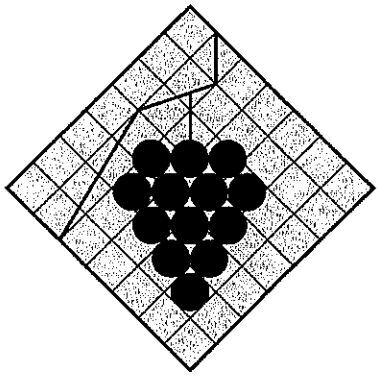


Assessment of French and American hybrid varieties as suitable rootstocks for vineyard establishment in acid soils

FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **DAS 12 GW**

Principal Investigator: **R Cirami**

Research Organisation: **SARDI**

Date: **October 1994**

GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

FINAL REPORT FOR PROJECT DAS 12 GW

Project Title	Assessment of French and American hybrid varieties as suitable rootstocks for vineyard establishment in acid soils.
Organisation	South Australian Research and Development Institute
Location	Nuriootpa Viticultural Centre
Supervisor	Richard Cirami
Principal Researcher	Richard Cirami
Time Span	1 July 1991 - 30 June 1994
Objectives	To test the effectiveness of 42 French and American hybrids used as rootstocks for Pinot Noir grown in acid soils. To identify those varieties which can improve the growth of the Pinot Noir scion during the establishment phase (3 years) of vineyard development.

Industry significance:

Acidic soils are common in all grape growing areas of Australia, particularly in the higher rainfall areas. (Acidic soils are considered to be those with a pH below 5.0.) Soils of low pH result in decreased availability of most major plant nutrients and increased levels of the toxic elements aluminium and manganese. Vine growth and vigour can be severely affected and severe stunting of vine roots can also occur.

The traditional rootstocks used for phylloxera and nematode resistance are not ideally suited to soils of low pH. A rootstock which could tolerate acid soils would be invaluable.

(c) Background

In the desire for quality, viticulturists are continually searching for areas with cool climates and a long growing season. Unfortunately, many of the more promising areas also receive higher rainfall and have acidic soils. A rootstock which was able to tolerate and thrive in acid soils would be an invaluable aid to viticulturists endeavouring to extend vine growing into areas of acid soil.

Some species of grapevine evolved in areas of acid soils in North America and they and their hybrids may have tolerance to the low pH soils found in Australia. Australia has introduced some 40 French and American hybrid varieties which are hybrids of *Vitis labrusca* and other species. It was decided to assess their value as rootstocks under Australian growing conditions where acidic vineyard soils occurred.

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(d) Methodology

A site at Mount Pleasant in the Adelaide Hills of South Australia was chosen. Vineyards already at the site are ideally suited for the production of high quality table wines, but the acidic soils have so reduced vine vigour and yield that grape production was only just viable. The soil was characterised as a red-yellow podsolic with small areas of skeletal soil (C.L. Rudd, private communication). Soil pH for the surface layer was tested in the laboratory by the standard 1:5 soil/water and 0.01M $CaCl_2$ methods and by field kit measurement.

Table 1. Mean pH values for surface soil for the three analytical methods.

1:5 soil/water	0.01M $CaCl_2$	Field Kit
5.88	4.83	6.27

Pinot Noir clone Mariafeld (0014) was green grafted to 42 American and French hybrid varieties in summer 1990. Table 2 contains a list of the varieties and their species origin/parentage. Varieties were arbitrarily numbered from 1 to 42 for identification purposes. One additional variety, Early Niabell, proved to be extremely difficult to propagate and was dropped before planting. Over one half of the trial vines were successfully grafted during 1990-91 but the relatively thinner diameter of the 'rootstocks' presented an unforseen difficulty, with grafting success reduced, and many combinations required regrafting during 1991 and 1992.

