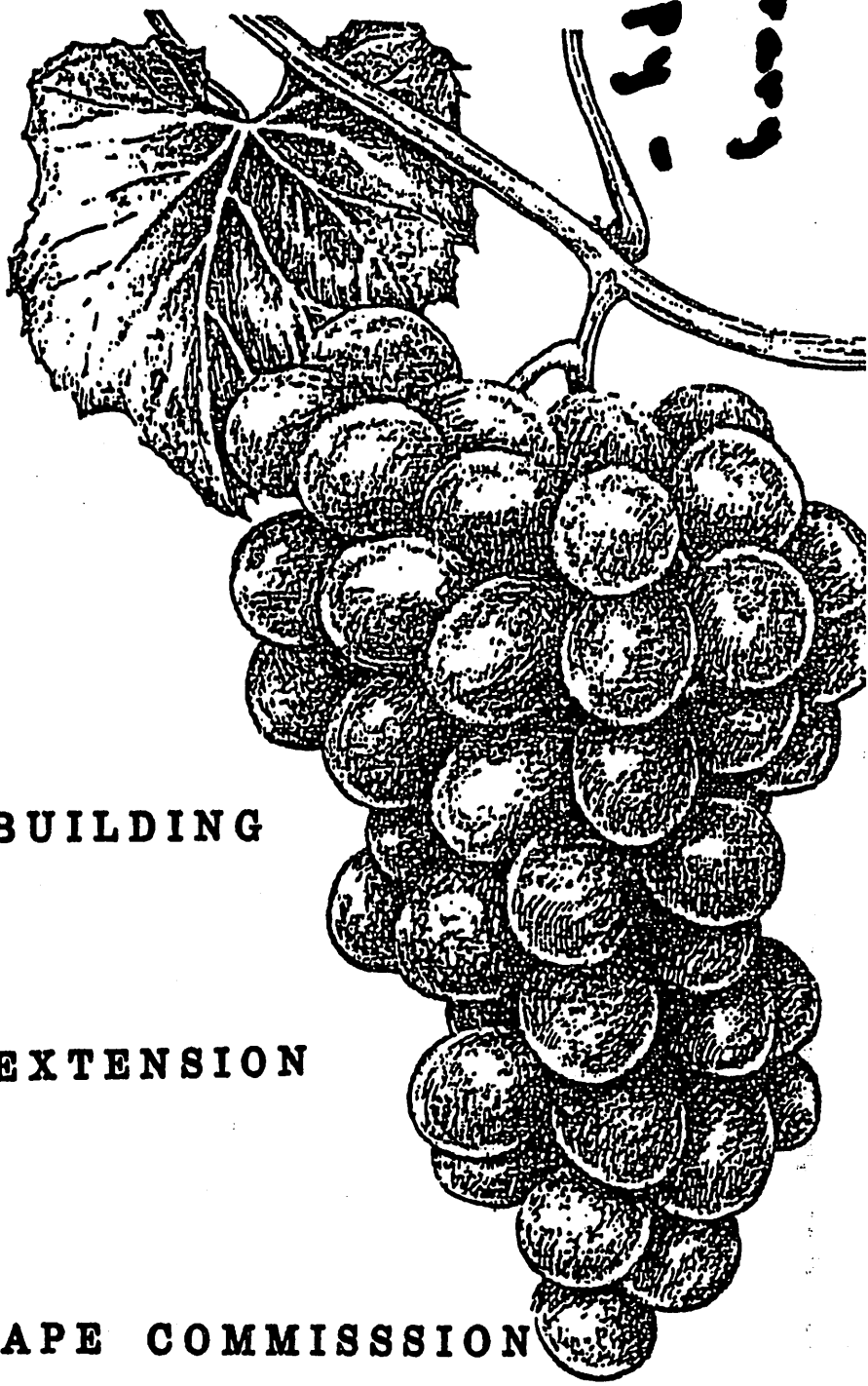
# 1985 PROCEEDINGS





# TABLE GRAPE SEMINAR



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U.C. COOPERATIVE EXTENSION

AND

CALIFORNIA TABLE GRAPE COMMISSSION

February 20,1985

The Cooperative Extension of the University of California and the California Table Grape Commission jointly sponsored the TABLE GRAPE SEMINAR, an educational meeting designed to bring the latest research findings to the attention of table grape producers. Summaries of the presentations are published here to give a record of the information discussed.

*1985 PROGRAM CHAIRMAN:*

*Donald A. Luvisi, Farm Advisor, Kern County*
*University of California, Cooperative Extension*

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# Zinc Foliar Sprays of Grapevines -

# Maximizing Response, Minimizing Costs

Peter Christensen

Zinc deficiency is the most widespread micronutrient problem in California grape vineyards. The two most effective and widely used methods for correction have been the daubing of fresh pruning cuts with a zinc sulfate solution and foliar spraying.

Daubing has largely given way to foliar sprays because it is labor intensive. Thus, there has been a continuing research effort to determine the most cost-effective zinc foliar spray methods.

Work to date has shown the following recommendations to give maximum zinc uptake:

Spray method: Dilute, full-wetting spray

Timing: 2 weeks before bloom to full bloom (80% cap fall)
Anytime during day or night

Material: Neutral or basic zinc sulfate (50-52% Zn) at maximum label recommendation or 4 to 6 lbs. product per acre.

Many zinc products are available on the market and used by growers. However, numerous screening trials have yet to come up with a more effective or economical product than the neutral zinc sulfate product listed above. However, there continues to be numerous claims that the solubility of the product and the presence of additives such as chelates, "complexing" agents (lignosulfonate), and other nutrients enhances uptake and response. This led to two zinc spray studies in 1984: Zinc Compound and Rate Comparisons -- 5 zinc compounds at label rates and equal rates of elemental zinc per acre, and Zinc Plus Urea -- 2 zinc compounds with and without the addition of urea to the spray solution.

## SPRAY METHODS

The two trials were conducted in zinc deficient Fresno County Thompson Seedless raisin vineyards. Application was made at 80% bloom on May 7, 1984 as a full wetting dilute spray at 200 gpa. The eight vine plots were replicated 6 times in a complete, randomized block design.

### Zinc compound and rate comparisons

Five zinc compounds were compared at equal rates of zinc per acre (.72 lb.). Three are completely soluble -- zinc sulfate (36% Zn powder), zinc EDTA chelate (6.5% Zn liquid), and zinc lignosulfonate "complex" (7% Zn liquid) -- and two are of low solubility -- neutral zinc (52% Zn) and zinc oxide (75% Zn). The .72 lb. Zn/acre rate is based on the maximum recommended rate of zinc lignosulfonate. This rate is about two-times the maximum label recommendation of Zn EDTA and one-fifth that of neutral zinc and

zinc oxide. Additionally, neutral zinc and zinc oxide were compared at their maximum label recommendation of 4 lbs. Zn/acre.

Zinc plus urea

Two zinc compounds, neutral zinc (52% Zn) and zinc sulfate (36% Zn), were compared with and without the addition of urea to the spray solution. Neutral zinc and zinc sulfate were used at 4 lbs. and 1 lb. Zn/acre, respectively, and urea (46% N) at 4 lbs. N/acre (7.7 lbs. product). Trial design and spray methods were similar in both studies.

## VINE MEASUREMENTS

Zinc uptake differences were monitored by shoot tip zinc analysis. The purpose of shoot tip analysis was to avoid sample contamination with zinc spray deposit. Thus, zinc level differences would be due to zinc uptake alone and would not involve spray deposit contamination. Contamination was avoided by waiting for a sufficient post-treatment time for the shoot tips to grow beyond sprayed tissue. Post treatment shoot tip samples were taken weekly on 3 dates -- May 17, 24, and 31 and analyzed for zinc.

Fruit effects at harvest were determined on 48 randomly selected cluster laterals (2nd lateral from top of each cluster) per plot. Fruit measurements included average berry weight, berry set (number of berries per centimeter of the lateral length), and % soluble solids (°Brix).

## RESULTS AND DISCUSSION

Zinc compound and rate comparisons

The shoot tip zinc levels in table 1 show the neutral zinc at the 4 lbs. zinc/acre rate to give the greatest initial zinc uptake and overall uptake (average of 3 sampling dates). Zinc oxide at the high rate (4 lbs.) was second in uptake and better than all of the lower rate (.72 lb.) zinc treatments at the first post-treatment sampling. All of the zinc products applied at the same rate of zinc (.72 lb.) per acre show similar levels of uptake except for the Zn EDTA chelate which was significantly poorer than neutral zinc. Also, the Zn EDTA treatment did not result in significantly higher shoot tip zinc levels than those of check, untreated. The other zinc treatments were intermediate in zinc uptake.

The fruit measurements in table 2 show the zinc EDTA compound to produce the greatest berry set with the other compounds being intermediate and similar in berry set response. Berry size was also increased with zinc treatment except for the zinc EDTA and zinc lignosulfonate compounds which were no better than check, untreated.

The fruit from the check, untreated vines had the highest soluble solids (°Brix) while zinc EDTA, neutral zinc (4 lb. rate), and zinc oxide (4 lb. rate) had lower fruit soluble solids at harvest. Grape soluble

solids are recognized as being influenced by zinc treatment, i.e., a greater response or correction increases berry set, berry size, and total fruit volume, which in turn lowers the concentrations of soluble solids.

These results indicate that neutral zinc or zinc oxide at the high rate would be the preferred treatment in serious cases of zinc deficiency. They show the highest levels of zinc uptake through a 17 day period after treatment. They also produced favorable fruit response in increased berry set and berry size. However, as might be expected, the resulting increased fruit volume contributed to lower fruit soluble solids than that of the check, untreated vines.

All zinc sources, whether soluble or insoluble or containing chelating or complexing compounds, gave some, but variable responses. Zinc EDTA was least effective in increasing shoot tip zinc levels and increasing berry

Table 1. Zinc Compounds and Rates
Post Treatment Shoot Tip Zinc Levels

| | | Zinc, ppm, dry wt. | | | |
|---|---|---|---|---|---|
| Treatments | Zn/Acre | May 17 | May 24 | May 31 | Average effect of treatment |
| Check | -- | 51 e[1] | 41 d | 38a | 43 e |
| ZnEDTA chelate | .72 lb. | 69 cde | 39 d | 32a | 47 de |
| Zn lignosulfonate | .72 lb. | 76 cd | 48 cd | 39a | 54 cde |
| Zinc sulfate | .72 lb. | 79 cd | 49 cd | 39a | 54 cde |
| Neutral zinc | .72 lb. | 82 c | 50 cd | 45a | 59 c |
| Zinc oxide | .72 lb. | 81 cd | 50 cd | 38a | 56 cd |
| Neutral zinc | 4 lbs. | 214a | 77ab | 47a | 113a |
| Zinc oxide | 4 lbs. | 194 b | 60 bc | 44a | 100 b |

[1]Figures with like letters within a column are not significantly different at 5% level.

