Grape and wine

Grape rootstock – scion interactions on shoot growth and cane maturing

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Summary: Interaction between the rootstock and scion varieties (clones) was examined. Berlandieri x Riparia T. K. 5BB, Berlandieri x Riparia T.5C being the most widely used varieties in Hungary, Fercal, Ruggeri 140 being recently used on special soil conditions ; Georgikon 28 a new established variety and Berlandieri x Riparia T. 8B GK 10 clone were the rootstocks used. The V. vinifera L. varieties were a clone of Italian Riesling and two new hybrids from the same cross population { (Noble Italian Riesling X Ezerjó) X (Noble Italian Riesling X Pinot Gris) }. This study presents the results how the growth habit depends on different scion/stock combinations in the first three years.

Shoot growth characters were observed during the initial years after plantation in the vineyard until we got the first yields. Our results did not agree with those of *Pospisilova* (1977) that the anticipated vigour of shoot growth will appear later in the vineyard only. However we agree with *Zimmerman* (1970), who showed that the differences are caused by the rootstocks in the growth habit of vines during the first two years already. The differences in shoot elongation decreased similarly to the rootstocks in the first year of fruit production. It shows us that the intense root development caused vigorous shoot growth, which we think to be a rootstock effect. When the vegetative and generative development are balanced already, the effect of scions in shoot elongation became stronger than the effect of rootstock.

We also found great differences in the maturation of wood each year from planting of the vineyard to the year of fruit production. During the first years the differences of cane maturation were greater according to the scion varieties, the means were significantly different. In the first ripening year the differences dwindled or increased due to the rootstocks. This means that the effect of the rootstock on cane maturation became stronger in the first year of fruit production.

Introduction

The breeding of the new rootstock varieties was stimulated by the spreading and highly devastating effect of Phylloxera (Daktulosphaira vitifoliae FITCH) which invaded Europe. The breeders made a great number of crosses between American, American and Eurasian Vitis species (Millardet, de Grasset, Castel, Couderc and so on), and selected new cultivars from the seedlings *(Teleki, Szilagyi, Kober, Durlach* and so on).

The evaluation of the new varieties made by crossing, and of course that of the selected clones is very important too. They have to be compared with the varieties which already exist in the practice and to the newly developed varieties too. On the basis of these evaluations these varieties could be recommended for practical viticulture, to be adopted in the field. In the highly developed viticultural countries suitable rootstocks are matched with the scion varieties depending on the soil types.

The question is which component of the graft has more decisive influence on shoot growth and on maturation as a result of interaction between rootstock and scion.

To the best of our knowledge the rootstock influences the vigour of the vine, and also influences the yield. Up to the last decades the literature on the interaction of the rootstock and the scion was examined from the side of vegetative production *(May et al.,* 1973; *Blaha,* 1975; *Gaprindasvili* et al., 1980; *Cirami* et al., 1984; *Crescimano* et al., 1984; *Ochaba,* 1987, 1988). *Striegler* and *Howell* (1991) dissociated the effect of the rootstock for primary or direct and secondary or indirect effects. According to their experiments the choice of the rootstock does not influence the vigour of the vine and the development of the canopy. The rootstocks have a reducing effect on yield by influencing the cluster weight.

The primary effect of the rootstock must appear in the vegetative growth whereas the secondary effect will appear as consequence of the primary effect.

In contradiction with these most of the authors showed that the rootstock effect got manifested in the size of the vine (kg pruning weight/vine) *(Pongrácz,* 1983; *Carbonneau* and *Casteran,* 1987; *Howell,* 1987; *Pouget,* 1987a; *Pouget,* 1987b). But on the basis of this examination it is hard to verify unambiguously that the rootstock has a more important role in influencing the vegetative vigour of the vines than the scion variety. It seems impossible as most of these studies talk only about the rootstock effect or about one scion variety grafted on different rootstocks *(Ezzahouani* and *Larry,* 1997) or they used the same cultivars of comparable vegetative behaviour *(Stevens et al.,* 1996). As these experiments did not exploit all the possible graft combinations (rootstock/scion/vegetative behaviour) we have to add our results in order to contribute to find a good rootstock-scion combination for the production.

Material and methods

It was a very important point of view to choose rootstocks and scions, which are genetically very close to each other, but they have different cultural characteristics, mainly in this vegetative behaviour.

Rootstocks: Berlandieri x Riparia Teleki 5C – very vigorous with large cane production. Berlandieri x Riparia Teleki Kober 5BB – vigorous with large cane production.

These two rootstocks are commonly used all over the world in viticulture.

Ruggeri 140 – medium vigorous with a lot of thin canes. Fercal – medium vigorous in the rootstock plantation with small cane production. These two rootstocks are commonly used on soils of high lime content and the Fercal is one of the last new variety.

