‘Star 50’ and ‘Star 74’: new dwarfing grape rootstocks

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Abstract

As part of a breeding programme initiated in 1990 to develop dwarfing stocks for *Vitis vinifera*, commercial rootstocks under self-or open-pollination led to 400 seedlings, subsequently tested via cuttings for rooting ability and graft compatibility with wine grape ‘Cabernet Sauvignon’, ‘Chardonnay’, ‘Sangiovese’ and table grape ‘Muscat de Hambourg’. In a second step, the ‘Sangiovese’-grafted cuttings that performed best were tested for vigour and resistance to high concentration of active limestone in comparison with 7 commercial stocks. The 26 best-performing grafted accessions, together with the 7 commercial stocks grafted with ‘Sangiovese’, were planted in field to test the long-term induced effects on scion. This trial resulted in the selection of two stocks bred by self-fertilisation with ‘Binova’, a hermaphrodite flower-bud mutation of ‘SO4’. The two new stocks were commercially denominated ‘Star 50’ and ‘Star 74’. Both are marked by good vigour control, good lime tolerance and proved capable of controlling ‘Sangiovese’s excessive cropping while improving its grape composition.

Keywords: dwarfing rootstocks, vigour, lime resistance, pruned wood, grape composition

INTRODUCTION

The rootstocks currently used in Italy for *Vitis vinifera* belong to a few dozen cultivars developed via inter-specific crosses of the American species *V. riparia*, *V. rupestris* and *V. berlandieri*, or by crossing them with *V. vinifera.* While the primary goal was to develop stocks resistant to phylloxera, the rooting capacity of cuttings, the tolerance to soil lime and the graft compatibility with European grapes were pursued. At present, the most promising commercial rootstocks used in Italy for lime tolerance belong to the *V. berlandieri* × *V. rupestris* group, like 140R, 110R and 1103P,and to that of *V. berlandieri* × *V. riparia*, like 420A and 161/49C (Galet, 1979). Generally speaking, the most resistant to chlorosis, i.e., 140R, 110R and 1103P, are also considered fairly tolerant to drought (Galet, 1979). While the most part of the commercial stocks induce high vigour to the graft, 420A, 161/49C and 3309C do so to a lesser extent. Briefly, it is a general situation that contrasts with the demands of a modern viticulture that is more orientated to mid-to-medium-high planting densities that need stocks capable of reducing vine vigour. This aim was pursued at Bologna University’s Viticulture Section through a breeding programme initiated in 1990 (Intrieri and Allegro, 2010), based on open- and self-pollination of several commercial rootstocks. Self-pollination was considered important, since inbreeding often leads to reduced vigour and leads to viable dwarfing stocks if they combined other needed traits (Intrieri and Filippetti, 2012).

MATERIALS AND METHODS

Rootstocks cultivated in a germplasm collection were used as mother plants in 1990 to develop 400 seedlings via open-pollination of the parental cultivars 325R, 41B, Teleki 5, Teleki 8B, Kober 5BB, Cosmo 2 and Cosmo 10 and via self-pollination of ‘Binova’, a mutation of ‘SO4’ selected in Germany and not well-known in Italy. Although ‘Binova’ has very similar traits to ‘SO4’, it differs from the latter in having true hermaphrodite flowers that can produce seeds via self-pollination.

In 1994 numerous cuttings produced by seedlings arising from open- and self-pollination were then grafted to ‘Sangiovese 12T’ and to the other key commercial winegrape cultivars ‘Cabernet Sauvignon’ and ‘Chardonnay’ and to table grape ‘Muscat de

Hambourg'. They were tested for rooting ability and good graft-union callus tissue. In winter 1994-1995 the 'Sangiovese'-grafted cuttings that performed best were divided in two groups and transferred in a two bench experiment, characterized by two different levels of active lime, respectively 1% (control bench) and 17.8% (treated bench).

'Sangiovese' vines grafted to the commercial stocks *V. berlandieri* × *V. rupestris* 140R, 110R, 1103P and 779P, and *V. berlandieri* × *V. riparia* 157/11, SO4, 420A and 161/49C were also placed in the experiment as external controls.

