Crop Profile for Kiwi in California

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General Production Information

- California ranks first in the national production of kiwifruit, accounting for nearly 95% of all kiwifruit produced nationally (1).
- World wide, Italy ranks first in kiwifruit production, followed by New Zealand. The United States ranks seventh in the world production of kiwifruit (8).
- The value of California's kiwifruit crop in 1997 was $18,119,640 (4).
- In 1997, 5,000 acres of kiwifruit were harvested in California. The yield per acre was 6.6 tons of kiwifruit with a price of $518 per ton (4).

Production Regions

Kiwifruit plants need a long growing season, at least 240 frost-free days. In dormancy they can withstand temps to 10ºF (2). The leading production counties in California are Tulare, Butte, Yuba, Sutter, Kings, Kern, and Fresno (1).

Production Practices

Kiwifruit plants are woody twining vines that are trellised on a single wire, 3-5 wires or t-bar for cultivation. Kiwifruit are grown in sunny locations protected from strong winds. The plants need large volumes of water during the growing season and prefer well-drained, slightly acidic (pH 5 – 6.5) soil. Nitrogen is applied during the first half of the growing season.

Plants bear either male or female flowers, thus plants of both sexes are needed to produce fruit. The best female cultivar, grown worldwide, is the New Zealand Hayward. Two New Zealand males are used. Matua is the most common in commercial orchards. Tomuri is late blooming and extends the male pollen season. The Chico male is also grown in California (2).

Kiwifruit plants are routinely pruned both in the summer and winter. Summer pruning helps open the dense canopy to allow for air movement and filtered sunlight. This reduces the incidence of botrytis fruit rot and fruit softening. Winter pruning trains the plant on the trellis system (2, 7). Kiwifruit harvest

season is October 1 – May 31 (1).

Pesticide Data:
Label rates, re-entry intervals and pre-harvest intervals for all chemicals listed in this document are from labels. Many of the labels are contained in the Crop Protection Reference (5) or at http://www.cdms.net/manuf/manufac.asp. Percent of acres treated, average number of applications, median application rate, and total lb a.i. applied are from the 1997 California Department of Pesticide Regulation 100% Reporting database (6).

Insect Pests

Armored Scales

Greedy scale: *Hemiberlesia rapax*
Latania scale: *Hemiberlesia lataniae*
Oleander (Ivy) scale: *Aspidiotus nerii*

Scale insects attack the bark and fruit of kiwifruit. Scales appear on the canes or fruit of kiwifruit as small, thin light gray circular to oval specks. Heavy scale infestations reduce the vigor of the plant and cause the fruit to be offgrade (3).

Control:

Non-Chemical:
Scales can be managed by the introduction of natural enemies (7). Some of the natural enemies include lacewings, predaceous mites and tiny parasitic wasps.

Chemical:

- Methidathion – Label has a rate of 1.5-2 lb a.i./acre. 48–hour REI. In 1997, 807 lb a.i. were applied to 11.08% of the kiwifruit acreage in California 1 time at a median application rate of 1.59 lb a.i./acre. Applied during dormancy. Available under Section 24(c) registration.
- Phosmet - 24–hour REI. In 1997, 92 lb a.i. were applied to 1.41% of the kiwifruit acreage in California 1 time at a median application rate of 1.52 lb a.i./acre. Available under Section 24(c) registration.
- Horticultural Oil - Label has a rate of 31.3-47 lb a.i./acre. 4–hour REI. In 1997, 9,895 lb a.i. were

applied to 7.87% of the kiwifruit acreage in California 1 time at a median application rate of 28.23 lb a.i./acre. Oil spray is an organically acceptable method of control. Available under Section 24(c) registration. Not effective on high populations of scale.

Leafrolling Caterpillars

Omnivorous leafroller: *Platynota stultana*
Fruittree leafroller: *Archips argyrospilus*
Obliquebanded leafroller: *Choristoneura rosaceana*
Orange tortix: *Argyrotaenia citrana*

Leafrolling caterpillars directly damage fruit by scarring the surface when they feed. Of the four leafrolling caterpillars that attack kiwifruit, omnivorous leafroller is the most common and the most damaging. It has four to six generations per year. The body of the omnivorous leafroller ranges in color from cream to brown with light brown to black head capsules. Omnivorous leafroller moths may develop on host plants outside the orchard. Both the fruittree leafroller and obliquebanded leafroller are minor pests on kiwifruit and have two generations per year. Orange tortix is found in the cool, coastal regions where it has two to four generations per year (3).

Control:

Non-Chemical:
None.

