USDA United States Department of Agriculture
Southwest Regional Climate Hub and California Sub Hub
http://www.usda.gov/climatehubs

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

Melons and cucumbers

Cucumis melo (honeydew and cantaloupe); *Citrullus lanatus* (watermelon); *Cucumis sativus* (cucumber); Cucurbitaceae

California and Arizona are the two leading states for cantaloupe production (together, 82% of the U.S. total) and honeydew production (89% of the U.S. total) [2]. Both are major watermelon producers, together supplying about 22% of the U.S. total. California supplies about 10% of cucumber production overall, but produces the majority of fresh-market cucumbers [3] (Figure 1).

Watermelon requires ample irrigation during establishment, but after the initial establishment period, several weeks of reduced irrigation encourages growth of a deep root system. This allows watermelons to tolerate a significant degree of soil moisture stress during vegetative growth. During fruit set and the fruit sizing period, irrigation must be managed to minimize water stress [4]. Insufficient water at fruit set leads to small fruit and an increase in blossom end rot, while excess water may cause fruit to split as it enlarges. Salt stress can also lead to blossom end rot [5]. Watermelons must be pollinated by bees, and for seedless watermelons, a large fraction of the field (up to 30%) needs to be devoted to less-marketable or unmarketable pollinator varieties of watermelon [4].

Cantaloupe, a warm-season annual plant, is sensitive to freezing temperatures at any growth stage. Slow growth occurs below 15.6°C (60°F), and optimal growth occurs from 29.4-35°C (85-95°F), yet cantaloupe can tolerate temperatures greater than 40°C (104°F). Cantaloupe, like watermelon, requires bee pollination for fruit set. Suboptimal weather conditions that reduce bee activity (cold, rain, wind, or clouds) may reduce yield [6]. Enhancement of native bee populations could help support melon pollination [7]. Under typical cantaloupe growing conditions in California, 10 to 15 inches of irrigation water is applied, but this can vary depending on irrigation efficiency, leaching requirements, and the need for pre-irrigation. Recent estimates indicate that at least 20% of cantaloupe acreage in California is drip irrigated [6].

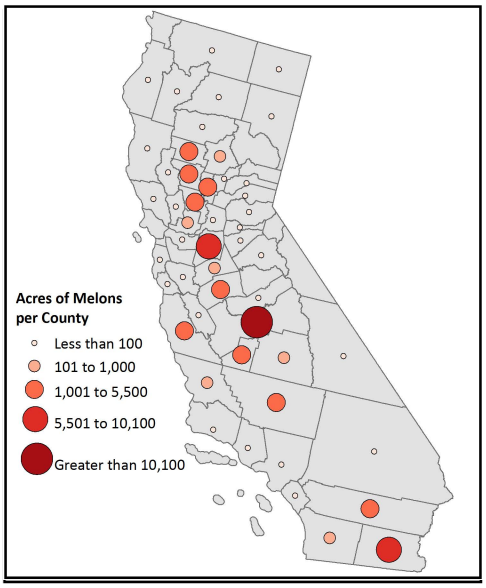

Figure 1. Acres of melons grown in CA in 2012 (67,694 acres). Not shown: 22,100 acres in AZ. [1]

Cucumbers, like cantaloupe and watermelon, are warm-season plants. They grow best in temperatures from 18.3-23.9°C (65-75°F) with a minimum temperature of 15.6°C (60°F) and a maximum of 32.2°C (90°F) (Table 1). Seeds do not germinate well at temperatures below 15.6°C (60°F), and prolonged temperatures below 12.8°C (55°F) can lead to chilling injury [8]. However, row covers or tunnels are sometimes used to keep cucumber plants warm in the field, allowing for earlier planting than would otherwise be possible [8].

Watermelons, cantaloupes [6] and cucumbers [8] are vulnerable to many fungal and viral diseases [4]. Some of these diseases are favored by warm

temperatures (bacterial fruit blotch); others by moderate temperatures (powdery mildew), [9] and still others by cool temperatures (Fusarium root rot) [10].