An experiment which utilised a completely randomised block design with 42 treatments (rootstocks) and ten single vine replicates was planted during January-March 1992. Vines were planted 1.2 m apart in rows 2.7 m apart and were drip irrigated and trained to the trellis wire during the 1992-93 seasons. An excessively wet spring 1993 and early summer 1994 resulted in waterlogged conditions for lengthy periods and vine growth was affected, with a number of vines dying. Replanting occurred during the remainder of the 1994 season.

Petiole samples were taken from three of the more uniform replicates during late November 1993. Petioles were dried, ground and digested with nitric perchloric acid. Aluminium was analysed by inductively coupled plasma atomic emission spectrometry; manganese by atomic absorption spectrometry.

Total length of annual shoot growth was recorded at pruning in 1993 and 1994. Observations on shoot die-back were also recorded in both years. Pruning weight per vine was recorded in 1994. All data were subjected to analysis of variance.

Results

An assessment of the mature parent 'rootstocks' made during the growing season to provide some background on their habit of growth and cropping potential is noted in Table 2.

The average shoot length for the two years is shown in Table 3 and Figure 1. Pruning weights for 1994 are shown in Table 4. In 1994 shoot lengths ranged up to 3 fold between varieties and pruning weight ranged almost 10 fold. Only one variety, Verdelet, had significantly more vigour (expressed as either shoot length or as pruning weight) than ungrafted Pinot Noir vines. Baco Noir, Catawba, Couderc Noir, New York Muscat and *Vitis labrusca* had significantly less vigour than Pinot Noir, had a higher frequency of shoot dieback, and can not be regarded as suitable for use as a rootstock.

Aluminium and manganese levels in petioles are shown in Table 5 and demonstrate a three-fold difference between varieties. Shoot length responses to aluminium were evident in some varieties

(e.g. Baco Noir had low shoot length and high aluminium; conversely, Verdelet had high shoot length and low aluminium) but the relationship did not always apply (e.g. Americano and LN 33 had high shoot lengths and high aluminium). The relationship between manganese and shoot length was just as variable (e.g. Alicante Bouschet had high shoot length and high manganese; New York Muscat had low shoot length and high manganese; Couderc Noir had low shoot length and low manganese; Americano had high shoot length and low manganese). It would appear that neither aluminium nor manganese levels in petioles are suitable predictors for vine vigour. No obvious species tolerance of acid soil was evident in the data.

Discussion

Subsequent to the commencement of this project, Himelrick (1991) published a report which compared the performance of 2 *Vitis vinifera*, 2 *Vitis labrusca*, 2 French-American hybrids and 3 rootstocks in pot culture for their tolerance to strongly acid (pH 4.8) and slightly acid (pH 6.7) soil. He noted that low pH reduced the growth of all cultivars, except for the 2 *Vitis vinifera* (Riesling and Chardonnay). Pinot Noir (also *Vitis vinifera*) responded in a similar manner in our experiment. He suggested that grape cultivars varied in their tolerance to very acid soil, and this was certainly apparent in our study. Values for aluminium and manganese for the 4 labrusca and labrusca hybrids used in his experiment were quite different from those in our study, but our vines were field-grown Pinot Noir grafted on to different varieties, while he used ungrafted vines grown in pots.

The initial objectives of the project have been achieved. A well replicated comparison of potentially useful rootstocks for use in acid soils has been established. A wide range of vine vigour has been observed as well as a wide range of aluminium and manganese levels in petioles. Five varieties have been identified as being unsuitable as 'rootstocks' and one variety was eliminated due to propagation difficulties. It now remains for the vines to attain a mature cropping stage for detailed assessment of vine performance and fruit quality to proceed

References

Himelrick, D.G. (1991). Growth and nutritional responses of nine grape cultivars to low soil pH. HortScience 26(3):269-71.

Acknowledgments

The assistance of Southcorp Wines who allowed us to experiment on their vineyard is duly acknowledged. The contributions of Kerrie Neldner, Gael Ellis, Erald Burgemeister and Jim Furkaliev are gratefully acknowledged. The financial support of the Grape and Wine Research and Development Corporation is gratefully acknowledged.

