

POTENTIAL NEW ROOTSTOCKS FOR FLORIDA VITICULTURE

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Abstract. Improved vine growth and yield have been obtained on certain bunch grape cultivars by grafting them on nematode-resistant rootstocks. The 8 rootstock trials reported in this paper were planted at various dates between 1968 and 1982. Out of 83 different potential rootstock cultivars, 53 were discarded while in test because of disease or nematode susceptibility, poor vine growth, poor rooting from dormant cuttings, unsatisfactory graft unions, or excessive sprouts from below the graft unions. Data from the 30 remaining selections were compared to presently recommended rootstocks Dog Ridge, Lake Emerald, or Tampa. Twelve of the 30 met all minimum requirements for a satisfactory rootstock. These 12 originated from 7 different parental combinations in the breeding program and should be tested throughout Florida. Six of the 12 exceeded standard rootstocks by 0.8 to 2.5 tons/acre (1.8 to 5.6 MT/ha) in yields of the scions grafted on them: Florida numbers P8-20, N4-15, 13C-12, N6-1, 13B-5, and O7-19.

With the prevalence of parasitic nematodes in sandy lands, grafting bunch grapes on nematode-resistant rootstocks has improved vine growth and fruit production (3). As early as 1889, Neal (7) reported improved growth of grapevines in nematode-infested Florida soils when grafted on *Vitis vulpina* L. rootstocks. 'Dog Ridge' (*Vitis champini* Planch.) is currently the most outstanding rootstock introduced from outside Florida, with resistance to Pierce's disease (PD) as well as nematodes (4). It was originally selected from the wild near Temple, Texas by Munson (6), and is now known worldwide as a nematode-resistant stock (3). 'Dog Ridge' sprouts readily from below the graft union, necessitating thorough disbudding of cuttings prior to rooting in the nursery. In 1982 a new rootstock named 'Tampa' was released from IFAS Agricultural Research and Education Center in Leesburg (5). 'Tampa', like 'Dog Ridge', is resistant to PD, nematodes, and drought, but does not sprout readily from below the graft union. 'Lake Emerald' has also been successfully used in Florida as a rootstock (2,8). A total of 83 different additional rootstock types have been selected from the grape breeding program at Leesburg and were placed in replicated trials, using 'Lake Emerald', 'Dog Ridge', or 'Tampa' as standard rootstocks.

A good rootstock is vigorous and long-lived in Florida's soils and climate. It is also vigorous and productive when bearing a scion of a different cultivar. Also essential is a high percentage of successful graft unions, with strong, compatible unions whether bench-grafted or field-grafted. Minimum sprout emergence from below the graft union and ease of rooting from hardwood cuttings are also

minimum requirements. Survival and continued vigor when grown as replants in an older vineyard are essential, as are resistance to Pierce's disease and parasitic nematodes. Resistance to grape root borer and pathogenic fungi are desirable, along with tolerance to stress such as cold, low chilling hours, heat, high humidity, soil salinity, wet feet, leached soils, and drought. The purpose of this paper is to discuss how the best selections tested at Leesburg may more nearly conform to the above characteristics than currently available cultivars.

Materials and Methods

The 8 rootstock trials reported in this paper were planted at various dates between 1968 and 1982 (Table 1). Out of 83 different rootstock cultivars, 53 were discarded while in test due to obvious weaknesses; only the 30 remaining are discussed in this paper. Standard rootstocks include 'Dog Ridge' (4), 'Lake Emerald' (8), and 'Tampa' (5). Trunks were cut-off during the dormant season and cleft-grafted with either 2- or 3-bud scions, then covered with damp builder's sand enclosed in tarpaper rings or half-gallon milk cartons. Sand and rings were removed after 10-12 inches of shoot growth emerged on the scions. Staking and tying was performed as needed to support new growth and train scions up on the trellis. Rootstock sprouts were removed as needed and the number per vine recorded. Other data recorded were percentage rooting from cuttings, rootstock vigor, percentage successful unions after grafting, scion vigor, trunk circumference, weight of pruned wood, fruit yields, and resistance to insects and diseases.