Temperature: In response to increases in mean temperature, melons and cucumbers are likely to suffer less than cool-season annual crops like lettuce and broccoli. Melons grow well in warmer temperatures, although cucumbers have a slightly lower temperature tolerance than melons. Recent research has suggested that increases in mean mid-summer maximum temperatures by mid-century may necessitate a shift from moderately heat-tolerant crops (such as bell peppers and sweet corn) to very heat-tolerant crops (such as melons) in some parts of Northern California [11].

Water: Melons require relatively less irrigation than many other annual crops, and in some areas of California they have been effectively dry-farmed [12], though this is not an economically viable proposition for most commercial farms. Melons are moderately but not extremely sensitive to salinity. Although negative impacts from reduced water quality or quantity are certainly possible, melons will likely be relatively less affected by climate-change-induced water stress than many other crops.

Other factors: Because melons are heavily dependent on bee pollination, any effect of climate change on bee populations (including the interaction of climate with other factors, such as pesticide use) could have major implications for melon production. The effect of climate change on melon pests and pathogens will be complex and difficult to predict, as it depends on the precise timing of temperature and humidity changes. Both positive and negative effects are likely.

Table 1. Vulnerability of melons and cucumbers to climate change in California.

Exposure	Sensitivity	Adaptive Capacity
• Temperature: Moderate to high exposure (Central Valley: 2-2.5°C (3.6-4.5°F) rise by 2060; inland southern CA and AZ 3°C (5.4°F) rise). • Water: Decreased water availability very likely. • Extreme events: heat waves.	• Low sensitivity to increases in average temperature. • Low sensitivity to water limitation: irrigation • Low sensitivity to extreme heat events. • Possibly high sensitivity to climate-pollinator or climate-pest interactions.	• Temperature: Moderate. Melons are already heat-resistant (cucumbers less so). Improving heat tolerance has not been a major focus so far. • Water: unknown, but probably moderate to high. Further efficiency gains may be possible (e.g. more drip irrigation).

References

1. National Agricultural Statistics Service, *2012 Agricultural Census*. 2014, US Department of Agriculture: Washington, DC.
2. National Agricultural Statistics Service, *Vegetables: Final Estimates 2008-2012*. 2014, US Department of Agriculture: Washington, DC. p. 111.
3. Starrs, P.F. and P. Goin, *Field Guide to California Agriculture*. 2010, Berkeley, CA: University of California Press. 475.
4. Baameur, A., et al., *Watermelon Production in California*, University of California Division of Agriculture and Natural Resources, Editor. 2008: Oakland, CA.
5. Mayberry, K.S., T.K. Hartz, and J. Valencia, *Watermelon production in California*. 1996, University of California Division of Agriculture and Natural Resources. p. 3.
6. Hartz, T., et al., *Cantaloupe Production in California*, University of California Division of Agriculture and Natural Resources, Editor. 2008: Oakland, CA.
7. Kremen, C., *Integrated crop pollination for resilience against climate change (and other problems)*, in *CDFA Climate Change Consortium*. 2013: Sacramento, CA. p. 52.
8. Schrader, W.L., J. Aguiar, and K.S. Mayberry, *Cucumber Production in California*, University of California Division of Agriculture and Natural Resources, Editor. 2002: Oakland, CA.
9. *Bureau of Land Management letter to Permittees in Las Cruces grazing district*, B.o.L.M. U.S. Department of Interior, Editor. 2011: Las Cruces, NM. p. 11.
10. UC Davis. *Cucurbits: Year-Round IPM Program*. 2011 September 2011 23 January 2015]; Available from: http://www.ipm.ucdavis.edu/PMG/C116/m116yi01.html.
11. Jackson, L.E., et al., *Case study on potential agricultural responses to climate change in a California landscape.* Climatic Change, 2011. **109**(1): p. 407-427.
12. Bland, A., *To Grow Sweeter Produce, California Farmers Turn Off The Water*, in *National Public Radio.* 2013: Washington, D.C.

Contact Us

Southwest Regional Climate Hub
http://climatehubs.oce.usda.gov/southwest
http://swclimatehub.info
Published 2016

California Sub Hub
http://climatehubs.oce.usda.gov/california
http://caclimatehub.ucdavis.edu/