Table 2. Zinc Compound and Rate Comparisons
Fruit Measurements

| Treatment | Zn/Acre | Avg. berry wt., grams | Number berries per cm. lateral | °Brix |
|---|---|---|---|---|
| Check | -- | 1.07 d[1] | 3.69 c | 19.9a |
| ZnEDTA chelate | .72 lb. | 1.20 cd | 5.14 a | 17.2 d |
| Zn lignosulfonate | .72 lb. | 1.25 bcd | 4.34 b | 18.3 bc |
| Zinc sulfate | .72 lb. | 1.37 abc | 4.14 bc | 18.8 b |
| Neutral zinc | .72 lb. | 1.42 ab | 4.26 b | 18.4 b |
| Zinc oxide | .72 lb. | 1.49 a | 4.15 bc | 18.8 b |
| Neutral zinc | 4 lbs. | 1.51 a | 4.61 b | 17.8 bcd |
| Zinc oxide | 4 lbs. | 1.49 a | 4.55 b | 17.4 cd |

[1] Figures with like letters within a column are not significantly different at 5% level.

Table 3. Zinc Plus Urea
Posttreatment Shoot Tip Zinc Levels

| Treatment | Zinc, ppm, dry wt. | | | |
|---|---|---|---|---|
| | May 17 | May 24 | May 31 | Avg. effect of treatment |
| Check | 67 d[1] | 55 d | 51a | 58 c |
| Neutral zinc | 194a | 90ab | 56a | 113a |
| Neutral zinc + urea | 162 b | 82 bc | 58a | 101a |
| Zinc sulfate | 116 c | 66 cd | 52a | 78 b |
| Zinc sulfate + urea | 110 c | 64 cd | 51a | 75 b |

[1]Figures with like letters within a column are not significantly different at 5% level.

Table 4. Zinc Plus Urea
Fruit Measurements

| Treatment | Avg. berry wt., grams | Berry set number berries per cm. lateral | °Brix |
|---|---|---|---|
| Check | 1.45a[1] | 4.34 b | 17.1a |
| Neutral zinc | 1.32ab | 5.72a | 16.6a |
| Neutral zinc + urea | 1.21 b | 5.61a | 16.3a |
| Zinc sulfate | 1.49a | 4.68 b | 14.1a |
| Zinc sulfate + urea | 1.40a | 4.65 b | 15.7a |

[1]Figures with like letters within a column are not significantly different at 5% level.

size. However, it improved berry set the most. Thus, the zinc EDTA produces a somewhat different zinc response.

Zinc plus urea

The shoot tip zinc levels in table 3 show the greatest amount of uptake from the neutral zinc product spray treatments as compared to the zinc sulfate (36% Zn) treatments. This might be expected in view of the higher zinc per acre rates used with the neutral zinc. The overall average zinc levels for all three dates show no differences when urea was added to either neutral zinc or zinc sulfate. However, on the first post-treatment sampling date the addition of urea to the neutral zinc product actually caused a decrease in shoot tip zinc levels.

The fruit analyses in table 4 show the neutral zinc treatments to significantly increase fruit set over check and the zinc sulfate treatments. Again, this might be expected because of the higher zinc rates involved. However, the berry weights were not improved with any zinc treatment and were actually smaller in the neutral zinc-urea combination as compared to check, no zinc treatment. Possibly the smaller berry size resulted from the effects of increased berry set and berry numbers per cluster.

Conclusions:

The inclusion of chelate, a "complexing" agent, or urea to zinc sprays did not improve zinc uptake in this study. This corresponds to previous work by the author that showed that the addition of phosphorus and zinc nitrate to zinc sprays also did not improve uptake. Thus, such additives do not appear to be of benefit and only add to treatment cost.

Zinc solubility was not shown to influence zinc uptake. The low solubility neutral zinc and zinc oxide gave responses similar to the other fully soluble compounds.

Thus, growers can choose zinc compounds on the basis of cost alone. Neutral zinc and zinc oxide at full rates would be the preferred choices where zinc deficiency is a recognized problem. Lower rates such as used here (.72 lb. Zn/acre) of other compounds could be considered where zinc deficiency is mild. However, it should be noted that the Zn EDTA chelate was used at double the labeled rate to achieve its response in this trial.

None of the compounds at these rates caused visible vine foliage toxicity. Higher rates of the soluble compounds should be used with caution.

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## AN UPDATE ON THE BIOLOGY OF VARIEGATED GRAPE LEAFHOPPER

Harry Andris, Farm Advisor, Fresno County

Within the past four years most grape growers and pest control advisors have become aware that the variegated grape leafhopper is now well established throughout much of the grape growing areas of the Central San Joaquin Valley. Since our first observations of this pest in the Sanger area of Fresno County in 1980 its population and geographical distribution has increased dramatically. Today, the variegated grape leafhopper inhabits much of Merced, Madera, Fresno, Tulare, Kings, and Kern Counties.

Until recently it was believed that this insect was not well adapted to the cold winter temperatures of the San Joaquin Valley since its distribution was previously limited to areas of Southern California, around San Bernardino County and the Coachella Valley, Texas, and the various states of Mexico. Today, this pest poses a serious threat to one of the most successful pest management programs ever developed for an agricultural commodity - that of the biological control of grape leafhopper by the wasp, Anagrus epos.

To combat this threat posed by the variegated grape leafhopper a combined effort by members of the University of California have produced new information on the biology of this pest which may be helpful in better understanding why we are having difficulty in controlling this serious pest of grapes.

Historically, grape growers in the San Joaquin Valley who live near natural blackberry refuges along rivers such as the San Joaquin, Kings, Kaweah and their tributaries have had few problems with leafhoppers in their vines because of the activity of the tiny egg parasite Anagrus epos. This wasp leaves the wild blackberries in the spring and moves into the vineyards where it seeks out the eggs of the grape leafhopper, depositing a wasp egg within the leafhopper egg case where the Anagrus egg develops; thus, killing the leafhopper egg in the process. The ability of this wasp to find and parasitize these eggs has resulted in fewer chemical sprays applied to grapes grown in areas where the Anagrus is present. Within Fresno County only about 50% of the vineyards required treatment for grape leafhopper because of this biological control by Anagrus. Today virtually all vineyards where the variegated grape leafhopper is present must be chemically treated to prevent defoliation by this pest. Why then are growers having to treat for variegated grape leafhopper when no treatment was required by many growers for the grape leafhopper.

The word biology comes from the Greek meaning the study of life and it is from these studies that we find clues as to why the variegated grape leafhopper is more difficult to control than the grape leafhopper.

Egg Deposition and Distribution - Studies conducted by W. Settle, a graduate student at U. C. Davis, show that 84% of the grape leafhopper eggs are obiposited in the open areas of the leaf blade while only 16% were found adjacent to the primary or secondary leaf veins. In

addition, these eggs produce a "bubble" on the surface of the leaf which is clearly visible with the naked eye. In contrast the variegated leafhopper eggs are injected deeper within the leaf and do not produce a "bubble" on the surface. These eggs are also more closely aligned with the major and secondary veins of the leaf. Only 15% of the eggs are found in the open areas of the leaf which 85% are found immediately adjacent to the veins. In order to see these eggs the leaf must be back lighted and looked at with the aid of a magnifying lens.

Parasitism by Anagrus - Although the Anagrus wasp is capable parasitizing both species of leafhopper eggs the apparent problem is that the Anagrus has difficulty finding the variegated leafhopper eggs. There are no surface indicators like the "bubble" on the surface of the leaf; therefore, variegated leafhopper eggs are not hampered in their development.

Distribution within the Vine Canopy - Grape leafhopper monitoring guidelines were developed nearly 20 years ago and growers were familiar with selecting fully mature leaves which showed leafhopper feeding injury when making their counts. As the season developed and the canopy expanded, the grape leafhopper would abandon the older leaves deep within the canopy and would move to the more succulent growth on the developing shoots. The habitation of the variegated leafhopper is very different in that it does not move to the outer portions of the developing canopy. In contrast the variegated leafhopper is found distributed throughout the entire canopy later in the season during its second and third broods (Figure 1). It will continue to feed and oviposit on severely injured leaves deep within the canopy. Both species prefer the cooler north side of the vine.

Vine Preference - It has long been recognized that end vines tend to have greater leafhopper populations. This is in part because these vines have less competition from an adjacent vine, better light, etc. When studing the variegated leafhopper, it was found that this species prefers vigorous vines. Thompson Seedless on Saltcreek rootstock has approximately eight times the population of the own rooted Thompson Seedless. Vine vigor plays an important role in population dynamics and table grape growers with large vigorous vines should be aware of this. Likewise, any vine under stress is more likely to be prematurely defoliated. Many raisin growers who cut off water for raisin drying found their vines denuded of leaves by mid September or early October because of their stressed condition. Vineyards which utilize a summer grass cover have shown lower leafhopper populations. Although the reasons for this are not clear the belief is that there are more preditors working, particularly spiders, in these vineyards (Figure 2).

Feeding Injury - Injury from leafhoppers is of two types. Loss of chlorophyll and eventual defoliation is one type and cosmetic effects to the fruit is another. Raisin and wine grape growers can generally tolerate more injury than table grape growers who must constantly be aware of the appearance of the fruit. The feeding injury of grape versus variegated leafhopper are shown in Table 1. Both the nymph and the adult variegated leafhopper do surprisingly more damage to the vine than the grape leafhopper and control is very important. When comparing

the area of leaf surface injured by the two species, the variegated nymph does over 40% more injury to the leaf while the variegated adult can injure about 85% more area in its feeding.

