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Short Communication

INFLUENCE OF ROOTSTOCK ON PLUM FLOWERING INTENSITY IN DIFFERENT GROWING REGIONS

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The aim of the investigation is to evaluate the influence of different rootstocks on the flowering intensity of two plum cultivars: a hybrid `Kubanskaya Kometa` and European plum 'Victoria' in diverse locations. Sixteen well known European rootstocks were used, of which eight were clonal (St. Julien A, Brompton, Ackermann, Pixy, GF8/1, G5/22, GF655/2, Hamyra) and eight were seedlings (St. Julien INRA2, St. Julien d Orleans, St. Julien Noir, Brompton, Wangenheims Zwetche, St. Julien Wädenswil, Myrobalan, P. cerasifera *var.* divaricata*). The evaluation was conducted in experimental orchards which were established in spring 2001 in Latvia, Estonia and Belarus. Trees were planted at a spacing of 5 × 3 m in four replications, three trees per plot. The obtained data from the years 2008–2012 are presented. The flowering intensity of plum trees depended on the cultivar rootstock combination. The influence of rootstock on flowering intensity differed between the years and growing region, and was closely correlates with meteorological conditions during the wintering period. Cv. 'Kometa Kubanskaya' had the highest blooming intensity in Pūre on rootstocks GF 655/2 and Wangenheims Zwetche; in Brest on Brompton seedlings, Julien d' Orleans G5/22 and Ackermann; and in Polli on GF 8/1 and Brompton seedlings. 'Victoria' plum trees had the highest intensity of flowering on rootstocks Pixy and Wangenheims Zwetche in Pūre; on St. Julien INRA 2 and Ackermann in Brest; and on GF 655/2 and Ackermann in Polli.*

Key words: Prunus*, cultivar, flower buds, meteorological conditions, Latvia, Estonia, Belarus.*

It has been demonstrated in practice that one of the main preconditions for the establishment of high yields and sustainable orchards is the right choice of rootstock. Lack of appropriate rootstocks is one of the reasons for difficulties in the establishment of commercial plum orchards in north-eastern Europe. A grafted tree is a composite organism consisting of two different genotypes — rootstock and cultivar. The compatibility of rootstock and cultivar is a significant precondition for high tree productivity and the optimal development of parameters influencing productivity. Therefore, tree longevity, hardiness to unfavourable meteorological conditions, crown size, the beginning of yield period and yield intensity depend not only on the cultivar or rootstock, but also on the interaction of rootstock and cultivar (Wertheim, 1998).

The most popular rootstock for plums in Latvia, Belarus and Estonia is Caucasian plum (*Prunus cerasifera* Ehrh. var. *divaricata* C. K. Schreid). However, this rootstock is not suitable for intensive plum orchards because of its vigorous growing habit (Grzyb *et al*., 1998). In addition, incompatibility symptoms of Caucasian plum seedlings with some European cultivars have been observed (Lepsis *et al*., 2004). In Pūre Horticultural Research Centre, unsatisfactory health status of the trees grafted with Caucasus plum has been found (Lepsis *et al*., 2008). This indicates the necessity for alternative rootstocks, suitable for growing in modern orchards of north-eastern Europe and in their specific climatic conditions. The rootstocks Myrobalan, St. Julien A, Wangenheims Zwetche and Pixy are widely used in other European countries (Sosna, 2002; Rozpara and Grzyb, 2007). Recently, some investigations with rootstocks for plums have been carried also in Latvia (Kaufmane *et al*., 2007). However, until 2001, only a few studies were performed and published on the effect of rootstocks on growth and yield of plum trees in Latvia, Estonia and Belarus (Lepsis, *et al*., 2004).

The plum cultivar 'Victoria' (*Prunus domestica* L.) and the hybrid cultivar 'Kubanskaya Kometa' (*P. salicina* Lindl. ×

P. cerasifera Ehrh.) are widely grown in north-eastern Europe. Therefore, they were included in the evaluation of rootstocks.

