

## COMPARATIVE STUDY OF WAVIT<sup>®</sup> ROOTSTOCK WITH TWO PLUM AND TWO APRICOT CULTIVARS IN NURSERY

**Anton Ivanov Yordanov<sup>\*</sup>, Sava Georgiev Tabakov and  
Pantaley Valeriev Kaymakanov**

Department of Fruit Growing, Agricultural University – Plovdiv,  
12 Mendeleev Str., 4000 Plovdiv, Bulgaria

**Abstract:** In order to expand the knowledge about the behavior of Wavit<sup>®</sup> rootstock, we compared the growth characteristics which it induces on two plum and two apricot cultivars in nursery together with two commonly used rootstocks in Bulgaria for these species, *Prunus cerasifera* seedling and M29C. The study was conducted in the period 2012–2014 in a commercial nursery near Plovdiv. Plum cultivars Jojo and Cacanska Lepotica were T-budded on *P. cerasifera* seedling and Wavit<sup>®</sup> rootstocks, and apricot cultivars Pricia and Primaya were T-budded on Wavit<sup>®</sup> and M29C rootstocks. All trees were grown in the same conditions with individual support stakes and drip irrigation. It was found that Wavit<sup>®</sup> induced less vigor in plum cultivars Jojo and Cacanska Lepotica compared with the commonly used *P. cerasifera* seedling rootstock. Similarly, Wavit<sup>®</sup> induced less vigor in apricot cultivar Primaya compared with the commonly used M29C rootstock, but in the other tested apricot cultivar Pricia, no significant differences between these rootstocks were found for this trait. The percentage of bud take on Wavit<sup>®</sup> rootstock in combination with plum and apricot cultivars tested, does not differ significantly compared with the percentage of bud take on commonly used *P. cerasifera* seedling and M29C. In our study, the influence of rootstocks on lateral branching and length of lateral shoots in different cultivars was not found.

**Key words:** plum, apricot, lateral branching, vigor, bud take, nursery tree quality.

### Introduction

Modern trends in fruit growing are associated with the desire for more rapid reaching of the full cropping, high and consistent yields of homogeneous size, shape and color of fruits for many years (Vercammen, 2004; Robinson et al., 2011). To achieve these goals, fruit growers rely not only on improvement in tree training and orchard nutrition, but also on the use of scion-rootstock combinations

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\*Corresponding author: e-mail: aiyordanov@abv.bg

allowing denser planting and earlier flower bud formation. Tree vigor, beginning of fruit bearing, tree productivity and quality of the fruits depend on the choice of proper rootstock (Southwick and Weis, 1999; Kaska, 2006; Sosna, 2006; Sosna and Licznar-Małańczuk, 2012). Therefore, finding the ‘perfect rootstock’ is practically impossible. The vast diversity of cultivars with different growth and productivity habits makes the study of their behavior with common and newly selected rootstocks necessary (Kviklys, 2002; Hernández et al., 2010; Stefanova et al., 2012; Licznar-Małańczuk and Sosna, 2013). To solve the problem, in recent years many researchers have tested different scion-rootstock combinations in different growing conditions.

The study of growth and reproductive characteristics of poorly known plum rootstock Wavit<sup>®</sup> is still in its early stages. The origin of Wavit<sup>®</sup> is a clone of *Prunus domestica* ‘Wangenheim’. It was selected from a seedling population at the nursery Schreiber (Austria) because of its positive characteristics. Wavit<sup>®</sup> combines the well-known qualities of ‘Wangenheims Seedling’ with good fruit size and the advantages of a clonal rootstock (excellent uniformity in the nursery and in the orchard). Trees on Wavit<sup>®</sup> start cropping early (with standard training and management from the 3rd/4th year) and produce regularly high yields. Besides good fruit size, the accelerated fruit ripening (some days) is of great advantage. Further positive traits of Wavit<sup>®</sup> are good compatibility with all types of plums and also apricots. The grafting unions are hardly visible and trees do not need support. Suckers have not been observed up to now. Wavit<sup>®</sup> has a fine root system with some strong main roots and is very winter hardy.