Results and Discussion

Growth as measured by trunk circumference and weights of pruned wood on 'Stover' was superior to standard rootstocks in Fla. 449 and 2A-55 (Table 2). 'Liberty' performed best with 13B-5 and N6-3 rootstocks (Table 3). Fruit yields of Fla. E11-40 scions were best with 'Tampa', N6-34, P8-20, O7-19, 13B-5, N4-17, 2A-55, N5-43, and 13B-8 among 15 rootstocks (Table 4). After regrafting the same 15 rootstocks with 'Suwannee', 6 stocks, E9-67; P8-20; Demko 5; O7-19; 'Lake Emerald'; and N4-17, stimulated the best yield (Table 5). Among 20 rootstocks grafted with 'Conquistador', 10 increased yields above the yield of

Table 1. Information on 8 different rootstock trials conducted at the Agricultural Research and Education Center, Leesburg.

Year			No. rootstocks	1-vine replicates	Scion grafted
rooted	grafted ²	planted			
1967	1970	1968	8	2	Stover
1976	1977	1978	10	2-4	Liberty
1977	1981	1979	15	6	E11-40
1977	1984	1979	15	6	Suwannee
1978	1980	1979	20	4,8	Conquistador
1979	1980	1981	4	6	Conquistador
1979	1980	1981	4	6	Stover
1980	1981	1982	12	5	Stover

²Nursery grafted 1 year before field planting or else field-grafted 1 or 2 years after planting.

Table 2. Characteristics of 8 rootstocks planted in AC vineyard in 2-vine plots in 1968 and grafted with 'Stover' scions in 1970.

Rootstock	Trunk circumference (inches)				Survival (%)	1972-1977 pruned wood (lb/vine)
	1970	1971	1973	Mean		
Fla. 449	4.3	5.6	6.5	5.5	50	6.9
2A-55	3.2	4.7	5.7	4.5	100	8.7
Tampa	2.5	4.3	5.0	3.9	100	6.9
2B-37	2.9	3.3	5.0	3.8	100	5.1
Dog Ridge Lake	3.5	3.9	4.8	4.1	50	6.7
Emerald	2.8	3.0	3.9	3.2	100	4.4
1AC 766	2.3	2.7	3.7	2.9	100	7.6
C5-24	1.4	1.9	2.6	2.0	50	1.8

Table 3. Characteristics of 10 rootstocks grafted in the nursery in 1977 with 'Liberty' scions and transplanted to vineyard in 1978.

Rootstock	Nursery unions (%)	Vine survival (%)	Scion vigor ¹		1982 to 1985 yield (T/acre)	Sprouts per vine (no.)
			Nursery	Vineyard		
13B-5	60	100	4.0	3.3	3.15	5.3
N6-3	40	100	3.0	4.8	2.75	0.5
13B-8	60	100	4.0	4.8	2.20	3.5
N4-17	40	100	4.5	4.0	2.42	0.5
2B-37	80	67	3.0	4.3	2.38	0.0
Meyer 6-7	20	100	2.0	4.0	2.36	1.0
Lake Em.	80	100	3.5	3.9	2.48	1.8
N5-42	60	50	3.5	4.0	1.74	1.5
Blue Lake	80	100	4.0	3.8	1.66	1.0
N6-34	100	50	3.5	5.0	1.54	0.0

¹Scion vigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

Table 4. Characteristics of 15 rootstocks planted at vineyard spacing in 1979 and grafted in 1981 with 'Fla. E11-40' scions.

