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Winter Bud Injury of Grapevines 1981-1982

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Abstract

Mature dessert and wine grape cultivars and numbered selections at the State Fruit Experiment Station of Southwest Missouri State University were classified according to the percentage of primary, secondary, and tertiary buds alive after minimum temperatures of −27°C and −25°C were reached in mid-January 1982. Concord Seedless, GR-7, Ives, and Steuben were the most hardy of the 81 cultivars and selections whereas Lakemont, S-14117, and Suffolk Red were the least hardy.

Introduction

The State Fruit Experiment Station of Southwest Missouri State University is located in the west Ozarks of Missouri with an average annual precipitation of 104 cm. The Experiment Station is located in Mountain Grove at 442 meters above sea level where the winters are generally mild. Temperatures below −18°C on consecutive nights are unusual for this area. The soils are classified in the Viraton series. This is a slowly permeable silt loam underlain by a fragipan at a depth of 41-89 cm (10).

Winter bud hardiness data were collected from dessert and wine grape cultivars and numbered selections in the State Fruit Experiment Station vineyards after record breaking low temperatures of mid-January 1982. These temperatures provided an excellent opportunity to evaluate winter bud hardiness. The purpose of this study is to ascertain the winter bud injury suffered by these *Vitis* cultivars and selections after exposure to low winter temperatures.

Materials and Methods

Weather. The grape yield in 1981 at the Fruit Experiment Station was light, due probably to the drought of 1980. Temperatures in 1981 were close to normal and annual precipita-

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tion was normal, although its distribution was not. Considering the precipitation from August 1981 through January 1982; August, September, November and December were dry; whereas, October and January were wet (see Table 1). Temperatures from January 1 through 7 were mild. Minimum temperatures of −27°C on January 10 and 11, −15°C on January 16, and −25°C on January 17 and 18 were recorded (Fig. 1). The previous record low of −24°C was recorded in 1940 and 1977.

Test areas. Vineyard F, established in 1973, is a mixture of wine and dessert grape cultivars and numbered selections. The vines were trained to the four-arm Kniffin system and are spaced 2.44 meters apart. The rows run north-south and are spaced 2.05 meters apart. The vineyard is nonirrigated and has a 3.5% eastern slope. Each cultivar or numbered selection was originally planted in a section containing 10 vines. Vineyard T was established in 1976 of primarily dessert grapes. The sections, each containing 12 vines, were trained to the bilateral cordon-single curtain system but were not combed in 1981. The vineyard has 4.5% southern slope and is trickle irrigated. The majority of plants in vineyard T were infected with anthracnose and were the subjects of a fungicide trial in 1981. Otherwise, both vineyards received the commercial pesticide-fertilizer program recommended for Missouri.

Sampling Procedure. Three 10-bud cane sections were randomly collected from mature vines of each cultivar or numbered selection between January 28 and February 5, 1982. The cane sections collected were of live wood of uniform size, suitable to be retained after pruning for the next season. Row-end vines or those of relatively low vigor were avoided if possible. Extreme basal or tip buds were not sampled. Of the 30 buds collected in each case, 25 were cut and a mortality count of primary (1°), secondary (2°), and tertiary (3°) buds was recorded. Canes were kept at 4.4°C for 4 days, then at room temperatures for 1-2 days before buds were cut. Mortality was recorded if the tissue in the center of the bud was brown. Tissue browning has been evaluated as an accurate test in determining death when compared to other methods (9). Total mortality is the average of 1°, 2°, and 3° bud mortality percentages and is used as an index by which to rank the relative bud hardiness of the vines. All samples were taken from vineyard F or T except for Concord. Three 10-bud canes were collected from 1 unpruned plant in a nearby Concord vineyard. A 3-plant sample was not available because the vineyard had been pruned.

Results and Discussion

Concord Seedless, GR-7, Ives, and Steuben were the hardiest of the 47 cultivars and 34 numbered selections with 4% 1° bud mortality (Table 2). The least bud hardy with 90% or greater total bud mortality were Lakemont, S-14117, and Suffolk Red. There was no significant correlation between plant mortality and either primary or total bud mortality of the vines. Cultivars of commercial interest in Missouri that were classified in this study are listed in order of decreasing winter bud hardiness as follows: Catawba, DeChaunac, Concord, Chancellor, Vidal Blanc, Chelois, Villard Blanc, and Seyval Blanc.

