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DRIP IRRIGATION FOR GRAPES

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When fruit set and rainfall are sufficient, grape yields in Arkansas are high, but rain is not always sufficient in Arkansas. There is enough, in terms of inches, but it often comes at the wrong times. Records during the past 20 years have shown that in all but 3 years in Northwest Arkansas, there have been brief dry spells during the growing season that lasted for at least two or three weeks. These dry periods stress the vine and affect fruit growth, and extended dry spells play havoc with a grape crop.

Fruit growers have considered grapes to be the least responsive of the fruit crops to supplemental irrigation due to their extensive root systems. However, research at the University of Arkansas has shown that what really happened over the years was that grape growers have been adjusting the fruit load (number of fruiting nodes left per vine) to a level that would allow for the crop to mature even when the annual drought occurs.

Another reason that the 'Concord' producers of Northwest Arkansas have not considered using irrigation was the lack of irrigation water sources. The concept of drip irrigation conserves water and has helped to alleviate this problem.

Concept of Drip

Drip irrigation (also called trickle or daily flow) is based on the concept that the best use of available water resources and best plant performance may be realized through preventing moisture stress (as opposed to correcting moisture stress) by maintaining favorable soil moisture conditions on only a portion of the root system. By applying water in measured quantities under low pressure (15 lbs or less) at slow rates (1 to 1 1/2 gallons per hour) and at frequent intervals maintains part of the soil at or near field capacity (optimum moisture content). Individual emitters are located at each vine to give a drop-by-drop discharge pattern that provides the same amount of water to every single vine in the vineyard. The capacity of the drip system should be adequate to replace water that is lost from the soil by transpiration and evaporation.

Water Quality

One of the essential requirements for an efficient and reliable drip irrigation system is good quality water. Well water has the advantage of the natural filtering effect of rock and sand in keeping it relatively free of suspended particulate matter. Water from ponds, lakes, and rivers contains a variety of contaminants, both inorganic and organic in nature. Contaminated water tends to plug emitters. However, almost any water source can be used after it has been filtered.

Observations from Israel indicate that drip irrigation even permits the use of water having a higher salt content than with a sprinkler or furrow system. The salt accumulation is leached to the edge of the wetted-soil mass and drip irrigation takes the highest salt concentration away from the vine where furrow irrigation would result in the opposite effect. Most all wells, ponds and lakes in Arkansas do not have water with high salt content, however, at certain times of the year the water in the Arkansas river can have high levels of salts.

Four basic methods that are used for clarification of water are settling, coagulation, floculation, and filteration. Determination of the contaminants is critical to the design of a filtration system. It is important to know the particle size, distribution, and the nature of the particles. The selection of filters will depend on knowing what material needs to be filtered out. When selecting a filter it is also important to know the flow rate required per square foot of surface area, the operating pressure of the system and filter, and the backwash requirements versus the operating flow rate.

A proper filtering system and properly engineered water mains and submains are critical to the success of the drip system. Charts are available to help determine the correct diameter and length of supply tubes, and an irrigation engineer should be consulted to design the total system.

Research Studies

Studies relative to the use of drip irrigation in a mature Geneva Double Curtain trained grape vineyard were initiated in 1975 in a research vineyard at the Main Experiment Station in Fayetteville, Arkansas. The soil was a Taloka Mounded series having a field capacity of 17.10 and a wilting percentage of 5.2. The experiment was designed to study the effects of drip irrigation, fruit load (pruning severity), and nitrogen on the yield and quality of 'Concord' grapes.

Vines were either not irrigated or drip irrigated to maintain field capacity in the drip zone and to a depth of two feet. This required supplemental irrigation at the rate of 11.7 acre-inches of water in 1975 and 13.7 acre-inches of water in 1976.

Fruit loads or pruning severities used in this study were the conventional 30+10 level (30 nodes left for the first pound of dormant prunings and 10 additional buds for each additional pound of prunings) and a 60+10 level. These two pruning severities were established on 6 node canes.

Two nitrogen levels were established using either no nitrogen for the two year period or 135 pounds of actual nitrogen per acre in 1975 and 200 pounds of actual nitrogen per acre in 1976.