Berlandieri x Riparia Teleki 8B GK10 – vigorous with a medium cane production.

Georgikon 28 – very vigorous in the rootstock plantation with large cane production. The new clone of T. 8B is better in rooting ability than the basic variety. The new hybrid has very valuable characteristics in the rootstock plantation in comparison with other varieties.

Scion varieties: Noble Italian Riesling – medium vigorous variety. This clone produces more yield than the basic variety (Italian Riesling) with more fruity flavour.

Hungarian Riesling, (Noble Italian Riesling x Ezerjo) x (Noble Italian Riesling x Pinot Gris) – very vigorous, with a high yield. The wine is similar to the Riesling but more attractive; it has a more intense flavour.

Vinitor, (Noble Italian Riesling x Ezerjo) x (Noble Italian Riesling x Pinot Gris) – less vigorous, with moderate yield. The wine is harmonious, full bodied, hard; the acids are very delicious.

The canes were taken from the basic vineyard at the same time. The growing factors were the same for all varieties. The 6 rootstock and 3 scion varieties resulted 18 graft combinations. The grafts were made in short-whip (short-tongue) by hand. They were raised in plastic containers (8 x 18 cm). The plantation was established in October 1992 and with Noble Italian Riesling in June 1993. The canes were pruned back to one bud each in the first year. It was possible to form the arm at the third year. The rows faced East – West, the spacing was 300 cm X 100 cm. Each stock was observed and data were taken from each. The vineyard layout was repeated four times with 10-10 vines per block at random.

The shoot growth was measured after the first growing period and after flowering at the end of June. The maturity of the canes was surveyed in November. The data were analysed by IBM PC 486 DL using Statgraf 3.0 and Windows Excel 5.0, to compare them a multiple-factor analysis was used according to the Dixon-probe.

Results and discussion

It is well known that the growth habit of the variety depends also on the rootstock-scion combinations, but it is not clear which of the components has more influence on this cultural characteristic. In our study we would like to present the differences among the scion/rootstock combinations, which may help to understand the influence of rootstock in the rootstock-scion interaction.

The shoot length of Noble Italian Riesling on T. 8B GK 10 rootstock was the shortest in 1994 which was exceeded significantly by the vines on Fercal *(Table 1).* The length of the developed shoots on the other rootstocks ranged between 291.3–327.2 mm. In 1995 we got higher differences depending on the rootstocks and their order also changed. The Noble Italian Riesling combination with Fercal showed even more vigorous shoot growth characteristics, while the weakest growth was on T. 5C (501.7 mm). This value was significantly lower in comparison with other rootstocks.

Table 1 The average shoot length of the variety Noble Italian Riesling on different rootstock (Cserszegtomaj, 1994–95)

Rootstock varieties	Shoot length (mm)	
	1994	1995
Berl. X Rip. T. 5C	291.3 ab*	501.7 a
Berl. X Rip. T. K. 5BB	327.2 abc	618.1 bc
Georgikon 28	318.9 abc	601.7 bc
Fercal	342.0 bc	655.3 c
Ruggeri 140	295.4 ab	578.9 bc
Berl. X Rip. T. 8B GK10	283.3 a	563.0 ab

* significant difference among the rootstock varieties, the same letter marks homogeneous groups (P=0,05%)

The shoot length of Hungarian Riesling increased year by year. The order changed each year among the rootstocks. The shortest shoot length was measured on T.K. 5BB in 1993, while the longest was on the same rootstock in 1994.

Table 2 shows how the rootstock related differences of the graft combinations with Hungarian Riesling depending on the time which passed after establishing the plantation. This tendency was verified by statistical analyses too.

The new variety, the Vinitor had a vigorous shoot growth in the first year after the establishment of the vineyard. The greatest difference was obtained among the rootstock

Table 2 The average shoot length of Hungarian Riesling on different rootstock varieties (Cserszegtomaj, 1993–1995)

Rootstock varieties	Shoot length (mm)		
	1993	1994	1995
Berl. X Rip. T. 5C	341.8 e*	435.9 b	552.9 ab
Berl. X Rip. T. K. 5BB	194.5 a	445.6 b	578.3 bc
Georgikon 28	196.3 ab	354.7 a	532.0 a
Fercal	235.6 abc	424.7 b	588.0 bc
Ruggeri 140	253.0 bcd	396.7 ab	561.8 ab
Berl. X Rip. T. 8B GK10	266.6 cd	434.7 b	565.8 ab

* The statistically significant differences among the rootstock varieties, the same letters marks homogeneous groups (P=0,05%)

varieties in 1993 (190.8–368.4 mm) in case of Vinitor. The smallest difference was measured in 1995 (423.5–479.7 mm). Vigorous plants resulted on combination with T. 5C in all of the three years examined but growth habit on T.K. 5BB was weak in the first and second years and on T. 8B GK10 in the third year *(Table 3)*, respectively.