With this background on the biology of the variegated leafhopper we can begin to formulate a plan of attack for its control. We know that the variegated leafhopper develops later in the season in the second and third broods than grape leafhopper and that it hangs back in the canopy. We also know that the Anagrus wasp is still very helpful in keeping the grape leafhopper under control and the more Anagrus activity the better off we are. We also know that the variegated leafhopper is more damaging to the vine and that vigorous vines have higher populations and stressed vines are more easily defoliated. With these thoughts in mind a grower may choose to "renozzle" his spraying equipment to force the spray upward and deep into the vine canopy. Avoid equipment which sprays the outer canopy only. Remember that large volumes of liquid may be "shingled" off if the spray is oriented downward and may not get well into the canopy. Raisin and wine grape growers should avoid treating first brood if possible. Treatment of the second brood and/or third brood should be pursued if the populations are likely to defoliate the vine early in the season. Chemicals which are easy on preditors like Anagrus are preferred. Table grape growers who are concerned about spotting of fruit and reentry time limits for doing shoot and cluster thinning should use special care in their chemical selections. Since more frequent applications are expected critical timing will be the key to success. All growers should treat while the insects are still in the nymph stages. Once the nymphs mature and begin to fly they are more difficult to kill and their feeding injury is more severe.

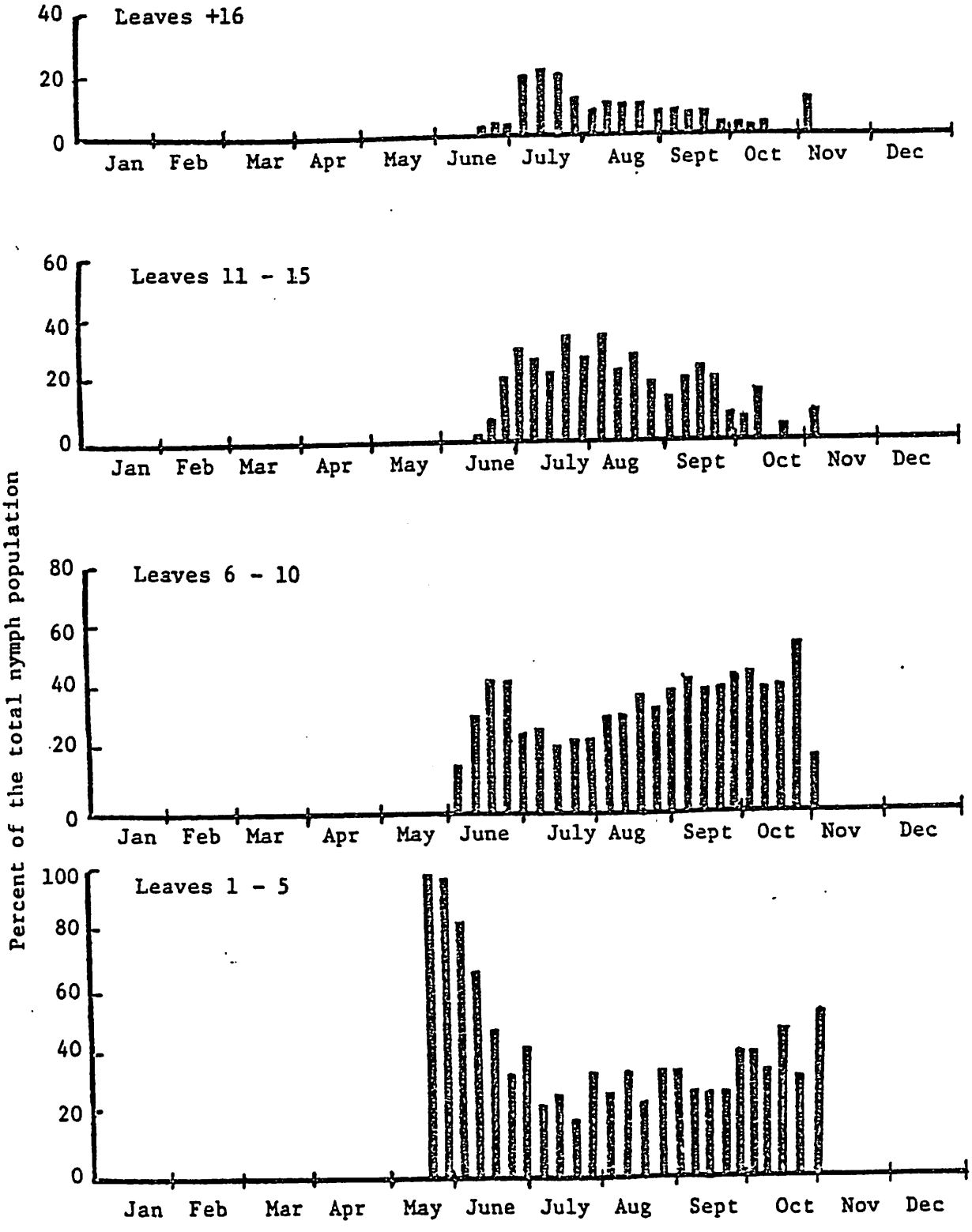
There are approximately 18 materials which have registration for leafhopper control. A few of these were abandoned some years ago because of reduced effectiveness; however, some of these may be helpful again today if they have not been used for several years. Long lived materials may span the time differential between hatches of the second and third broods of both species. Short lived materials must be applied when they will do the most good.

The variegated leafhopper has disrupted a delicate pest/preditor balance in the San Joaquin Valley. It can be expected that more chemicals will be used as time goes on to control this pest. Many of these chemicals will kill the Anagrus; thus, diluting its effectiveness against grape leafhopper. Also, as more chemicals are used we can expect to see additional disruption develop particularly in the area of mite control since preditor mites will also be destroyed by many of these chemical treatments.

Table 1. Feeding rate of variegated grape leafhopper (VGLH) vs. grape leafhopper (GLH).

| Temperature | Leaf area ($mm^2$) damaged per day VGLH | GLH | Percent increase VGLH vs. GLH |
|---|---|---|---|
| Nymph | | | |
| 65 | 1.90 | 1.62 | + 17 |
| 75 | 4.12 | 2.80 | 47 |
| 85 | 6.25 | 4.45 | 40 |
| Adult | | | |
| 65 | 3.15 | 1.70 | 85 |
| 75 | 5.77 | 3.12 | 85 |
| 85 | 7.96 | 4.90 | 62 |

FIGURE 1. Location of leafhopper nymphs on the shoot.



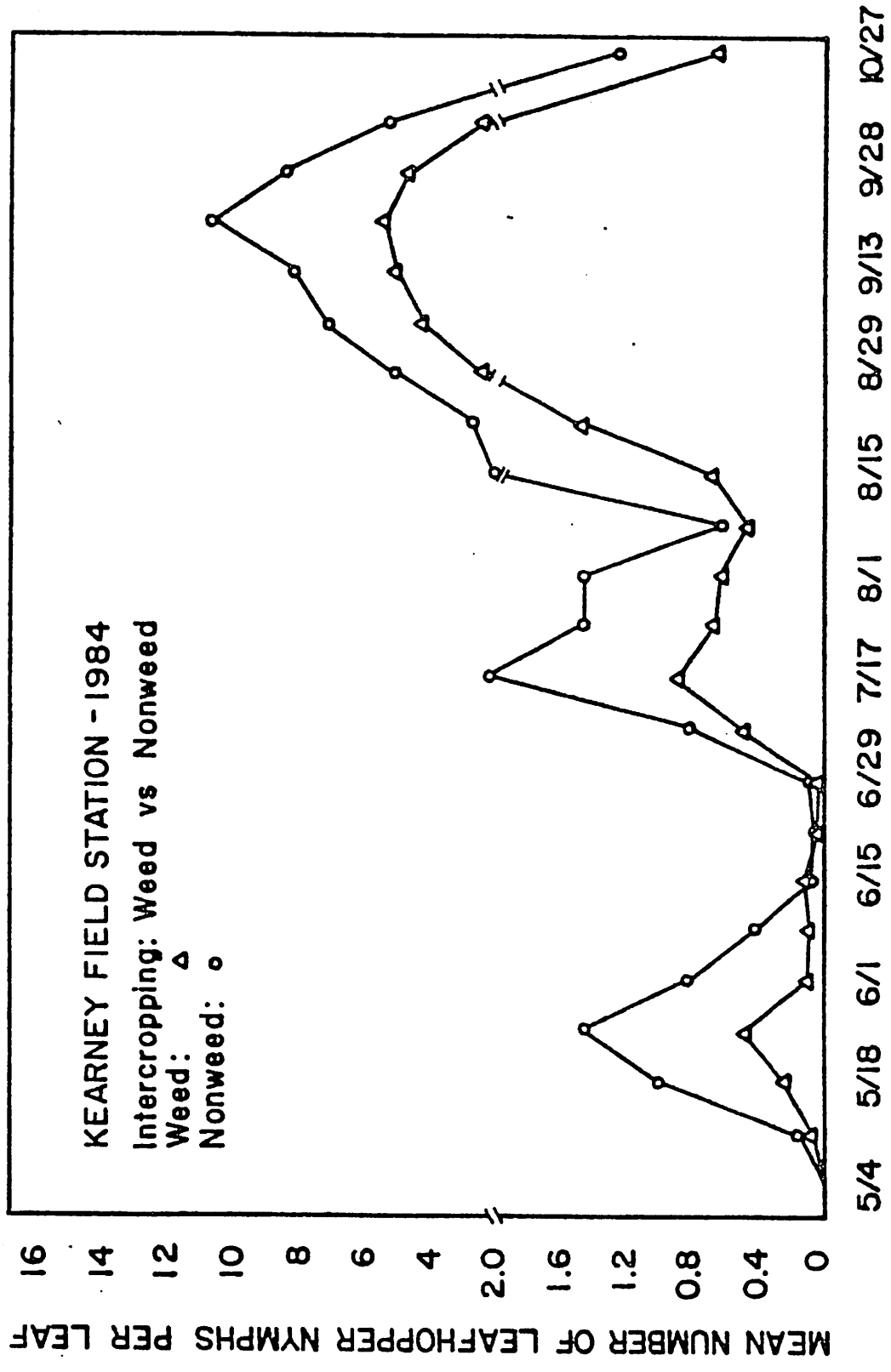

KEARNEY FIELD STATION - 1984
Intercropping: Weed vs Nonweed
Weed: Δ
Nonweed: o
MEAN NUMBER OF LEAFHOPPER NYMPHS PER LEAF
0
0.4
0.8
1.2
1.6
2.0
4
6
8
10
12
14
16
5/4
5/18
6/1
6/15
6/29
7/17
8/1
8/15
8/29
9/13
9/28
10/27
SAMPLE DATE

FIGURE 2.

