# AN EVALUATION OF THE EFFECT OF SELECTED ROOTSTOCKS ON THE GROWTH AND HARVESTING ON HIBERNAL VARIETY

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*Abstract:* Hibernal is an interspecific cultivar of grapevine that has been cultivated in Germany. It was created by crossing the cultivars Rheinriesling and Seibel 7053 and has very promising potential in terms of fungus-resistant (PIWI) cultivars, so that it can be used for organic wine-making. The study is focused on the impact of seven selected rootstocks (125AA, Amos, Börner, CR2, 5BB, K1SO4, and T5C) on the quantitative characteristics of variety Hibernal. The experiment was carried out in 2015. The aim was to evaluate the influence of rootstocks in the selected locality, based on the following traits: plant vitality, yielding capacity of individual plants, number and weight of bunches per vine, and the weight of 50 berries. The results show that rootstock cultivar 125AA and K1SO4 performed best in the evaluation.

*Key Words:* Hibernal, quantitative characteristics, PIWI varieties, rootstock

## INTRODUCTION

Currently, there are an increasing number of people, who are at the forefront of breeding new varieties and rootstocks with higher resistance. These varieties, called PIWI (from German world "pilzwiderstandsfähige Rebsorten"), are more resistant against pest *Viteus vitifolie* and pathogens *Erysiphe necator* and *Plasmopara viticola*. The bases in turn affect the grafted varieties, not only in terms of the size of fruit and earliness of harvest, but more importantly they solve problems concerning resistance to drought and frost, pests and diseases, and the different chemistry of the soil (Brighenti et al. 2011).

The effect of rootstocks is dependent on the ratio between the leaf area of the plant and its yield. Examinations of the uptake of nutrients and water show them to be closely related to changes in the phenology of plants and it is well known that these processes are significantly influenced by rootstocks (Pulko et al. 2012).

In quantitative terms, it is therefore important to monitor the growth vitality of the varieties of rootstocks used, since the quantity and quality of the harvest depends on it (Brighenti et al. 2012).

When establishing a new vineyard, a well-chosen rootstock and scion combination represents one of the first important steps on the way to success (Keller et al. 2012).

The aim of this work was to evaluate the influence of rootstock used for quantitative parameters on monitored grafted variety of Hibernal at a given location. Hibernal is medium-late to late, interspecific wine grape vine variety, used for producing white wine, first bred in 1944 in Germany (Hillebrand et al. 2003).

## MATERIAL AND METHODS

### Characteristics of the vineyard

The grapes used in individual analyses were harvested in the vineyard with the gene-pool collection facilities of the research station Mendeleum in Lednice na Moravě (Czech Republic). The altitude of this locality is 176 m a.s.l. and – from the bioclimatological point of view – it is characterised

as a dry region (sub-region dry, district warm and dry with mild winters). The locality is open and well insulated. The plot is predominately flat and slightly sloping to the north-east. The soil is classified as a sandy clay loam with 20–24% of clay particles.

**Climatic characteristics**

The average annual number of rainy days is 90. A long-term average of the annual sum of precipitation is 524 mm (of this, 61% occurs within the growing season. The period with air temperatures higher than 10 °C lasts from the April 10 to October 10 - i.e., 175 days.

**Experimental design**

The cultivar under study (i.e., "Hibernal") was grafted onto 7 different rootstocks (125 AA, Amos, Börner, CR2, 5BB, K1SO4, and T5C). Vines were planted in the year 2005. The vine training was of the medium height with one cane (8–10 eyes per cane). The spacing of vines was 1m x 2.2m.

**Cultivar Hibernal**

This variety was bred by H. Becker et al. in Geisenheim (Germany) as the second filial generation seedling crossed with varieties of Chancellor (Seibel 7053) x Rheinriesling 239. In the Czech Republic, the variety has been allowed since 2004. (Sotolář 2006)

**Rootstocks**

Altogether, 7 rootstock varieties were tested. All of them are routinely used in viticultural practice. Two were very vigorous (5BB, Börner), two showed medium vigour (125AA, CR2), and the growth of the remaining three (Amos, K1SO4, and T5C) was weak. (Pospíšilová et al. 2005)

125AA - *Vitis berlandieri x Vitis riparia*

Amos - Severnyj (Malingre x *V.amurensis*) x Schwarzmann (*V. riparia x V. rupestris*).