Table 3 The average shoot length of Vinitor on different rootstock varieties (Cserszegtomaj, 1993–1995)

Rootstock varieties	Shoot length (mm)		
	1993	1994	1995
Berl. X Rip. T. 5C	368.4 e*	458.7 c	439.7 ab
Berl. X Rip. T. K. 5BB	190.8 a	362.0 a	461.0 ab
Georgikon 28	224.3 abc	398.0 ab	476.9 abc
Fercal	260.0 cd	351.8 a	479.7 abc
Ruggeri 140	254.7 cd	348.5 a	467.8 ab
Berl. X Rip. T. 8B GK10	304.6 de	435.8 bc	423.5 a

* The statistically significant differences among the rootstock varieties, the same letters mark homogeneous groups (P=0,05%)

The effects of each rootstock and each year were analysed by multifactor variance analyses. Of course, the shoot length increased year by year till the beginning of flower production. The statistical analysis of the findings verified unambiguously that the effect of the scion varieties were greater during this period. The effect of the rootstocks was also important besides this influence, but according to our evaluation this rootstock effect will decrease later *(Table 4)*.

Our results show the shoot length of the scion varieties was different depending on the rootstocks in the average of the second and the third years. Each rootstock established another type of interactions with the scions. A vigorous growth habit was observed in the combination of 140 Ruggeri with Noble Italian Riesling *(Table 1)*, however shorter shoots were observed in its combination with Vinitor. The Hungarian Riesling on T. 5C produced very vigorous vines, but the same rootstock developed shorter shoots with the Noble Italian Riesling. The shoot lengths were relatively equal in case of all the three varieties on T. 8B GK10.

The differences in the shoot length depend highly on the rootstocks in the first year after the establishment of the plantation. For example the Hungarian Riesling and Vinitor

Table 4 The average shoot length of scion varieties depending on the rootstock varieties (Cserszegtomaj, 1993–1995)

Rootstock varieties	Shoot length (mm)		
	Noble Italian Riesling	Hungarian Riesling	Vinitor
Berl. X Rip. T. 5C	396.5 a*	443.9 c	418.4 c
Berl. X Rip. T. K. 5BB	472.6 bc	406.0 b	337.9 a
Georgikon 28	423.2 ab	422.3 bc	387.9 b
Fercal	490.2 c	416.1 bc	359.8 ab
Ruggeri 140	460.4 bc	361.0 a	366.4 ab
Berl. X Rip. T. 8B GK10	437.2 ab	403.8 b	357.0 a

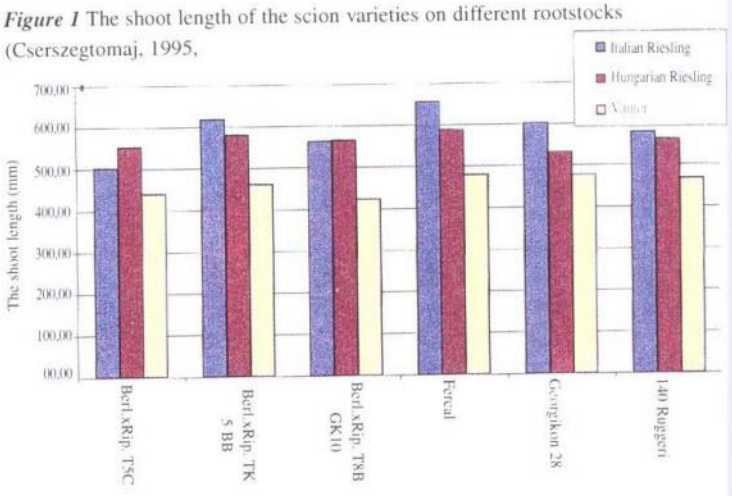
* The statistically significant differences among the rootstock varieties, the same letters mark homogeneous groups (P=0,05%)

produced the lowest vigour on T.K. 5BB in 1993, while their vigour was much higher on T. 5C.

The rootstock's related differences were more visible in the second year, for example the shoot growth was stronger on T. 5C than on Georgikon 28, 140 Ruggeri or Fercal. However, the differences were much smaller in case of the Hungarian Riesling, which variety could be considered as very vigorous.

The rootstocks seemed to have less significant influence on shoot length in the period of the vineyard's turn into bearing. These equalisations were expressed on the bar diagram too *(Figure 1)*.

