What does Climate Change Mean for Specialty Fruit Crops of the Pacific Northwest? Adaptation Strategies for a Changing Climate

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Specialty Fruit Crops in the Northwest

The Farm Bill defines specialty crops as fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops. By dollar value the Northwest is the leading producer of tree fruit, nuts, and berries in the United States. For example, by value, Oregon and Washington produce 100% of the US hazel nuts, and 68-78% of us cherries apples and pears. Though the northwest produces 8% (by value) of US grapes, climate change is expected to make the region even more suitable for premium wine production in the future[1]

2015 Value of utilized production for selected specialty fruit crops in OR and WA

	 Apples	 Pears	 Sweet Cherries	 Grapes	 Hazel Nuts
	(Thousand Dollars)				
OR	44,383	152,497	67,571	147,550	129,600
WA	2,396,250	239,750	436,918	296,787	
Total	2,440,633	392,247	504,489	444,337	129,600
U.S.	3,394,185	500,416	758,915	5,561,719	129,600
% of U.S.	72%	78%	66%	8%	100%

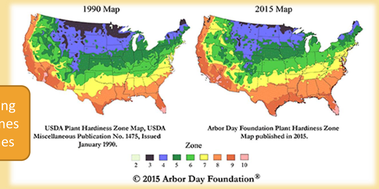
Source: USDA/NASS, 2016, Noncitrus Fruits and Nuts 2015 Summary. ISSN: 1948-2698.

Climate Changes in the PNW

- Annual average temperature in the PNW increased 1.3°F during 1895-2011 and is projected to increase by 3.3–9.7°F by 2070–2090 compared to 1970–1999[3]
- The length of the frost-free season has been increasing since the 1980's and is projected to continue lengthening, particularly in the western United States[4]
- Spring snowmelt in the PNW is projected to occur three to four weeks earlier by mid-century[3]
- Warmer winters are already causing spring runoff to peak 25–30 days earlier than they did in the mid 1900s throughout the Northwest (Stewart et al. 2004)
- Annual precipitation in the Northwest has generally increased since 1900 and precipitation is expected to increase slightly overall, but decrease during the summer[2,3]
- Extreme weather events such as heavy downpours and heat waves have increased and increased frequency and intensity of extreme precipitation events are projected in the future[4]
- In the Cascades, as cool-season temperatures have risen over the past several decades, snowpack has declined by an average of 20 percent—and up to 60 percent in some areas[3] resulting in decreased summer water supplies

What Climate Change Means for Fruit Crops in the Northwest

Currently, many of the effects of climate change are mild or positive, but by mid-century, climate impacts are projected to be negative for most U.S. Crops[5]. In the Northwest climate change will lengthen the dry season, raise temperatures during both the winter chilling period and the growing season, threaten summer water availability, and facilitate the spread of fungal diseases and insect pests. Such changes have the potential to substantially reduce net returns due to increased input costs and altered yields and product quality. One of the most notable changes is the shift in hardiness zones since 1990, indicated in the Arbor Day Foundation map below. This shifting in hardiness zones will be both beneficial and challenging in the future.



Shifting hardiness zones

Climate Change Benefits:

- Less frost and longer growing seasons in the PNW will create a greater potential for premium wine sites in the region (for at least the next 50–100 years[6]
- Less risk of freeze damage during the winter
- Longer growing season
- The northward shift in hardiness zones will expand suitable area

Reduced chilling hours will make some regions unsuitable for many current varieties of tree fruits

Climate Change Challenges:

- By mid-century, insufficient winter chill hours (the cumulative number of hours below 45 degrees), will make some regions unsuitable for many tree fruits – insufficient winter chill hours can disrupt pollination, delay flowering, lower yield, and reduce fruit quality
- Declining snowpack will result in less water availability during summer months for irrigation and climate control
- Hotter growing seasons will increase competition for water
- Hotter growing seasons may decrease product quality (flavor and texture of fruit)
- Increase insect populations and incidence of plant diseases
- Earlier spring onset may lead to more false springs, resulting in frost damage from subsequent freezing temperatures

