

DROUGHT AND ITS EFFECT ON FRUIT TREES

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Impact of the 2012 freeze and drought on the tree fruit industry

- The April 11 and 12th spring frost damaged most of the fruit crop in the central and northern parts of the state

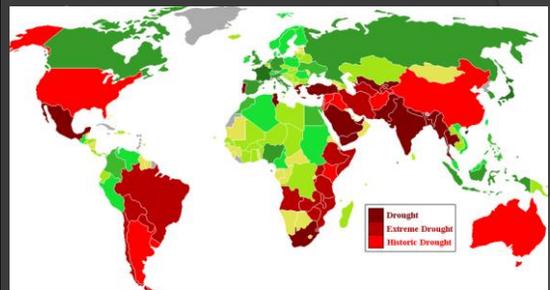


Droughts in North America

- The most severe is the Dust Bowl
- Started about 1930 and lasted for almost a decade.
- By 1934, more than 75% of the country was affected by the drought with 27 states affected severely.
- In 1937, Roosevelt addresses the nation in his second inaugural address, stating, "*I see one-third of the nation ill-housed, ill-clad, ill-nourished.*"
- Other droughts include:
 - 1956. Resulted in an estimated 50% loss in yield and about \$12 billion total loss in Agriculture revenue.
 - 1988
 - 2011 and 2012

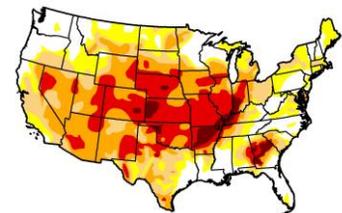


Droughts around the world in 2012



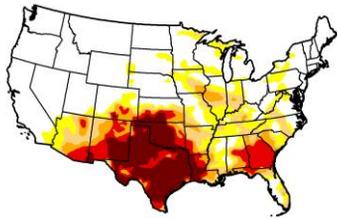
US drought distribution, July, 2012

Abnormally dry
 Moderate
 Severe
 Extreme
 Exceptional



US drought distribution, August, 2011

Abnormally dry
Moderate
Severe
Extreme
Exceptional



2012 Drought

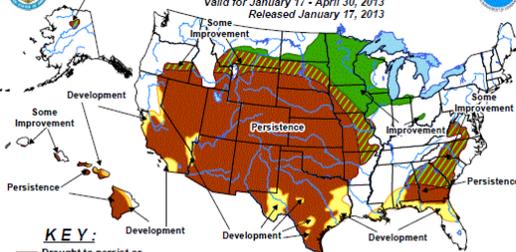
- Worst since December 1956
- The dry and hot weather of 2012 was ranked the 3rd worst in 118 years of record keeping
- In June, nearly 70% of the country was reported to be under drought
- USDA designated more than 1,300 counties as natural disaster areas
- Gary Schnitkey, a University of Illinois extension economist, calculated that 2012 insurance payout to corn farmers alone could exceed \$3.2 billion.
- Bruce Babcock UIW estimated that total crop insurance claims for 2012 could reach \$40 billion.
- Nearly \$10.7 billion were spent on weather related insurance claims in 2011.

U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for January 17 - April 30, 2013

Released January 17, 2013

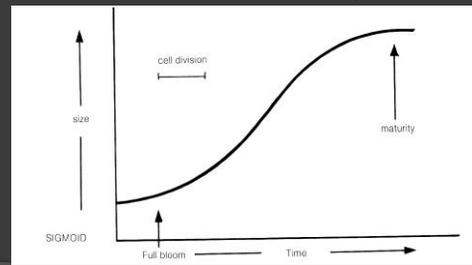


KEY:
 Drought to persist or intensify
 Drought ongoing, some improvement
 Drought likely to improve, impacts ease
 Drought development likely

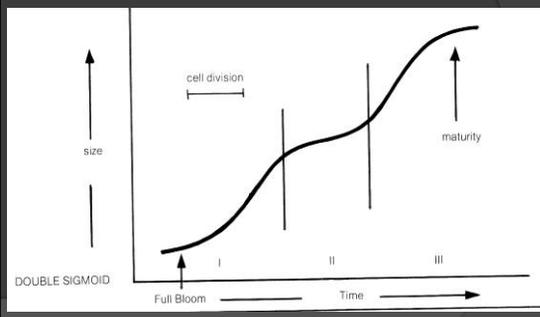
Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events – such as individual storms – cannot be accurately forecasted more than a few days in advance. Use caution for applications – such as crops – that can be affected by such events. “Ongoing” drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

Fruit growth

- Most fruits grow in a sigmoidal curve
- Example include apples, pears, oranges, strawberries

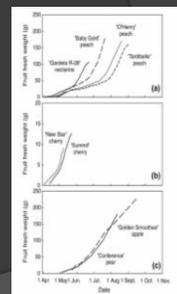


- Stone fruits like peaches, apricots, cherries, plums have double sigmoidal growth curve



Impact of drought on fruit growth

- Apple fruit growth continues during the season. Constant water supply is needed.
- Peaches, apricots, and plums fruit growth slows during pit hardening, but picks up afterwards.
- Studies have shown that peach fruit growth is linearly related to the water status of the tree.