Table 2. Brief Description of Varieties Tested for Use as Rootstocks

Identity Number	Variety	Species Origin/Parentage
1	Alden	*labrusca* (Ontario) x *viniera* (Gros Guillaume) A black tablegrape which ripens in mid season. Drooping growth habit.
2	Alicante Bouschet	Teinturier x *vinifera* A red winegrape with coloured juice. Ripens mid season. Semi erect growth.
3	Americano	*riparia x cordifolia* ? A male-flowered 'glory vine' type. Rampant growth.
4	Aurore	Complex *labrusca* (Seibell 788 x Seibell 29) A white dual purpose variety (table/wine). Early budburst and maturity. Semi drooping growth. Susceptible to downy mildew.
5	Baco Blanc	*labrusca x riparia* (Noah) x *vinifera* (Folle Blanche) A white wine variety used for brandy production in France. Ripens mid season. Semi drooping growth and vigorous. Some resistance to downy mildew and botrytis but susceptible to powdery mildew.
6	Baco Noir	*riparia x vinifera* (Folle Blanche) A red wine variety. Early budburst and ripening. Vigorous. Semi drooping growth with good vigour Good resistance to downy and powdery mildews but susceptible to botrytis.
7	Canada Muscat	*labrusca x vinifera* A white wine variety which ripens early. Drooping growth habit.
8	Canadice	*labrusca x vinifera* (Bath x Himrod) A red table grape variety ripening early. Semi drooping growth. Very low vigour. Leaf drop occurs early.
9	Carolina Blackrose	*vinifera* (Chaouch) x *labrusca* (Villard Blanc) Black tablegrape which ripens in early mid season. Semi erect growth.
10	Cascade	Complex *labrusca* (Seibell 7042 x Seibell 5049) A red wine variety which ripens in mid season. Semi drooping growth. Quite resistant to powdery mildew but needs some protection from downy mildew.
11	Catawba	*labrusca x aestivalis* A dark red tablegrape which ripens in mid season. Drooping growth. Sensitive to downy mildew and phylloxera. Early leaf drop.

Table 2. Brief Description of Varieties Tested for Use as Rootstocks (con't)

Identity Number	Variety	Species Origin/Parentage
12	Cayuga White	Complex *labrusca* (Seyve Villard x Schuyler) A white wine variety ripening mid season. Semi drooping. Early leafdrop.
13	Chambourcin	Complex *labrusca* (Joannes Seyve 26.205) A red wine variety ripening early. Drooping growth and vigorous. Good resistance to downy and powdery mildew but sensitive to lime and dry soil conditions.
14	Concord	*labrusca* A red winegrape which ripens in mid season. Very popular for grapejuice. Early leaf drop.
15	Couderc Noir	*rupestris x lincecumii x vinifera* A red winegrape ripening mid season. Semi drooping growth. A vigorous high yielding variety with good resistance to fungal diseases. Has insufficient resistance to phylloxera and lime.
16	De Chaunac	Complex *labrusca* (Seibell 9549) A red winegrape ripening early. Drooping growth. Good resistance to downy mildew.
17	Delaware	*labrusca x aestivalis x vinifera* A pink-red wine/tablegrape ripening in early. Drooping growth habit. Susceptible to phylloxera and fungal diseases. Early leaf drop.
18	Delaware, clone 8154	*labrusca x aestivalis x vinifera* A pink-red wine/tablegrape ripening in early. Drooping growth habit. Susceptible to phylloxera and fungal diseases. Early leaf drop.
19	Pinot Noir, clone Mariafeld	*vinifera* A red winegrape ripening early. Semi erect growth.
20	Elvira	*labrusca x riparia* A white wine grape ripening early. Drooping growth. Early leaf drop.
21	Foch	*riparia x rupestris* (101-14) x *vinifera* (Goldriesling) A red winegrape which ripens early and is vigorous, with drooping growth. Fairly resistant to fungal diseases.
22	Glenora	*labrusca* (Ontario) x *vinifera* (Russian Seedless) A black tablegrape which ripens early mid season. Drooping growth.

