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Grape Notes

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Drying Emulsion Accelerates Drying of DOV Raisins

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Drying emulsions to accelerate raisin drying were developed in ancient times in the Mediterranean area and Asia Minor using olive oil and wood ash. Today, esterified fatty acids from canola oil (oleate) are used in place of olive oil and food grade potassium carbonate (K_2CO_3) has replaced wood ash. Oleate rearranges the outermost layer of the berry, the cuticle, which consists of cutin material covered with wax platelets. The K_2CO_3 neutralizes free fatty acids and fixed charges on the berry surface which also enhances water loss.

Australian growers use oleate/K_2CO_3 emulsion to produce a light, amber-colored raisin destined for specific markets. Faster drying allows them to successfully dry raisins under less than ideal drying conditions. They either spray fresh grapes placed on drying racks or they spray the fruit on the vine soon after canes are cut to facilitate the production of dried-on-vine (DOV) raisins.

California growers experimented with oleate/K_2CO_3 in the 1970's and early 1980's. A spray-on-tray (SOT) treatment was developed by Fresno State researchers as a means to shorten drying time and thus rain risk. Once the grapes were spread on the trays they were sprayed with emulsion from a tractor straddling an elevated terrace. SOT was largely abandoned by 1988 due to the added production costs, absence of premium prices for SOT raisins, and a limited market for light colored raisins.

In the 1970's, Oleate/K_2CO_3 emulsion treatment were also tested on DOV raisins. Like in Australia, the emulsion was applied when canes were severed to initiate the drying. Raisin drying was accelerated and an amber colored raisin was produced. However, the entire vine was sprayed with the emulsion, and vine vigor and yields went down as a result of damage to canopy and next year's fruiting canes. The production of oleate/K_2CO_3 DOV raisins never got off the ground.

Today, DOV raisins are produced using systems that separate the renewal from the fruiting areas of the vine. This allows oleate/K_2CO_3 emulation to only be sprayed on the fruiting area, thus eliminating the problem of spray damage to next years fruiting canes. DOV systems that distinctly separate the vine's renewal and fruiting sections include the South Side (Sun Maid) system, WRAB DOV (Peacock) system, and the alternate middle overhead (Simpson) systems, Photos 1. In addition, a new drying oil significantly reduces damage to the foliage compared to oils used in the 1970's.

Therefore, we revisited the process of producing DOV raisins using oleate and potassium carbonate as a drying aid. The following two experiments evaluated oleate/K_2CO_3 emulsion sprays in the production of DOV raisins.

Materials and Methods: Trials were located in a mature Thompson Seedless vineyard located at the Kearney Research and Extension Center in 2004. The 'T' trellis consisted of a 48- inch crossarm on a seven foot stake with four wires. The Peacock DOV system was used to produce DOV raisins, Photos 2. Vines were pruned to four canes. Shoots were thinned in late April by removing shoot from the top of the trunk head, which separated the renewal and fruiting areas of the vine, and eight shoots on the renewal side of the vine were retained. Four shoots to become next years fruiting canes were positioned onto wires in late May and cluster on the head of the vine were also removed.

Experiment I was designed as a randomized complete block with six blocks and six treatments and using two vine plots. Canes were severed on August 19th and fruit soluble solids were 18.1 °brix. Treatments were as follows:

1. Control – no drying aid applied;
2. 8/25 – Oleate/K_2CO_3 (0.5% and 0.6%);
3. 8/25 - Oleate/K_2CO_3 (1.0% and 1.2%);
4. 8/25 & 9/1 – Two applications of Oleate/K_2CO_3 (0.5% and 0.6%);
5. 9/1 - Oleate/K_2CO_3 (0.5% and 0.6%);
6. 9/1 - Oleate/K_2CO_3 (1.0% and 1.2%).

Experiment II was designed as a randomized complete block with four blocks and three treatments using two vine plots. Canes were severed on September 1st fruit and soluble solids were 19.2 °brix. Treatments were as follows:

1. Control – no drying aid applied;
2. 9/7 – Oleate/K_2CO_3 (0.5% and 0.6%);
3. 9/7 and 9/14 – Two applications of Oleate/K_2CO_3 (0.5% and 0.6%);

The drying emulsion used was Victoria™ Fruit Drying Oil produced by Victorian Chemicals of Australia. It contains 59.6% ethyl and methyl esters of fatty acids produced from food grade canola oil. We refer to the product as oleate. The potassium carbonate used was also a food grade material.

