# Changes in Integrated Pest Management in California Prunes from 2002 to 2018

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## Introduction

Pest Management Strategic Plans offer agricultural commodities a means to document current integrated pest management (IPM) practices and needs. In 2002, a group of prune growers, commodity association representatives, pest control advisors (PCAs), regulators, researchers and cooperative extension advisers met to develop the first Pest Management Strategic Plan (PMSP) for California prune production. The PMSP documented important pests and then-current pest management practices using a pest-by-pest approach through the growing season. It also included practitioner evaluations of the field-level efficacy of chemical and non-chemical IPM tools, and descriptions of the research, regulatory, and education needs of the industry.

In 2018, the prune industry came together again to revise and update its PMSP. Over the 16 years between the two PMSPs, the California prune industry changed considerably. California continues to produce nearly 100% of all U.S. prunes, but its share of worldwide prune production has declined from almost 70% in 2002 to just under 40% in 2017 (the most recent statistics available). From 2002 to 2017, California prune production contracted from 1,200 growers farming 86,000 bearing acres of prunes to 800 growers farming 45,000 bearing acres. Total crop also declined from about 215,000 tons in 2000 to about 105,000 tons in 2017.

This report examines the 2002 and 2018 PMSPs and independent evidence from California Pesticide Use Reports to document significant changes in pest management practices in California prune production.

## Prune Production

Prunes are the dried fruit of European plums (*Prunus domestica*). About 2% of prune production is organic and about 1% is sold fresh (not dried). About 90% of California prune production is in the Sacramento Valley and the remaining 10% is in the southern San Joaquin Valley.

The variety “Improved French” has been the industry standard for decades and accounts for over 95% of California acreage. Typical rootstocks are Lovell, Marianna 2624, and Myrobalan 29C, which have also been industry standards for decades. Some new rootstocks are available, but 2018 PMSP workshop participants did not believe these newer rootstock types were being adopted.

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Prune trees are planted 16 to 20 feet apart to allow for mechanical harvest by shaking the fruit onto a catch frame. After harvest, fruit are transported to dehydration sheds where they are washed and then dehydrated at 180-185°F to about 21% moisture. The dried fruit are then stored until processed into a final product.

**Prune IPM Changes**

The 2018 Prune PMSP places greater emphasis on the following IPM practices compared to the 2002 document:

- Starting with certified disease-tested nursery stock
- Proper irrigation and nutrient management to maintain tree health and reduce tree stress
- Regular scouting
- Conservation biological control
- Pollinator protection
- Use of biological or botanical-based pesticides

These changes suggest growers have adopted a more complete IPM approach than was the case in 2002. The 2018 document also includes information on vertebrate pest management, which was not included in the 2002 PMSP.

Crown gall, caused by *Agrobacterium tumefaciens*, was a significant issue for the industry in 2002 and the problem was related to infected nursery stock. In the 2018 meeting, participants noted that nurseries have been effective in controlling this issue by switching from field grown, bare-root trees to containerized, potted trees using sterile potting media. The nursery stock certification program was also reported to be very effective in providing clean nursery material.

In 2002, flood irrigation was common and cross-disking was used to manage weeds. Cross-disking is disking down rows and then across rows to reduce weeds both between and within the tree row. The switch to micro-sprinkler or drip-irrigation eliminated the option of cross-disking since the irrigation tubing remains in the field year-round. The change in irrigation method resulted in higher irrigation efficiency, reduced orchard water stress and reduced orchard tillage, but also in increased need for chemical weed management.

In 2018, weed management was achieved by a combination of mowing the row middles and herbicide application to the rows. Vertebrate pest management was also impacted by the change in irrigation practices. In 2002, routine flood irrigation and cross-disking reduced pocket gopher, vole and ground squirrel populations by flooding and mechanically disrupting burrows. The 2018 PMSP contained additional descriptions of vertebrate pest monitoring and management practices, which reflects the need for more intentional management of these pests in orchards irrigated by drip or microsprinklers. Thus, sustainable agriculture improvements through improved irrigation efficiency and reduced tillage contributed to increased herbicide use and additional management needs to control vertebrate pests.

**Pesticide Use on Prunes**

California Pesticide Use Reports document notable changes in pesticide use in prune production between 2002 and 2017 (the most recent data available). While total pounds of pesticide applied decreased 38%, from 1,597,000 pounds active ingredient (AI) in 2002 to 986,000 pounds AI in 2017, total prune acreage decreased 49%.

On a per acre basis, there were increases in fumigant, herbicide and fungicide use, and decreases in insecticide use between 2002 and 2017. These changes were driven by diverse factors including changes in production practices, regulatory changes, new registrations, and adoption of IPM practices. The IR-4 minor-use pesticide program supported the registration of 11 new pesticides and re-registration of seven pesticides for prunes.

Methyl bromide use was eliminated and replaced by increases in 1,3-dichloropropene and chloropicrin for soil fumigation prior to planting. The amount of field fumigants applied increased from 62,000 pounds in 2002 to 182,000 pounds in 2017. Methyl bromide was a broad-spectrum soil fumigant, whereas 1,3-dichloropropene and chloropicrin have efficacy against specific types of pests and, therefore, may be used together to achieve the same level of control as methyl bromide. Pre-plant ring nematode management is especially important since root infection by this nematode makes scions more susceptible to bacterial canker and there are no effective post-plant ring nematode management tactics. Planting certified disease-tested nursery stock into fumigated soil is commonly used to manage soilborne pests and provides continuing benefits through the lifespan of the orchard.