Chemical:

- Phosmet - 24–hour REI. In 1997, 92 lb a.i. were applied to 1.41% of the kiwifruit acreage in California 1 time at a median application rate of 1.52 lb a.i./acre. Available under Section 24(c) registration.
- Bacillus thuringiensis - Label has a rate of 0.03-0.13 lb a.i./acre. 4–hour REI. In 1997, 52 lb a.i. were applied to 10.81% of the kiwifruit acreage in California 1 time at a median application rate of 0.12 lb a.i./acre. *Bacillus thuringiensis* is an organically acceptable method of control.
- Cryolite - Label has a rate of 9.6 lb a.i./acre and a 12–hour REI. 30-day PHI. In 1997, 27,193 lb a. i. were applied to 15.29% of the kiwifruit acreage in California 1 time at a median application rate of 9.6 lb a.i./acre.

Diseases

Armillaria Root Rot

Armillaria mellea

Armillaria mellea survives for many years on diseased wood and roots below ground. Plant roots become infected when they come in contact with inoculum from a previous crop or infected oak trees. Infected vines usually completely collapse. White mycelial strands can be seen interwoven with darkened cortical tissue. Dark rhizomorphs grow from the root into the soil after infection develops, but are readily evident after symptom expression (3).

Control:

Non-Chemical:
Before planting, roots greater than 1 inch in diameter are removed and destroyed to help reduce inoculum.

Chemical:

Pre-plant

- Methyl Bromide - Label has a rate of 294-392 lb a.i./acre. In 1997, 196 lb a.i. were applied to 0.21% of the kiwifruit acreage in California 1 time at a median application rate of 26.13 lb a.i./ acre.

Botrytis Fruit Rot (Gray Mold)

Botrytis cinerea

Gray mold is the most important postharvest disease of kiwifruit in California and is caused by the fungal pathogen *Botrytis cinerea*. The ubiquitous fungus commonly grows on senescing or dead tissue and can spread to fruit causing a soft rot. On kiwifruit, the fungus mostly develops on senescent blossom parts. It is thought that infection occurs during the bloom period. Since the pathogen requires free-moisture for spore germination and infection, disease is more severe when rainy weather occurs during bloom. The fungus is generally first visible on the fruit surface as grayish-white tufts of mycelium. The mycelium can readily penetrate healthy tissue during fruit to fruit contact, thus enlarging a nest of rotting fruit. The disease results in post-harvest fruit loss. The pathogen appears in storage as gray-brown fungal growth (3). A method has been developed to predict the incidence of gray mold of stored fruit. Fruit are sampled in the field and sent to a lab where sepals are plated on media. Results of the assay determine

the percent of predicted gray mold and if pre-harvest spraying is necessary (9).

Control:

Non–Chemical:
Dead leaves can be removed from the vine and field debris and fruit mummies are removed from the field to prevent spread of the fungus, however, this has not been shown to be economical. Summer pruning to open the canopy for increased air movement may also reduce disease incidence (7).

Chemical:

- Vinclozolin - In 1997, 285 lb a.i. were applied to 6.04% of the kiwifruit acreage in California 2 times at a median application rate of 1.0 lb a.i./acre.

Other diseases of kiwifruit that do not have or do not require a chemical treatment include; bacterial blight, bleeding canker, crown gall, and Phytophthora root and crown rot.

Nematodes

Root Knot Nematodes

Meloidogyne spp.

California kiwifruit plantings are very susceptible to root knot nematodes. Root knot nematodes reduce root efficiency and interfere with plant growth and nutrient uptake. They disrupt the orderly uptake of water and nutrients by their physical presence within root tissues. Vine damage is eventually manifested as reduced vigor and yield with slight yellowing of leaves.

Root-knot nematodes in high populations are damaging to the root system. Vines become weakened and the fruit size may be reduced (3).

Control:

Non-Chemical:
Nematode problems can be avoided by frequent watering, removing broadleaved weeds and avoiding cover crops susceptible to root-knot nematode (3).

Chemical:

Preplant

- Methyl Bromide - Label has a rate of 294-392 lb a.i./acre. In 1997, 196 lb a.i. were applied to 0.21% of the kiwifruit acreage in California 1 time at a median application rate of 26.13 lb a.i./ acre. This was most likely due to spot treatments.

Postplant

- Fenamiphos - Label has a rate of 1.5-3 lb a.i./acre and a 31–day PHI. 48–hour REI. In 1997, 95 lb a.i. were applied to 0.92% of the kiwifruit acreage in California 1 time at a median application rate of 1.93 lb a.i./acre.