In both experiments, the emulsion was applied with a hand wand using 300 gallons per acre and clusters were thoroughly wetted. Spray was only applied to the fruiting section and not the renewal section. Fruit was sequentially sampled during the drying process to determine the drying rate and compare treatments. Raisin moisture was determined by taking raisin samples from treatments, oven drying until no further weight loss, and then calculating raisin moisture based on weight lost during drying. Raisins were harvested on October 13th and yield and fruit quality were documented.

The oleate/K_2CO_3 emulsion was prepared by applying 0.5 gallons of Victoria™ Fruit Drying Oil and 5 pounds of food grade K_2CO_3 per 100 gallons of water. When applying 300 gallons per acre the material cost equaled $33.00 per acre.

Results and Discussion: The application of oleate/K_2CO_3 accelerated raisin drying in both experiments. Canes were severed on August 25th in Experiment I, and the untreated control fruit took 50 days to dry to 16% moisture; whereas, oleate/K_2CO_3 treated fruit took 35 days. Doubling the application rate of oleate/K_2CO_3 improved drying rates initially, but this advantage diminished by the end of the drying process. Spraying a second time, again one week later, also improved drying rate initially but the advantage diminished. It appears that the emulsion can be applied as much as two weeks after canes are cut and still get a positive response, Fig. 1.

In Experiment II, canes were cut on September 1. In this case, applying the emulsion made the difference between successfully drying the raisins on the vine or not. Oleate/K_2CO_3 sprayed raisins dried below 16%; whereas, the untreated fruit never got below 25% moisture. Applying Oleate twice, September 7th and again on September 14th, did not improve the drying rate compared to a single application on September 7th, Table 2, and this agrees with the findings in Experiment I. The emulsion's effect on drying appeared to be more positive with Experiment II, and this may have been associated with higher fruit sugar when canes were severed on September 1st rather than August 19th.

Oleate/K_2CO_3 spray had no impact on either yield or raisin quality, Tables 1 and 2. Oleate/K_2CO_3 treated raisins had a light amber color appearance compared to unsprayed fruit, Photos 3. The color is not uniform, however, with some raisins darker than others. The darker raisins result from fruit not covered by emulsion, and these are usually berries in the interior of the cluster. Local grower experience has demonstrated that increasing the application volume above 300 gallons per acre improves penetration of the emulsion within the cluster and improves the uniformity of raisin color. As much as 900 gallons per acre have been used to produce premium colored raisins, but this triples both material and application costs.

Presently, there is very little oleate DOV raisin produced in California, a few hundred tons. But, it has great potential. Oleate/K_2CO_3 emulsion spray allows a DOV raisin grower to delay cane cutting until September 1 and successfully dry raisin on the

vine. Delaying cane severance until September 1 improves raisin grade and yield. It also allows growers to spread the cane severance operation over a longer time period.

Note that at the bottom of the Figures and Tables the L.S.D. $_{.05}$ values are shown for each sampling date. Treatment means that are equal or greater than the value given for that date are significantly different, and the probability of a difference being true is 95%.

Conclusion: Based on this study, one application of oleate/K_2CO_3 at a concentration of 0.5% oleate and 0.6% K_2CO_3 applied at 300 gallons per acre and one week after cane severance is a good program using the Peacock DOV system. Grower experience has shown similar results with the Sun Maid south side system. There is no clear advantage of increasing the concentration of oleate/K_2CO_3 beyond 0.5% oleate and 0.6% K_2CO_3. We found that a single application applied a week after cane severance was just as good as applying two applications of the spray a week apart. Good spray coverage of fruit is essential and 300 gallons per acre, at a minimum, is needed. Grower experience has demonstrated that increasing the gallons per acre of emulsion applied can improve the uniformity of the amber colored raisins. Applications should be made 4 to 7 days after cane severance to allow leaves to dry and improve coverage of fruit.