Due to the switch to drip or micro-sprinkler irrigation and the elimination of cross-disking described perviously, herbicide use, measured in pounds of active ingredient, increased 43% despite the 49% reduction in acreage. On a per acre basis, herbicide use increased from 0.9 pounds AI per acre in 2002 to 2.5 pounds AI per acre in 2017. Glyphosate use increased from about 55,000 pounds AI in 2002 to 63,000 pounds AI in 2017. Glufosinate was not used in 2002 but 10,000 pounds AI were used in 2017 as a response to the emergence of glyphosate-resistant weeds (ryegrass, fleabane, horseweed) in orchards. Pendimethalin use increased from 1,000 pounds AI in 2002 to 13,900 AI pounds in 2017, in part because of the option to apply the product through irrigation lines.

Application of pesticides to control plant diseases (both bactericides and fungicides) decreased 32%. However, because of the decline in prune acreage, the per-acre use of pesticides to control plant diseases increased from 3.9 pounds AI per acre in 2002 to 5.1 pounds in 2017. Sulfur, which is also used for mites, was the predominate plant disease pesticide representing 60 and 46% of pounds AI applied for diseases in 2002 and 2017, respectively. A portion of the decrease in sulfur use is due to increased use of strobulurin fungicides (FRAC Group 11), which are also effective against rust.

Two dozen new active ingredients for plant-disease management began to be used between 2002 and 2017, including six new biologically-based products. The 2018 PMSP documents a greater focus on irrigation and nutrient management and pruning practices to maintain tree health and reduce tree stress as a means to manage diseases.

Use of insecticides and miticides (not including oils) decreased 88% from 2002 to 2017 and oil use decreased 65%. On a per acre basis, insecticide and miticide use (not including oils) decreased from 0.6 pounds of AI per acre in 2002 to 0.1 pounds in 2017. Oil use also declined from 12.9 pounds of active ingredient per acre in 2002 to 8.5 pounds in 2017. The use of organochlorine and carbamate

insecticides was eliminated and organophosphate insecticide use decreased 99.5%. Pyrethroid use increased 49% and growers began using neonicotinoids and insect growth regulators. The use of biologically-based insecticide products increased 100% from 2002 to 2017. Overall, there was a shift from broad-spectrum to more targeted insecticides.

The 2018 PMSP documents a greater emphasis on conservation biological control and pollinator protection. Mating disruption is now available for peach twig borer management and this practice was beginning to be adopted as documented in the 2017 Pesticide Use Reports. Scouting practices and monitoring techniques have improved since the 2012 publication of the Prune Production Manual (Buchner 2012) and 2009 update to the Pest Management Guidelines for Prunes (Adaskaveg et al.). These documents are likely to have contributed to reductions in pesticide use through the increased use of spot treatments.

**Conclusion**

The 2018 Prune Pest Management Strategic Plan describes a more integrated approach to maintaining tree health as a pest management tactic and documents an increased awareness of the importance of pollinator protection. Changes in irrigation management practices resulted in improved environmental sustainability but also a greater use of herbicides and increased need for rodent management practices.

Improved production practices, monitoring techniques, economic thresholds and narrow-spectrum pesticides have significantly reduced the risks from insecticides applied in prune production in California.

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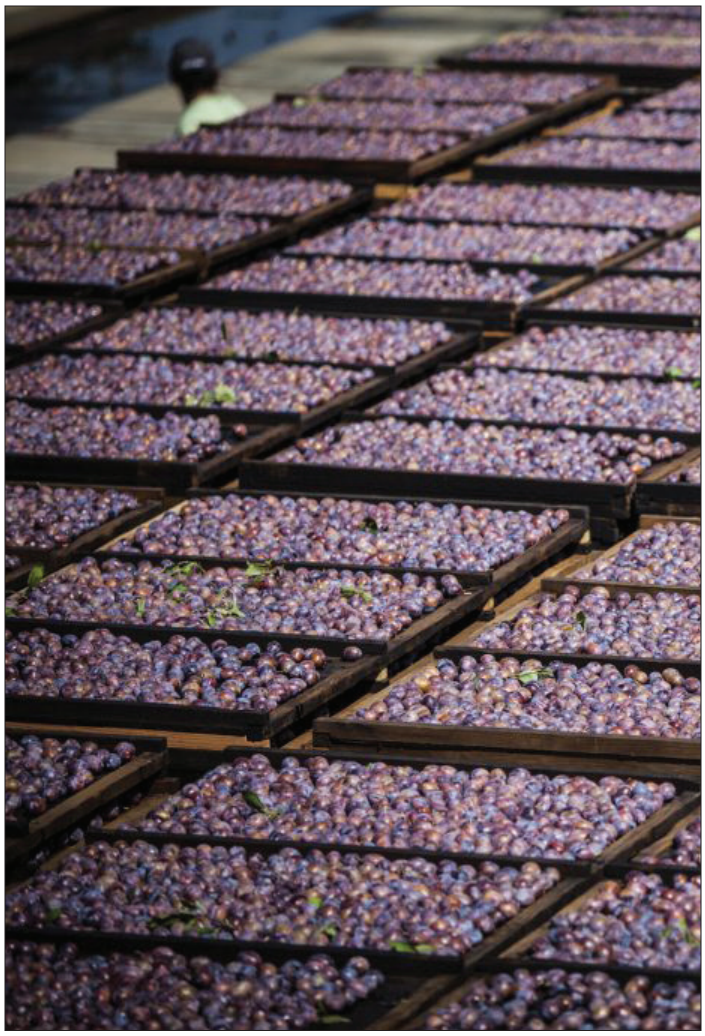

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