# The Uptake and Distribution of Fertilizer Nitrogen in Grapevines as Affected by Time of Application

W. L. Peacock, P. L. Christensen, F. E. Broadbent 1/

The common practice of applying fertilizer N in late winter through spring is based on the concept that rain and spring irrigations move nitrate to the root zone, allowing uptake during the rapid shoot growth period, thus maximizing fertilizer nitrogen in plant tissue by bloom. But, conventional fertilizer timing experiments have not conclusively proven this, and the most efficient time to apply fertilizer has not been accurately established.

In the past, researchers have been unable to distinguish between tissue nitrogen originating from fertilizer and that derived from the much larger pool of indigenous soil nitrogen. We now have a research tool to distinguish between fertilizer and soil nitrogen using isotopically labeled fertilizer. This method also affords a means of estimating the carry-over of nitrogen from one year to the next, uncomplicated by the contribution of soil N, or even by subsequent applications of unlabeled fertilizer.

The objective of this research, utilizing isotopically labeled fertilizer, was to determine seasonal variations in nitrogen uptake and timing necessary to maximize fertilizer nitrogen in tissue at bloom. Additional objectives were to determine the carry-over of fertilizer nitrogen in tissue from one year to the next and to better understand the partitioning of fertilizer nitrogen between various vine organs.

Two trials were conducted in San Joaquin Valley Thompson Seedless vineyards, one at the University of California's Kearney Agricultural Center, 1981-82, and the other near Kingsburg, Tulare County 1983-84. The soils consist of a moderately drained Hanford fine sandy loam and a rapidly drained Tujunga sand, both formed in recent granite alluvium, at Kearney and Kingsburg, respectively. Both experiments were replicated and designed for a sensitive statistical analysis of data. Treatments consisted of applying fertilizer in April, July, September and then April the following year.

Trunk, root, cane and leaf samples were analyzed for fertilizer nitrogen periodically to determine fertilizer uptake, storage and utilization.

The percent N from fertilizer in leaves sampled at Kingsburg are shown in the figure. Leaf samples were collected periodically during the 1983 season through bloom 1984. The fertilizer N in leaves at bloom, 1984, clearly indicates that April fertilization results in the poorest uptake, either applied the current April or the previous April. The most efficient time to apply fertilizer was September since the highest level of tissue nitrogen at bloom, 1984, resulted from September fertilization, 1983. July application was just as efficient as the September fertilization when tissue was sampled 4/5/84; but, by bloom, 5/11/84, the tissue levels of fertilizer nitrogen indicated the September timing to be slightly more efficient.

It is apparent that much of the fertilizer applied is not used in that season's growth but is stored in roots, trunk and canes and then used the following season. The comparison of storage of spring, summer and fall fertilizer nitrogen in dormant wood at the Kingsburg site is shown in the table. More fertilizer nitrogen was stored in dormant tissue when applied in July or September. April fertilization is very inefficient considering that little nitrogen was stored in tissue by dormancy. Previous studies with isotopically labeled nitrogen show that little fertilizer would remain in the root zone for future uptake (California Agriculture, 1982).

This research shows that to maximize fertilizer nitrogen in tissue during the period of rapid spring growth through bloom, fertilizer should be applied from post bloom to early fall the year before; thus, the primary benefit from fertilization will be achieved the next growing season.

Critical values for nitrogen ranging from deficiency to toxicity have been established for grapevines in the San Joaquin Valley. These levels are based on leaf petioles taken from opposite flower clusters at full bloom. Our work suggests an efficient management approach is to evaluate the nitrogen status of petioles at bloom and then fertilize with amounts based on results sometime during the period from post bloom to post harvest. Less fertilizer should be applied than past practices since fertilizer efficiency is greatly improved compared to dormant or early spring fertilization.

Late season shoot growth is primarily a problem with vigorous vines subject to warm fall weather and ample soil moisture or regrowth of vines prematurely defoliated by pest or water stress. In the above trials, late season growth and cane immaturity did not occur; however, additional research is needed to determine the effect of delayed nitrogen application on vine growth. We expect that late season growth can be prevented, regardless of fertilizer timing, by managing soil-moisture levels in the fall and avoiding premature defoliation by pests. Future research will determine the validity of this statement.

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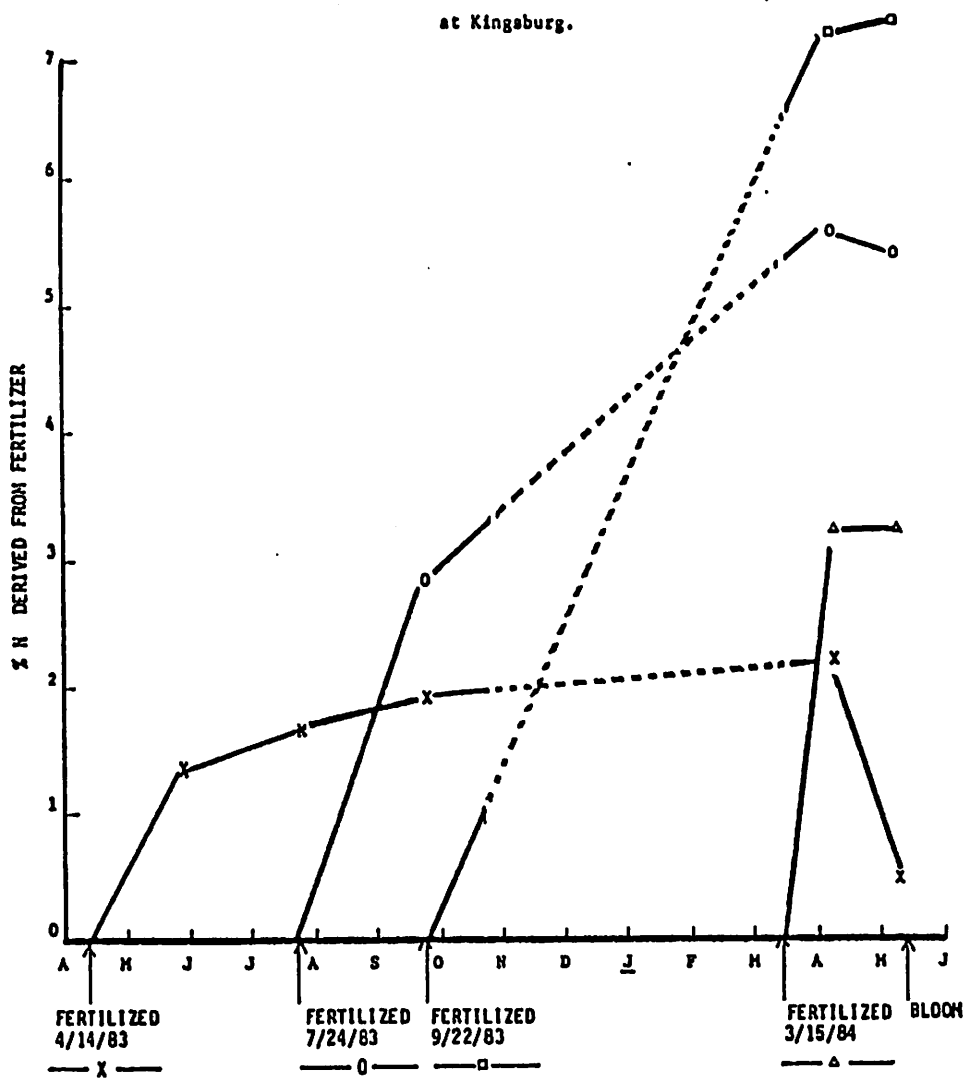
F. E. Broadbent, Professor of Soil, University of California, Davis, California

The % N derived from fertilizer in leaves sampled at Kingsburg.




The % derived from fertilizer in cane, trunk and roots sampled 3/5-11/84 at Kingsburg.

| Time of Fertilization | % Nitrogen Derived from Fertilizer Cane | Trunk | Roots |
|---|---|---|---|
| 0 | 0.0 b | 0.0 b | 0.0 b |
| 4/14/83 | .15 b | 1.70 b | 0.0 b |
| 7/24/83 | 3.91 a | 2.01 ab | 5.35 a |
| 9/22/83 | 2.83 a | 4.01 a | 3.03 ab |

Mean separation within columns by L.S.D., 5% level.

# BUNCH ROT OF GRAPES

W. D. GUBLER

Unlike diseases such as powdery mildew and phomopsis, bunch rot is not necessarily caused by a single species of organism. Rather it usually is the effect of the activity of many microbes both pathogenic and saprophytic.

The bunch rot organisms fall into 2 major categories: primary (1°) pathogens and secondary (2°) invaders.

- 1° pathogens are capable of establishing infections in undamaged fruit under conducive environmental conditions. Control by controlling pathogen.

- 2° invaders are only capable of colonizing tissue which has been damaged in some way, such as by birds, insects and disease. Control by controlling the source of injury.

More than 70 species of fungi + bacteria have been associated with rots of grapes, most of them 2° invaders.

Of the fungi known to be 1° pathogens, Botrytis cinerea is probably the most important. The first symptoms in the spring are microscopic: The blossom style becomes infected during flowering and the fungus remains dormant until later in the season.

- The bunch rot phase begins with single berries that turn brown and rot, producing masses of spores first at skin cracks.

→Then over the entire berry surface to produce the characteristic grey mold appearance.

→Spores are moved to other berries and infection increases.

→Further spread.

Sporulation

→Disease will continue to increase as long as conditions remain conducive for development.

→Berries become mummified

Disease Cycle

Sclerotia in mummies → overwinter

Produce spores in spring

Wind or water dispersed

Shoot blight phase (during warm, spring rains)

Flower infections → quiescent

Resumes growth during fruit ripening

Spread to adjacent berries

Spores produced → direct infection of mature berries near harvest

This latter phase is dependent upon sugar conc. and the length of time that RH is above 92% or free water present.

The rate of infection also depends on temperature. In general infections do not progress rapidly at humidities below 90% and in most cases severe BR epidemics are associated with preharvest rains. These storms provide both moisture and temperatures that favor development (58°- 82°). If temperature increases to 95° infections commonly dry up.

Factors affecting susc.