The biggest obstacle is developing a market for these unique, flavorful DOV oleate raisins. Presently, only a few hundred tons are produced in California. Research and development is needed to develop a market. DOV oleate raisins would add another raisin type for consumers, and widen the demand for California raisins.

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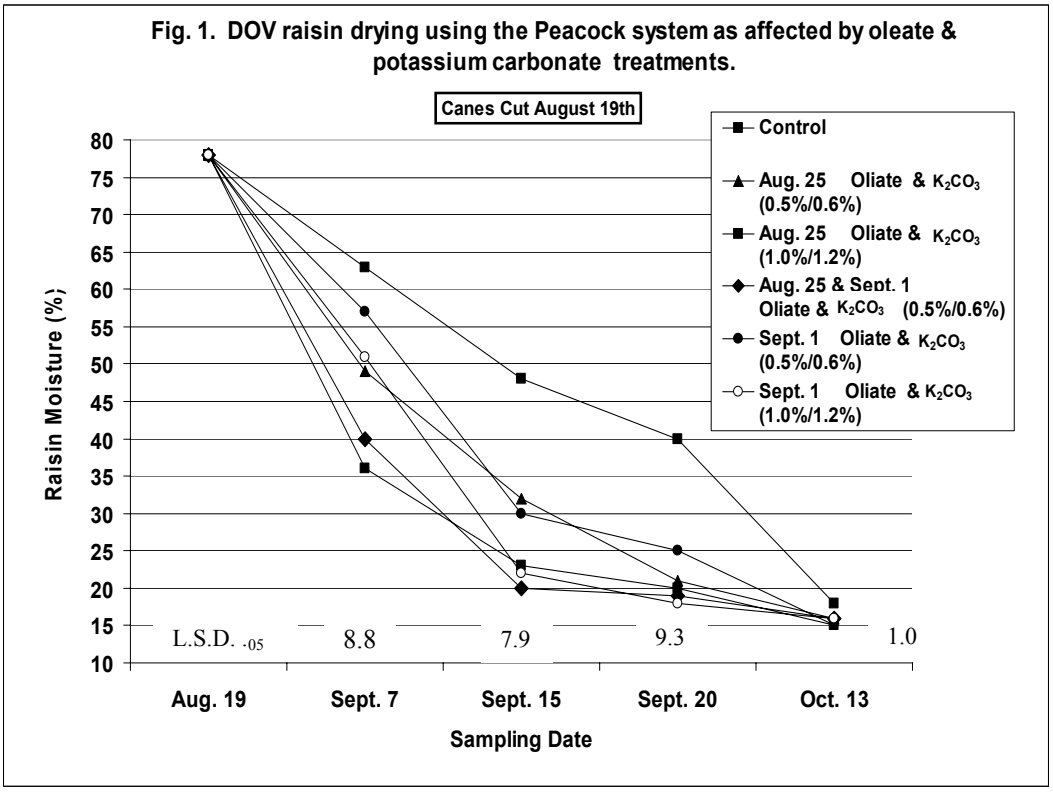
1. * Bill Peacock is with UCCE Tulare County; Mike Michigan formerly with UCCE Tulare County; Leslie Peacock is a student at UC Davis.