The first test results of Wavit<sup>®</sup> confirm the information of license owners (CDB GmbH) that it reduces the tree vigor of plum cultivars, increasing the fruit size and shows high winter hardiness (Stefanova et al., 2009; Murri et al., 2013). Furthermore, it does not form suckers and has good tree anchorage. The interaction of Wavit<sup>®</sup> rootstock with apricot cultivars is also of great interest because up to now it has demonstrated good compatibility, productivity and has had a low rate of tree mortality (Wurm, 2014).

In order to expand the knowledge about the behavior of Wavit<sup>®</sup> rootstock, we compared the growth characteristics which it induces on two plum and two apricot cultivars in nursery together with commonly used rootstocks in Bulgaria for these species – *Prunus cerasifera* seedling and M29C.

### Material and Methods

The study was conducted in the period 2012–2014 in a commercial nursery near Plovdiv in Southern Bulgaria. The rootstocks Wavit<sup>®</sup> and M29C were *in vitro* propagated and planted in the field at 4-mm thickness. *Prunus cerasifera* seedling rootstocks were propagated by seeds in the previous year. All rootstocks were

planted in the period from 1 to 10 March at a density of 120 x 30 cm. T-budding was performed in the period from 20 to 30 August at 15 cm above the soil surface. Plum cultivars Jojo and Cacanska Lepotica were budded on *P. cerasifera* seedling and Wavit<sup>®</sup> rootstocks, and apricot cultivars Pricia and Primaya were budded on Wavit<sup>®</sup> and M29C rootstocks. All trees were grown in the same conditions: using individual support stakes, drip irrigation and removal of all sprouts up to 60 cm above the soil surface. The experiment was set up in a randomized block design. Six replications and twenty trees per plot were budded in each variant. The trees with the highest and the lowest values of both scion height and thickness were excluded and twelve plants per plot were statistically processed by the method of analysis of variance. The following parameters were evaluated at the end of each vegetation: rootstock thickness (at 10 cm above the soil surface), scion thickness (at 10 cm above the graft union), tree height, cumulative scion growth, mean number of lateral shoots per tree (longer than 10 cm), mean length of a lateral shoot, percentage of the bud take. Each tree with the scion height greater than 80 cm was estimated as successfully budded. The percentage of the bud take was calculated annually using 100 plants of each scion-rootstock combination.

### Results and Discussion

*Prunus cerasifera* seedling is a commonly used rootstock for plum cultivars in Bulgaria, while Wavit<sup>®</sup> is still little known. The growth characteristics induced by these rootstocks on a semi-vigorous to vigorous cultivar Cacanska lepotica (Blažek and Pišteková, 2012) and a relatively weaker growing cultivar Jojo (Milošević et al., 2012) are presented in Tables 1 and 2.

Table 1. Growth characteristics of two plum cultivars.

Variants	Rootstock thickness (mm)			Scion thickness (mm)			Scion height (cm)		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Jojo									
<i>P. cerasifera</i>	19.98	20.95	21.78	17.33	17.18	18.03	230.19	228.81	238.30
Wavit	15.96	14.63	15.78	13.87	12.89	14.07	135.63	138.06	139.50
LSD <sub>0.05</sub> /R <sub>0.05</sub>	2.61	4.06	2.67	1.11	3.49	2.13	29.70	22.18	24.27
Cacanska Lepotica									
<i>P. cerasifera</i>	18.63	19.43	18.73	16.58	17.28	16.61	224.88	221.06	242.24
Wavit	16.43	15.63	15.92	12.75	13.50	13.54	166.44	163.95	167.06
LSD <sub>0.05</sub> /R <sub>0.05</sub>	2.58	3.03	2.66	3.44	1.87	2.28	22.69	53.89	44.02

Concerning cultivar Jojo, the differences between the used rootstocks in terms of tree height, scion thickness and the cumulative scion growth were significant

during the whole period of the study. There is an obvious tendency of rootstock Wavit® to induce weaker vegetative growth than *P. cerasifera* seedling. A similar tendency can be seen in combination Cacanska Lepotica on Wavit®. In this cultivar, there is no significant difference in some years concerning rootstock thickness and cumulative scion growth. However, *P. cerasifera* seedling obviously encourages stronger vigor compared with Wavit® rootstock.