Rootstock	Unions		Yield (T/acre)	Sprouts /vine	Scion grades ¹	Cuttings	
	(%)	Vigor ²				(%)	Vigor ²
Tampa	100	4.7	6.97	0.7	A,B	58	3.8
N6-34	33	5.0	6.17	5.0	A,B	59	4.0
P8-20	100	4.5	5.92	10.0	B	70	4.0
O7-19	67	5.0	5.15	7.5	A	58	4.5
13B-5	67	5.0	4.90	4.0	A,B	66	4.6
N4-17	83	4.9	4.57	0.2	B	59	3.8
2A-55	67	5.0	4.61	4.8	A-D	80	4.3
N5-43	67	4.1	4.21	3.0	B-E	81	3.8
13B-8	33	5.0	4.17	6.0	A-D	73	4.4
L3-50	40	4.3	3.34	1.5	B-D	63	4.2
N6-3	33	3.5	2.18	0.0	C	59	4.2
Demko 5	100	4.0	1.63	16.0	C	90	2.0
E9-67	33	5.0	2.80	0.0	A,C	73	4.8
N5-42	50	4.7	1.74	2.0	B-E	73	3.5
Lake Emerald	50	4.8	0.80	9.3	D-E	58	3.7

¹Vigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

²Scion grades (A-E): A = vigorous and productive, B = moderately vigorous and productive, C = medium grade, D = lacking some vigor and productivity, and E = weak vigor and low production.

control cultivars: 13B-5, P8-20, 13B-8, N6-3, N6-34, N4-15, 13C-12, N6-1, 2B-37, and N4-17 (Table 6). Florida N5-43 yielded less than either standard rootstock in this test, but was 67% higher yielding than controls in another test with 'Conquistador' scion (Table 7). In a 4-stock test with 'Stover', 2A-55 was higher yielding than 13B-8 or

Table 5. Characteristics of 15 rootstocks planted at vineyard spacing in 1979 and grafted to 'Suwannee' scions in 1984.

Rootstock	Unions		Yield (T/acre)	Sprouts/vine	Rooting	
	(%)	Vigor ²			(%)	Vigor ²
E9-67	100	4.7	7.15	0.0	73	4.8
P8-20	100	5.0	6.97	12.0	70	4.0
Demko 5	100	5.0	5.52	1.0	90	2.0
O7-19	100	4.3	5.15	9.8	58	4.5
N4-17 Lake	83	4.9	4.94	0.0	59	3.8
Emerald	67	4.3	4.94	26.0	58	3.6
2A-55	80	4.5	4.68	23.5	66	4.0
Tampa	83	4.9	4.53	12.4	58	3.8
N6-3	67	5.0	4.25	0.0	59	4.2
13B-8	83	4.8	4.21	26.6	73	4.4
L3-50	67	4.8	4.21	1.0	63	4.2
N5-42	100	4.2	3.88	3.3	67	3.6
13B-5	100	4.5	3.41	15.5	66	4.6
N5-43	83	4.3	3.19	2.6	81	3.8
N6-34	50	4.8	2.69	1.3	59	4.0

²Vigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

Table 6. Characteristics of 20 rootstocks transplanted from nursery to vineyard in 1979 and grafted in 1980 with 'Conquistador' scions.

Rootstock	Root-stock vigor ²	Unions (%)		1983 to 1985 Pruned wood yield (lb/vine)(T/acre)	Sprouts /vine	Scion grades ¹
		Initial live	After regraft			
13B-5	4.0	33	50	0.6	8.96	5.4 A
P8-20	4.0	50	100	0.6	8.29	8.3 A,B
13B-8	3.9	89	100	0.8	7.88	9.5 A,B
N6-3	3.9	46	75	0.6	7.68	3.2 A,B
N6-34	4.1	89	100	1.3	7.62	0.9 A-C
N4-15	3.6	73	89	1.2	7.26	1.3 A,B
13C-12	4.3	100	100	0.8	7.00	4.8 A,B
N6-1	3.6	80	100	0.8	6.87	1.0 A-C
2B-37	4.1	70	88	0.7	6.12	5.7 A,B
Dog Ridge	4.1	50	100	0.8	5.51	30.9 B
LaPryor	2.9	88	88	0.3	5.37	7.2 A,B
N4-17	3.9	50	100	1.3	5.33	1.7 A-C
N5-42	4.1	43	75	0.6	5.06	1.0 A-C
E12-59	3.1	57	100	0.8	5.05	2.0 B,C
C5-24	3.2	89	100	0.5	4.60	0.2 A-C
Lake Emerald	4.0	50	88	0.5	4.59	4.5 B,C
C5-50	4.4	80	100	0.5	4.10	2.9 B
Meyer 6-7	3.6	36	63	0.3	3.90	3.5 C
Blue Lake	3.7	58	88	0.3	3.80	3.4 C,D
N5-43	4.3	50	88	0.3	2.82	7.1 B,C

²Vigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

¹Scion grades (A,E): A = vigorous and productive, B = moderately vigorous and productive, C = medium grade, D = lacking some vigor and production, and E = weak vigor and low production.