Figure 1 The shoot length of the scion varieties on different rootstocks (Cserszegtomaj, 1995,



Less rootstock effect was observed on the very vigorous varieties than on the others. The effect of rootstocks was stronger on the scions of weak growth habit after the period of the vineyard establishment, and this rootstock-effect stands out strongly.

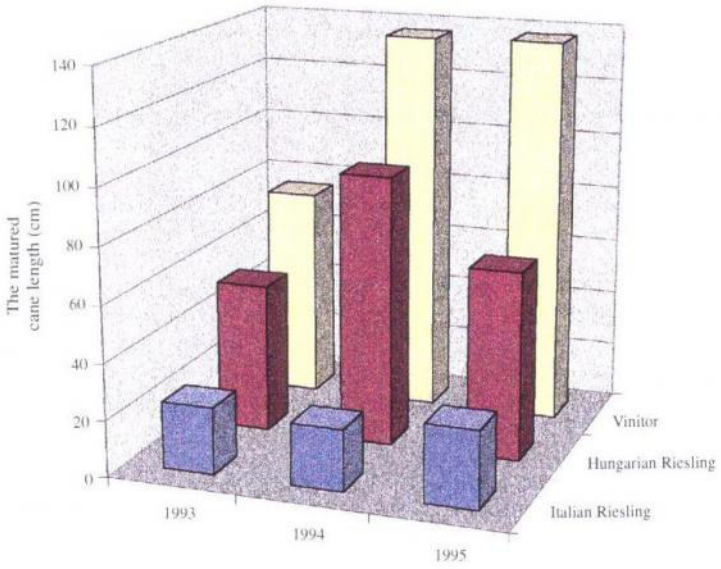
The maturing of the wood begins after the shoots have reached their full length and diameter during the period of berry – growth and the start of ripening. The primary visible sign of this process, a brown coloration of the surface begins from the internodes at the base of the shoot. Later on the wood will get the colour which characterises the variety *(Pongrácz,* 1978).

The data were collected during three years (1993–95), always at same date, in the first ten days of October. One characteristic of the excellent propagation material is the well-matured, lignified wood. It is very important that the maturation should be finished before the early autumn frosts.

Our results focus on the interaction between the rootstocks and scions in this process.

First of all, we determined the differences among the scion varieties on the average of rootstocks according to the respective year *(Figure 2)*. The data were analysed with two-way variance (at P=95%), the differences were verified among the scions. In 1993, the Vinitor's shoots ripened earlier than the two others. In the next year, the differences increased among the Vinifera varieties in the case of all rootstocks, and they were significantly different from each other. Very little differences were observed between the Hungarian Riesling and Vinitor but shoots of the Italian Riesling got hardly lignified in the last year examined.

Figure 2 The length of the matured canes of the scion varieties



The effects of each rootstock and each year were examined with the same method as the shoot length. We found that there were significant differences among the years in terms of maturity of wood, which had a close correlation with the increased of yearly shoot growth.

Table 5 shows the length of the matured wood of scion varieties depending on the rootstocks in average of three years. The same letter means no significantly different values.

Table 5 The lignification of cane depending on the rootstock varieties (Cserszegtomaj, 1993-1995)

Rootstock varieties	Length of the mature cane (mm)		
	Noble Italian Riesling	Hungarian Riesling	Vinitor
Berl. X Rip. T. 5C	593.9 b*	443.9 c	418.4 c
Berl. X Rip. T. K. 5BB	510.6 a	406.0 b	337.9 a
Georgikon 28	423.2 ab	422.3 bc	387.9 b
Fercal	490.2 c	416.1 bc	359.8 ab
Ruggeri 140	460.4 bc	361.0 a	366.4 ab
Berl. X Rip. T. 8B GK10	437.2 ab	403.8 b	357.0 a

* The statistically significant differences among the rootstock varieties, the same letters mark homogeneous groups (P=0,05%)

The mature wood canes were longer at Noble Italian Riesling on T. 5C than on the other rootstocks, which consisted of a statistically homogeneous group. The results of Hungarian Riesling were more variable on the rootstocks. Significant differences were observed among the Georgikon 28 and T. 5C, T. 8B GK10, Fercal, and between the Ruggeri 140. In case of Vinitor we did not observe verified differences in this characteristics. Mature canes of the three varieties were longer on T. 5C and the shortest on Georgikon 28. The differences were greater on the scion varieties then on the rootstock varieties. The rootstock did not have such a high effect on the lignification of the wood during the first two years. However, in the third year the differences were higher in the case of all the three scion varieties depending on the rootstocks.

This stronger influence could appear as the effect of the stored mass of carbohydrates. It is very important to know that because of the propagation we need well-lignified wood to get a high percentage of first class grafts. Of course, the mature wood of the vines is also the basis of yield in the next year.

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