From 1995 to 1997 pruning-wood weight and symptoms of foliar chlorosis monitored with the SPAD method according to Scudellari et al. (1994), were recorded in all the 'Sangiovese' tested vines. The 'Sangiovese' vines grafted to the 26 best performing new accessions and to the commercial stocks were then planted in 1999 to a Bologna University test plot, 8 per graft combination in two randomized blocks. The soil was characterised by 40, 36 and 24% of sand, silt and clay respectively; pH was 7.01; total and active lime were 0.8 and 0.5, respectively; total N was 0.9%, P 18 ppm, K 155 ppm and organic matter 1.4%. Planted at 1.25×2.80 m spacing and trained to spur-pruned cordon of 9 spurs of 2 buds per vine, all the vines were tested from 2001 to 2003 to assess vigour (trunk growth and pruning-wood weight), crop yield and fruit composition (cluster number and weight, must soluble solids, pH and titratable acidity). Statistical analysis was performed using SAS (SAS Institute, Cary, North Carolina, USA). Analysis of variance was performed for all data with means separation after the Tukey-test; probability values were P=0.05.

RESULTS AND DISCUSSION

The trial data showed that among all the tested new accessions, two derived from self-pollination of 'Binova' were the best-performing stocks and were designated as 'Star 50' and 'Star 74'. For the sake of simplicity, the data in the tables refer only to these two stocks and their comparison to the commercial control stocks 'SO4,' as vigorous control, and 420A and 161/49C, taken as good benchmarks for their resistance to lime and capacity to control vigour.

Table 1 compares the performances of 'Sangiovese' grafted to 'Star 50' and 'Star 74' to those grafted to SO4, 420A and 161/49C as per the average 1995-1997 bench tests and regarding chlorosis susceptibility and vigour. It shows that neither of the two new stocks induced chlorosis in 'Sangiovese', their SPAD values being practically the same as those for the control stocks grafted to the same cultivar. It has to be noted that SPAD values over 20 were considered routine and non-limiting, since they correspond to a chlorophyll content above 20 μg cm^{-2} (Scudellari et al., 1994, l.c.). The pruning wood weight of 'Sangiovese' grafted to the new stocks and derived from an average of both benches resulted below those of the other commercial control rootstocks and similar to 161/49C.

Table 1. Bench test. SPAD index and pruned wood weight of 'Sangiovese' cuttings grafted to trial stocks (avg. 1995-1997).

Rootstock	SPAD Control bench (1% active lime)	SPAD Treated bench (!7.8% active lime)	Pruned wood avg. of control and treated bench (g $vine^{-1}$)
Star 50	21.9 a	21.6 a	223 b
Star 74	23.6 a	23.1 a	231 b
420 A	22.3 a	23.0 a	318 a
161/49 C	22.7 a	22.7 a	238 b
SO4	23.4 a	20.6 a	381 a

Values marked by different letter per column differ statistically at P=0.05

The results of field trials (Table 2) shows that 'Star 50' and 'Star 74' induced a vine circumference growth above the graft union from 2000 to 2004 more or less in line with that of 420A, 161/49C and SO4. In the same period 'Star 50' and 'Star 74's circumference grew less below the graft union than controls. Both of the new accessions induced less pruned

wood than did 420A, 161/49C and SO4 on average over 2001-2003.

Table 2. Open field test. Vine trunk circumference growth (∑ from 2000 to 2004) and pruned wood weight of 'Sangiovese' grafted to trial stocks (avg. 2001-2003).

Rootstock	Growth above graft union (cm)	Growth below graft union (cm)	Pruned wood (kg vine^{-1})
Star 50	4.35 a	2.02 b	1.33 b
Star 74	5.00 a	1.70 b	0.94 b
420 A	4.90 a	3.85 a	2.05 a
161/49 C	4.82 a	3.17 a	1.92 a
SO4	4.12 a	2.90 ab	2.21 a

Values marked by different letter per column differ statistically at P=0.05.

The field growth and cropping data (Table 3) show that, starting from the same post-pruning bud load, the sprouted shoots were similar in all compared stocks, while cluster number per vine of 'Sangiovese' grafted to 'Star 50' and to 'Star 74' was similar than that recorded for 'Sangiovese' grafted to 161/49C, but plainly lower than that recorded for 'Sangiovese' on 420A and SO4. The two new accessions thus consistently reduced bud fertility. Table 4 shows that despite there were no significant differences in average bunch weight, 'Sangiovese' on 'Star 50' and 'Star 74' produced bunches of lighter weight, less than 300 g, compared to the more than 300 g bunch weight of 'Sangiovese' on the commercial control rootstocks. The combination of less fertility and lower bunch weight of 'Sangiovese' on 'Star 50' and 'Star 74' thus resulted in a balanced productivity, respectively 5.66 and 7.00 kg vine^{-1}, that regulated the excessive cropping 'Sangiovese' showed with 420A (10.22 kg vine^{-1}) and SO4 (12.05 kg vine^{-1}). That the two accessions also reduced vigour as shown in Table 2, their Ravaz index, i.e., the ratio of crop to pruned wood weight, ranged from 4 to 7, thereby indicating altogether a normal growth-cropping balance (Kliewer and Dokoozlian, 2005). No phylloxera damages were detected in vines grafted to 'Star 50' and 'Star 74' as well as on vines grafted on commercial stocks used as external controls.