Table 7. Characteristics of 4 rootstocks grafted in the nursery in 1980 with 'Conquistador' scions and transplanted to the vineyard in 1981.

Rootstock	Nursery unions (%)	Vineyard survival (%)	Scion vigor ²		Pruned wood (lb/vine)	1985 yield (T/acre)
			Nursery	Vineyard		
N5-43	83	67	4.6	4.6	2.4	5.69
Tampa	93	100	4.8	4.2	1.1	3.69
2B-37	87	100	4.2	4.4	1.6	3.51
Dog Ridge	92	100	4.1	4.1	1.7	3.11

²Vigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

Table 8. Characteristics of 4 rootstocks grafted in the nursery in 1980 with 'Stover' scions and transplanted to the vineyard in 1981.

Rootstock	Nursery unions (%)	Scion vigor ^z		1985 yield (T/acre)	Sprouts/vine (no.)
		Nursery	Vineyard		
2A-55	50	3.9	4.0	5.37	0.1
13B-8	86	4.6	4.7	4.53	0.6
Harmony	70	4.5	3.7	3.63	0.0
Freedom ^y	40	5.0	—	—	0.0

^zVigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

^yPlants became infected with Pierce's disease.

Table 9. Characteristics of 12 rootstocks grafted in the nursery in 1981 with 'Stover' scions and transplanted to vineyard in 1982.

Rootstock	Nursery unions (%)	Scion vigor ^z		Pruned wood (lb./vine)	1985 yield (T/acre)	Sprouts/vine (no.)
		Nursery	Vineyard			
N5-42	80	4.0	5.0	2.3	3.27	3.2
N5-43	100	3.9	4.2	1.4	1.96	3.2
N6-18	100	4.1	3.6	1.0	1.58	0.6
N6-3	80	4.6	3.8	1.0	1.58	1.4
E9-67	100	4.6	4.0	1.1	1.55	2.6
Lake Emerald	70	3.9	3.6	1.2	1.61	0.2
L3-50	70	4.1	2.9	1.0	1.52	4.6
O9-5	90	4.5	3.5	1.4	1.52	4.6
Dog Ridge	50	3.6	3.7	1.2	1.44	4.8
C5-24	90	4.3	2.8	0.7	1.39	0.4
Tampa	80	4.4	3.4	0.9	1.31	1.4
Champanel	70	4.3	3.6	1.0	1.31	2.8

^zVigor ratings (0-5): 0 = dead, 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.

'Harmony' (Table 8). 'Freedom' became infected with Pierce's disease and therefore was discarded before transplanting to the vineyard location. Out of 12 stocks grafted with 'Stover', 2 were higher yielding than Lake Emerald: N5-42 and N5-43 (Table 9). Three others had a higher percentage of nursery unions and better vigor than 'Lake Emerald' and were similar in yield: N6-18, N6-3, and E9-67.

The outstanding selections mentioned above were compared in yield to the controls in the 8 rootstock trials involving 5 different scion cultivars (Table 10). Plus (+) indicates yields equal to or greater than the mean yield of standard rootstocks 'Tampa', 'Dog Ridge', and 'Lake Emerald' for that experiment. Minus (−) indicates lower yields than controls.

