### San Joaquin Valley Table Grape Seminar
**Wednesday, February 22, 2006**
**Visalia Convention Center**

**REGISTRATION INFORMATION AND PROGRAM ENCLOSED**

## Understanding Water Units
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Good water management requires an understanding of **when** to irrigate, **how much** water to apply, and **how to** uniformly apply the water over the field. The first step to becoming an efficient water manager is to understand units of water measurement.

**One Acre-Foot** = 325,851 gallons

**One Acre-Inch** = 27,154 gallons

These are volume measurements, the volume of water that covers an acre of land one foot or one inch deep:

| Units of Measurements | |
| --- | --- |
| One acre | = an area of land that is 43560 $ft^2$ |
| One cubic foot ($ft^3$) | = 7.48 gallons |
| One acre-foot | = 43560 $ft^2$ x 1 foot water depth |
| | = a volume that is 43560 $ft^3$ |
| One acre-foot | = 43560 $ft^3$ x7.48 gallons/$ft^3$ |
| | = 325,851 gallons |
| One acre-inch | = 43560 $ft^2$ x .0833 ft (1 inch) a volume that is 3630 $ft^3$ |
| One acre-inch | = 3630 $ft^3$ x 7.48 gallons/$ft^3$ |
| | = 27,154 gallons |

The amount of water applied to a field is usually reported in acre-inches of water, and the rate of E.T. (evapotranspiration) for crops is usually given in acre-inches per day. However, pump discharge is usually given in gallons per minute, and herein lies some confusion when calculating pumping time for an irrigation.

Thinking in terms of gallons rather than acre-inches makes it easy to determine how long to run your pump to apply a given irrigation amount. A four inch irrigation is about 110,000 gallons per acre (4 inches x 27,154 gallons/inch = 108,616 gallons); a six inch irrigation is about 160,000 gallons per acre.

**Example:** Assume you are going to irrigate a 50 acre field and apply 110,000 gallons per acre (4 inch irrigation), and your pump discharges 750 gallons per minute. How long will you have to run the pump? **The answer is 5.1 days.**

Calculated as follows:
1) 50 acres x 110,000 gallons per acre
        = 5,500,000 gallons

2) 5,500,000 gallons/750 gallons per minute pumping discharge
        = 7333 minutes pumping time

3) 7333 minutes/60 minutes per hour
        = 122 hours; 122 hours/24 hours per day
        = 5.1 days

Keeping a record of how much water is applied each irrigation is the key to maximizing production and irrigation efficiency. By keeping records, the irrigator often discovers that too little water is applied during hot summer months when water infiltration rates are slow and crop water use is high; or it may be discovered that too much water is applied to shallow hard pan soils creating a water logged soil; or, that too much water is applied to well drained soils increasing energy and water costs.

A water meter is the most direct way of tracking irrigation amounts. However, irrigation amounts can also be determined by noting pumping time per irrigation along with pump discharge rate.

**Another Example:** You have 50 acres of drip irrigated vineyard with 454 vines per acre. The average E.T. for this vineyard during the month of July is 0.2 acre-inches per day. How many gallons of water must be applied daily to the vineyard to keep up with E.T.? How many gallons does an individual vine use each day? **The answers are 271,500 gallons per day for the 50 acre vineyard, and 12 gallons per day for an individual vine.**

Calculated as follows:

1) Vineyard E.T. (gals/acre/day) = 0.2 inches/day x 27,154 gals/inch

= 5430 gallons per day acre per day; 5430 gals. per acre x 50 acres

= 271,500 gallons per day for the entire 50 acres

2) Vine E.T. (gals/vine/day) = 5430 gals per acre/454 vines per acre

= 12 gallons per vine per day

With a water meter, drip irrigations are scheduled so that the 271,500 gallons of water required daily by the 50 acre vineyard are metered out accurately. Without a water meter, the irrigator must know the average flow of the drippers. For example, if every grapevine has two drippers and the average dripper flow is ½ gallon per hour; then, the drip system needs to run 12 hours each day to apply the required 12 gallons per vine – which is equal to 5430 gallons per acre, which is equal to 271,500 gallons for 50 acres.

**Final Example:** The evapotranspiration rate of a deciduous orchard during July averages 0.22 acre-inches per day. What is the E.T. of this orchard in gallons per minute per acre? You irrigate with a low volume irrigation system which has an application efficiency of 80%; what would be the minimum size pump discharge for one acre to meet the orchards E.T. requirement, allowing for the system inefficiency? **The answers are 4.1 and 5.1 gallons per minute, respectively**.

Calculated as follows:

1) E.T. = 0.22 inches per day x 27,154 gallons per inch

= 5974 gallons per acre per day

2) E.T. = 5974 gallons per day/24 hours per day

= 249 gallons per acre per hour

3) E.T. = 249 gallons per hour/60 minutes per hour

= **4.1 gallons per minute per acre**

4) Pump requirement = 4.1 gallons per minute/0.8

= **5.2 gallons per minute per acre**

To keep up with the E.T. of **one acre** during July, a pump discharging 5.2 GPM would have to run 24 hours a day (assuming the irrigation system has an application efficiency of 80%).

Note: To allow for down time and more flexibility, most irrigators would like to have a **minimum pump capacity of 10 GPM per acre.** Therefore, a 50 acre farm would require a pumping capacity of 500 GPM, etc.

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**More Units of Water Measurement**

**FLOW: Gallons Per Minute (GPM)**
- 452.5 GPM = one acre-foot in 12 hours
- 452.5 GPM = one acre-inch per hour
- 448.8 GPM = one cubic foot (7.48 gal) per second
- 694.4 GPM = 1,000,000 gallons per day

**HEAD:**
- 1 Pound Per Square Inch (psi) = 2.31 ft. head of water
- 1 Foot of Water = 0.43 psi
- 1 Atmosphere (at sea level) = 14.7 psi

**WEIGHT:**
- 1 U.S. Gallon Water = 8.34 pounds
- 1 Cubic Foot of Water = 62.4 pounds
- 1 Acre-Foot of Water = 2,719,226 pounds

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# Grape Notes

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## Table Grape Seminar
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