Börner - *Vitis riparia* 183G x *Vitis cinerea* „Arnold"

CR2 (Craciunel 2) - *Vitis berlandieri x Vitis riparia*

5BB (Kober 5BB) - *Vitis berlandieri x Vitis riparia*

K1SO4 - LE/K1 x SO4

T5C (Teleki 5C) - *Vitis berlandieri x Vitis riparia*

**Sampling**

Samples were collected at regular weekly intervals (0–5), namely on September 2, September 9, September 16, September 23, and September 29, 2015. Average samples of berries were collected on 50 plants from different parts of grapes. Each sample consisted of 200 berries. From these berries were randomly selected 3 x 50 berries and these berries were processed in the laboratory on the day of sampling. The evaluation of the harvest (i.e., the number and weight of grapes and the number and weight of annual shoots) was performed on September 29, 2015. In each combination of rootstocks and Hibernal grafts, parameters were evaluated from samples collected from 7 plants.

**Evaluation of uvological parameters**

Individual vines were monitored from the agrotechnical and ampelographical points of view. The following basic parameters were evaluated: number of annual shoots per vine, weight per plant, average weight of one annual shoot, number and weight of grapes per vine, average weight of one bunch of berries, and weight of 50 berries (this was a modified classificator CPVO-TP/50/1).

**Statistical analysis**

A statistical analysis was performed using the Excel 2007 package (Microsoft Office, USA) and table sheets and graphs were produced using the statistical software Statistica 10 (Copyright © StatSoft). Results in figures are expressed by mean. It was counted from 7 plants of each rootstock. Error bars represent the 95% confidence interval of a mean. Statistical significance was determined by examining the basic differences between among individual rootstocks using ANOVA and Scheffé's test.

## RESULTS AND DISCUSSION

### Evaluation of grapes and annual shoots

In 2015, an extensive study of the effects of 7 rootstocks on a selected grapevine cultivar (Hibernal) was performed in the Mendeleum vineyards in Lednice na Moravě (Czech Republic). The ripening of grapes of this cultivar was monitored at weekly intervals. Simultaneously, the yields and some other quantitative parameters were recorded. The results obtained were processed statistically and are presented below.

The number and weights of the grapes were evaluated because only these characteristics were influenced by tested rootstocks. The growth of the plants was also evaluated; specifically, the number of annual shoots per vine, and their weight.

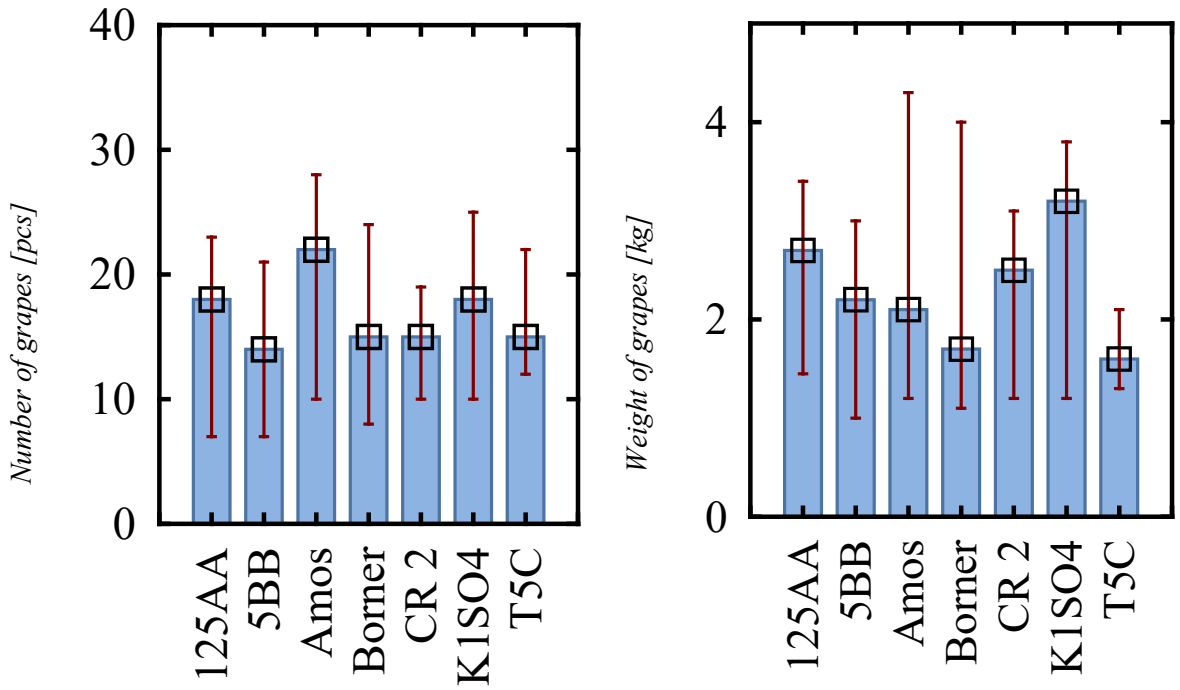
### The number and weight of grapes per plant

As shown in Figure 1A, the highest number of grapes in 2015 was obtained using the rootstock Amos, with 22 pcs per plant. Other high values were also obtained by rootstocks 125AA and K1SO4 (19 pieces).

