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Crop Fact Sheet series

Excerpted from **The Southwest Regional Climate Hub and California Subsidiary Hub Assessment of Climate Change Vulnerability and Adaptation and Mitigation Strategies** *(July 2015)*

This report describes the potential vulnerability of specialty crops, field crops, forests, and animal agriculture to climate-driven environmental changes. In the report vulnerability is defined as a function of exposure to climate change effects, sensitivity to these effects, and adaptive capacity. The exposure of specific sectors of the agricultural and forestry industries varies across the region because the Southwest is climatically and topographically diverse. The purpose of this analysis is to describe regional vulnerabilities to climate change and adaptive actions that can be employed to maintain productivity of working lands in the coming decades.

The report can be accessed here: http://swclimatehub.info/files/Southwest-California-Vulnerability-Assessment.pdf

Stone Fruit

Prunus persica (peaches and nectarines); *P. domestica* (plums); *P. armeniaca* (apricots); *P. avium* (sweet cherries); *P. cerasus* (tart cherries); Rosaceae

Collectively referred to as stone fruit, this group of closely related tree crops figures prominently in the Southwest's agricultural output. California produces about 70% of all the nation's peaches, 95% of apricots, 95% of fresh plums, 99% of dried plums, and 100% of nectarines [2] (Figure 1). Although California only produces about 20% of the nation's sweet cherries, this places it second in the nation, behind Washington State. Utah produces about 10% of the nation's tart cherries in an average year. All of California's stone fruit have a similar irrigation demand of about 36-40 inches per year [3]. However, they differ significantly in their chilling requirements [4] (Table 1).

In recent years, acreage of plums, peaches, and apricots has declined as almond acreage has increased [5]. This is partly because almonds are a durable and export-friendly product, whereas fresh stone fruit (especially apricots) are highly perishable. However, sweet cherry acreage in California has increased steadily since 1994, more than doubling over 20 years [6]. This is due to growing consumer demand both within and outside of California.

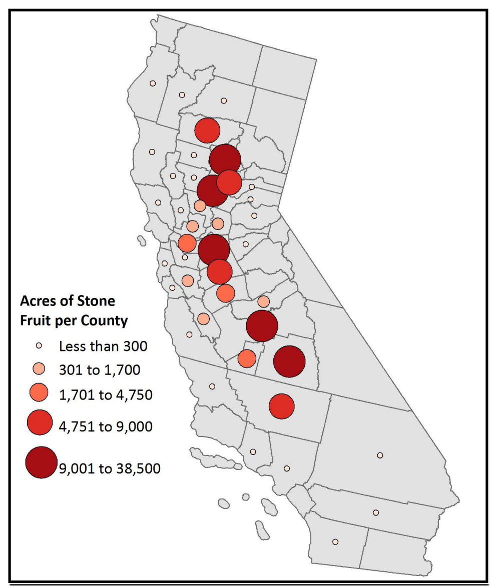

Figure 1. Acres of stone fruit grown in CA in 2012 (176,605 acres). Not shown: 5,300 acres in UT. [1]

Stone fruit are beset by a variety of pests and diseases, including leaf crinkle and other viruses, flower and fruit rots, *Phytophthora*, canker, powdery mildew, mites, aphids, borers, and birds [6]. Stone fruit also tend to be vulnerable to sunburn, excessive moisture, frost [2] and excessive heat during flowering [7]. They differ in their pollination requirements: cherries depend on bees for pollination, while plums are mostly pollinator-dependent depending on the variety. Peaches, nectarines and apricots are mostly self-fertile, however pollinators can increase yields in these stone fruit [8].

Temperature: Increasing temperatures are clearly the biggest threat to stone fruit production (Table 2). In fact, many farmers have already noticed the loss of chill-hours and the negative consequences for production [4, 9]. All stone fruit are vulnerable, but the most vulnerable crop appears to be sweet cherries. A highly-cited study by Lobell and Field [10] concluded that "among the 20 most valuable perennial crops, cherries are likely to be the most negatively affected by warming over the next decades," and that "the case of cherries is especially stark" because, unlike other stone fruit, cherries do not appear to benefit from increased temperatures in any season or at any stage of development.

Table 1. Stone fruit chilling hours requirements.

Peach and Nectarine	200-1,200 chill-hours
Apricot	350-1,000 chill-hours
Sweet cherry	600-1,400 chill-hours
European plum	700-1,800 chill-hours

The development and distribution of low-chill cultivars will be a key tool in helping stone fruit growers adjust warmer temperatures. Although there are some varieties of stone fruit that require only 200-300 chill-hours [7], the low-chill trait often comes at the expense of flavor, texture, or other desirable characteristics. For example, the popular and versatile Bing cherry (which accounts for two-thirds of California sweet cherry production) requires 700 chill-hours. According to the projections of Luedeling et al. [11], the Central Valley will no longer have significant land area suitable for Bing cherry production by 2060.

Higher temperatures pose two risks to stone fruit: not only does a lack of winter chill interfere with the timing and duration of blooming, but high temperatures in spring and summer can decrease fruit set, damage fruit production, and cause sunburn of tree trunks. The best long-term solution to the latter problems is to develop more tolerant cultivars [7], but in the short-term, orchard management practices such as early fruit thinning and careful irrigation may help to reduce losses.

Water: Curtailing water use in stone fruit is challenging because water stress can cause cosmetic defects that reduce the fruit's value or makes it unmarketable [12]. Water stress can also facilitate damage by mites and other pests and pathogens [13]. However, some degree of deficit irrigation can be employed with minimal losses if the timing is carefully controlled. For example, in early-maturing peaches, irrigation can be safely reduced after the fruit is harvested in May or June – but it must be restored in August and September, when next year's flowers are developing within the buds [13]. Another option is further development of rootstocks that are tolerant to drought and other abiotic stresses.

Because there are so many different varieties of stone fruit with a great diversity of phenology and cultivation practices, much work remains to be done on variety-specific deficit irrigation regimes. Thus, the risk of imposing excessive drought stress may be ameliorated by frequent measuring of stem water potential using a pressure chamber [12], though this technology is currently not accessible to most individual farmers.

Other factors: Warmer temperatures, potentially larger rainfall events, and the interaction of other stressors may exacerbate the already considerable pest and disease burden borne by stone fruit. If storms become more powerful, orchards may suffer increasing damage. Indirect effects of climate via pollinators, though perhaps not quite as severe for most other stone fruit as for almonds, still deserve close investigation.

Table 2. Vulnerability of stone fruit to climate change in California.

Exposure	Sensitivity	Adaptive Capacity
• Temperature: Moderate change (Central Valley likely 2.-2.5°C (3.6-4.5°F) rise by 2060). • Water: Decreased water availability very likely. • Extreme events: Higher frequency of heat waves; lower frequency of frosts; possibly increased intensity of storms.	• High sensitivity to loss of chill-hours (if below threshold). • Water requirements moderate to high though somewhat flexible. Irrigation-dependent. • Some are pollinator-dependent so may suffer indirect consequences. • Vulnerable to heat waves and sunburn in spring and summer.	• Temperature: Moderate to low capacity. Substitution of low-chill cultivars will be essential. • Water: moderate. Further irrigation efficiency gains may possible, and deficit irrigation strategies are under investigation. • Pollinators and storms: Low, due to unpredictability of these events.

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