Table 2. Branching characteristics of two plum cultivars.

Variants	Cumulative scion growth (cm)			Mean number of lateral shoots per tree			Mean length of a lateral shoot (cm)		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Jojo									
<i>P. cerasifera</i>	351.82	349.38	365.41	4.73	4.31	4.77	25.65	28.25	26.80
Wavit	231.47	225.18	235.69	4.24	3.50	3.81	22.83	24.93	25.40
LSD <sub>0.05</sub> /R <sub>0.05</sub>	20.01	29.17	15.18	1.35	1.06	1.02	3.45	5.36	4.19
Cacanska Lepotica									
<i>P. cerasifera</i>	349.27	357.22	375.02	6.38	6.25	6.23	19.40	21.73	21.60
Wavit	261.35	280.84	269.29	5.03	5.88	5.41	18.89	19.92	18.93
LSD <sub>0.05</sub> /R <sub>0.05</sub>	53.16	78.38	67.61	0.92	1.79	1.62	2.42	3.51	1.48

In apricot cultivars, in the second year in the nursery field, rootstock Wavit® induced significantly weaker vegetative growth than M29C only in combination with cultivar Primaya (Table 3). Concerning another tested apricot cultivar – Pricia, the differences in the tree vigor between the two rootstocks were significant only in some years, which proves that the interaction between cultivar and rootstock is individual.

Table 3. Growth characteristics of two apricot cultivars.

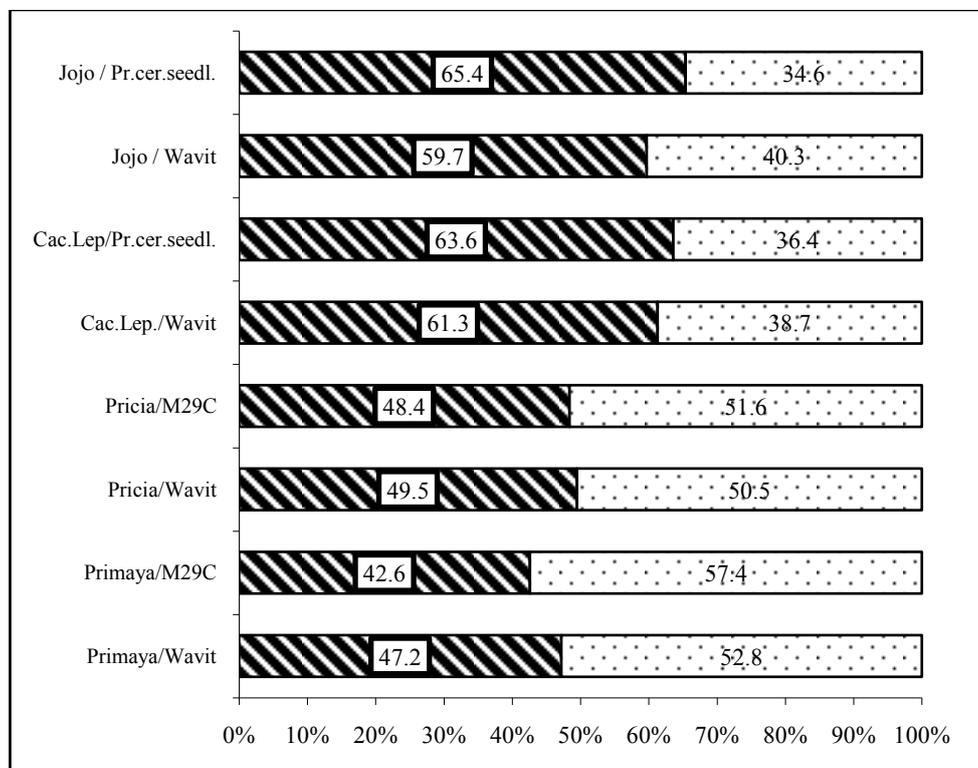
Variants	Rootstock thickness (mm)			Scion thickness (mm)			Scion height (cm)		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Pricia									
M29C	19.14	17.57	16.87	11.96	10.98	10.84	203.25	208.94	202.69
Wavit	13.94	14.38	13.65	10.61	11.19	10.57	180.88	175.75	182.88
LSD <sub>0.05</sub> /R <sub>0.05</sub>	4.70	4.13	3.17	2.20	2.39	2.67	46.33	30.39	18.95
Primaya									
M29C	21.71	21.05	19.40	15.99	14.07	13.53	224.38	230.81	214.36
Wavit	15.87	16.07	16.93	11.88	12.49	12.53	181.25	189.50	196.38
LSD <sub>0.05</sub> /R <sub>0.05</sub>	2.01	1.72	2.04	4.39	0.98	1.15	30.33	15.75	20.18

