OLIVE IRRIGATION MANAGEMENT UNDER DROUGHT CONDITIONS

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April 5, 2014

NEAR RECORD DROUGHT IN CALIFORNIA

- Growers statewide have been told to expect a "0% Allocation" from state and federal water projects.
- In many areas groundwater levels have fallen due to overdraft and lack of recharge due to minimal rainfall.
- As olives for oil production are a relatively low net revenue crop they are often planted in areas with reduced water supply, thus the drought issue is compounded for many olive growers
- **This however may prove to be an excellent year to be an olive grower**

SOME PERSPECTIVE

- The vast majority of olives grown worldwide are not irrigated
- The olive has evolved under harsh and dry Mediterranean climate conditions.
- Research has defined strategies for maximizing available water and reducing overall use.
- Olive water use is directly related to crop load.
- The olive is tolerant to poor water quality
- **The olive will not die with no irrigation applied**

WHY DO WE IRRIGATE OIL OLIVES?

- Most growers ask how often and how much should I irrigate my olives.
- Very few growers understand why they irrigate olives for oil and when it is important.
- Water demand varies considerably during different stages in crop development and by crop load.
- **Before developing an irrigation plan each grower should determine the production goals for their respective olive grove**.

SUGGESTED PRODUCTION GOALS

- 1. Production of high quality fruit to maximize;
  - Volume of fruit yield at sustainable level
  - Oil quality
  - Oil content in fruit at time of harvest
  - Extractability of oil from fruit to maximize net oil yield
- 2. Generate regrowth adequate to support consistent crop load for following year.
- 3. Maintain basic metabolic functions in tree and maintain a healthy balanced tree.

GOAL: SUSTAINABLE FRUIT YIELD

- Fruit production is optimized when tree is provided with adequate moisture and nutrition at key development stages
- Pre bloom and during bloom are the most critical stages where moisture stress can reduce fruit set
- Final fruit weight is influenced by moisture content at time of harvest
- Moisture content of fruit is critical for fruit removal at harvest

GOAL: MAXIMIZE OIL CONTENT

- Oil begins to accumulate in fruit after pit hardening.
- After pit hardening the fruit becomes the tree's priority for allocation of both water and nutrients.
- Managed irrigation after pit hardening to minimally maintain fruit can increase oil content and hasten maturity.

GOAL: OIL QUALITY AND EXTRACTABILITY

- Both excessive and inadequate irrigation can cause oil quality problems.
- Insufficent moisture in fruit causes fruit shrivel.
- Shriveled fruit tends to exhibit advanced color with reduced oil content, can be misleading.
- Shriveled fruit may require the miller to add water during processing thus slowing processing and damaging quality
- Excessive fruit moisture produces washed out flavor and low oil% yeilds

GOAL: REGROWTH TO SUPPORT BALANCED CROPS

- The olive is an alternate bearing plant in that crop yields fluctuate between "on" and "off" years.
- A significant factor in alternate bearing is the crops demand for water and nutrients thus limiting the trees ability to produce regrowth.
- If regrowth is limited there will not be sufficient fruit buds to support a consistent crop from year to year.
- The olive tree has two periods of rapid vegetative growth;
  - Early spring growth (March through May) corresponding with rising soil temperatures
  - Early fall normally corresponding with fruit veraison.
- The spring growth period is generally the most efficient time to encourage regrowth as the tree is not also supporting fruit and oil accumulation.

GOAL: MAINTAIN A HEALTHY BALANCED TREE

- Moisture supports basic photosynthesis and metabolic function
- Severe moisture stress at any period during the year will cause increased stress and exposure to disease pressure and frost damage.
- Growers often neglect to maintain moisture in the soil profile during dry winter months increasing frost damage.