Experiment I



Experiment II

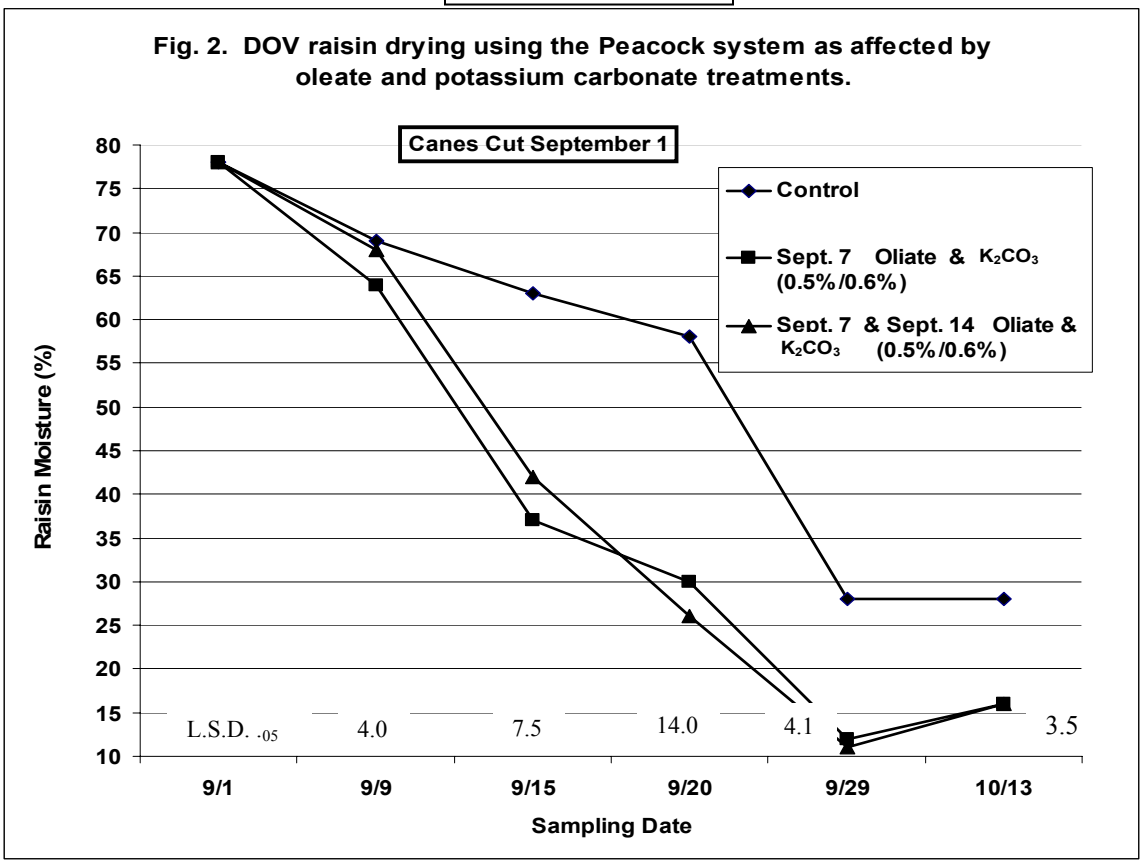


Fig. 2. DOV raisin drying using the Peacock system as affected by oleate and potassium carbonate treatments.

Table 1. Oleate and potassium carbonate (K_2CO_3) have no effect on DOV raisin yield or raisin quality.