Winters in Latvia, Estonia and Belarus are characterised by considerable fluctuations of temperature, which have negative influence on tree health and yield. The most susceptible organs for stone fruit trees during winter are flower buds, and they usually are the most severely affected. High and regular yield of plums depends on winter hardiness of flower buds (Proebsting, 1982). The winter hardiness of buds rapidly decreases by the beginning of vegetative growth processes in the tree. Therefore, the end of the winter, when dormancy has ended, is a very critical period for flower buds. The resistance of flower buds to low temperatures is extremely low during this period, and therefore, the winter hardiness of plum buds is closely related with low temperatures during spring (Proebsting, 1982). Some authors refer also to the mid-winter intense cold periods as the main contributor to plum injury (Jänes and Kahu, 2008).

The aim of this study was to evaluate the blooming intensity of two plum cultivars on sixteen different rootstocks in the years 2009, 2010, 2011 and 2012.

Plant material. 'Victoria' and 'Kubanskaya Kometa' plum trees were grafted on 16 different rootstocks: St. Julien A, Brompton, Ackermann, Pixy, GF8/1, G5/22, GF655/2 and Hamyra (clonal rootstocks); St. Julien INRA 2, St. Julien d'Orleans, St. Julien Noir, Brompton, Wangenheims Zwetche, St. Julien Wädenswil, Myrobalan and *Prunus cerasifera* var. *divaricata* (seedling rootstocks). The study was performed at the Pūre Horticultural Research Centre in Latvia, at the Polli Horticultural Research Centre in Estonia and at the Brest Regional Agricultural Experimental Station in Belarus. The experimental orchards were established in spring of 2001. Three trees were planted in each of 3 × 5 m plots in four replications, with. The soil texture was loam in Pūre, sandy clay in Polli and loamy sand in Brest (Поух и Матвеев, 2011).

The tree flowering intensity was quantified using a scale from 1 to 5, where 1 = no flowers, 5 = abundant flowering. Data were analysed using descriptive statistics and ANOVA. Differences between the means were tested by the least significant difference (LSD) at a 5% significance level.

Meteorological conditions. Meteorological data were recorded in each location. Significant differences of winter temperatures occurred between years of the investigation, but the differences were not significant between locations. Air temperature fluctuation tendencies were similar in all three countries. The highest sum of minimal temperatures was registered at Polli in all winters of the investigation. During the overwintering period of 2010/2011 it was 111.5 °C. A sharp drop of temperature was recorded in Brest in January 2009 (25.6 ^{O}C). The lowest temperature in winter of 2009/2010 was recorded in Polli during the third decade of January (35.3 ^{O}C). The winter of 2010/2011 was extremely cold, with low temperatures starting from the end of November. During the 1st decade of April 2012, the air temperature dropped down to 13.2 ^{O}C in Pūre (Table 1).

Table 1

MINIMUM AIR TEMPERATURES IN OCTOBER–MAY OF 2008/2009, 2009/2010, 2010/2011, AND 2011/2012

Month	Region	2008/2009	2009/2010	2010/2011	2011/2012
October	Polli	2.4	4.4	4.3	0.8
	Pūre	–0.4	–4.4	–3.2	–2.0
	Brest	–1.1	–2.4	–4.8	–5.8
November	Polli	–5.5	–6.8	–21.9	–6.6
	Pūre	–3.3	–4.7	–15.2	–6.2
	Brest	–3.8	–4.7	–14.9	–7.2
December	Polli	–8.7	–24.1	–14.4	–3.1
	Pūre	–6.1	–22.7	–18.0	–4.9
	Brest	–10.4	–23.6	–14.9	–5.0
January	Polli	–15.7	–35.3	–22.1	–21.7
	Pūre	–21.9	–28.6	–16.9	–22.5
	Brest	–25.6	–31.6	–16.2	–23.0
February	Polli	–20.5	–19.7	–33.5	–32.1
	Pūre	–15.6	–21.6	–28.5	–29.7
	Brest	–17.0	–15.8	–20.4	–30.0
March	Polli	–11.4	–18.3	–15.3	–19.0
	Pūre	–11.5	–20.4	–16.9	–13.0
	Brest	–11.4	–12.2	–19.2	–7.9
April	Polli	–6.4	–4.5	–3.7	–8.3
	Pūre	–5.4	–4.3	–4.0	–13.2
	Brest	–3.3	–1.9	–0.3	–4.2
May	Polli	–2.5	–2.9	–2.4	–1.7
	Pūre	–1.5	–3.2	–3.3	–1.2
	Brest	0.6	2.7	–1.0	3.3