Bunch tightness

hold water

prevents cuticle formation

Fullness of canopies

Higher RH

Decreased spray coverage

Irrigation

Drip more severe. Constant RH.

Sprinkling mature fruit may increase rot

Disease management. Cultural X Chemical

Sanitation

Removes mummies from vine, disc under

Irrigation

Sprinklers → not late or if necessary on warm, windy days.

Canopy management

To reduce RH in microclimate, accomplish by summer pruning

Fungicides

Benomyl, Captan, Rovral, Maneb

PANDOL BROTHERS BUNCH ROT TRIAL
THOMPSON SEEDLESS - Ranch 2

| Material | Rate (lbs/A) | Amount Per Treatment |
|---|---|---|
| Rovral 50WP | 2 lbs | 145 g |
| Captan 50WP | 2 lbs | 145 g |
| Wacker CO-6054 50WP | 1.5 lbs | 109 g |
| Dithane M-45 80WP | 4 lbs | 290 g |
| Botran 75WP | 2.75 lbs | 200 g |
| Mertect 340-F | 1 pt. | 76 mls |
| Control | no spray | ------- |

*50 mls Triton B-1956 added to all tank mixes (40 gals.). Volume was 250 gals/Acre. Plot was a randomized block design with 4 reps per treatment and 9 vines per rep. Sprays were applied at bloom, shatter, pre-bunch closure, and near veraison. Except for the Wacker 6054, which did not receive a shatter spray.

Table 1

| Treatment | Wt. of Rotted Fruit/9 Vines (in lbs) | |
|---|---|---|
| Wacker 6054 | 92.06 | |
| Mertect 340-F | 84.88 | |
| Botran | 84.38 | no significant differences |
| Rovral | 75.94 | (variances unequal) |
| Control (No Spray) | 64.44 | |
| Dithane | 52.83 | |
| Captan | 47.37 | |

Table 2

| Treatment | Percent Rot by Weight | |
|---|---|---|
| Mertect 340-F | 20.92 | |
| Wacker 6054 | 18.85 | |
| Botran | 15.78 | no significant differences |
| Rovral | 15.12 | (variances unequal) |
| Control (No Spray) | 14.20 | |
| Captan | 10.97 | |
| Dithane | 10.47 | |

Table 3

| Treatment | Degree Brix |
|---|---|
| Control | 18.10 A |
| Captan | 17.85 A |
| Mertect 340-F | 17.80 A |
| Rovral | 17.80 A |
| Dithane | 17.52 A |
| Botran | 17.20 A |
| Wacker 6054 | 15.70 B |

Means followed by different letters significant at P = .05 level.

Table 4

| Treatment | Acid (g tartaric/l) |
|---|---|
| Wacker 6054 | 0.698 A |
| Control | 0.578 B |
| Dithane | 0.575 B |
| Botran | 0.568 B |
| Mertect | 0.565 B |
| Captan | 0.562 B |
| Rovral | 0.552 B |

Table 5

| Treatment | Berry Weight (in grams) |
|---|---|
| Rovral | 4.73 A |
| Mertect | 4.73 A |
| Captan | 4.68 A |
| Control | 4.55 A |
| Botran | 4.55 A |
| Dithane | 4.51 A |
| Wacker | 3.95 B |

Means followed by different letters significant at P = .05.

Table 6

| Treatment | PPM Potassium |
|---|---|
| Rovral | 1941 |
| Captan | 1938 |
| Control | 1924 |
| Mertect | 1908 |
| Botran | 1870 |
| Dithane | 1819 |
| Wacker | 1674 |

Table 7

| Treatment | Post-Harvest Storage Study Average # rotten berries/lug |
|---|---|
| Mertect | 23.8 |
| Wacker | 18.5 |
| Control | 18.3 |
| Botran | 16.9 |
| Rovral | 14.2 |
| Dithane | 14.0 |
| Captan | 10.2 |

# AUTUMN SEEDLESS GRAPE

by

David Ramming USDA/ARS

The Agricultural Research Service, United States Department of Agriculture, hereby releases for propagation the grape cultivar AUTUMN SEEDLESS, formerly tested as C58-22. AUTUMN SEEDLESS resulted from the cross Calmeria x P64-18 (Muscat of Alexandria x Sultanina) made in 1958 at the U.S. Horticultural Field Station, Fresno, California. The original vine was planted in 1959 and first fruited in 1961 in plots cooperative with the California State University of Fresno. The original selection was made by John H. Weinberger and F. N. Harmon. It has been tested in California and Maryland, and is on trial in Arkansas and New York.

AUTUMN SEEDLESS is a late-maturing white seedless grape ripening about two weeks after 'Thompson Seedless'. The clusters are large (0.9-1.4 kg), conical with 2-3 shoulders, medium in length (18-24 cm), with well-spaced berries that result in loose to medium compactness of the bunches. The berries of AUTUMN SEEDLESS are large, averaging 19 mm in diameter and 4.0 to 4.5 grams in weight without gibberellic acid treatment or girdling. Berries can weigh up to 5.5 or 6.0 grams. The berries are ovoid, light green with a light white bloom and become yellow when exposed to excessive sunlight on the vine. The skin does not separate from the pulp and is of medium toughness with veins that are just slightly visible. The flesh is light green, translucent, meaty and of medium firmness with centers that are slightly softer than the outer portion. The eating quality is good, with a neutral, sweet flavor. An average of three very small soft seed traces exist per berry, but these are too small to be noticed when eating. AUTUMN SEEDLESS is sensitive to gibberellic acid because it causes very poor berry set and loose clusters. Therefore gibberellic acid is not recommended. The berry attachment is good to strong with a strong brush, which is light green. The pedicel is medium in length and stronger than those of 'Thompson Seedless'. The peduncle is medium in length, strong and of medium thickness. The fruit holds well in storage and has been held successfully until February.

AUTUMN SEEDLESS vines have moderate vigor, although cane growth is variable, producing some weak canes and bull canes. Productivity has been low in trials when spur pruned. Production might be increased if cane pruned; however, in many years, the canes do not mature, making selection of good canes difficult. A distinct character of the cane is its tendency to have shoots that are bifurcate, often bearing the cluster on the weaker shoot.

AUTUMN SEEDLESS has been successfully heat treated, indexed for known viruses and entered into the Foundation Plant Material Service, University of California, Davis, California. The Agricultural Research Service has no vines of AUTUMN SEEDLESS available for distribution. Limited quantities of cuttings may be obtained by writing David W. Ramming, USDA-ARS, P.O. Box 8143, Fresno, CA 93747.

The Agricultural Research Service, United States Department of Agriculture, hereby releases for propagation the grape cultivar AUTUMN BLACK, formerly tested as C15-162. AUTUMN BLACK resulted from the cross 'Calmeria' x 'Blackrose' made in 1960 at the U.S. Horticultural Field Station, Fresno, CA. The original vine was planted in 1961 and first fruited in 1964 in plots cooperative with the California State University, Fresno. AUTUMN BLACK was selected by John Weinberger and F. N. Harmon. It has been tested in California and is on trial in Arkansas.

AUTUMN BLACK is a late-maturing black seeded grape which ripens 2 weeks after 'Ribier'. The clusters are medium in size (0.7-0.9 kg), length (26-28 cm) and are conical, but not winged. The berries are well-spaced, resulting in medium to loose compactness. Clusters are generally looser when grown on 'Harmony' than on their own roots. The berries are large, averaging 7.5-9.0 grams, 22 mm in diameter, 32 mm long and are mostly truncate. The berries are bluish black with a light white bloom. The flesh is a pale yellow green, translucent, meaty, of medium firmness and does not separate from the skin. The flavor is good, with a sweet taste, although the skin is slightly astringent. The skin is medium tough. The berries commonly contain two seeds and the largest ones weigh about 80 mg.

AUTUMN BLACK has a medium to strong peduncle of medium length and a strong pedicel of medium length. The brush is large, strong, reddish and provides good attachment. AUTUMN BLACK stores well and has been held successfully until February. AUTUMN BLACK vines are moderately vigorous and are productive on spurs.

AUTUMN BLACK was submitted for heat treatment and virus indexing February 1984 to the Foundation Plant Material Service, University of California, Davis, California. The Agricultural Research Service has no vines of AUTUMN BLACK available for distribution. Limited quantities of cuttings may be obtained by writing David W. Ramming, Horticultural Crops Research Laboratory, P.O. Box 8143, Fresno, CA 93747.

# EFFECT OF DRIP IRRIGATION MANAGEMENT ON TABLE GRAPE FRUIT QUALITY

by Don Luvisi and Kater Hake
Kern County Farm Advisors

This is the second year of a three year project to evaluate the effect of different drip irrigation management regimes on the production and quality of Thompson Seedless Table Grapes. This concludes the second year of evaluation. A third year of data collection is planned since vine growth and fruit yield differences should be occurring due to the difference of the irrigation regimes.

One of the difficulties experienced with a plot of this size, especially in evaluation of table grape quality, is the variation between pickers and packers. It is anticipated that in 1985 we will attempt to harvest the complete test plot with one packing crew in order to minimize this variation. It is especially important if we look at a three label pack with a high quality number one, a good number one, and a number two label. Differences between packers are tremendous and it is not difficult to obtain statistical differences between packing crews.

## METHODS

Thompson Seedless Vines are drip irrigated throughout the growing season at various levels of water use. Water was applied at either 0.5 ET, 1.0 ET, or 1.5 ET during each of three growth stages of the fruit. Grow phase I or (a) was from bud break to fruit set; grow phase II or (b) was from fruit set to veraison; and phase III (c) was from veraison to harvest. A total of 10 treatments were replicated five times in eight vine plots to allow detailed analysis of soil tension, vine development, fruit yield, and quality. Data collected for this research plot was used in 1984 to help validate the grape vine computer model that represented the only table grape vineyard to be included in this project.

Table grapes were picked and packed by commercial crews and 5 boxes from each plot were held in cold storage for eight weeks. The condition of the fruit was evaluated before shipment to market. Soil moisture was evaluated in two of the five replications with tensiometers placed at 18 inches and 36 inches. The soil moisture tensions through the growing season are listed for each plot in figures one thru ten which represent treatments one through ten. Tables one through six summarize the data collected from the various fruit and vine parameters measured. Tables seven through nine represent water application rates.

## RESULTS

Initial cluster counts in April 1984 on the three base treatments of .5 ET, 1.0 ET, and 1.5 ET were not statistically different.