Table 2. Brief Description of Varieties Tested for Use as Rootstocks (con't)

Identity Number	Variety	Species Origin/Parentage
23	Himrod	*labrusca* (Ontario) x *vinifera* (Sultana) White tablegrape which ripens early. Semi drooping.
24	Isabella	*labrusca x vinifera* A red winegrape ripening in early mid season. Drooping growth.
25	Jacquez	*aestivalis x cineria x vinifera* Red winegrape/rootstock. Ripens late mid season. Very resistant to powdery mildew and botrytis but susceptible to downy mildew. Drooping growth.
26	Joannes Seyve 23-416	complex *labrusca* hybrid (Bertille Seyve 4825 x Seibel 7053) White winegrape which ripens early. Good resistance to downy mildew. Semi drooping growth.
27	Kyoho	*labrusca* Black tablegrape with large berries and pronounced flavour. Vigorous and semi erect growth.
28	LN 33	1613 x *vinifera* (Sultana) A white fruited variety used as a virus indicator. Horizontal growth.
29	Mantey	*chambou?* A red juice variety from Florida which ripens late. Drooping growth. Doe not show lime induced chlorosis. Ripens late season and fruit holds well on vine.
30	New York Muscat	*labrusca* A black tablegrape which ripens in mid season. Drooping growth.
31	Romulus	*labrusca* (Ontario) x *vinifera* (Sultana) A white winegrape which ripens mid season. Drooping growth.
32	Royalty	Alicante Ganzin x *vinifera* (Trousseau) A red winegrape used for its colour. Ripens mid season. Drooping growth.
33	Rubired	Alicante Ganzin x *vinifera* (Tinta Cao) A red winegrape used for its colour. Ripens mid season. Semi erect growth.
34	Schuyler	*labrusca* (Ontario) x *vinifera* (Zinfandel) A red tablegrape ripening early. Drooping growth.

Table 2. Brief Description of Varieties Tested for Use as Rootstocks (con't)

Identity Number	Variety	Species Origin/Parentage
35	Seneca	*labrusca* (Ontario) x *vinifera* (Lignan) A white winegrape that ripens early. Horizontal growth.
36	Seyval	Complex *labrusca* (Seibell 5656 x Seibell 4986) A white winegrape which ripens early. Semi drooping growth. Moderately vigorous. Moderately resistant to fungal diseases but subject to botrytis at maturity.
37	Suffolk Red	*labrusca* (Fredonia) x *vinifera* (Russian Seedless) A red tablegrape which ripens early. Semi erect growth.
38	Venus	*labrusca* A black early ripening tablegrape. Drooping growth.
39	Verdelet	Complex *labrusca* (Seibell 5455 x Seibell 4938) A white winegrape ripening mid season. Drooping growth. Medium vigour and very sensitive to downy mildew.
40	Villard Blanc	Complex *labrusca* (Seibell 6468 x Seibell 6905) A white winegrape ripening mid season.Has better resistance to downy mildew than to powdery mildew. Semi erect growth.
41	Villard Noir	Complex *labrusca* (Seibell 7053 x Seibell 6905) Red winegrape which ripens mid season. Practically resistant to downy mildew but sensitive to powdery mildew and botrytis. Medium vigour with semi erect growth.
42	*Vitis labrusca*	*labrusca* This specimen has red fruit which ripens in early mid season. Horizontal growth. Very sensitive to limy soils. Early leaf drop.

Table 3. Average shoot length of Pinot Noir grafted on Vitis labrusca hybrid varieties, 1993-94. (Ranked in decreasing order.)