Differences between the flowering intensity of 'Kubanskaya Kometa' plum trees on different rootstocks were found in Pūre and Polli, but not in Brest. Generally, the most intense flowering of both cultivars tested during all five years of investigation was observed in Brest (Figs. 1 and 2). For all rootstocks tested, the highest blooming intensity of 'Kubanskaya Kometa' trees (maximum score of 5 on the scale used) was in 2008. The same year was the most favourable also for tree flowering in Pūre and Polli. The lowest flowering intensity of 'Kubanskaya Kometa' was observed in 2010 and 2011 in Polli, when flower buds were almost completely damaged by very low temperatures (35.3 ^{O}C in January 2010 and 33.5 ^{O}C in February 2011). As the cultivar blossoms early, also in Pūre in 2010 and 2011 flower buds were partially damaged by spring frosts (3.3 ^{O}C) recorded at the beginning of May, shortly before blossoming.

In Pūre the highest average flowering intensity of the 'Kubanskaya Kometa' in each year of investigation was observed on Wangenheims Zwetche and GF 655/2 rootstocks (score 3.5), the lowest on Pixy and Myrobalan (scores 2.5 and 2.7, respectively), whereas in Polli the highest average intensity was noted on Brompton seedlings and GF 8/1 (scores 3.6 and 3.8, respectively) and the lowest on root-

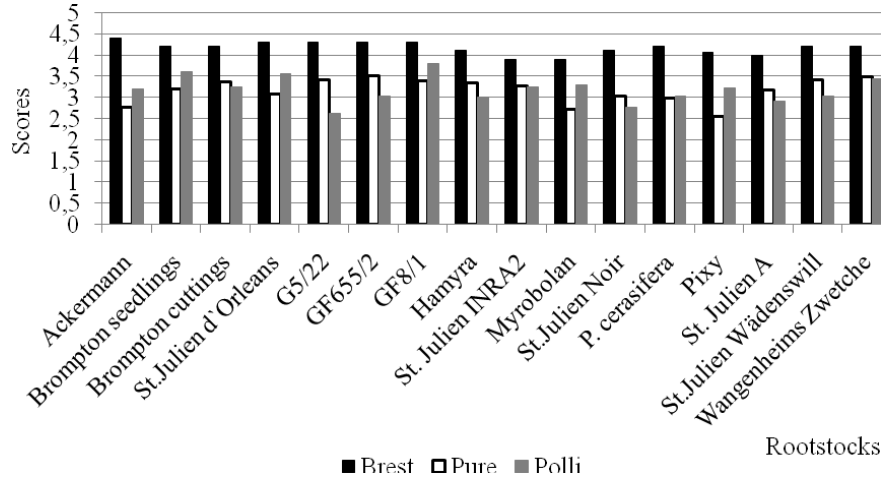

Fig 1. Average flowering intensity during the period 20082012 for cv. 'Kubanskaya Kometa' (score from 1 to 5) ($LSD_{0.05}$ = 0.29, $LSD_{0.05}$ = 0.50 for regions).