Time of drought and its effect on current and next year's crop

- Effect on current year's crop
 - Drought causes yield reduction in all fruit trees tested.
 - Effect was mainly on fruit size and weight, but not fruit number
 - One study showed that June drop was more severe under drought stress
- Effect on next year's crop
 - Decrease pollen viability
 - Decrease root carbohydrate content
 - Less fruit number but has no effect on fruit weight

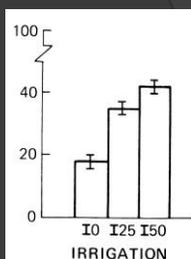
Tree mortality from winter injury and diseases was higher following a severe drought year.

Effect of drought stress after fruit harvest on next year's crop

- Decreased yield in apricots, nectarines, peaches, and plums the following year.
- In plums, severe drought after harvest reduced the following year's crop load by about 64%.
- Moderate drought had little effect on next year's crop in peaches, pears, cherries.
- Trees under severe stress could take up to two years to recover.
- Conference pears pack-out was reduced by 85% when trees were exposed to drought stress

Effect of drought stress on root growth

- Trees under low water stress form most of their roots in the upper 1.5 ft of the soil.
- Dry soil restricts root formation.
- Trees under stress suffer more from nutrient deficiency
- In peaches most nutrient uptake is from small fibrous roots in the upper foot of soil.



Percent of total roots of 11-year old Harken peach trees exposed to no irrigation (I0), low irrigation (I25) and high irrigation (I50)

Lane et al., J. Amer. Soc. Hort. Sci., 1986

Changes in nutrient levels in drought stressed trees

- Has no effect on nitrogen or phosphorous
- Increased magnesium and manganese
- Decreased calcium, potassium, and boron
- Reduced photosynthesis and respiration
- Reduced leaf size, shoot length, and root growth

Effect of drought on graft union of dwarfing rootstocks



Effect of rootstocks on one year old Fuji tree growth and function

Rootstock	Total shoot length (cm)	Branches		Photosynthesis $\mu\text{mol CO}_2/\text{m}^2/\text{sec}$
		< 1"	> 1"	
Vigorous (Ottawa-3)	471a	5.2a	8.9a	18.3a
Semi vigorous (Malling-9)	383b	5.9a	8.0a	20.5a
Dwarfing Malling-27	244c	6.4a	6.2a	12.3b

Towkoski and Fazio

Dwarfing rootstocks are very sensitive to water stress



Severe flooding during fruit growth and development causes premature fruit ripening followed by tree death. (Pinova on M.9).
Photos by Jozef Racsko.

Apple rootstocks susceptibility to drought stress

- Very susceptible
 - Sub-dwarfing rootstocks M.27 and P.22
 - Geneva 11
 - Geneva 30
- Moderately susceptible
 - M.9 and clones
 - M.26
- Low susceptibility
 - M.7
 - MM.111 and 106

G.5202, G2034, G41, G.935



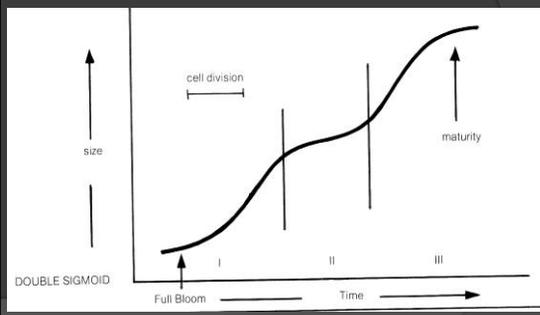
Influence of drought on peaches

- Redhaven trees on several rootstocks showed signs of stress, but no tree mortality.
- Recommendations.
 - Water stress increases soluble solids and color, but it significantly reduces fruit size. Fruit size is more influenced by stress during the first and second phases of growth than during pit hardening.
 - Trees of early maturing varieties are more vulnerable to water stress than late maturing varieties.
 - Trees maybe vigorously pruned or dehorned under severe drought in order to keep them alive

It is highly recommended that you apply boron to plums, especially after a severe drought



- Stone fruits like peaches, apricots, cherries, plums have double sigmoidal growth curve



Influence of drought on peach trees and fruits



After harvest

Before harvest