Campbell and Ghosheh (1) found the greatest difference in varietal cold injury response of grape canes within the temperature range of −23°C to −27°C in the laboratory. The Mountain Grove vines were exposed to temperatures within this range on 4 occasions in January 1982 (Fig. 1). These low temperatures were each recorded on 2 consecutive nights. Proebsting (7) found that there was a general relationship between the temperature at

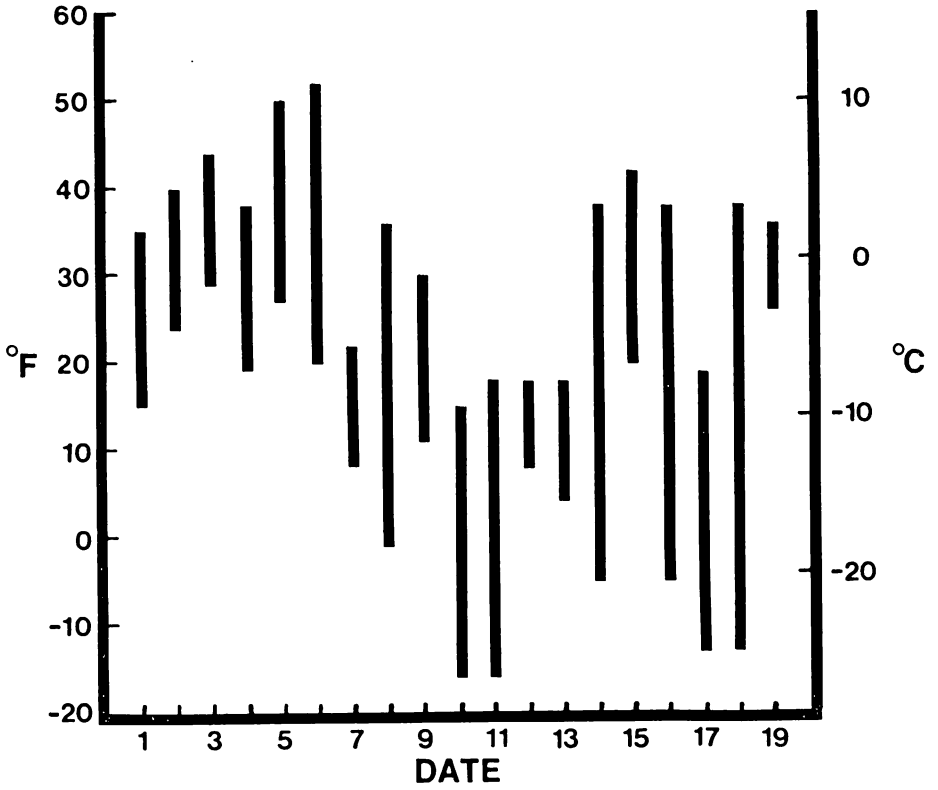

Fig. 1. Maximum and Minimum Temperatures for January 1-19, 1982 at Mountain Grove, Missouri.

which 50% of peach buds die in winter and the mean temperature of the 2 preceding days and that hardiness is more readily lost in the latter part of winter depending on bud development. The weather prior to the onset of the critically cold period was mild and may be a factor in the extent of winter injury observed on the grapes in this study.

Gladwin (4) and Clark (3) classified primary bud hardiness of grapes after winter temperatures between −25°C and −27°C were recorded. The relative order of primary bud hardiness was similar for cultivars common to the Mountain Grove study and the previous ones. Concord is considered hardy in all the evaluations above and can serve as a point of reference between them. Campbell and Hadle (2) recorded cane bud mortality after a winter minimum of −34°C. Of the cultivars in common with the Mountain Grove evaluation, Concord, Aurore and Rosette had surviving buds whereas Alden, Both, Delaware, Romulus, Steuben, Chancellor, Cascade, Chelois, Villard Blanc, Seyval Blanc and Baco Noir did not. A high relative hardiness in Concord was exhibited by both the Campbell and Hadle and Mountain Grove Grove studies. However, it should be emphasized that there was a 7-9°C difference between the killing temperatures from which the two evaluations result. In the general hardiness charts of Shaulis (8) and Gloor (5), Catawba was classi-

Table 1. Summary of meteorological data from August 1981 through January 1982 at Mountain Grove, Missouri[z].

Month/year	Precipitation cm	Average precipitation cm	Average temperature °C	Overall average temperature °C
August 1981	6.12	8.64	23	25
September 1981	2.06	9.58	20	21
October 1981	17.68	8.31	13	15
November 1981	3.28	6.08	8	8
December 1981	4.78	6.35	1	3
January 1982	12.12	5.84	−4	1

[z]Weather data supplied by Mr. Merlyn A. Haag, Cooperative Observer at Mountain Grove for the National Weather Service. Averages are from the Climatological Summary of 1931-1980 recorded at Mountain Grove, MO.

fied less hardy than Concord, but the opposite was found in the Mountain Grove study. Baco Noir, Steuben and Golden Muscat were classified less hardy in the general charts than in the Mountain Grove evaluation.