	Variety	1993 Shoot Length (cm)		Variety	1994 Shoot Length (cm)
8	CANADICE	191.5	39	VERDELET	644.1
4	AURORE	188.5	28	LN 33	629.4
5	BACO BLANC	185.3	21	FOCH	627.6
19	PINOT NOIR 0014	184.8	2	ALICANTE BOUSCHET	609.3
25	JACQUEZ	183.0	3	AMERICANO	582.1
34	SCHUYLER	178.8	38	VENUS	543.4
12	CAYUGA WHITE	178.0	5	BACO BLANC	494.2
39	VERDELET	177.3	7	CANADA MUSCAT	488.0
17	DELAWARE	175.8	23	HIMROD	475.6
9	CAROLINA BLACKROSE	175.3	9	CAROLINA BLACKROSE	466.7
28	LN 33	174.5	29	MANTEY	466.7
38	VENUS	174.5	14	CONCORD	464.7
29	MANTEY	174.1	13	CHAMBOURCIN	461.0
35	SENECA	172.8	16	DE CHAUNAC	460.9
20	ELVIRA	172.3	19	PINOT NOIR 0014	454.2
21	FOCH	169.1	4	AURORE	452.2
24	ISABELLA	167.8	8	CANADICE	452.2
32	ROYALTY	165.0	34	SCHUYLER	449.1
22	GLENORA	162.0	25	JACQUEZ	445.5
2	ALICANTE BOUSCHET	161.0	10	CASCADE	445.4
37	SUFFOLK RED	158.5	31	ROMULUS	442.9
40	VILLARD BLANC	157.5	22	GLENORA	431.4
7	CANADA MUSCAT	156.3	41	VILLARD NOIR	430.4
23	HIMROD	156.0	24	ISABELLA	410.0
27	KYOHO	155.8	26	JOANNES SEYVE 23-416	403.6
1	ALDEN	154.8	35	SENECA	396.3
14	CONCORD	153.0	1	ALDEN	394.7
33	RUBIRED	153.0	32	ROYALTY	383.0
13	CHAMBOURCIN	148.8	20	ELVIRA	376.0
10	CASCADE	148.5	17	DELAWARE	375.9
41	VILLARD NOIR	140.3	12	CAYUGA WHITE	370.4
3	AMERICANO	140.0	40	VILLARD BLANC	327.3
18	DELAWARE - CLONE 8154	137.2	36	SEYVAL	318.6
31	ROMULUS	136.5	18	DELAWARE - CLONE 8154	307.6
26	JOANNES SEYVE 23-416	131.5	37	SUFFOLK RED	287.2
6	BACO NOIR	122.8	33	RUBIRED	279.5
42	VITIS LABRUSCA	120.0	27	KYOHO	255.2
11	CATAWBA	116.0	11	CATAWBA	249.3
16	DE CHAUNAC	113.5	6	BACO NOIR	213.4
15	COUDERC NOIR	107.8	15	COUDERC NOIR	207.6
36	SEYVAL	102.8	42	VITIS LABRUSCA	134.0
30	NEW YORK MUSCAT	85.8	30	NEW YORK MUSCAT	90.0
	lsd	49.0		lsd	184.1

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Figure 1. Average shoot length of Pinot Noir grafted on Vitis labrusca hybrid varieties, 1993-94.