Figure 1B shows that the highest weight of the grapes on the plant was achieved with rootstock K1SO4 (3.2 kg). Low yields were obtained with rootstocks Borner and T5C (weighing less than 2 kg).

*Figure 1 Number and weight of grapes per plant*

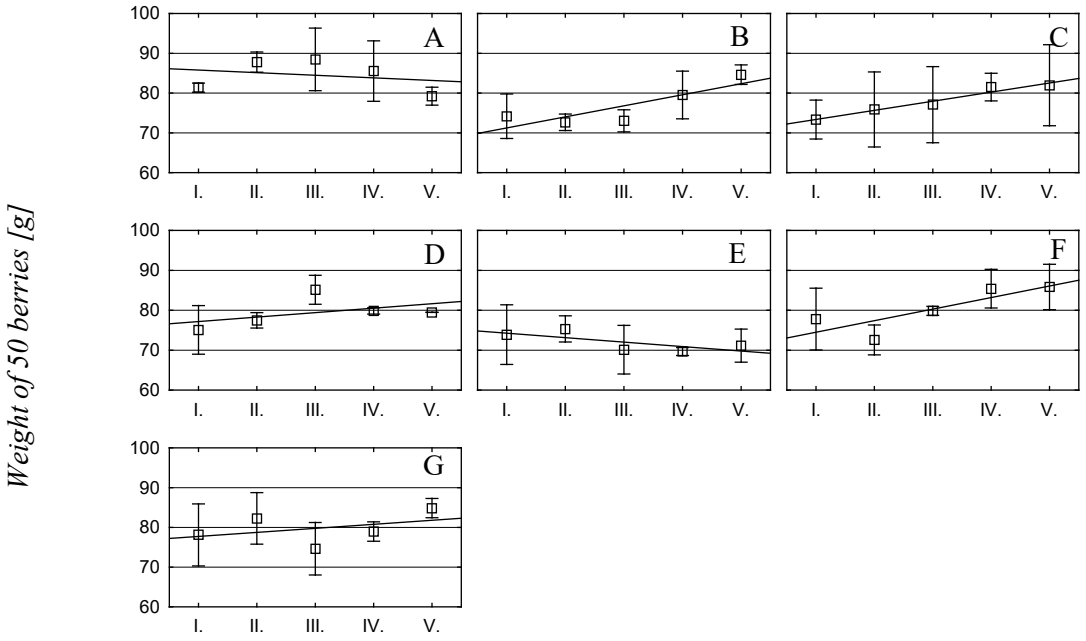
*A) Number of grapes* *B) Weight of grapes*




### The weight of 50 berries

The lowest and highest values of the weight of 50 berries were recorded in the beginning in variants with rootstocks Amos and 125AA respectively (72 and 81 g.). In the course of the ripening period, the highest value of the growth rate of berries was observed with the rootstock K1SO4. On the other hand, the lowest growth rate (negative growth rate) was recorded in the variant crossed with the rootstock CR2. The graphs presented in Figure 2 illustrate the growth rates of individual combinations of rootstocks.

*Figure 2 Weight of 50 berries (in grams), as determined on different sampling dates (I.–V.) in experimental combinations with individual rootstocks – (A) 125AA; (B) 5BB; (C) Amos; (D) Börner; (E) CR2; (F) K1SO4 and (G) T5C.*

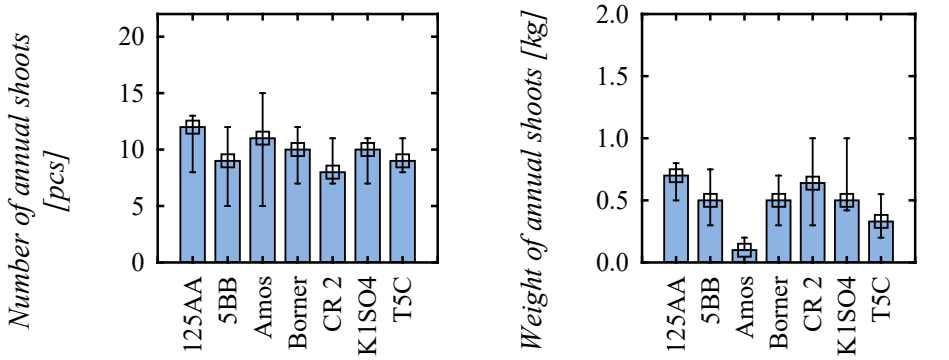



**The number and weight of annual shoots per plant**

The average number of shoots between rootstocks was very balanced, at around 10 pcs. A slightly higher yield of 12 pcs was obtained with rootstocks Amos and 125AA. The highest weight based on trimmed vines was achieved using rootstocks 125AA and CR2, at 0.7 kg. The lowest weight was with the rootstock Amos. Other rootstocks have balanced weights.

