Prediction of 'Concord' Grape Harvest

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EARLY prediction of grape harvest would facilitate scheduling of machine harvesting and processing operations. The purposes of this study were to develop a prediction model for 'Concord' grape harvest, and determine the variations encountered in predicting fruit maturation.

Samples for quality analysis were collected each year from 6 vineyards by the area manager of National Grape Cooperative Assn., starting prior to color development and continuing on 7-to 10-day intervals until soluble solids developed to 16%. Samples were collected over 19 years (1960 to 1978). Degree-day accumulations and actual calendar days each were used for covariance analysis with development of grape soluble solids. For both prediction systems, accumulation was begun each year from the date of peak bloom, and when soluble solids reached 8%.

DD were calculated as [(maximum temperature + minimum temperature/2) base temperature]. Base temperatures used in DD calculations were varied from 0° to 15°C on 2.5° increments. Because excessive heat may not contribute in a positive manner to maturity, upper temperature limits of 25, 27.5, 30, 32.5, and 35°C were incorporated into the degree day formulas along with no upper temperature limit.

The standard method of calculating DD for grapes is by using a base temperature of 10°C and no upper temperature limit. Results of this study did not indicate sufficient improvement in predictability of grape harvest to justify altering the base temperature or including an upper temperature limit in calculations. Use of actual number of calendar days was found more accurate for predicting harvest than DD accumulations. The predicted number of DD required from peak bloom to 'Concord' harvest at 16% soluble solids development was 1399, using a base temperature of 10°C and no upper temperature limit. The predicted number of calendar days from peak bloom to harvest was 96. The date that fruit actually reached 16% soluble solids varied by 18 days from the earliest to the latest year using the DD prediction but by only 11 days basing the prediction on calendar days.

Error was reduced when predictions were made from 8% to 16% soluble solids development. The predicted number of DD was 445 and calendar days was 27. However, the variation between the earliest and latest ripening years of the 16 year period still was 16 days for the DD prediction and 10 days for the prediction based on calendar days.

The average date of peak bloom for the 16 years was May 19, but ranged from May 8 to May 27. The average calendar dates and number of days from peak bloom to 8 and 16% soluble solids development are shown in the Table 1. The large variations between years and between vineyards within a given year cannot be accounted for by variations in temperature.

In another study, vines were selected in 1978 in an ongoing study of irrigation and fruit load in a research vineyard at the Main Experiment Station. The extremes in soluble solids development that can occur within a given vineyard and year due to vine variation, crop load, and soil moisture were examined.

Of the vines selected for monitoring soluble solids development, the two high yielding irrigated vines developed 8% soluble solids on July 28 and July 29 but did not attain 16% by the time sampling ended on Sept. 8 (Table 2). One of the low-yielding irrigated vines reached 8% soluble solids on July 25 and 16% on August 21. This interval matched the 27 days forecast by the best prediction model. Another vine that was treated identically required 5 days more than the predicted 27 days to go from 8 to 16% soluble solids. The two nonirrigated high yielding vines required 13 and 18 days beyond the predicted 27 days. One of the low-yielding nonirrigated vines developed 16% soluble solids 3 days earlier and the other vine 4 days later than the predicted date.

Climatic variations other than temperature and differences in cultural practices prevent accurate and reliable use of a forecasting system for 'Concord' grape maturation in Arkansas. Long-range estimates from a prediction model may be useful to determine the start of initial fruit sampling, but continuous monitoring of fruit maturation is necessary to determine actual harvest dates and scheduling of facilities.

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Table 1. Variations in Maturation of 'Concord' Grapes

Variable	Soluble solids 8%	16%
Calendar dates		
Mean	July 27	Aug. 23
Range between years'	July 14-Aug. 6	Aug. 9-Sept. 2
Range between vineyards	July 11-22	Aug. 17-Sept. 1
Days from peak bloom		
Mean	69	96
Range between years	63 to 75	90 to 101
Range between vineyards	63 to 74	90 to 105
Acidity (as % tartaric)		
Mean	2.70	1.05
Range between years	2.50 to 3.15	0.90 to 1.20
Range between vineyards	2.45 to 2.95	0.95 to 1.45
Color (O.D.)		
Mean	x	9.3
Range between years		6.4 to 15.6
Range between vineyards		8.1 to 15.1

'Variation between earliest and latest years (mean for each year determined by averaging across 6 vineyards) Maximum variation between 6 vineyards in a year. xInsufficient color development for determination at 8% soluble solids.

Table 2. Possible Variation Extremes in Development of Soluble **Solids Due to Irrigation, Fruit Load, and Vine, Same Vineyard**

Variable	Yield (MT/ha)	Date of 8% sol.sol	Date of 16% .sol.sol.	Days from 8 to 16% sol.sol.	Prediction' error (days)
Irrigated[2]					
High yield			[3]		
Vine 1	22.0	July 29			
Vine 2	24.5	July 28			
Low yield					
Vine 1	11.4	July 25	Aug. 21	27	0
Vine 2	10.6	Aug. 2	Se	32	+5
Not irrigated			pt. 3		
High yield					
Vine 1	11.5	July 23	Sept. 6	45	+18
Vine 2	12.8	Jul	Se	40	+13
Low yield		y 29	pt. 7		
Vine 1	6.7	July 28	Aug. 21	24	-3
Vine 2	6.8	July 25	Aug. 25	31	+4

' Based on 27 days required from 8 to 16 percent soluble solids development; +indicates development later than forecast. [2]Soil moisture tension maintained between 100 and 200 mb. [3]Fruit did not reach 16%o soluble solids by Sept. 8. On Sept. 8 vine 1 had 14.4 percent and vine 2 had 14.6 percent sol. sol.