2024 Final Report R-14

Title:
Effect of Stem Cutting Propagation Strategies on Grapevine Species (*Vitis*)

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Objective:

The objective of this study is to evaluate different propagation strategies on rooting of semi-hardwood and hardwood cuttings of various grapevine species (*Vitis*). By fine-tuning IBA levels, we hope to achieve more consistent and faster root development, leading to increased plant yields. This would not only streamline production processes, but could ensure a more reliable supply of these plant species, ultimately benefiting both growers and consumers alike.

Justification and Description:

Improving stem cutting propagation of grapevine species holds immense importance with the growing interest in grapevine cultivation in the region. Propagating these plants from stem cuttings can be a challenging endeavor. As a result, this research initiative seeks to address this issue by exploring methods to enhance the success rate of stem cutting propagation. By developing more efficient and reliable techniques, nurseries

can increase their ability to supply grapevine plants to local growers. This not only expands the availability of grapevines in the market, but also plays a pivotal role in bolstering the wine industry in Mississippi. By facilitating the growth of this industry, improved grapevine propagation methods contribute to economic development, agricultural diversification, and ultimately benefiting the local economy and wine enthusiasts.

Grapevines, in the family Vitaceae, are some of the world's most important fruit crops (6, 13). They are propagated in many ways: grafting, layering, seeds, and vegetative cuttings. Propagation via vegetative cutting is generally the most popular way to propagate grapevines. Cuttings can take less time to get a rooted plant than propagation from seed and are usually observed to be more economical (6, 7, 10). In general, varieties that fall withing *Vitis vinifera* L., bunch grapes, have been observed to be easy to propagate with hardwood cuttings (2, 7, 16). However, there are some hybrid varieties and selections that have been observed to be more difficult to propagate than others, Norton and OK392 (1, 5, 11).

The use of indole-3-butyric acid (IBA) has been observed to aid in the formation of adventitious roots in cutting propagation. The range of IBA that induces the highest root percentages has been anywhere from 500 to 2000 ppm, pending the variety being propagated (3, 4, 12, 14, 15).

Materials and Methods:

The study will take place at the Mississippi State University, MAFES South Branch Experiment Station in Poplarville, MS. This study will be done using semi-hardwood cuttings and hardwood cuttings to give growers the ability to propagate them at

the most efficient time during their crop rotations. Four and one-half inch deep containers will be filled with 100% pine bark substrate (50% fresh, 50% aged) and three to four node cuttings will be placed in the container to a depth of two inches. Containers will then be placed under intermittent mist that will be adjusted as needed throughout the study. Four varieties of bunch grape will be evaluated and will include, (dependent on availability) but are not limited to, 'Miss Blanc', 'MidSouth', 'Norton' and OK392 (8). Hormone treatments of IBA and ascorbic acid will be applied as a basal quick dip to cuttings. Ascorbic acid (ASC) has been documented to aid in rooting of difficult to root plant species (9). Hortus (Hortus IBA Water Soluble Salts™, Phytotronics, Inc.®, Earth City, MO) will be utilized as the IBA source. The 10 hormone treatments will be an un-treated control, 50 ppm ASC, 500 ppm IBA, 500 ppm IBA + 50 ppm ASC, 1000 ppm IBA, 1000 ppm IBA + 50 ppm ASC, 1500 ppm IBA, 1500 ppm IBA + 50 ppm ASC, 2000 ppm IBA, 2000 ppm IBA + 50 ppm ASC (Table 1). The experiment will be conducted in a completely random design with 4 replications of each treatment combination for both semi-hardwood and hardwood cuttings. Sixty days after treating, rooting percentage, growth index (new shoots), cutting quality (0-5, with 0 = dead and 5 = transplant-ready cutting), total root number, average root length (of three longest roots), and root quality (0-5, with 0=no roots and 5=healthy, vigorous root system) data will also be collected.

Results:

Hardwood Cuttings

No significant interactions between cultivar and hormone treatment were observed for growth index and average length of shoots, however differences for these