The quality of nursery trees depends a lot on the number of the lateral shoots longer than 10 cm developed in the crown zone, which allows faster crown formation and faster entry into cropping (Slowinski and Sadowski, 2000; Sadowski et al., 2005). Lateral branching is closely connected with the cultivar features (Licznar-Małańczuk and Sosna, 2006). The influence of the rootstocks on branching is evaluated mostly as the vigor, which they induce to the scion (Poniedziatek et al., 1996; Sitarek and Jakubowski, 2006; Bielicki and Pasko, 2013). The rootstocks have a significant influence on the lateral shoot formation in nursery trees. The results in Table 2 indicate that *P. cerasifera* seedling, independently of its stronger vigor which it induces to the scion, does not induce significantly higher number and length of lateral shoots than Wavit<sup>®</sup> with plum cultivars Jojo and Cacanska Lepotica. Only the apricot cultivar Primaya (Table 4) in combination with Wavit<sup>®</sup> rootstock forms significantly lower number of lateral shoots compared with the same cultivar on M29C rootstock. In Pricia cultivar, no significant differences between rootstocks were recorded for the same parameter. Regardless of the used rootstocks, the mean lengths of a lateral shoot in both apricot cultivars do not differ significantly. These results confirm the information of Lipecki and Janisz (1999) and Jacyna (2007), who pointed out that there is no correlation between the propensity for branching and some of the parameters of vegetative growth.

Table 4. Branching characteristics of two apricot cultivars.

Variants	Cumulative scion growth (cm)			Mean number of lateral shoots per tree			Mean length of a lateral shoot (cm)		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Pricia									
M29C	451.88	414.25	404.35	7.54	5.59	5.73	33.15	36.96	35.59
Wavit	347.95	354.37	386.85	5.13	5.75	6.13	32.63	31.24	33.30
LSD <sub>0.05</sub> /R <sub>0.05</sub>	36.78	14.44	34.02	1.35	0.93	1.45	5.74	3.29	8.82
Primaya									
M29C	521.32	546.31	502.43	7.31	8.19	7.63	40.92	38.67	37.80
Wavit	398.97	385.94	415.44	6.06	5.31	6.00	37.16	36.93	36.50
LSD <sub>0.05</sub> /R <sub>0.05</sub>	98.00	27.43	76.04	0.56	0.76	1.36	12.36	6.99	3.44

The major part of the cumulative scion growth is formed by the central axis of the tree in both plum cultivars on both rootstocks (Figure 1). Due to the shorter nursery trees on Wavit<sup>®</sup> rootstock, lateral shoots have a higher share in the cumulative scion growth. The apricot cultivars which have greater natural branching ability than plum cultivars form a high percentage of cumulative scion growth on lateral shoots in both rootstocks tested.