Of the 27 rootstocks summarized in Table 10, 15 received +1 or higher ratings. Of the 15, Florida 449 rooted poorly from dormant cuttings and O9-5, E12-59, and N6-18 had reduced scion vigor ratings. The remaining 11 most nearly conform to the characteristics of a good rootstock. These, along with 2B-37, which increased the average yield or 'Conquistador' more than a ton/acre (2.2 MT/ha), are given in Table 11 with their characteristics. All 12 are resistant to PD and demonstrate enough tolerance to nematodes that they grow vigorously in nematode-infested sandy land.

As reported previously (1,3), rootstocks are rather specific in their interaction with certain scion cultivars. Among the above 12 cultivars, the best rootstocks for 'Stover' were 2A-55, N5-43, N6-3, and E9-67; for 'Conquistador' 13B-5,

Table 10. Performance of 27 rootstocks grafted with 5 different scion cultivars as related to the mean performance of standard rootstocks, 'Dog Ridge', 'Tampa', and 'Lake Emerald' for each of 8 rootstock trials.

Rootstock	Scion cultivar					Total
	Stover	Liberty	E11-40	Suwannee	Conquistador	
2A-55	+, + ^z		+	+		+4
N4-17		+	+	+	+	+4
P8-20			+	+	+	+3
13B-5		+	+	−	+	+2
O7-19			+	+		+2
13C-12					+	+1
N5-43	+		+	−	−, +	+1
N6-3	+	+	−	−	+	+1
N4-15					+	+1
N6-18	+					+1
E9-67	+		−	+		+1
E12-59					+	+1
O9-5	+					+1
Fla. 449	+					+1
N6-1					+	+1
Lake Emerald	−, +	+	−	+	−	0
2B-37	+	−			+, −	0
N6-34		−	+	−	+	0
Demko 5			−	+		0
Tampa	+, −		+	−		0
13B-8	−	−	+	−	+	−1
N5-42	+	−	−	−	+	−1
Dog Ridge	−				+, −	−1
L3-50	+		−	−		−2
Blue Lake		−			−	−2
Meyer 6-7		−			−	−2
C5-24	−, −				−	−3

^z+ sign indicates yield equal to or greater than the mean of standard rootstocks; − sign indicates lower yields with that scion.

Table 11. Characteristics of the 12 most promising rootstock selections and 3 presently recommended cultivars from 8 different trials.

Rootstock	Scion cultivars ^z	Yield increase ^y (T/acre)	Rooting (%)	Graft unions (%)	Sprouts/vine (no.)
P8-20	C,E,Su	2.50	70	83	10.1
N4-15	C	2.21	50	73	1.3
13C-12	C	1.95	85	100	4.8
N6-1	C	1.82	55	80	1.0
13B-5	C,E,L,Su	1.05	66	75	7.6
O7-19	E,Su	0.81	58	84	6.4
Tampa	C,E,St,Su	0.74	58	88	3.2
2A-55	E,St,Su	0.48	80	74	9.5
E9-67	E,St,Su	0.46	73	78	0.7
N5-43	C,E,St,Su	0.38	81	75	4.1
2B-37	C,L,St	0.36	78	69	2.9
N4-17	C,E,L,Su	0.26	59	79	0.6
N6-3	C,E,L,St,Su	0.16	59	65	0.5
Dog Ridge	C,St	0.05	75	50	17.9
Lake Em.	C,E,L,St,Su	−0.65	58	67	8.4

^zC = Conquistador, E = E11-40, L = Liberty, St = Stover, and Su = Suwannee.

^yMean yield increase over the mean of standard rootstocks in each of the 8 experiments.

13C-12, P8-20, N5-43, N6-3, N4-15, N6-1, 2B-37, and N4-17; for 'Suwannee' E9-67 and P8-20; for E11-40 P8-20, O7-19, 13B-5, and N4-17; and for 'Liberty' 13B-5 and N6-3. The most frequently mentioned rootstocks were 13B-5 and N6-3, indicating good overall compatibility.