Grape composition at harvest showed some slight differences among the tested stocks: 'Sangiovese' on 'Star 74' had higher sugar concentration compared to the one on 420 A, while all the others do not significant differ and range from 20.5 to 20 °Brix. The pH and must titratable acidity showed no differences between the two new accessions and the commercial controls (Table 5).

Table 3. Open field test. Number of shoots and of clusters and fertility of 'Sangiovese' vines grafted to trial stocks (avg. 2001-2003).

Rootstock	Shoot (no. vine^{-1})	Cluster (no. vine^{-1})	Fertility (cluster shoot^{-1})
Star 50	19.4 a	20.7 b	1.07b
Star 74	19.3 a	24.6 b	1.27 b
420 A	19.4 a	32.9 a	1.69 a
161/49 C	18.7 a	25.9b	1.38 b
SO4	21.1 a	34.6 a	1.64 a

Values marked by different letter per column differ statistically at P=0.05.

Table 4. Open field test. Yield, average cluster and berry weight of 'Sangiovese' vines grafted to trial stocks (avg. 2001-2003).

Rootstock	Yield (kg vine^{-1})	Avg. cluster weight (g)	Avg. berry weight (g)	Ravaz index (kg of grape kg^{-1} of wood)
Star 50	5.66 b	273.5 a	2.79 ab	4.25 ab
Star 74	7.00 b	284.7 a	2.54 b	7.44 a
420 A	10.22 a	310.9 a	2.79 ab	4.98 ab
161/49 C	7.81 ab	301.4 a	2.54 b	4.05 b
SO4	12.05 a	348.3 a	2.93 a	5.45 a

Values marked by different letter per column differ statistically at P=0.05.

Table 5. Open field test. Grape composition at harvest of 'Sangiovese' vines grafted to trial stocks (avg. 2001-2003).

Rootstock	Soluble solids (°Brix)	pH	Titratable acidity (g L^{-1})
Star 50	20.5 ab	3.37 a	7.92 a
Star 74	21.2 a	3.39 a	7.52 a
420 A	19.5 b	3.38 a	8.59 a
161/49 C	20.0 ab	3.43 a	8.00 a
SO4	20.1 ab	3.40 a	8.18 a

Values marked by different letter per column differ statistically at P=0.05.

CONCLUSIONS

Overall, the 'Star 50' and 'Star 74' stocks proved that they can control the noted vigour and the over-fertility of 'Sangiovese', which often needs topping to contain excessive shoot growth as well as costly manual cluster thinning, and deliver well-balanced cropping while exerting a positive influence on grape composition. These are important goals for several wine grape cultivars, and well in line with such modern planting demands, as densities of not less than 4,000 vines ha^{-1}, reduced plant growth and high-quality yields of regulated productivity. 'Star 50' and 'Star 74', which also showed no phylloxera damages, have recently been added to Italy's National Grapevine Registry and are currently in pre-multiplication.

Literature cited

Galet, P. (1979). A Practical Ampelography. Grapevine Identification (Ithaca, NY, USA: Cornell University Press).

Intrieri, C. and Allegro, G. (2010). Vitigni e portinnesti ottenuti per incrocio intraspecifico e interspecifico. L'Informatore Agrario *Supplemento n. 445*, 41–44.

Intrieri, C. and Filippetti, I. (2012). Nuovi portinnesti ad azione nanizzante. Vignevini (*1/2*), 56–57.

Kliewer, W.M., and Dokoozlian, N.K. (2005). Leaf area crop weight ratios of grapevines: influence on fruit composition and wine quality. Am. J. Enol. Vitic. *56* (*2*), 170–181.

Scudellari, D., Poni, S., Tagliavini, M. and Toselli, M. (1994). Attendibilità di un metodo non distruttivo per la determinazione della clorofilla. Atti II Giornate Scientifiche S.O.I. – San Benedetto del Tronto, 22-24 giugno 1994, p.485–486.