Chilling Hour Requirements for Common Commercially Grown Fruit Varieties in the Northwest*

Apples	Chill Hours Required	Pears	Chill Hours Required	Sweet Cherry	Chill Hours Required
Honeycrisp	800-1000	D'Anjou	800	Bing	700
Red Delicious	700	Red Anjou	800	Rainier	700
Braeburn	700	Comice	600	Royal Rainier	600-700
Golden Delicious	700	Bosc	500-600	Rosie Rainier	600
Fuji*	500	Seckel	500	Lapins	500
Gala	500				
Granny Smith	400				
Pink Lady***	200-400				

Notes
*most grapes require less than 150 chill hours.
**Fuji is generally listed as requiring 500 chill hours, but some now rate it at less than 500 chill hours due to its success in the Southwest.
*** Pink Lady currently represents only 3% of NW fresh apple crop production.
Sources for chill hour requirements: Northwest Horticulture Society and Dave Wilson Nursery. http://nwhort.org http://www.davewilson.com

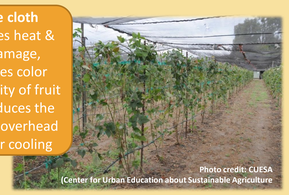
Adaptation Strategies

Many adaptation strategies are already being used to either prolong growing seasons in marginal production areas or improve production and quality in established production regions. These strategies involve moderating temperatures and controlling and compensating for mismatches between phenology and seasonal weather conditions.

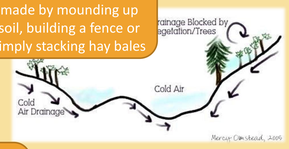
Heat damage can be reduced by pruning the canopy to prevent direct exposure to sunlight, applying clay, calcium carbonate, or wax emulsion sprays and scheduling irrigations to reduce water stress. More costly methods such as shade cloth and overhead sprinkler cooling systems are commonly used in the apple and blueberry industry, where the economic consequences of heat damage are very large.

Frost damage can be minimized by delaying pruning until frost danger has passed, or by double pruning (a rough pruning in the colder months when the vine is completely dormant and a final pruning just after budbreak). Because buds emerge first on the tips, the damage will occur to buds that need to be pruned off anyway. If delayed pruning is not practical, prune twice.

Shade cloth minimizes heat & sun damage, increases color and quality of fruit, and reduces the need for overhead sprinkler cooling



Manage for cold air drainage: A solid fence built around an orchard can keep out cold air or a diversion dam can be made by mounding up soil, building a fence or simply stacking hay bales



Pruning to minimize frost damage

Wind turbines *are used to prevent frost from settling on crops*

Adaptation strategies require availability of labor and capital to both pay workers and invest in research and technologies

Genetic engineering and plant breeding are also important adaptation strategies. Well before breeders were aware of climate change they have been breeding many crops for low-chill varieties. For example blueberry breeders have been breeding for reduced chilling requirements over the last 50 years, consequently, blueberry cultivars are now available with chilling requirements ranging from 0–1000 chill hours[7].

Promising advancements in marker-assisted breeding and phenomics could accelerate development of climate-ready fruit and nut crops[8,9].

Development of more climate resilient technologies and management strategies will require the availability of both labor and capital.

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Conclusions

The agricultural sector's ability to adapt can offset some adverse impacts of a changing climate, however, development of more climate resilient technologies and management strategies is not costless. In order to develop a comprehensive adaptive management strategy, produces will need to gather data on both short and long-term future climate conditions for a variety of climate variables and thresholds specific to individual crops, as well as information about management alternatives and how these will affect management goals and net returns. A way to evaluate the tradeoffs associated with the costs and benefits of each adaptation method also needs to be considered.

USDA United States Department of Agriculture National Institute of Food and Agriculture

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