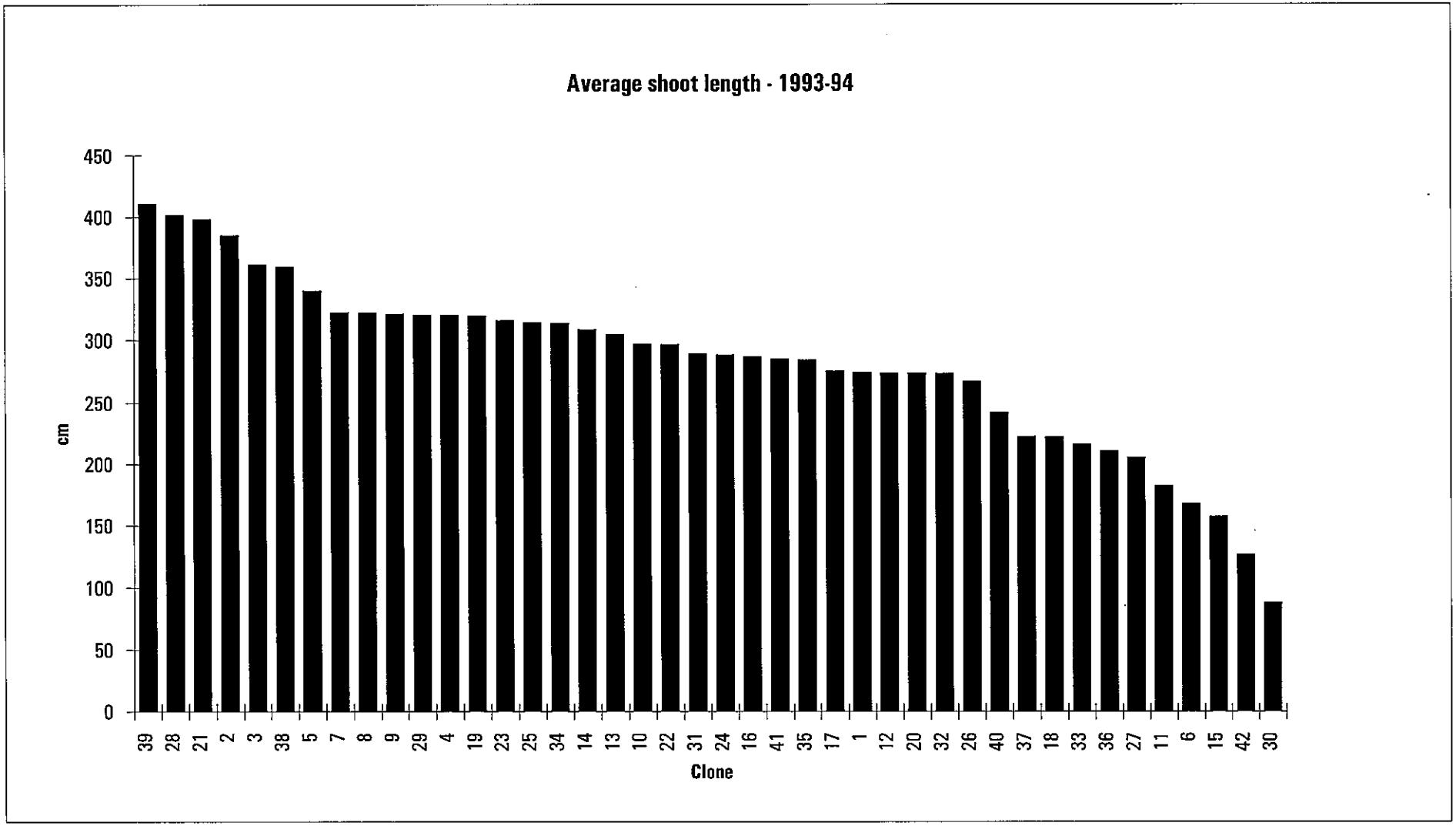


Table 4. Average pruning weight of Pinot Noir grafted on Vitis labrusca hybrid varieties, 1994. (Ranked in decreasing order.)

	Variety	Pruning Weight (g)
39	VERDELET	314.3
21	FOCH	254.3
38	VENUS	247.1
28	LN 33	245.7
3	AMERICANO	218.6
4	AURORE	214.3
35	SENECA	212.4
5	BACO BLANC	211.4
34	SCHUYLER	210.0
41	VILLARD NOIR	194.6
19	PINOT NOIR 0014	192.9
8	CANADICE	188.6
2	ALICANTE BOUSCHET	185.7
25	JACQUEZ	181.4
13	CHAMBOURCIN	180.0
31	ROMULUS	177.8
7	CANADA MUSCAT	177.1
9	CAROLINA BLACKROSE	172.9
10	CASCADE	172.9
1	ALDEN	168.6
20	ELVIRA	165.7
26	JOANNES SEYVE 23-416	164.3
24	ISABELLA	161.4
29	MANTEY	161.4
16	DE CHAUNAC	158.6
22	GLENORA	158.6
12	CAYUGA WHITE	152.9
14	CONCORD	144.3
23	HIMROD	142.9
32	ROYALTY	138.6
17	DELAWARE	133.8
18	DELAWARE - CLONE 8154	132.1
37	SUFFOLK RED	114.3
36	SEYVAL	108.6
40	VILLARD BLANC	104.3
27	KYOHO	84.3
11	CATAWBA	83.2
33	RUBIRED	70.2
15	COUDERC NOIR	41.2
6	BACO NOIR	34.6
42	VITIS LABRUSCA	23.3
30	NEW YORK MUSCAT	10.0
	lsd	112.2