Variation was quite prevalent since a three cluster average difference between treatments did not show a statistical difference (table 1).

Berry firmness at harvest and after eight weeks of cold storage were evaluated with a Berry firmness tester. Initially some of the softer or less firm fruit tended to be in plots which had a .5 ET sometime during the growing season. The firmer fruit tended to be in plots that had 1.0 ET or 1.5 ET except that the extremely wet treatment of 1.5 ET had somewhat softer fruit. Stress in the plant later did not seem to soften the fruit as much as a water stress early or during the mid season. After eight weeks of cold storage there was no significant difference in the berry firmness readings (table 2).

## VISUAL EVALUATION

At harvest time on, August 7, 1984, vines were visually evaluated for estimated vine growth, berry size, berry and cluster uniformity, cluster tightness, sunburn, and rot damage (table 3). These were generally made on a 0 to 10 rating and were made early in the morning of August 7th. In vine growth the 0.5 ET treatment had significantly less growth while the 1.5 ET treatment had more growth than other treatments.

In estimating berry size, the 0.5 ET and the .5 ET dried down between berry set and veraison had fruit which was estimated to be smaller in berry size. This tends to follow the trend that a water stress occurring from growth to berry set or from berry set to veraison had the greater effect upon berry size.

Berry and cluster uniformity was the poorest at the 0.5 ET where the vines were dried down between berry set and veraison. Water stress between bloom or between start of growth and berry set, or between berry set and veraison had lesser effects upon estimated berry and cluster uniformity. Cluster tightness was greatest in the 0.5 ET although not significantly different from many of the other treatments. Sunburn was higher in the 0.5 ET from a lack of foliage cover. The least amount of sunburn occurred in the 1.5 ET which had an excessive quantity of foliage.

Rot estimates indicated that there was somewhat more rot in the 0.5 ET and lesser amount of rot in other treatments. No effect on water berry was observed, therefore, no evaluations were made for this parameter.

## MATURITY DATA

Data was collected on two dates, July 11 and August 1, 1984, berry weight, Degree Brix, percent acid, and Brix to acid ratio, were determined. Initially the 1.5 ET, the .5 ET, between start of growth and berry set and the .5 ET between berry set and veraison had somewhat smaller berry sizes.

The rest of test plots were quite close together. On August 1st, vines that were stressed with 0.5 ET (treatments one thru five) had smaller berry size. Larger berry sizes tended to be when vines received

adequate amounts of water during the growing season. Treatment ten with 1.5 ET did have smaller berry size and could be partially due to competition between fruit and foliage. The percent acid and Brix to acid ratio showed considerable variation on both sampling dates.

Harvest data was collected on August 7th and there was no significant difference in total pounds harvested (table 5) due to the wide variation in yield between the test plots. There was no statistical difference in total number of packable pounds of fruit. However, when converted to percent packable there was a significant reduction in the .5 ET of approximately 10 percent. The percentage of culls tended to increase when vines were stressed early from start of growth to berry set, or between berry set and veraison.

Five boxes of fruit from each plot was held in cold storage from August 7 to September 28, 1984. Lids were opened on five boxes of each treatment and fruit ambering, stem condition, overall condition, and brown berries were evaluated.

The amber fruit was in the .5 ET and the greenest fruit was obtained in the moderate to high irrigation plots. Plots with 0.5 ET during the growing season generally had intermediate amber ratings. Poorest stem condition was observed in the .5 ET and the best stem condition was observed in the treatment eight. Generally the 0.5 ET treatment had the lowest fruit quality when evaluating amber color, stem condition, overall box appearance, and brown berries.

## WATER APPLICATION

Table 7 summarizies the seasonal water applications for the ten treatments. Summaries include acre inches of water applied to harvest and through September 9, 1984. Effective winter rainfall during the winter of 1983-84 was minimal and would be in addition to the water applied through the drip system.

## SUMMARY

1984 data indicates that packable fruit decreases when water stress occurs during phases I or II. Fruit defects were high when less than 16 inches of water was applied, and a water stress occurred in phases I or II. A water stress in phase III or in phase II followed by 1.5 ET application had minimal effect on fruit quality.

These test plots demonstrate that adequate crops can be obtained with 16-19 acre inches of water applied from start of growth through harvest. Application rate of 21 through 28 acre inches of water did not result in improved table grape quality. Additional statistical analyses need to be run on this data correlating data to water application rates.

Seasonal application rates were from 11.3 inches to 33.9 acre inches when post harvest irrigation is added in. Seasonal water rates are shown since the phase III ET's were maintained after harvest until September 20, 1984 cutoff.

Table 1. Drip Irrigation Trial - 1984

Cluster Counts

| Treat | ET Phase I/ | II/ | III/ | April 1984 |
|---|---|---|---|---|
| 1 | .5 | .5 | .5 | 19.8 a |
| 7 | 1.0 | 1.0 | 1.0 | 17.7 a |
| 10 | 1.5 | 1.5 | 1.5 | 16.6 a NS 1/ |

1/ means separation by Duncan's Multiple Range Test.
.05 NS = not significant
I/ Start of growth to berry set
II/ Berry set to veraison
III/ Veraison to harvest

Table 2. Drip Irrigation Trial - 1984
Berry Firmness Data

| Treat | ET Phase I/ | II/ | III/ | Pre Harvest 8/2 grams | 1/ 9/23 grams |
|---|---|---|---|---|---|
| 1 | .5 | .5 | .5 | 413 c | 354 a |
| 2 | 1.0 | 1.5 | .5 | 471 a b | 399 a |
| 3 | .5 | 1.0 | 1.0 | 458 a b c | 398 a |
| 4 | 1.0 | .5 | 1.0 | 405 c | 366 a |
| 5 | 1.0 | 1.0 | .5 | 441 b c | 376 a |
| 6 | 1.0 | .5 | 1.5 | 449 a b c | 346 a |
| 7 | 1.0 | 1.0 | 1.0 | 503 a | 390 a |
| 8 | 1.0 | 1.5 | 1.0 | 501 a | 405 a |
| 9 | 1.0 | 1.0 | 1.5 | 485 a b | 399 a |
| 10 | 1.5 | 1.5 | 1.5 | 461 a b c | 409 a |
| | | | | .05 2/ | .05 2/ |

I/ Start of growth to berry set II/ Berry set to veraison III/ Veraison to harvest

1/ = after 8 weeks cold storage
2/ = mean separation by Duncan's Multiple Range Test

Table 3. Drip Irrigation Trial - 1984
Visual Evaluation Data
At Harvest August 7, 1984

| Treat | ET Phase I/ | II/ | III/ | Estimate 1/ Vine Growth | Estimate 2/ Berry Size | Estimate 3/ Berry/Cluster Uniformity | Estimate 4 Cluster Tightness | Estimate 5/ Sunburn | Estimate 6/ Rot |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .5 | .5 | .5 | 3.6 d | 6.1 c | 4.8 c | 7.6 a | .6 b | 6.8 a |
| 2 | 1.0 | 1.5 | .5 | 7.3 a b c | 7.6 a b | 6.4 a b | 6.6 a b | 1.2 a b | 2.4 c d |
| 3 | .5 | 1.0 | 1.0 | 6.6 b c | 8.8 a | 7.3 a | 7.1 a b | 1.4 a b | 3.1 b c |
| 4 | 1.0 | .5 | 1.0 | 5.6 c | 6.6 b c | 5.4 b c | 7.1 a b | 1.6 a b | 4.4 b |
| 5 | 1.0 | 1.0 | .5 | 7.5 a b c | 8.0 a | 6.2 a b c | 6.0 b | 1.0 a b | 1.4 c d |
| 6 | 1.0 | .5 | 1.5 | 6.7 b c | 8.0 a | 7.2 a | 7.2 a b | 1.0 a b | 1.4 c d |
| 7 | 1.0 | 1.0 | 1.0 | 8.7 a b | 8.5 a | 7.3 a | 6.6 a b | 1.3 a b | 1.0 d |
| 8 | 1.0 | 1.5 | 1.0 | 8.7 a b | 8.4 a | 6.8 a b | 6.0 b | 1.1 a b | 1.2 c d |
| 9 | 1.0 | 1.0 | 1.5 | 7.0 a b c | 7.9 a | 6.9 a b | 6.6 a b | 1.0 a b | 2.4 c d |
| 10 | 1.5 | 1.5 | 1.5 | 9.1 a | 7.9 a | 6.4 a b | 6.0 b | 1.7 a | 1.0 d |
| | | | | .05 7/ | .05 7/ | .05 7/ | .05 7/ | .05 7/ | .05 7/ |

1/ 1 = Least Growth; 10 = Excessive Growth 2/ 0 = Small Berry; 10 = Large Berry
3/ 1 = Poor Uniformity; 10 = Good Uniformity 4/ 0 = Loose; 10 = Tight
5/ 0 = Sunburn; 10 = No Sunburn 6/ 0 = No Rot; 10 = Rot
7/ Mean separation by Duncan's Multiple Range Test

I/ = Start of Growth to Berry Set II/ = Berry Set to Veraison III/ = Veraison to Harvest

Table 4. Drip Irrigation Trial - 1984

Maturity Data

Sample Dates 7/11/84 and 8/1/84

| Treat | ET Phase | | | Berry Wt. Grams Date | | °Brix Date | |
|---|---|---|---|---|---|---|---|
| | I/ | II/ | III/ | 7/11 | 8/1 | 7/11 | 8/1 |
| 1 | .5 | .5 | .5 | 3.42 c | 4.89 a b | 12.0 a b | 18.3 a b |
| 2 | 1.0 | 1.5 | .5 | 3.63 a b | 4.84 b | 11.7 b | 17.7 b c |
| 3 | .5 | 1.0 | 1.0 | 3.57 b c | 5.06 a b | 11.6 b | 17.5 b c |
| 4 | 1.0 | .5 | 1.0 | 3.59 a b c | 4.98 a b | 12.3 a b | 18.6 a |
| 5 | 1.0 | 1.0 | .5 | 3.65 a b | 4.97 a b | 11.6 b | 17.9 a b c |
| 6 | 1.0 | .5 | 1.5 | 3.78 a | 5.10 a | 12.3 a b | 18.3 a b |
| 7 | 1.0 | 1.0 | 1.0 | 3.63 a b | 5.02 a b | 11.9 a b | 17.9 a b c |
| 8 | 1.0 | 1.5 | 1.0 | 3.69 a b | 5.10 a | 11.5 b | 17.2 c |
| 9 | 1.0 | 1.0 | 1.5 | 3.67 a b | 5.13 a | 11.8 a b | 17.9 a b c |
| 10 | 1.5 | 1.5 | 1.5 | 3.66 a b | 4.90 a b | 12.6 a | 18.2 a b |
| | | | | .05 1/ | .05 1/ | .05 1/ | .05 1/ |