*Figure 3 Number and weight of annual shootsper plant*

A) *Number of annual shoots* B) *Weight of annual shoots*

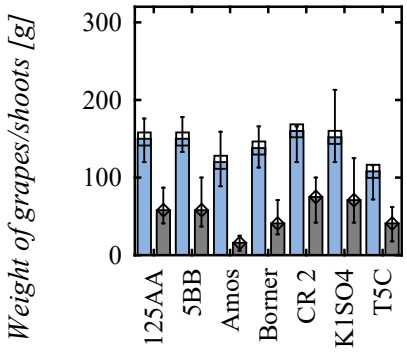



**Average weight of one grape and annual shoot**

The weight per vine corresponds in this case with the weight of all cropped cuttings. The highest values were from rootstock CR2, and the lowest were again from rootstock Amos, with only 16 g per shoot.

The weight of one grape ranged from 100 to 150 g. The highest weights were obtained by rootstocks K1SO4, 5BB, and CR2.

*Figure 4 Weight of one grape (first blue column) and one annual shoot (second grey column)*




The number of shoots on the plant should be roughly constant (this is also dependent on the cutting). If there are more annual shoots on the plant, it has shorter internodes and there will be more grapes on the plant, but they are smaller and lighter. If there is a lower number of annual shoots, it has longer internodes, meaning the shoots are larger, there are large leaves, and the grapes are fewer but larger and heavier. By contrast, stronger shoots need more nutrients. The number and weight of the shoots should be regulated using appropriate measures (Cohen and Naor 2002) It was also found that if row spacing (distance) was reduced to 1 meter for a number of shoots on the vine, yields per unit area (i.e., per hectare) were higher, while qualitative parameters remained unchanged (Kliewer et al. 2000). Tethal et al. studied effects of rootstock varieties on qualitative parameters of Cerason juice in 2011 in vineyards of Mendel University in Lednice. In the juice of the berries, the following parameters were monitored: concentrations of sugar, total acids, tartaric acid, malic acid, ratio of tartaric to malic acid (β-ratio), concentration of yeast assimilable nitrogen, and pH value. The best results were recorded in 125AA and 5BB rootstock varieties.(Tethal et al. 2015)

The varieties grafted on the rootstock Amos consist of shorter internodes, resulting in the expected higher number of shoots. At the same time, however, they lead to weaker growth shoots, and their weight reached lower values. The fertility has good characteristics, in that it is high, and creates medium-sized grapes of a favourable weight. The T5C base is suitable for loamy soils with ground water; it grows weakly and also forms shorter internodes. Their numbers were comparable to other rootstocks, but their weight was the second lowest. The average weight of one annual shoot was also the lowest in these two rootstocks. In a given year, the T5C rootstock has average numbers of grapes, but their weight is among the lowest. The size of the grape was also the smallest. The 125AA rootstock is an average in lush of growth. The number of shoots left on the plant was the highest, but their weight was too high. The number of bunches and the weight was the second highest. The grapes are medium-sized, creating the assumption that there will be ideal ripening, i.e., there is a good balance between quantity and quality. The luxuriant rootstock 5BB showed a lower number of shoots, but the mass of shoots on the plant was middling. Regarding the grapes, their number was on this rootstock high, but their weight shifted her to diameter.

Börner is an exuberant, moderate to strong-growing rootstock, which reached the average number of annual shoots with less weight on the annual shoots per plant and the weight of one annual shoot. The number of grapes was average and their weight was very low, suggesting small grapes. This is not an ideal level of fertility for the given conditions. The CR2 base is an average lush, with the low number of annual shoots compensated by a higher weight. It is therefore logical that they will achieve the maximum weight, reflecting their very strong growth. The number and weight of grapes from this rootstock was average; the average weight of one grape, however, was the highest. The K1SO4 base had an average number of annual shoots and weight. This rootstock was the third best. It was the highest rated in terms of the weight of bunches on the plant, and was among the highest concerning the average weight of one grape.

## CONCLUSION

This study was intended to evaluate the suitability of a combination of Hibernal variety with seven grapevine rootstocks. The best combinations were chosen on the base of an evaluation of a number of

selected parameters. The results of the yields also played a key role. Rootstocks 125AA and K1SO4 performed the best, while 5BB could also be a suitable rootstock for Hibernal. The experimental values obtained could have been influenced by the weather conditions in the year 2015 or by the pedological conditions of the experimental vineyard.

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