two data parameters were observed between cultivars across all treatments (Table 2). It was observed that Miss Blanc has the highest growth index, having a higher average number of new shoots when compared to Norton, MidSouth, and OK392. Miss Blanc was also observed to have a longer average lengths of shoots when compared to Norton, MidSouth, and OK392 cultivars. Significant interactions between cultivar and hormone treatments were observed for cutting quality, root number, root quality, average length of three longest roots, and root percentage (Table 3). Miss Blanc receiving treatments 1, 2, 5, 6, 7, 9 had significantly higher cutting quality than OK392 receiving treatments 2, 5, 6, 7, 8, 9, 10, Miss Blanc receiving treatment 10, and MidSouth and Norton across all treatments. The number of roots were greater for Miss Blanc receiving treatments 5, 7 than Miss Blanc receiving treatments 3, 4, 6, 10, and OK392, MidSouth and Norton across all treatments. Higher root quality was observed with Miss Blanc receiving treatments 2, 5, 7, in comparison with OK392 receiving treatments 2, 3, 5, 6, 7, 8, 9, 10, and MidSouth and Norton across all treatments. For average root length, OK392 receiving treatments 3, 4 had significantly longer roots than Miss Blanc receiving treatment 10, OK392 receiving treatments 5, 6, 7, 8, 9, 10, and MidSouth and Norton across all treatments. Finally, higher rooting percentages were observed with Miss Blanc receiving treatments 1, 2, 3, 5, 6, 7, 8, 9 and OK392 receiving treatments 1, 4, when compared to OK392 receiving treatments 2, 5, 6, 7, 8, 9, 10, and MidSouth and Norton across all treatments.

Semi-Hardwood Cuttings

No significant interactions between cultivar and hormone treatment were observed for root number and average length of shoots, however differences for these two

data parameters were observed between cultivars across all treatments (Table 4). It was observed that OK392 had the highest average number of roots when compared to Norton, MidSouth, and Miss Blanc. OK392 was also observed to have a longer average lengths of shoots when compared to Norton, MidSouth, and Miss Blanc cultivars. Significant interactions between cultivar and hormone treatments were observed for growth index, cutting quality, root quality, average length of three longest roots, and root percentage (Table 5). OK392 receiving treatment 2 had a significantly greater number of shoots than Miss Blanc receiving treatments 1, 2, 3, 4, 5, 7, 8, 9, 10, OK392 receiving treatments 1, 3, 5, 6, 8, 9, 10, and MidSouth and Norton across all treatments. Higher cutting quality was observed in OK392 receiving treatment 2 compared to OK392 receiving treatments 1, 3, 5, 8, 9, 10, and MidSouth, Miss Blanc, and Norton across all treatments. Higher root quality was also observed in OK392 receiving treatment 2, 7 compared to Miss Blanc receiving treatments 1, 2, 3, 4, 5, 7, 9, 10, OK392 receiving treatments 1, 3, 8, 9, 10, and MidSouth and Norton across all treatments. OK392 receiving treatment 2 had significantly longer roots than OK392 receiving treatments 1, 3, 5, 6, 8, 9, 10, and MidSouth, Miss Blanc, and Norton across all treatments. Finally higher rooting percentages were observed with OK392 receiving treatment 2 compared to MidSouth receiving treatments 1, 2, 4, 5, 6, 8, 9, 10, Miss Blanc receiving treatments 1, 2, 3, 5, 9, 10, OK392 receiving treatments 1, 3, 9, 10, and Norton across all treatments.

Discussion:

Based on the results of these studies, Miss Blanc would be recommended to growers wanting to grow grapes from hardwood cuttings. Miss Blanc hardwood cuttings treated with any presented treatment, except for 50 ASC + 2000 IBA, resulted in the best

hardwood cutting. OK392 would be recommended to growers wanting to grow grapes from semi-hardwood cuttings. OK392 semi-hardwood cuttings treated with 50 ASC, 50 ASC + 500 IBA, and 1500 IBA resulted in the best semi-hardwood cutting.

Table 1. Treatment number key for results.

Treatment Number	Treatment
1	Control
2	50 ASC
3	500 IBA
4	50 ASC + 500 IBA
5	1000 IBA
6	50 ASC + 1000 IBA
7	1500 IBA
8	50 ASC + 1500 IBA
9	2000 IBA
10	50 ASC + 2000 IBA

Table 2. Growth index and average length of shoots differences between four grapevine cultivars hardwood cuttings.

Cultivar[z]	Growth Index[y]	Average Length of Shoots (cm)
Norton	0.05c	0.1125c
MidSouth	0.025c	0.1196c
Miss Blanc	1.6a	5.7225a
OK392	0.625b	4.295b
P-value[x]	*<0.0001*	*<0.0001*

[z]Analysis of variance was performed using PROC GLIMMIX (SAS 9.4). Means followed by the same letter are similar and not significantly different ($\alpha = 0.05$).
[y]Growth index=(average number of new shoots present).
[x]P values for differences between means were obtained at $P \leq 0.05$.

Table 3. Interaction of cultivar and hormone treatment on cutting quality, root number, root quality, average length of three longest roots, and rooting percentage of four grapevine cultivars hardwood cuttings.