-  Percentage of the cumulative scion growth, formed by the central axis of the tree.  
 Percentage of the cumulative scion growth, formed by the lateral shoots of the tree.

Figure 1. Percentage distribution of the cumulative scion growth formed by the central axis and the lateral shoots in tested scion-rootstock combinations, average for the period 2012-2014.

The percentage of bud take is very important parameter for all producers of fruit trees. The data in Figure 2 indicates that the cultivar Jojo has a lower percentage of bud take on both tested rootstocks. Probably this is due to harder budwood which makes the budding difficult. Equal percentage of bud take was recorded in Cacanska Lepotica on both tested rootstocks. The apricot cultivar Primaya (Figure 3) has a lower percentage of bud take on both rootstocks, but there is no significant difference between rootstocks for this parameter.

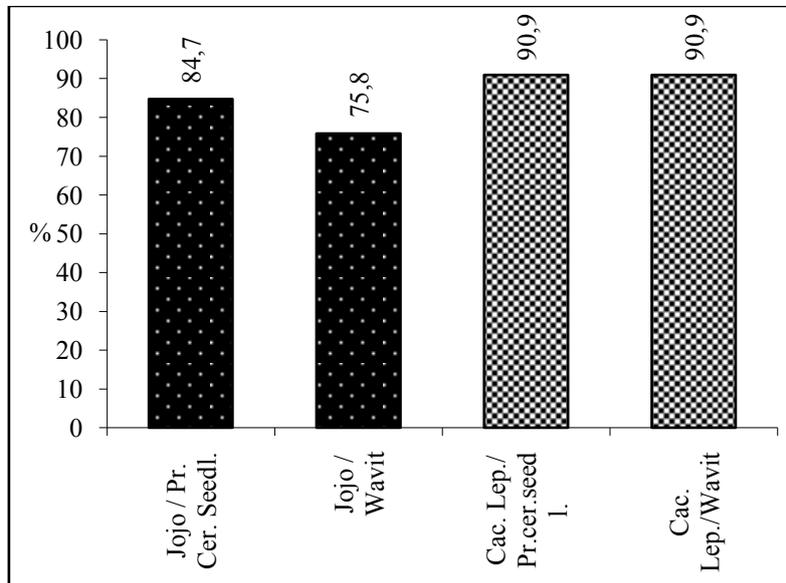


Figure 2. Percentage of bud take of plum cultivars Jojo and Cacanska Lepotica, average for the period 2012–2014.

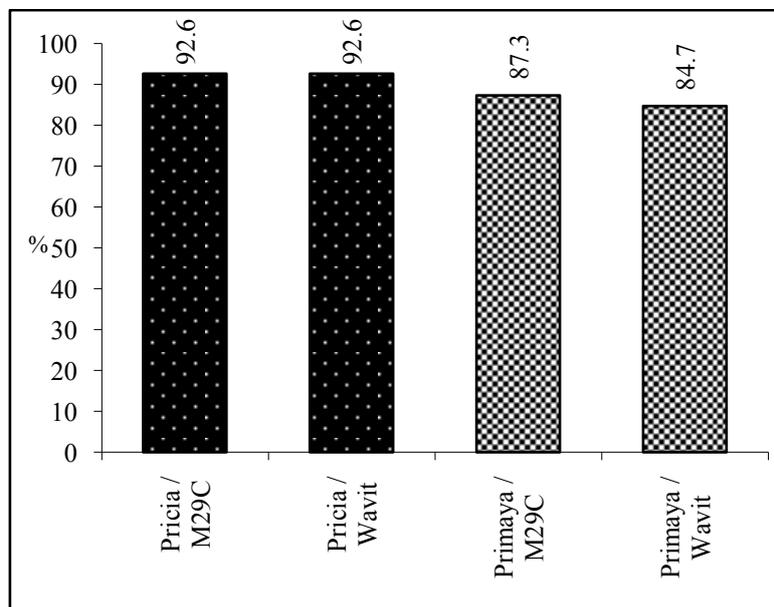


Figure 3. Percentage of bud take of apricot cultivars Pricia and Primaya, average for the period 2012–2014.