The 12 outstanding rootstocks come from 7 different parental combinations: *V. shuttleworthii* cv. Haines City ×

'Alden' (13C-12 and 13B-5); *V. aestivalis* ssp. *simpsoni* cv. Duval × 'Demko 14' (Edna × *V. aestivalis* ssp. *simpsoni*) (N4-15, N4-17); *V. aestivalis* ssp. *smalliana* cv. Yalaha no. 1 × 'Daytona' (N6-1, N6-3, and N5-43); *V. aestivalis* ssp. *simpsoni* cv. Belleview 6 × 'Alden' (2A-55, 2B-37); Florida W716 (*V. aestivalis* ssp. *smalliana* × 'Golden Muscat') × open pollinated male vine (probably *V. aestivalis* ssp. *simpsoni* cv. Loucks) (P8-20); Florida C5-50 × Florida F16-10 (O7-19); 'Norris' × 'Blue Lake' (E9-67). None of the 12 selections have world-known rootstocks such as 'Dog Ridge' or 'Saint George' in their parentage. However, all were superior in growth and yields to world-known rootstocks that have been tested at Leesburg such as the above and 'Kober 5BB', 'Couderc 3309', 'Teleki 5A', 125-1, 143A, 420A, and SO4.

Florida 13C-12 and 13B-5 both are self-fertile, vigorous, root and grow well from cuttings and make good, compatible unions when grafted. Their performance in bench grafting is unknown, and should be tested. Outstanding scion vigor and yields suggest broader trial as rootstocks in Florida. Disbudding of cuttings prior to rooting is required.

Florida P8-20 is a male cultivar that roots and grows vigorously from cuttings and forms compatible unions with scions. Yields were consistently higher than all currently recommended rootstocks, and scion vigor was exceptionally high. Disbudding of cuttings before rooting is required to reduce sprouting from below the graft union. Florida P8-20 should be tested on a limited commercial scale as a Florida bunch grape rootstock.

Florida O7-19 originated from a controlled cross between Florida C5-50 and Florida F16-10. Florida C5-50 was the strongest segregant in a cross between W1521 (Florida 449 × 'Lake Emerald') and 'Villard Blanc'. Florida F16-10 was a cross of D4-171 ('Norris' × 'Schuyler') × 15B-14 (W716 × 'Sultanina'). Florida O7-19 is a female cultivar that grows vigorously from cuttings and is a good graft bearer. Disbudding of cuttings before rooting is required. Florida O7-19 carries a genetic marker for red leaf color that appears in the fall, so any foliage originating from the rootstock can be easily identified in a grafted vineyard.

Florida E9-67 is a self-fertile selection that forms excellent callus, roots well from cuttings and forms good graft unions with 'Stover' and 'Suwannee'. It should be tested with other scions such as 'Conquistador' and 'Orlando Seedless.' Yields were above the average for presently recommended rootstocks. Sprouts from below graft union are rare, so disbudding is unnecessary with Florida E9-67.

This selection merits wider testing in Florida as a bunch grape rootstock.

Florida N4-15 and N4-17 root well but begin growing more slowly than the above described selections. They are male and female, respectively. Both form compatible graft unions and increase yields above those of standard rootstocks. Their low incidence of sprouts from below the graft union make disbudding an unnecessary procedure. Both are recommended for limited commercial trial as Florida rootstocks.

Florida 2A-55 and 2B-37 are both self-fertile and root and grow vigorously in the nursery. They form strong unions, promoting outstanding scion vigor. Because of a tendency to form sprouts from below the graft union, Florida 2A-55 requires disbudding but 2B-37 does not. Both were superior to standard rootstocks and should be tested across Florida as potential bunch grape rootstocks.

Florida N5-43, N6-1, and N6-3 are respectively female, self-fertile, and female selections. Florida N5-43 roots well from cuttings, but the other two root less readily (Table 11). All form strong graft unions with moderate scion vigor. Disbudding is optional, since sprouts from below the union are limited in occurrence. These selections merit further testing as bunch grape rootstocks.

Since the new rootstock selections have not been released, they are not available for nursery and grower use. However, for growers desiring to test the rootstocks on a limited basis, permission may be obtained by signing a non-propagation agreement with the Agricultural Research and Education Center, Leesburg. Limited amounts of cuttings may be obtained by those persons for trial during Jan. and Feb. each year from the author.

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