Although the differences in location, climate, and growing season are major factors to consider when comparing various hardiness studies, the rhizosphere of the vines also should be noted in our case especially. The Viraton soils at the Experiment Station are underlain by a fragipan, a dense and acid layer, which can effectively restrict root depth to 41-89 cm. Grapes are generally considered deep rooted plants (11). This soil condition may affect varietal performance and thus hardiness.

There were hardiness differences between sites on the Fruit Experiment Station (Table 2). The A-1163 sample from vineyard T is categorized hardier (group A) than the sample from vineyard F (group C). The Interlaken sample from vineyard F is categorized hardier (group C) than the sample from vineyard T (group D). The Interlaken sample pair had the greatest differences between their 1° bud mortality and total bud mortality percentages, followed by the Himrod sample pair. The two A-1163 samples and the Canadice sample pair both had the same amount of difference in the 1° bud mortality, but the Canadice pair had a lower total bud mortality difference. There was very little difference between sample pairs of the extremely cold tender Romulus and Suffolk Red.

The differences between vineyards F and T which may have contributed to differences in varietal performance are site, irrigated vs. non-irrigated conditions, severity of anthracnose infection, and vine age difference. The extent to which these factors affected the results are not known. These differences in varietal response illustrate the point that although critically low temperature is viewed as the maior factor in bud injury in this study, many other factors including site to site variation were involved. The 1981-82 winter bud hardiness data will be important information in the compilation of general grape hardiness recommendations for Missouri.

Many factors besides low winter temperatures are involved in the determination of winter bud hardiness in grapevines. Weather conditions, cultural practices, site, maturity of wood, vigor of vines, and overcropping can affect the winter bud hardiness of any vine (4, 8). The hardiness of bud tissue on a single vine can vary up to 12°C depending on factors encountered during the growing season (6). This study considers the primary factor affecting the winter bud hardiness of the test vines to be the low

Table 2. Wine and dessert grape winter bud hardiness data following the test winter 1981-82.

Cultivar or numbered selection	Location and planting date[z]	Percent plant mortality[y]	Percent winter bud mortality 1°	2°	3°	total[x]
Group A. Very hardy cultivars or numbered selections with 10.0% or less total bud mortality[x]						
Concord Seedless	T-76	0	4	0	0	1.33
GR-7	F-75	30	4	0	0	1.33
Ives	F-74	20	4	0	0	1.33
Steuben	F-74	10	4	0	0	1.33
Baco Noir	F-73	0	8	0	0	2.67
Foch	F-73	30	8	0	0	2.67
Golden Muscat[w]	F-74	0	8	0	0	2.67
BS 2862	F-74	10	12	0	0	4.00
Catawba	F-73	0	12	0	0	4.00
DeChaunac	F-73	0	12	0	0	4.00
A 1163[w]	T-76	25	16	0	0	5.33
Bath	F-74	20	16	0	0	5.33
Castel 19637	F-74	0	16	0	0	5.33
GS-5	F-74	30	12	4	0	5.33
GW-7	F-74	40	16	0	0	5.33
Golden Muscat[w]	T-76	8	8	8	0	5.33
Humbert #3	F-74/75	0	16	0	0	5.33
JS 23-416	F-74	60	16	0	0	5.33
Concord	C-71	—	20	0	0	6.67
GW-8	F-74	40	20	0	0	6.67
JS 26-627	F-74	30	20	0	0	6.67
Leon Millot	F-73	10	16	4	0	6.67
Totmur	F-74	10	12	8	0	6.67
Neva Munson[v]	T-76	92	10	20	0	10.00
Venus[v]	T-76	92	30	0	0	10.00
Group B: Hardy cultivars or numbered selections with 10.1 to 20.0% total bud mortality[x]						
Cascade	F-73	10	28	4	0	10.67
Delaware	F-74	10	20	12	0	10.67
Chancellor	F-73	10	40	0	0	13.33
S 7136	F-74	0	32	8	0	13.33
SV 18 307	F-74	10	36	8	0	14.67
S 23047	F-74	0	44	0	0	14.67
BS 18-307	F-74	40	40	4	4	16.00
GW-10	F-74	30	48	4	0	17.33
SV 23-512	F-74	10	48	4	0	17.33
Veeport	F-74	20	36	12	4	17.33
Captivator	F-74	30	48	8	0	18.67
NY Muscat	F-74	20	48	8	4	20.00
Rosette	F-73	0	40	16	4	20.00