A factorial design with 4-vine plots replicated 6 times was used and all treatments were imposed on the same vines each year.

Samples of fruit were obtained at 2-week intervals and frozen for later quality analysis, at which time they were thawed and blended. Percent soluble solids was determined on the raw juice. Samples were cooked and strained. For color analysis, five ml of juice diluted to 100 ml with distilled water was used to determine absorbance at 520 nm. Titratable acidity, expressed as percent tartaric acid, was determined by titration.

For the two-year average, irrigation increased yield and maintained vine size (indicated by pruning weight in table). The high fruit load that resulted from irrigation reduced the percent soluble solids and color (indicated by a lower absorbance value) of the juice. Juice acidity was not affected by irrigation by the final harvest (See Table).

Main effects of irrigation, pruning severity and nitrogen on yield, pruning weight, and juice quality at harvest of 'Concord' grapes.[1]

Main effect[2]	Yield	Pruning wt. (kg/vine)	Soluble solids %	Tartaric acid %	Absorbance at 520 nm
Irrigation					
Irrigated	5.4a	1.2	18.1b	0.68a	0.32b
Not irrigated	4.3b	0.8b	18.9a	0.67a	0.37a
Pruning severity					
30+10	3.7b	1.1a	18.8a	0.68a	0.37a
60+10	6.0a	1.0a	18.1b	0.66a	0.32b
Nitrogen					
Low	4.6a	1.0a	18.4a	0.69a	0.35a
High	5.1a	1.1a	18.6a	0.66b	0.34a

[1] Mean separation between treatments within a row by Duncan's Multiple Range Test, 5% level.
[2] Means within main effect blocks are pooled over six replications and all other variables in the table.

By decreasing pruning severity, yield was increased by about 2.3 tons per acre with no reduction in vine size. Juice quality was reduced at the 60+10 schedule as indicated by lower percent soluble solids and poorer color, but acidity did not differ. Nitrogen had no significant effect on yield. The trend was for nitrogen to have a greater effect in the non-irrigated plots, probably due to better foliage early in the growing season before the dry spells. Pruning weight, soluble solids, and absorbance, were not affected by nitrogen level, but acidity was reduced at the high nitrogen level.

The two-year average yield of each of the treatments is shown in Figure 1. The highest yielding treatment (60+10 irrigated, high nitrogen) and the lowest yielding treatment (30+10 not irrigated, low nitrogen) differed in yield by almost 4 tons per acre. All treatments produced juice of acceptable quality (15 percent soluble solids or more) by harvest (Figure 2).

As maturity progressed, % soluble solids and color increased, while acidity decreased (Figure 2). Despite the smaller crop load, fruit maturity was not as advanced on the initial sampling date in 1976 as in 1975. This may have been due to the lower degree-day accumulations in 1976. However, the final sample in 1976 had higher soluble solids and lower acidity than the corresponding sample in 1975.

Fruit maturity was delayed by irrigation and at the reduced pruning severity, as indicated by a reduction in % soluble solids and color. Acidity was greater in juice from irrigated plots on the initial sample date, but differences in acidity at harvest were not significant. Nitrogen had no significant effect on fruit maturity other than a slight, but significant, reduction of 0.03% tartaric acid at harvest at the high nitrogen level.

For the two-year average, non-irrigated 30+10 fruit produced juice of higher soluble solids and better color than any other treatment on a given sampling date (Figure 2). Percent tartaric acid was not affected by the interaction of irrigation x pruning severity x sampling date, although there were differences in acidity early in the season due to irrigation: Attainment of 15 percent soluble solids in fruit from the highest yielding treatment (60+10 irrigated) was delayed 10 to 14 days compared with the lowest yielding treatment (30+10 not irrigated).

Although fruit maturity was delayed when vines were irrigated and/ or pruned to 60+10 nodes/vine, these treatments may be feasible for Arkansas since weather conditions after harvest would not be prohibitive of a delay in harvest.