Treatments[z]		Cutting Quality Rating[y]	Roots (no.)	Root Quality Rating[x]	Average Length of 3 Longest Roots (cm)	Rooting (%)
Cultivar	Hormone					
MidSouth	Control	0g	0l	0e	0g	0d
Miss Blanc	Control	4.25a	29.75ab	3.75ab	12.8333abc	1a
Norton	Control	0g	0l	0e	0g	0d
OK392	Control	3.75ab	19.5cdef	3.75ab	14.5833ab	1a
MidSouth	50 ASC	0g	0l	0e	0g	0d
Miss Blanc	50 ASC	4a	28abc	4a	13.3333ab	1a
Norton	50 ASC	0g	0l	0e	0g	0d
OK392	50 ASC	2.25bcde	8.5hijkl	1.75cd	9.125abcdef	0.5bc
MidSouth	500 IBA	0g	0l	0e	0g	0d
Miss Blanc	500 IBA	3.75ab	22.25bcde	3.25ab	12.7917abcd	1a
Norton	500 IBA	0g	0l	0e	0g	0d
OK392	500 IBA	3abcd	11.25fghij	2.5bc	15.125a	0.75ab
MidSouth	50 ASC + 500 IBA	0.5fg	1.5lk	0.5de	3.9583fg	0.25cd
Miss Blanc	50 ASC + 500 IBA	3.25abc	15efghi	3.25ab	10.1667abcde	0.75ab
Norton	50 ASC + 500 IBA	0g	0l	0e	0g	0d
OK392	50 ASC + 500 IBA	3.5ab	17.75defg	3.5ab	15.0833a	1a
MidSouth	1000 IBA	0g	0l	0e	0g	0d
Miss Blanc	1000 IBA	4.25a	32a	4.25a	10.125abcde	1a
Norton	1000 IBA	0g	0l	0e	0g	0d
OK392	1000 IBA	0.6997efg	5.75jkl	1de	7.1667cdef	0.5bc
MidSouth	50 ASC + 1000 IBA	0g	0l	0e	0g	0d
Miss Blanc	50 ASC + 1000 IBA	4.25a	21.75bcde	3.5ab	11.125abcde	1a
Norton	50 ASC + 1000 IBA	0g	0l	0e	0g	0d
OK392	50 ASC + 1000 IBA	1efg	4jkl	0.75de	3.7917fg	0.25cd
MidSouth	1500 IBA	0g	0l	0e	0g	0d
Miss Blanc	1500 IBA	4.5a	32.75a	4.25a	12.5417abcde	1a
Norton	1500 IBA	0g	0l	0e	0g	0d
OK392	1500 IBA	1.75cdef	9.75ghijk	1.5cd	8.625bcdef	0.5bc
MidSouth	50 ASC + 1500 IBA	0g	0l	0e	0g	0d
Miss Blanc	50 ASC + 1500 IBA	3.75ab	25.5abcd	3.5ab	13.375ab	1a
Norton	50 ASC + 1500 IBA	0g	0l	0e	0g	0d
OK392	50 ASC + 1500 IBA	1.5defg	7ijkl	1.25cde	6.4583ef	0.5bc
MidSouth	2000 IBA	0g	0l	0e	0g	0d
Miss Blanc	2000 IBA	4a	24abcde	3.75ab	13.375ab	1a
Norton	2000 IBA	0.25fg	0l	0e	0g	0d
OK392	2000 IBA	0g	0l	0e	0g	0d
MidSouth	50 ASC + 2000 IBA	0g	0l	0e	0g	0d
Miss Blanc	50 ASC + 2000 IBA	1.75cdef	17.25defg	1.75cd	6.7083def	0.75ab
Norton	50 ASC + 2000 IBA	0.25fg	0l	0e	0g	0d

OK392	50 ASC + 2000 IBA	0.75efg	4.25jkl	0.75de	3.4375fg	0.25cd
P-value[w]		0.016	0.0301	0.0142	0.0377	0.0302

[z]Analysis of variance was performed using PROC GLIMMIX (SAS 9.4). Means followed by the same letter are similar and not significantly different (α = 0.05).
[y] Cutting quality (0-5, with 0=dead and 5=transplant ready cutting).
[x] Root quality (0-5, with 0=no roots and 5=healthy, vigorous root system).
[w]P values for differences between means were obtained at $P \leq 0.05$.

Table 4. Average length of shoots and root number differences between four grapevine cultivars semi-hardwood cuttings.

Cultivar[z]	Average Length of Shoots (cm)	Roots (no.)
Norton	0.25b	0.38b
MidSouth	1.88b	3.68b
Miss Blanc	1.79b	3.75b
OK392	3.99a	10.35a
P-value[y]	0.0011	*<0.0001*

[z]Analysis of variance was performed using PROC GLIMMIX (SAS 9.4). Means followed by the same letter are similar and not significantly different (α = 0.05).
[y]P values for differences between means were obtained at $P \leq 0.05$.

