Aerial Root Development on Winegrape Cultivars Following a Spring Freeze

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Abstract

Aerial rooting in grapes has been described as an indication of cold injury. This study was conducted in summer 2007 to determine if there is a difference in the amount of aerial root formation between cultivars, rootstock type (1103P vs. own root), location on the vine (distal and basal for cordons and trunk), and planting year. Budbreak date and prior visual winter injury ratings were also analyzed for correlation with the number of aerial roots produced. Aerial roots were counted separately on basal and distal portions of the trunk, and basal and distal portions of the North and South cordons. Mean number of aerial roots was significantly different between eleven cultivars. Different sections of the vine also produced a significantly different number of roots. The distal regions of both cordons produced the greatest mean number of aerial roots, followed by the basal regions of the cordons, and lastly the basal and distal regions of the trunk. There was no significant difference between the North and South cordons, but the pooled cordon data revealed a significantly greater amount of aerial roots (mean=11.35) when compared to the pooled trunk data (mean=0.36). No significant difference in aerial rooting was found between rootstock type or year of planting. Aerial root production appears to differ based on the cultivar, as well as location on the vine. Budbreak date and injury ratings appear to have no relationship with the number of aerial roots produced.

Introduction

An aerial root is one that develops adventitiously above the soil surface (Pratt, 1974). The cause of adventitious rooting has been attributed to cold injury (Lindley, 1855; Clark, 2001). Clark (2001) used the production of aerial roots as an indicator of winter hardiness in muscadine grape cultivars in Arkansas. Clark indicated that the cultivars with observed aerial root formation had lower cold hardiness than those cultivars that did not produce any aerial roots. In Oklahoma, a warm March combined with a spring freeze in early April 2007, was injurious to grapevines. Following this freeze, the production of aerial roots was observed on grapevines at the Oklahoma State University Cimarron Valley Research Station at Perkins, Okla. This study was conducted to determine if there was a difference in the amount of aerial root formation between cultivars, rootstock type (1103P vs. own root), location on the vine (distal and basal for cordons and trunk), and planting year.

Materials and Methods

Aerial roots were observed growing from the cordons and trunks of winegrape cultivars at the Oklahoma State University Cimarron Valley Research Station at Perkins, Okla. (Fig. 1-4), following the 2007 freeze on April 7 and 8. At the time of the freeze, 'Chardonnay' had been pushing new growth for three weeks (Fig. 5). The temperature reached a low of - 4.6°C, which resulted in the death of much of the new growth on the grapevines (Fig. 6). According to a study by Stafne (2007), which assigned freeze injury ratings to the primary bud growth of individual vines, earlier budbreak correlated with higher injury rating.

The vineyard planting consisted of 11 cultivars arranged in a randomized complete block design. All vines were grown on a bilateral, high cordon system and were spaced 2.5 m between plants and 3.7 m between rows. Vines with a rootstock were planted in 2001 and own-rooted vines were planted in 2002. Management of the vineyard was consistent with standard industry practices. Aerial roots were counted during August 2007 when it was evident no new roots would be initiated. Each cultivar was assessed on a single day. Each plant was divided into six distinct regions; distal and basal regions of the North cordon, distal and basal regions of the South cordon, and distal and basal regions of the trunk. The distal region was defined as the half of the cordon farthest from the trunk. The number of aerial roots was counted separately for each region, then totaled for each cordon, trunk, and the entire plant. When a region of the plant was missing, it was recorded as missing data. Data were analyzed with JMP (SAS, Inc.) in the Fit Model Procedure.

Figure 1 – Aerial root growth from vine cordon.

Figure 2 – Aerial root growth from vine cordon.

Figure 3 – Aerial root formation from vine trunk.

Figure 4 – Aerial root formation from vine trunk.

Figure 5 – Early season shoot growth of 'Chardonnay' before freeze event.

Figure 6 – Early season shoot growth of 'Chardonnay' after freeze event.

Results and Discussion

Significant difference in the total number of aerial roots produced was observed between cultivars (Table 1). 'Chambourcin' and 'Petit Verdot' had the greatest mean number of aerial roots produced per vine with 122.4 and 121.7, respectively. 'Shiraz' had the fewest mean number of roots produced, with 1.9 roots per vine. Significant difference was also seen between regions of the vine (Table 2). The distal portions of each cordon had significantly greater mean number of roots than the basal portion of each cordon. There was not a significant difference between the North and South cordons. Both the distal and basal portions of each cordon had significantly greater mean number of roots than the distal or basal regions of the trunk. There was no significant difference between the number of aerial roots produced by vines growing on rootstock 1103P versus those that were own rooted. There was also no correlation in number of aerial roots produced in relation to date of planting, timing of budbreak, or prior injury rating (Stafne, 2007).

Table 1 – Mean number of aerial roots (per vine) produced on 11 grape cultivars.

Cultivar	Mean Number of Aerial Roots (per vine)	Mean Separation
Chambourcin	122.4	A [z]
Petit Verdot	121.7	A
Viognier	70.7	B
Merlot	32.6	C
Pinot Gris	21.7	CD
Cynthiana	21.5	CD
Ruby Cabernet	18.3	CDE
Sangiovese	14.2	DE
Cabernet Sauvignon	12.3	DE
Malbec	6.9	DE
Shiraz	1.9	E

[z]Means followed by the same letter are not significantly different , P< 0.05.

Table 2 – Mean number of aerial roots (per vine) produced on six regions of the grapevine.

Location on Plant	Mean Number of Aerial Roots (per vine)	Mean Separation
Distal South	11.1	A [z]
Distal North	10.2	A
Basal North	6.6	B
Basal South	6.3	B
Basal Trunk	0.35	C
Distal Trunk	0.18	C

[z]Means followed by the same letter are not significantly different , P< 0.05.

Conclusions

Aerial root formation due to the 2007 freeze event on 11 winegrape cultivars varied based on the cultivar. Root formation also varied by location on the vine. Rootstock or own rooted, year of planting, timing of budbreak, and injury ratings appeared to have no correlation to the number of aerial roots produced by the vine.

To determine the ability of each of the eleven cultivars in this study to root, a greenhouse study is planned. The greenhouse study will evaluate the amount and total production of roots by cuttings taken in early 2008. This study will help determine if the number of aerial roots produced is correlated with the natural ability of the plant to root.

Literature Cited

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