The yield increases in this study resulting from irrigation and less severe pruning indicate that the yield potential of 'Concord' vineyards in Arkansas may not have been fully exploited. If irrigation is employed in Arkansas 'Concord' grape vineyards, it is possible to leave additional fruiting nodes and mature larger crops and still produce juice of acceptable quality.

Some Arkansas vineyards are already being converted to drip irrigation. Pianalto Vineyards in Tonitown, AR are establishing a new 50 acre 'Concord' grape vineyard trained to Geneva Double Curtain and they are in the process of installing a drip irrigation system in this new planting. Also, a large acreage of Arkansas wine grapes, owned and operated by Wiederkehr Wine Cellars in Altus, is being irrigated by drip irrigation.

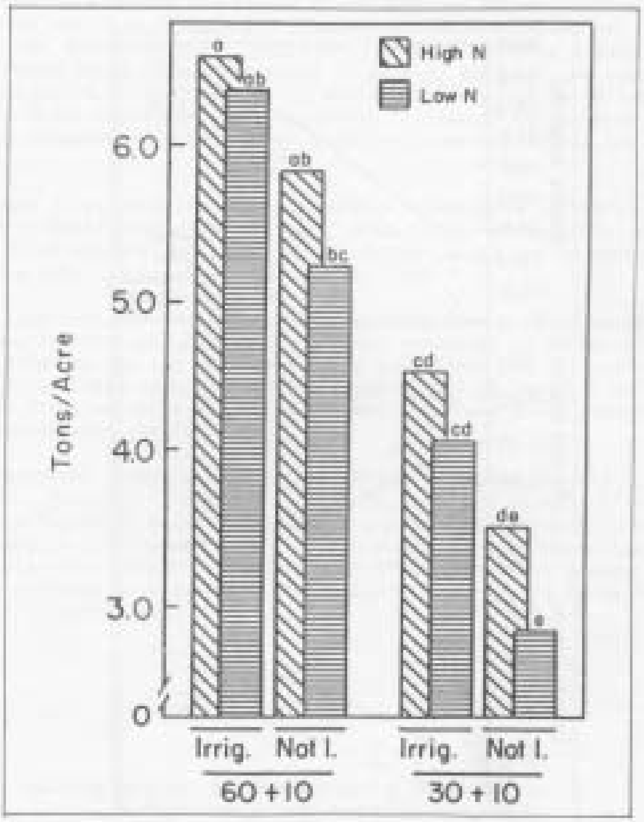

Figure 1. Effects of irrigation, nodes/vine, and nitrogen on yield of 'Concord' grapes (ave. of 1975 and 1976). Source: Spayd and Morris, University of Arkansas.

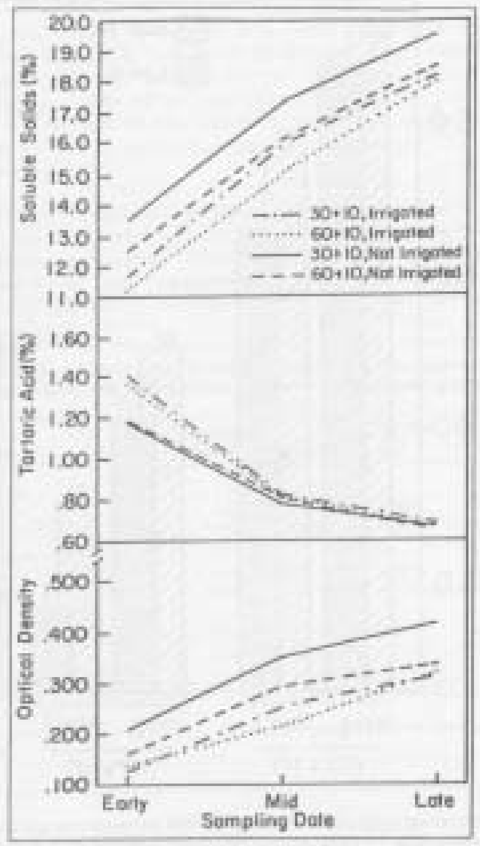

Figure 2. Interactive effects of irrigation X nodes/vine on the maturation of 'Concord' grapes (ave. of 1975 and 1976). Source: Spayd and Morris, University of Arkansas.