Table 5. Interaction of cultivar and hormone treatment on growth index, cutting quality, root quality, average length of three longest roots, and rooting percentage of four grapevine cultivars semi-hardwood cuttings.

Treatments[z]		Growth Index[y]	Cutting Quality Rating[x]	Root Quality Rating[w]	Average Length of 3 Longest Roots (cm)	Rooting (%)
Cultivar	Hormone					
Norton	Control	0e	0f	0e	0g	0c
MidSouth	Control	0e	0f	0e	0g	0c
Miss Blanc	Control	0.25de	0.75def	0.5cde	4.675defg	25bc
OK392	Control	0.25de	0.75def	0.75cde	5defg	25bc
Norton	50 ASC	0.25de	0.25f	0.25de	1.075fg	25bc
MidSouth	50 ASC	0.25de	0.75def	0.5cde	4.125efg	25bc
Miss Blanc	50 ASC	0e	0f	0e	0g	0c
OK390	50 ASC	2a	4.25a	3.75a	26.6a	100a
Norton	500 IBA	0.25de	0.5ef	0.25de	1.3fg	25bc
MidSouth	500 IBA	0.75bcde	1.75cdef	1.75bcde	11.375bcdefg	50abc
Miss Blanc	500 IBA	0e	0f	0e	0g	0c
OK392	500 IBA	0.5cde	1cdef	1bcde	5.575defg	25bc

Norton	50 ASC + 500 IBA	0e	0f	0e	0g	0c
MidSouth	50 ASC + 500 IBA	0e	0f	0e	0g	0c
Miss Blanc	50 ASC + 500 IBA	0.5cde	1cdef	1.25bcde	5.775defg	75ab
OK392	50 ASC + 500 IBA	1.5ab	2.75abc	2.75ab	18.275abc	75ab
Norton	1000 IBA	0e	0f	0e	0g	0c
MidSouth	1000 IBA	0e	0f	0e	0g	0c
Miss Blanc	1000 IBA	0e	0f	0e	0g	0c
OK392	1000 IBA	0.75bcde	2.25bcde	2.25abc	14.75bcd	50abc
Norton	50 ASC + 1000 IBA	0e	0f	0e	0g	0c
MidSouth	50 ASC + 1000 IBA	0e	0f	0e	0g	0c
Miss Blanc	50 ASC + 1000 IBA	1.25abc	2.25bcde	2.25abc	15.7abcd	75ab
OK392	50 ASC + 1000 IBA	0.5cde	2.5abcd	2.25abc	12.25bcdef	50abc
Norton	1500 IBA	0e	0f	0e	0g	0c
MidSouth	1500 IBA	0.75bcde	1.75cdef	1.5bcde	11.975bcdef	50abc
Miss Blanc	1500 IBA	0.5cde	1.25cdef	1.25bcde	10.35bcdefg	50abc
OK392	1500 IBA	1.25abc	3.75ab	3.75a	21.825ab	75ab
Norton	50 ASC + 1500 IBA	0e	0f	0e	0g	0c
MidSouth	50 ASC + 1500 IBA	0.5cde	0.75def	0.75cde	5.625defg	25bc
Miss Blanc	50 ASC + 1500 IBA	1bcd	2.25bcde	2abcd	14.5bcde	75ab
OK392	50 ASC + 1500 IBA	0.25de	0.75def	0.75cde	5.325defg	50abc
Norton	2000 IBA	0e	0f	0e	0g	0c
MidSouth	2000 IBA	0e	0f	0e	0g	0c
Miss Blanc	2000 IBA	0e	0f	0e	0g	0c
OK392	2000 IBA	0e	0f	0e	0g	0c
Norton	50 ASC + 2000 IBA	0e	0f	0e	0g	0c
MidSouth	50 ASC + 2000 IBA	0.25de	0.75def	0.75cde	7.5cdefg	25bc
Miss Blanc	50 ASC + 2000 IBA	0e	0f	0e	0g	0c
OK392	50 ASC + 2000 IBA	0.5cde	1.25cdef	1.25bcde	6.8cdefg	25bc
P-value[v]		0.003	0.021	0.024	0.008	0.024

[z]Analysis of variance was performed using PROC GLIMMIX (SAS 9.4). Means followed by the same letter are similar and not significantly different ($\alpha = 0.05$).
[y]Growth index (average number of new shoots present).
[x] Cutting quality (0-5, with 0=dead and 5=transplant ready cutting).
[w] Root quality (0-5, with 0=no roots and 5=healthy, vigorous root system).
[v]P values for differences between means were obtained at $P \leq 0.05$.

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