## Conclusion

As a result of the study, we obtained information about the behavior of poorly known rootstock Wavit<sup>®</sup> in the nursery. It was found that Wavit<sup>®</sup> induced less vigor in plum cultivars Jojo and Cacanska Lepotica compared with the commonly used *P. cerasifera* seedling rootstock.

It was found that Wavit<sup>®</sup> induced less vigor in apricot cultivar Primaya compared with the commonly used M29C rootstock, but in the other tested apricot cultivar – Pricia, no differences between rootstocks for this trait were found.

The percentage of bud take on Wavit<sup>®</sup> rootstock in combination with plum and apricot cultivars tested, did not differ significantly compared with the percentage of bud take on commonly used *P. cerasifera* seedling and M29C rootstocks.

The influence of rootstocks on lateral branching and length of lateral shoots in different cultivars was not found in this study.

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## KOMPARATIVNO ISPITIVANJE PODLOGE WAVIT<sup>®</sup> SA DVE SORTE ŠLJIVE I DVE SORTE KAJSIJE U RASADNIKU

**Anton Ivanov Yordanov<sup>\*</sup>, Sava Georgiev Tabakov i  
Pantaley Valeriev Kaymakanov**

Odsek za voćarstvo, Poljoprivredni univerzitet – Plovdiv,  
Mendeljejeva 12, 4000 Plovdiv, Bugarska

### R e z i m e

U cilju proširenja znanja o ponašanju podloge Wavit<sup>®</sup>, uporedo je proučavan uticaj podloge na karakteristike rasta dve sorte šljive i dve sorte kajsije u rasadniku zajedno sa dve uobičajeno korišćene podloge u Bugarskoj za ove vrste, sejance *Prunus cerasifera* i M29C. Istraživanje je sprovedeno u periodu 2012–2014. godine u komercijalnom rasadniku blizu Plovdiva. Sorte šljive Jojo i Čačanska lepotica su bile okulirane na podlogama sejanca *P. cerasifera* i Wavit<sup>®</sup>, dok su sorte kajsije Pricia i Primaja bile okulirane na podlogama Wavit<sup>®</sup> i M29C. Sve sadnice su uzgajane u istim uslovima, sa naslonom u vidu pojedinačnih pritki i navodnjavanjem kap po kap. Utvrđeno je da Wavit<sup>®</sup> indukuje manju bujnost sadnica sorti šljive Jojo i Čačanska lepotica u poređenju sa uobičajeno korišćenom podlogom sejanca *P. cerasifera*. Slično tome, Wavit<sup>®</sup> je indukovao manju bujnost i kod sorte kajsije Primaja u poređenju sa uobičajeno korišćenom podlogom M29C. Međutim, kod druge testirane sorte kajsije, Pricia, nisu utvrđene značajne razlike između podloga za ovu osobinu. Prijem pupoljaka na podlozi Wavit<sup>®</sup> u kombinaciji sa testiranim sortama šljive i kajsije nije se razlikovao značajno u poređenju sa prijemom pupoljaka na uobičajeno korišćenim podlogama (sejancu *P. cerasifera* i M29C). U našem istraživanju nije utvrđen uticaj podloga na bočno grananje i dužinu bočnih grančica kod različitih sorti.

**Ključne reči:** šljiva, kajsija, bočno grananje, bujnost, prijem pupoljka, kvalitet sadnica.

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\*Autor za kontakt: e-mail: aiordanov@abv.bg