Table 5. Aluminium and manganese levels in petioles of Pinot Noir vines grown on a range of hybrid rootstocks.

	Rootstock	Aluminium (mg/kg)		Rootstock	Manganese (mg/kg)
6	BACO NOIR	60.00	2	ALICANTE BOUSCHET	70.00
3	AMERICANO	44.30	4	AURORE	68.46
9	CAROLINA BLACKROSE	39.00	5	BACO BLANC	63.39
16	DE CHAUNAC	35.00	10	CASCADE	60.00
30	NEW YORK MUSCAT	34.00	8	CANADICE	56.33
27	KYOHO	32.69	34	SCHUYLER	56.00
32	ROYALTY	32.00	24	ISABELLA	55.67
35	SENECA	31.00	30	NEW YORK MUSCAT	55.67
28	LN 33	30.33	20	ELVIRA	55.33
10	CASCADE	29.67	18	DELAWARE (8154)	54.67
34	SCHUYLER	28.79	19	PINOT NOIR 0014	53.65
15	COUDERC NOIR	28.67	6	BACO NOIR	50.67
31	ROMULUS	28.67	14	CONCORD	49.33
42	VITIS LABRUSCA	28.33	32	ROYALTY	48.00
2	ALICANTE BOUSCHET	26.33	16	DE CHAUNAC	45.33
22	GLENORA	26.29	31	ROMULUS	45.00
41	VILLARD NOIR	25.63	11	CATAWBA	43.00
1	ALDEN	24.67	28	LN 33	42.33
18	DELAWARE (8154)	24.67	17	DELAWARE	41.67
36	SEYVAL	24.00	35	SENECA	40.64
19	PINOT NOIR 0014	23.69	39	VERDELET	38.96
17	DELAWARE	23.67	25	JACQUEZ	38.33
38	VENUS	23.29	1	ALDEN	36.67
24	ISABELLA	23.00	42	VITIS LABRUSCA	35.00
21	FOCH	22.52	36	SEYVAL	34.46
20	ELVIRA	22.00	9	CAROLINA BLACKROSE	33.67
4	AURORE	21.79	29	MANTEY	33.64
40	VILLARD BLANC	21.60	40	VILLARD BLANC	33.33
33	RUBIRED	20.41	33	RUBIRED	33.15
7	CANADA MUSCAT	20.27	23	HIMROD	32.33
13	CHAMBOURCIN	20.00	7	CANADA MUSCAT	31.67
23	HIMROD	19.67	26	JOANNES SEYVE 23-416	31.33
12	CAYUGA WHITE	19.10	12	CAYUGA WHITE	31.00
11	CATAWBA	19.00	27	KYOHO	29.67
25	JACQUEZ	18.79	13	CHAMBOURCIN	29.00
14	CONCORD	18.00	21	FOCH	27.33
5	BACO BLANC	17.02	37	SUFFOLK RED	27.14
29	MANTEY	15.19	38	VENUS	25.33
37	SUFFOLK RED	15.19	41	VILLARD NOIR	25.00
8	CANADICE	13.63	22	GLENORA	22.00
26	JOANNES SEYVE 23-416	11.52	15	COUDERC NOIR	21.33
39	VERDELET	6.72	3	AMERICANO	19.93
	lsd	39.40			27.8