I/ = Start of Growth to Berry Set
II/ = Berry Set to Veraison
III/ = Veraison to Harvest
1/ = mean separation by Duncan's Multiple Range Test.

| Treat | ET Phase | | | % Acid Date | | °B/% Acid Date | |
|---|---|---|---|---|---|---|---|
| | I/ | II/ | III/ | 7/11 | 8/1 | 7/11 | 8/1 |
| 1 | .5 | .5 | .5 | 1.64 c | .64 c | 7.4 a | 29.5 a |
| 2 | 1.0 | 1.5 | .5 | 2.02 a | .77 a | 5.8 b | 23.1 c |
| 3 | .5 | 1.0 | 1.0 | 1.99 a | .74 a b | 5.8 b | 23.5 c |
| 4 | 1.0 | .5 | 1.0 | 1.71 b c | .65 b c | 7.4 a | 28.6 a b |
| 5 | 1.0 | 1.0 | .5 | 1.96 a | .74 a b | 6.0 b | 24.2 c |
| 6 | 1.0 | .5 | 1.5 | 1.64 c | .70 a b c | 7.6 a | 26.4 a b c |
| 7 | 1.0 | 1.0 | 1.0 | 1.91 a b | .74 a b | 6.2 a b | 24.3 c |
| 8 | 1.0 | 1.5 | 1.0 | 1.95 a b | .72 a b c | 5.9 b | 24.5 b c |
| 9 | 1.0 | 1.0 | 1.0 | 1.80 a b c | .70 a b c | 6.8 a b | 25.7 a b c |
| 10 | 1.5 | 1.5 | 1.5 | 1.71 b c | .68 a b c | 7.4 a | 27.2 a b c |
| | | | | .05 1/ | .05 1/ | .05 1/ | .05 1/ |

I/ = Start of Growth to Berry Set
II/ = Berry Set To Veraison
III/ = Veraison to Harvest
1/ = Mean separation by Duncan's Multiple Range Test

Table 5. Drip Irrigation Trial - 1984

Harvest Yield Data

Replications 1 - 4

| Treat | ET Phase I/ | ET Phase II/ | ET Phase III/ | Total Fruit lbs. | Total Packable lbs. | % Packable | % Culls | % #1 | % #2 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .5 | .5 | .5 | 217 a | 166 a | 74 b | 26 a | 61 b | 24 a |
| 2 | 1.0 | 1.5 | .5 | 177 a | 157 a | 89 a | 11 b | 58 b | 29 a |
| 3 | .5 | 1.0 | 1.0 | 240 a | 200 a | 84 a | 16 b | 68 a b | 22 a |
| 4 | 1.0 | .5 | 1.0 | 202 a | 172 a | 86 a | 14 b | 65 a b | 23 a |
| 5 | 1.0 | 1.0 | .5 | 171 a | 155 a | 91 a | 9 b | 77 a b | 16 a |
| 6 | 1.0 | .5 | 1.5 | 206 a | 185 a | 90 a | 10 b | 74 a b | 18 a |
| 7 | 1.0 | 1.0 | 1.0 | 167 a | 149 a | 90 a | 10 b | 83 a | 8 a |
| 8 | 1.0 | 1.5 | 1.0 | 243 a | 220 a | 90 a | 10 b | 76 a b | 14 a |
| 9 | 1.0 | 1.0 | 1.5 | 228 a | 200 a | 85 a | 15 b | 70 a b | 20 a |
| 10 | 1.5 | 1.5 | 1.5 | 187 a | 166 a | 89 a | 11 b | 69 a b | 22 a |
| | | | | NS 1/ | NS 1/ | .05 1/ | .05 1/ | .05 1/ | NS 1/ |

I/ = Start of Growth to Berry Set; II/ = Berry set to Veraison; III/ = Veraison to Harvest
1/ = Mean separation by Duncan's Multiple Range Test NS = not significant

Table 7. WATER APPLICATION PER TREATMENT DURING
Phases I thru IV - 1984 Season

| Treat | ET Phase I/ | ET Phase II/ | ET Phase III/& IV/ | Acre Inches Phase I | Acre Inches Phase II | Acre Inches Phase III | Acre Inches Harvest | Acre Inches Phase IV | Total Season |
|---|---|---|---|---|---|---|---|---|---|
| 1. | .5 | .5 | .5 | 4.34 | 2.85 | 2.29 | 9.40 | 1.89 | 11.29 |
| 2. | 1.0 | 1.5 | .5 | 8.68 | 8.54 | 2.21 | 19.43 | 1.89 | 21.32 |
| 3. | .5 | 1.0 | 1.0 | 4.34 | 5.69 | 4.41 | 14.44 | 3.78 | 18.22 |
| 4. | 1.0 | .5 | 1.0 | 8.68 | 2.85 | 4.41 | 15.94 | 3.78 | 19.72 |
| 5. | 1.0 | 1.0 | .5 | 8.68 | 5.69 | 2.21 | 16.58 | 1.89 | 18.47 |
| 6. | 1.0 | .5 | 1.5 | 8.68 | 2.85 | 6.62 | 18.15 | 5.67 | 23.82 |
| 7. | 1.0 | 1.0 | 1.0 | 8.68 | 5.69 | 4.41 | 18.78 | 3.78 | 22.56 |
| 8. | 1.0 | 1.5 | 1.0 | 8.68 | 8.54 | 4.41 | 21.63 | 3.78 | 25.41 |
| 9. | 1.0 | 1.0 | 1.5 | 8.68 | 5.69 | 6.62 | 20.99 | 5.67 | 26.66 |
| 10. | 1.5 | 1.5 | 1.51 | 3.02 | 8.54 | 6.62 | 28.18 | 5.67 | 33.85 |

# Application Of Nematicides Through Drippers, A Three Year Summary

Michael V. McKenry*

## OBJECTIVES:

Several organophosphate and carbamate nematicidal compounds are amenable for use in dripper irrigation systems. Dripper systems tend to concentrate the vine's root system and thereby concentrate the root zone requiring protection. It is anticipated that nematode control agents applied through dripper systems could provide a practical remedy for nematode problems. The object of this work has been to test and further develop tools enabling nematicide applications within dripper irrigation systems. Other items tested include:

1. Nematicide application timed to the spring and fall root flushes.
2. Closed-system applications using buried by-wall tubing.
3. Nematicides with varying persistence and movement characteristics.

## PROCEDURES:

Five vineyards have now been treated with nematicides via a dripper system. The vineyards include: #1) Ruby Seedless, 6 yr of age, Parlier; #2) French Colombard, 6 yr, Carruthers; #3) Flame Seedless, 2 yr, Dinuba, #4) Thompson Seedless, 30 yrs, Kingsburg #5) Thompson Seedless, 40 yr, Selma. Each vineyard has now been treated for a 2-year-period with treatments specifically targeted to disorient the root knot nematode during the spring and fall root flushes. Yield data have now been collected for the third year in vineyards #1 and #2. In vineyard #3 the grower is anxious to treat the entire field and thus we would have no untreated vines for comparison. In vineyards #4 and #5 yield data will be collected again in 1985.

Nematode counts have been made three times annually and the major nematode is root knot nematode except there are others in vineyard #4. Nematode samples were taken 6 inches away from the center of the dripper puddle. Additional samples were taken between drippers in vineyard #5 where 4' and 6' emitter spacings were tested.

The dripper tubing is not necessarily similar in each vineyard. We have now tested emitter spacings ranging from 4 inches to 6 feet in length.

Chemicals we have tested include: Standak in vineyards 1,2 and 4; Nemacur in vineyards 1,2,3,4 and 5; Vydate in vineyards 1,2 and 3; GY-81 in Vineyards 4 and 5; Nudrin, Mocap and Advantage in vineyard 1 only. Each test site involves 4 replicates and from 8 to 35 vines in each treated area. Vineyards 1 and 2 also received a doubled treatment rate resulting from the use of two dripper tubes on either side of the vines.

* Dept. of Nematology, University of California, Riverside, located at Kearney Agricultural Center. This report presented to California Table Grape Commission in January 1985.

Yields were collected in an appropriate fashion and soluble solids were measured on occasions where greater crop load could have influenced maturity.

RESULTS:

Nemacur provided at least a 50% reduction in nematode population in each of the 5 vineyards where it was tested, except at the higher treatment rates in vineyard #2 (See Table 1). Yield benefit from Nemacur was only clearly attained in vineyards #1 and #3. There may have been some benefit in vineyard #4 but no benefit and perhaps some damage occurred in vineyards #2 and #5. Trends toward yield reduction were associated in every instance with the treatments which gave best nematicide coverage onto the berm surface. In vineyard #1 Nemacur was the only chemical which continued to provide yield benefit one year after the last treatment. There does appear to be some carry-over of benefit in Nemacur. Initial yield benefits do not appear as rapidly with Nemacur so one must be patient during the first year of its use.

Standak provided adequate nematode control in every site except vineyard #4. It provided the most dramatic yield benefit in vineyard #1 and no benefit in vineyard #2. Nematode control was not as good in the second year but it was still adequate. During the second year we used a newer formulation of the material and the biological activity of the two formulations should be compared.

Vydate can provide nematode reductions of 25 to 50% however populations are quick to return. Based on experiences with dripper systems in nursery rows and the the root lesion nematode (Pratylenchus vulnus) there is little benefit from the use of Vydate as an agent of nematode control once the nematodes are within the roots. On the other hand, if nematodes are not in heavy abundance Vydate is an excellent growth stimulator on young trees and does keep the root lesion nematode under control using monthly treatments. Vydate did not perform dramatically in the 2-year old vines of vineyard #3. If Vydate is to be tested in the future the rates of application should be at least 1 lb/Acre rate and higher rates should be tested.

Mocap liquid was most destructive to certain plastic components of the dripper systems. It provided yield benefit with only short-term or minimal reductions in nematode population levels. Surprisingly, each year it was applied there was noticeable reduction in the damage caused by the leaf folder, (Desmia funeralis).