Cultivar or numbered selection	Location and planting date[z]	Percent plant mortality[y]	Percent winter bud mortality 1°	2°	3°	total[x]
Group C: Moderately hardy cultivars or numbered selections with 20.1 to 50.0% total bud mortality[x]						
A 1163[w]	F-73	0	44	12	8	21.33
Vignobles	F-73	0	56	8	0	21.33
Isabella	F-74	30	56	12	0	22.67
Ravat 578	F-74	60	56	16	0	24.00
Aurore	F-73	10	68	8	0	25.33
Elvira	F-74	0	60	16	0	25.33
A 1041[v]	T-76	92	80	0	0	26.67
Vincent	F-74	0	60	16	4	26.67
GW-2	F-74	20	76	8	4	29.33
Himrod[w]	T-76	0	52	32	4	29.33
Canada Muscat	F-74	60	40	20	0	30.00
Canadice[w]	T-76	8	56	24	16	32.00
Cayuga White	F-74/75	30	64	28	8	33.33
A 1026	F-73	30	72	32	0	34.67
Alden	F-74	30	72	8	4	34.67
Canadice[w]	F-74	20	84	12	8	34.67
Rougeon	F-73	0	72	28	4	34.67
Vidal Blanc	F-73	0	72	32	0	34.67
A 1105	T-76	58	100	8	0	36.00
S 2986	F-74	30	68	36	12	38.67
Vinered	F-74	10	68	36	12	38.67
SV 23410	F-74	10	56	40	36	44.00
Interlaken[w]	F-74	30	48	48	40	45.33
S 10868	F-74	50	96	24	18	46.00
GW-4	F-74	50	88	48	4	46.67
Himrod[w]	F-74	70	84	44	10	46.67
NY 36661	T-76	25	68	52	24	48.00
GR-3	F-74	40	68	68	12	49.33
GW-9	F-74	40	100	36	12	49.33
Group D: Cold tender cultivars or numbered selections with 50.1 to 70.0% total bud mortality						
Chelois	F-73	0	84	52	24	53.33
Villard Blanc	F-74	0	64	60	36	53.33
JS 12-428	F-74	50	100	51	16	56.00
Chambourcin	F-75	60	100	80	4	61.33
Colobel	F-73	30	100	52	36	62.67
Landal	F-75	10	96	56	40	64.00
Seyval Blanc	F-74	10	96	80	28	68.00
Interlaken[w]	T-76	33	92	72	44	69.33

Cultivar or numbered selection	Location and planting date[z]	Percent plant mortality[y]	Percent winter bud mortality 1°	2°	3°	total[x]
Group E: Very cold tender cultivars or numbered selections with 70.1 to 100.00% total bud mortality[x]						
Dutchess	F-74	20	100	76	36	70.62
S 7136	F-74	70	100	84	32	72.00
Seneca	F-74	0	100	68	64	77.33
Romulus[w]	F-74	50	95	84	56	78.67
Glenora	T-76	0	95	84	60	80.00
Romulus[w]	T-76	0	96	84	76	85.33
GR-8	F-74	70	100	96	64	86.67
SV 12-303	F-74	10	100	92	72	88.00
Landot 4511	F-74	30	100	96	72	89.33
Lakemont	T-76	8	100	88	84	90.67
S-14117	F-74	10	100	100	72	90.67
Suffolk Red[w]	F-74	0	100	92	88	93.33
Suffolk Red[w]	T-76	0	100	100	96	98.67

[z]T denotes location in vineyard T. F denotes location in vineyard F, and C denotes location in the 'Concord vineyard. The number(s) following the location letter denotes the year(s) in which the block was planted.
[y]Percent plant mortality is the percentage of plants that died between the planting date and November 1, 1981.
[x]Total bud mortality is the average of the percentages of 1° (primary), 2° (secondary), and 3° (tertiary) bud mortality. It is used as an index by which to order the cultivars or numbered selections into the hardiness classification of the above table.
[w]This cultivar or numbered selection is planted in both the T and F vineyards.
[v]Only 1 vine remains from the original planting for this cultivar or numbered selection, therefore one 10-bud cane from the vine was used to determine bud mortality percentages.

temperatures of mid-January 1982. The vines suffered a loss of vigor due to the drought of 1980, and did not bear a large crop in 1981. The weather prior to dormancy was not unusually warm or wet, although October was wetter than normal. Temperatures in early January 1982 were mild. These events could be contributing factors to the final results, but the decisive factor is viewed as the mid-January temperatures in the critical range.

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