit can be stored for over eight months.
- New kiwifruit varieties with different flavors, colors, and textures are being developed to fill premium niches in world markets; a recently patented golden flesh variety of kiwifruit from New Zealand ("Gold") is being commercially grown on a limited number of acres in California.
- Bees are required for pollen transfer, so honeybees are routinely placed around vineyards for pollination.
- After initial fruit set, only 50 – 60% of the crop will actually make it to the market place due to weather-related factors that affect fruit size and quality, industry enforced quality standards, thinning, and culling.
- Approximately 15 – 20% of the annual U.S. kiwifruit crop is exported, mainly to Mexico and Canada, followed by Korea and Japan.
- The most important pests of California kiwifruit are post-harvest disease (*Botrytis*), armored scales, omnivorous leaf rollers, soil-borne nematodes and diseases.
- Approximately 8% of California's kiwifruit acreage is organically farmed.

## California Kiwifruit Production Regions

While kiwifruit is grown in many parts of California, the majority is produced in the Sacramento Valley (Butte, Yuba, and Sutter counties) and the Southern San Joaquin Valley (Tulare, Kern, Fresno, and Kings counties), with fruit coming occasionally from San Bernardino, Santa Barbara, San Luis Obispo, Ventura, and San Diego counties. Fruit in the San Joaquin Valley ripens 7 to 10 days earlier than that in the north, but otherwise conditions in both growing regions are very similar. Figure 1 shows the primary kiwifruit production regions in California.

Figure 1: Kiwifruit Production Regions



## Stages and Approximate Length of Time for California Kiwifruit Development

DORMANCY	BUD BREAK THROUGH BLOOM	FRUIT SET THROUGH PRE-HARVEST	HARVEST	POST-HARVEST
December through March	early March through mid-May	mid-May through late September	late September through late November	fruit can be stored more than eight months

## Differences in the Major Kiwifruit Production Regions of California

	<b>Southern SJV</b>	<b>Sacramento Valley</b>
<b>Soil Types</b>	sand/loam/clay	sandy loam/loamy sand
<b>Bud Break Period</b>	late April – mid May	May
<b>Dormancy (length)</b>	shorter	longer
<b>Annual Rainfall</b>	6 – 9"	20 – 24"
<b>Temperatures</b>	higher maximums	moderate

## Important Pests in the Major Kiwifruit Production Regions of California

Kiwifruit plants are relatively free from pest problems, possibly due to their lack of heavy planting in localized areas.

- Scale (greedy, latania, oleander) insects can be a problem if populations build up too extensively; if present in the soil, nematodes will reduce plant vigor.
- Of the four leaf-rolling caterpillars that attack kiwifruit (omnivorous, fruit-tree, oblique-banded, and orange tortrix), omnivorous leaf roller is the most common and the most damaging.
- *Phytophthora* crown and root rot is one of the more serious diseases of kiwi grown in California.
- *Botrytis*, or gray mold, is the most important post-harvest disease of kiwifruit in California; since the pathogen requires free-moisture for spore germination and infection, disease is more severe when rainy weather occurs during bloom.
- Kiwifruit plants can be severely damaged by root knot nematodes.
- Two-spot spider mites can build up on plants during hot, dry weather, particularly on plants grown in greenhouses and occasionally on plants grown outside.
- Perennial grasses (Bermuda grass, Johnsongrass, and dallisgrass) are persistent weeds in kiwifruit vineyards.
- Major vertebrate pests of kiwifruit include gophers, squirrels, rats, and rabbits. Deer can cause problems by feeding on the leaves; voles can be pests in kiwifruit vineyards where weed growth is not controlled.

**Work Group Recommendations for Disease Management  
from Fruit Set through Pre-Harvest**

<b>Research</b>	<ul style="list-style-type: none"> <li>• Continue to evaluate new materials for <i>Botrytis</i></li> <li>• Develop organic controls for <i>Botrytis</i></li> <li>• Research mefenoxam (Ridomil® Gold)</li> </ul>
<b>Regulatory</b>	<ul style="list-style-type: none"> <li>• Expedite the registrations of Elevate®, Scholar®, and Vanguard®</li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• Provide training on resistance management</li> <li>• Provide training on water management</li> <li>• Provide training on nitrogen management</li> <li>• Provide training on disease identification</li> </ul>

**SNAILS**

Snails can occasionally be a serious pest in kiwifruit orchards, feeding on various above ground plant parts and fruit. Copper bands make good barriers to keep snails from moving up the vines. Weed control around the base of the vines reduces snail problems. Commercial formulations of methaldehyde provide excellent control of snails.

Decollate snails provide very good biological control of pest snails; however, decollates are used only in the southern production region because they may be released only in the following California counties: Fresno, Kern, Imperial, Los Angeles, Madera, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Tulare, and Ventura. Additional information about using decollate snails in kiwifruit vineyards may be found on the internet at [http://www.ipm.ucdavis.edu/PMG/NE/decollate\\_snail.html](http://www.ipm.ucdavis.edu/PMG/NE/decollate_snail.html).

There are no work group recommendations for snail control in kiwifruit.

**VERTEBRATES**

Vertebrate control issues and management techniques for gophers, rabbits, voles, deer, coyotes, and rats in this season are similar to those described in the previous sections.

The work group has no recommendations for vertebrate control for the period from fruit set through pre-harvest.

**PLANT GROWTH REGULATORS (PGRs)**

Plant growth regulators affect cell division and are used to increase fruit size. A new plant growth regulator, CPPU, N-(2-chloro-4-pyridinyl)-N-phenylurea - a diphenylurea-type cytokinin, can be applied two to three weeks after bloom. This product is currently in the process of registration; its use is allowed under an Experimental Use Permit (EUP).

**Work Group Recommendations for PGR Management from  
Fruit Set through Pre-Harvest**

<b>Research</b>	<ul style="list-style-type: none"> <li>• None</li> </ul>
<b>Regulatory</b>	<ul style="list-style-type: none"> <li>• Obtain full registration of CPPU</li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• Educate growers on proper use of CPPU</li> </ul>