METHODS AND CONCEPTS FOR PRACTICAL IRRIGATION MANAGEMENT

- 1. Physical inspection of soil moisture in the wetted area
- 2. Understanding the volume of the wetted area, root depth, and root mass.
- 3. Understanding the time required to replenish moisture in the available wetted area.
- 4. Using envirotranspiration or Et for determining baseline irrigation targets
- 5. Concept of regulated deficit irrigation or RDI during key periods.
- 6. Monitoring and understanding fruit moisture content and the effects of high and low fruit moisture at different stages.

1. PHYSICAL INSPECTION

- Always the first and last determinant in irrigation timing and duration.
- Check soil depth from 0 to 20”
- Check are immediately under emitter and at edge of wetted area.
- Make sure orchard staff and farmer have uniform understanding of adequate moisture and terms.
- Backhoe soil pits are helpful to understand soil profile and rooting depth

2. THE WETTED AREA

- The olive is a relatively shallow rooted tree.
- Roots will grow and retract as the wetted area changes.
- Volume of the wetted area can be managed by;
  - Emitter spacing
  - Emitter flow rate
  - Multiple hoses
  - Irrigation duration and frequency
- Wetting pattern varies by soil type and infiltration rates.
- Short frequent irrigations often create small root mass

3. IRRIGATION DURATION

- The length of time water is applied can be determined using several factors;
  - Rate of application in terms of gallons per hour
  - Relative soil moisture holding capacity
  - Infiltration rate of water into soil considering any infiltration issues
  - Depth of roots
  - Hard pan, water table, salt intrusion or other physical limiting factors
- Applied irrigation should saturate soil to a minimum depth of 24”
- Irrigating for the same amount of time week after week can result in salt accumulation and limited root growth, it is good practice to vary duration occasionally.
- Consider water quality issues and soil conditions when planning irrigation duration, monitor for runoff.

4. USING ET FOR BASIC IRRIGATION GUIDE

- Et is the measure of the loss of water to the atmosphere through transpiration, evaporation, and leaching.
- Et is calculated using a baseline of the water use of one acre of fully irrigated grass
- Crop coefficients can be used to adjust Et to crop specific use, known as Kc or crop coefficient.
- Olive crop coefficient is between .55 and .75 depending on stage of tree development, crop load, and canopy area.
- Et forecasts and historical data is available through subscription weather service or at www.cimis.water.ca.gov. Look for the station nearest your grove.
- Et is best used during the period after pit hardening and verasion for deficit irrigation planning.

5. DEFICIT IRRIGATION AFTER PIT HARDENING

- Multiple studies in several countries have shown reduced irrigation levels after pit hardening are successful in;
  - Improving oil quality
  - Increasing oil quantity
  - Advancing maturity
  - Maintaining year to year cropping
- Et used in base planning with fruit moisture the best determinant of stress level
- Fruit condition must always take priority for irrigation timing.

THE TAPER METHOD; PIT HARDENING THROUGH VERASION

- Several multi year studies in California indicated the most successful method of deficit irrigation after pit hardening was the gradual reduction of of applied irrigation using Et.
- Irrigation levels were roughly 50% Et (no crop coefficient) at pit hardening.
- Applied irrigation was reduced by 5% Et weekly with minimum irrigation level of 20% Et.
- at time of verasion irrigation levels were increased to roughly 30% Et although fruit moisture level was used to adjust irrigation after verasion.
- Several long irrigations (12 to 16 hours) were applied 4 to 7 days before harvest
- **Taper method increased oil quantity and improved oil quality over 6 years of trial.**

STRATEGIES FOR SEVERE WATER LIMITATIONS

- If water supply is not sufficient or reliable to produce a commercial crop consider removal of crop at bloom or after fruit set.
- Compounds are available for foliar application to remove fruit after pollination and set.
- If crop is eliminated water can be concentrated during spring and early summer to produce regrowth for 2015 crop and allow for limited fertigation.
- If crop is not removed concentrate water application in May and June, then again in early October.
- Loss of failure of water supply is an insurable event under the USDA Olive crop insurance program including CAT coverage.