Weeds

Weeds reduce plant growth by competing for water, nutrients, and space. It is important that the area around the base of the kiwifruit vine remain free of weeds. This is especially important while the orchard is still young. After the fourth year, the vines are established and have shaded the area beneath the vine to reduce weed growth.

Weeds that are persistent problems in kiwifruit orchards are perennial grasses, bermudagrass, johnsongrass, and dallisgrass. These weeds are controlled before planting with glyphosate. Best control is achieved by cultivating and irrigating first. The new growth is then treated with glyphosate. Spot treatment with glyphosate or paraquat may be necessary if regrowth occurs. Treatment is most effective if treated when flowering. Field bindweed and yellow nutsedge are also difficult weeds to control. Both of these weed species are controlled by encouraging vigorous growth by irrigating in summer, then treating with glyphosate when flowering. Two or more herbicides are usually used in combination, usually a combination of preemergent and postemergent herbicides, to achieve adequate weed control (3).

Control:

Non-chemical:
Weeds between rows of vines are controlled by cultivating, mowing, tilling and planting cover crops. Synthetic mulches, propane burners, and hand cultivation are used to control weeds growing at the base of the vine. Growers can effectively control annual weeds by cultivating, irrigating to germinate new weeds and then cultivating again. This is especially effective if two cycles are used. Rhizomes of perennial weeds are cut to small pieces when the soil is dry (3).

Chemical:

- Glyphosate - Label has a rate of 1-4 lb a.i./acre and a 14–day PHI. 12–hour REI. In 1997, 3,514 lb a.i. were applied to 55.04% of the kiwifruit acreage in California 1 time at a median application rate of 1.0 lb a.i./acre. Glyphosate is used preplant, postemergence and postplant, postemergence.
- Napropamide - Label has a rate of 4 lb a.i./acre and a 35–day PHI. 12–hour REI. In 1997, 15 lb a. i. were applied to 0.61% of the kiwifruit acreage in California 1 time at a median application rate of 0.57 lb a.i./acre. Napropamide is used postplant, preemergence.
- Oryzalin - Label has a rate of 2-6 lb a.i./acre. 12–hour REI. In 1997, 1,041 lb a.i. were applied to 11.56% of the kiwifruit acreage in California 1 time at a median application rate of 2.0 lb a.i./ acre. Oryzalin is used postplant, preemergence.
- Oxyfluorfen - Label has a rate of 0.5-2 lb a.i./acre post-emergence and 1.25-2 lb a.i./acre pre-emergence. Can be applied up to February 15 (February 1 in the Coachella Valley). 24–hour REI. In 1997, 265 lb a.i. were applied to 9.27% of the kiwifruit acreage in California 1 time at a median application rate of 0.8 lb a.i./acre. Oxyfluorfen is used postplant, pre- or post-emergence.
- Paraquat Dichloride - Label has a rate of 0.63-0.94 lb a.i./acre and a 14–day PHI. 12–hour REI. In 1997, 231 lb a.i. were applied to 5.07% of the kiwifruit acreage in California 1 time at a median application rate of 0.87 lb a.i./acre. Paraquat is used postplant, postemergence.

PLANT GROWTH REGULATORS

- Hydrogen cyanamide - In 1997, 12,927 lb a.i. were applied to 19.38% of the kiwifruit acreage in California 1 time at a median application rate of 17.66 lb a.i./acre.

POST-HARVEST

Gray mold is the most important postharvest disease of kiwifruit in California and is caused by the fungal pathogen *Botrytis cinerea*. When the fungus sporulates, conidia contaminate surfaces of healthy fruit. Most infections result from contamination of wounds that occur during harvest and handling. During storage these infections may slowly develop into stem-end rot. The fungus grows slowly at 0° C (32° F). Decay mostly is observed after more than 4 months of storage at this temperature.

Control:

Chemical:
Pre-harvest applications of vinclozolin result are made when conditions favor development of gray mold.

Vertebrate Pests

Voles are pests in kiwifruit orchards where weed growth is not controlled.

- Strychnine - Label has a rate of lb a.i./acre. In 1997, 0.02 lb a.i. was applied to 0.06% of the kiwifruit acreage in California 1 time at a median application rate of 0.01 lb a.i./acre.
- Zinc Phosphide - Label has a rate of 0.12-0.2 lb a.i./acre. In 1997, 0.41 lb a.i. was applied to 0.17% of the kiwifruit acreage in California 1 time at a median application rate of 0.07 lb a.i./acre.
- Aluminum Phosphide - Label has a rate of lb a.i./acre. In 1997, 2 lb a.i. were applied to 0.17% of the kiwifruit acreage in California 5 times at a median application rate of 0.04 lb a.i./acre.

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