Canes severed on August 19, 2004

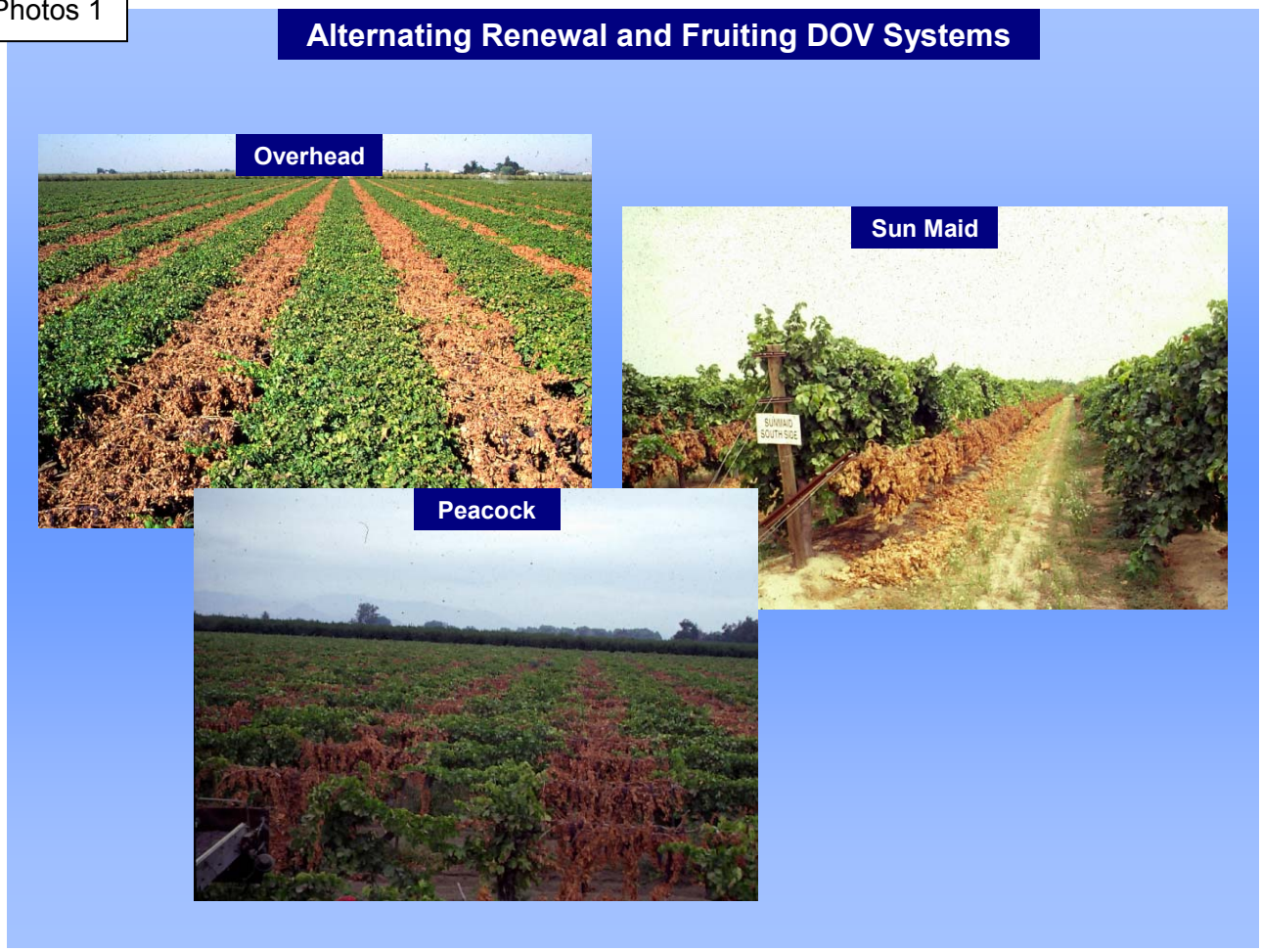
Treatments	Raisin Yield Adj. 14% (tons/acre)	Raisin Quality (B and better)	Raisin Quality (sub standard)
Control: No drying aid applied.	3.09	48.2	9.2
8/25 Oleate & K_2CO_3 (0.5% & 0.6%)	2.83	56.5	6.3
8/25 Oleate & K_2CO_3 (1.0% & 1.2%)	3.02	59.0	6.0
8/25 & 9/1 Oleate & K_2CO_3 (0.5% & 0.6%)	2.80	50.8	9.5
9/1 Oleate & K_2CO_3 (0.5% & 0.6%)	3.21	38.0	11.7
9/1 Oleate & K_2CO_3 (1.0% & 1.2%)	2.79	50.1	7.9
L.S.D.$_{.05}$	n.s.	n.s.	n.s.

Table 2. Oleate and potassium carbonate (K_2CO_3) have no effect on DOV raisin yield or raisin quality.

Canes severed on September 1, 2004

Treatments	Raisin Yield Adj. 14% (tons/acre)	Raisin Quality (B and better)	Raisin Quality (sub standard)
Control: No drying aid applied.	3.1	55.8	7.1
9/7 Oleate & K_2CO_3 (0.5% & 0.6%)	3.3	61.1	6.5
9/7 & 9/14 Oleate & K_2CO_3 (0.5% & 0.6%)	3.4	58.2	6.1
$L.S.D._{.05}$	n.s.	n.s.	n.s.

Photos 1



Photos 2

WRAB DOV (Peacock) System

Photos 3

Oleate/K2CO3 Treated Raisins

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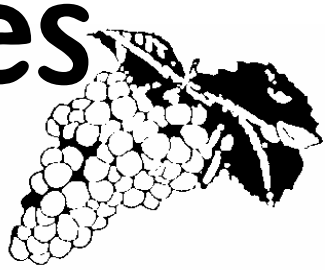

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