Nudrin gave yield benefits similar to Vydate but nematode control was of short duration.

Advantage, which degrades to Furadan, gave some control of nematode but as treatment rates were increased their tended to be a reduction in yield.

GY-81 provided some nematode reductions at treatment rates of 100 ml per vine applied three times within 30 days in spring and 2 times within 30 days in fall. A single treatment of 300 ml per vine in May of the second year provided no dramatic nematode reduction whether the chemical was applied to a single site at 6 times the concentration (6' emitter spacing) or spread along the berm at 1' emitter spacings.

The most striking result of our work thus far has been the non performance of nematicides in some vineyards compared to excellent performance in others. This discrepancy occurs even when nematode control is achieved. Essentially nematicides work in some vineyards but not in others. The French Colombard vineyard was characterized before the experiment initiated as having some vines with severe root restriction as a result of physical barriers in the soil. The roots did not penetrate below 18 inches. Our suggestion at that time was that this major problem of root restriction must be corrected in concert with the control of the root knot nematode. This suggestion was even more true than we had appreciated. The Flame Seedless vineyard involved 2-year-old vines with poor growth but great variability from vine to vine. Vydate provided no remedy from the problem but Nemacur reduced nematode populations dramatically and vine vigor was improved. Nemacur was a better nematicide and the growth stimulating effects of Vydate were not enough to offset the damage from the nematode attack.

Thus far it appears as though neither Thompson Seedless vineyard has responded significantly although adequate reduction in root knot nematode did occur in both. There are other nematodes in addition to root knot in vineyard 4 and any yield benefit there might be a result of suppression of the other nematodes. We should realize that the other nematodes such as ring and root lesion may require a different treatment strategy than that useful against root knot nematode. The first year of treatments in vineyard 4 were followed within 24 hr. with a furrow irrigation. This approach served to dilute any nematicidal benefits during that first year. By the second year we had partially corrected for this problem in nematicide application.

CONCLUSIONS:

Only 2 of 5 vineyards responded dramatically to the use of nematicides. In these the benefits were visible to the eye and they involved Flame and Ruby Seedless which are highly susceptible to root knot nematode. A young French Colombard vineyard did not respond to treatments presumably because other major problems discouraged plant growth. The two Thompson Seedless vineyards did not respond significantly to treatment and this is presumed to be a result of their tolerance to root knot nematode.

Nemacur, Standak and higher rates of Vydate can reduce nematode populations and provide yield benefit in the presence of root knot nematode if the grape variety is susceptible and vines are not experiencing other major cultural difficulties. This can be accomplished with 5 lb. per year of active ingredient applied monthly during the two periods of root flush. The reader should also be aware that the dramatic yield benefits in vineyard 1 were achieved in combination with liberal applications of steer manure and summer furrow irrigations applied to the vines treated or non treated with nematicide. This application strategy we have explored may not be the best if root lesion nematode or ring nematode is also present. In vineyards these three nematodes occur together on the sandiest of soils. There are two new directions for this research to take: One, try to simulate these results from dripper systems in furrow irrigated vineyards and two, identify the best application strategy against nematodes other than root knot. The second research direction will be most appropriately attempted among orchards rather than vineyards.

Table 1. Summary of nematode control and yield changes expressed as a percentage of untreated in 5 vineyards using various nematicides.

| VINEYARD | #1 | | #2 | | #3 | | #4 | | #5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pesticide | Nema Control[1] | Yield % | Nema Control | Yield | Nema Control | Yield % | Nema Control | Yield % | Nema Control | Yield % |
| Standak(1x) | Excellent | 166% | Adequate | 102% | | | Some | 113% | | |
| (2x) | Excellent | 154 | Adequate | 100 | | | | | | |
| | | | | | ES[2] | | | | ES | |
| Nemacur(1x) | Adequate | 134 | Adequate | 90 | 4' Excellent | 150% | Adequate | 110 | 6' Adequate | 98% |
| (2x) | Excellent | 150 | Some | 83 | 1' Excellent | 132 | | | 4' Adequate | 97 |
| Vydate (1x) | Some | 119 | Adequate | 93 | 4' None | 53 | | | 2' Excellent | 89 |
| (2x) | Adequate | 110 | Some | 100 | 1' Some | 82 | | | 1' Excellent | 84 |
| Mocap (1x) | None | 129 | | | | | | | | |
| (2x) | None | 130 | | | | | | | | |
| Nudrin (1x) | None | 116 | | | | | | | | |
| (2x) | None | 109 | | | | | | | | |
| Advantage (1x) | None | 113 | | | | | | | | |
| (2x) | Some | 100 | | | | | | | | |
| GY-81 | | | | | | | Some | 113 | 6' Some | 91% |
| | | | | | | | | | 4' Some | 96 |
| | | | | | | | | | 2' Some | 87 |
| | | | | | | | | | 1' Some | 93 |

1/ Nema Control (ROOT KNOT ONLY)
NONE = Unchanged from check
SOME = 25% reduction averaged over 24 months
ADEQUATE = 50% reduction averaged over 24 months
EXCELLENT = 75% reduction averaged over 24 months
(Samples taken 6 inches from emitter puddle)

2/ ES = Emitter Spacing

U.S. PATENTED U.C. GRAPEVINE CULTIVARS
LIST OF PRIMARY PROPAGATORS
December 20, 1984

| | WINEGRAPES | | | | TABLEGRAPES | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | CARMINE | CARNELIAN | CENTURION | SYMPHONY | BLUSH SEEDLESS | CENTENNIAL SEEDLESS | CHRISTMAS ROSE | DAWN SEEDLESS | REDGLOBE |
| U.S. PLANT PATENT NO. | 3929 | 3625 | 3870 | 5013 | 4856 | 4784 | 5056 | 4788 | 4787 |
| U.C. FILE NO. | 74-024 | 72-200 | 74-025 | 81-093 | 79-164 | 79-165 | 79-166 | 79-165 | 79-163 |
| FIRM OR INDIVIDUAL | LICENSED FOR: (X) | | | | | | | | |
| AGRI-SUN, INC.<br>6910 East Clarkson Avenue<br>Selma, CA 93662 | | | | X | | X | X | X | X |
| AMBERG, HERMAN<br>Road 2, Box 60<br>Clifton Springs, NY 14432 | X | | | | | | | | |
| APKARIAN, VAHAN<br>20682 East Manning<br>Reedley, CA 93654 | | | | | X | X | X | X | X |
| BARSAMIAN, LARRY<br>920 Lincoln Avenue<br>Dinuba, CA 93618 | | | | | | | X | X | X |
| BENKIRK, INC.<br>d.b.a. Williams Nursery Farms, Inc.<br>P.O. Box 8634<br>21976 Avenue 168<br>Porterville, CA 93257 | | | | | | X | X | X | X |
| CAL WESTERN NURSERIES<br>P.O. Box 282<br>Visalia, CA 93279 | | | | | | X | X | X | X |
| C.C.R.C. FARMS<br>939 West Charter Way<br>Stockton, CA 95206 | | | | | X | X | X | X | X |
| CLM MANAGEMENT, INC.<br>P.O. Box 875<br>Lafayette, CA 94549 | | | | | X | | X | | X |
| CORRIN PRODUCE AND SALES<br>P.O. Box 48<br>Reedley, CA 93654 | | | | | | X | | X | |
| D & L, INCORPORATED<br>11024 East Dinuba Ave.<br>Selma, CA 93662 | | | | | | X | | | |
| DAVE WILSON NURSERY<br>4306 Santa Fe Avenue<br>Hughson, CA 95326 | | | | | X | X | X | X | X |
| DE BAUN, KENNETH<br>c/o Air Monitor Corporation<br>P.O. Box 6358<br>Santa Rosa, CA 95406 | | | | | X | | | | |
| ENNS NURSERY<br>1330 East Roby<br>Porterville, CA 95406 | | | | | X | X | X | X | X |

| | WINEGRAPES | | | | TABLEGRAPES | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | CARMINE | CARNELIAN | CENTURION | SYMPHONY | BLUSH SEEDLESS | CENTENNIAL SEEDLESS | CHRISTMAS ROSE | DAWN SEEDLESS | REDGLOBE |
| U.S. PLANT PATENT NO. | 3929 | 3625 | 3870 | 5013 | 4856 | 4784 | 5056 | 4788 | 4787 |
| U.C. FILE NO. | 74-024 | 72-200 | 74-025 | 81-093 | 79-164 | 79-165 | 79-166 | 79-165 | 79-163 |
| FIRM OR INDIVIDUAL | LICENSED FOR: (X) | | | | | | | | |
| GALLAGHER VINEYARDS<br>5714 Peach Avenue<br>Manteca, CA 95336 | | | | X | | X | | | |
| GENO'S NURSERY, INC.<br>8868 Road 28<br>Madera, CA 93677 | | | | X | X | X | X | X | X |
| HART RANCHES<br>33857 Road 160<br>Visalia, CA 93277 | | | | | | X | | | |
| DR. LAWRENCE A. KELLEY<br>Box 299<br>Bull Shoals, AR 72619 | X | | | X | | | | | |
| LEYDEN, JAMES<br>Rte. 2, Box 204<br>Banks, OR 97106 | | | | X | | | | | |
| LINDA VISTA GRAPEVINE<br>4401 Linda Vista Avenue<br>Napa, CA 94558 | X | | | X | | | | | |
| PANDOL AND SONS<br>Route 2, Box 388<br>Delano, CA 93215 | | | | | | X | X | X | X |
| SACRAMENTO NURSERY GROWERS, INC.<br>P.O. Box 7118<br>Sacramento, CA 95826 | | | | | | X | X | X | X |
| SONOMA GRAPEVINES<br>1919 Dennis Lane<br>Santa Rosa, CA 95401 | | | | X | X | X | X | X | X |
| STEPHEN PAVICH AND SONS<br>Route 2, Box 291<br>Delano, CA 93215 | | | | | | X | X | X | X |
| SUNRIDGE NURSERIES, INC.<br>Rte. 5, Box 534 M<br>Bakersfield, CA 93307 | | | | X | X | X | X | X | X |
| TRANSVINE NURSERY AND PRODUCTS COMPANY<br>30667 Road 196<br>Exeter, CA 93221 | | | | | | X | X | X | X |