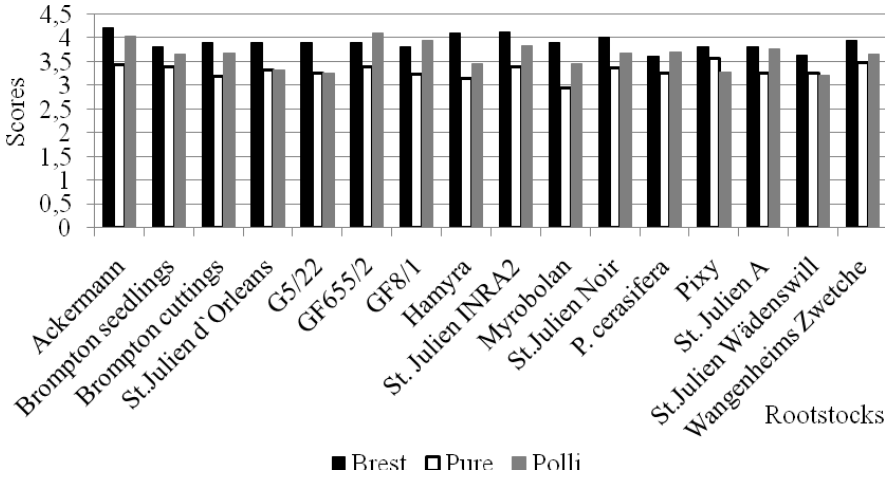

Fig. 2. Average flowering intensity during the period 2008–2012 for cv. 'Victoria' (score from 1 to 5) ($LSD_{0.05}$ = 0.26, $LSD_{0.05}$ = 0.40 for regions).

stocks G5/22 and St. Julien Noir (scores 2.6 and 2.7, respectively) (Fig. 1).

Our results showed that in all three locations the European plum 'Victoria' had higher flowering intensity than the hybrid plum 'Kubanskaya Kometa'. The most intense flowering of this cultivar on all rootstocks was observed in Brest, and the lowest in Pūre. Significant differences between trees on different rootstocks were observed in Polli only (Fig. 2). After the severe winter of 2009/2010, the flowering intensity of cv. 'Victoria' in Pūre and Polli averaged between a score of 3.5 and 4.5, while in Brest it was evaluated as good or very good (mostly 5 scores). In Pūre the highest flowering intensity of 'Victoria' trees in the period 2008–2012 was observed on Pixy and Wangenheims Zwetche, in Brest on St. Julien INRA 2 and Ackermann and in Polli on GF 655/2 and Ackermann rootstocks (Fig. 2).

In a study conducted in Estonia, during the winter of 2002/2003 almost all flower buds of cv. 'Kubanskaya Kometa' were killed by cold (Jänes and Pae, 2004). Although 'Kubanskaya Kometa' has high winter hardiness in the southern regions of Russia (Ерёмин, 1989), in Latvia and Estonia it is less winter hardy when compared with European plums (Lepsis *et al*., 2008; Jänes and Kahu, 2008). Different cultivars have different reactions to cold. According to Ерёмин (1993), the Caucasian plum is grouped in a type with a short deep dormancy period, but with high resistance to low temperatures. During the dormancy period these cultivars survive in the temperatures down to –30 °C. At the end of the dormancy period their resistance to low temperatures rapidly decreases to the level of –10 ... –15 °C, but this phase lasts only for a short period.

It found also in previous investigations, the wintering ability of plum trees is affected by the temperature regime before and after the critical temperatures. During winters when temperature decreases slowly and is below 0 °C before the critical temperatures, plants are hardened enough to survive. Bud injuries during such winters are usually insignificant. Significant injuries are very often observed during winters with strong fluctuation of temperature in a short time — a rapid decrease of temperature followed by a rapid increase. Differences between cultivars in the same phase of development have also been noted (Туровская, 1979).

Due to differences in flowering intensity, periodicity of yields was observed for cv. 'Victoria'. In Pūre both the highest intensity of flowering and the highest yield for this cultivar occurred in 2008 (Dēķena and Alsiņa, 2011). During the winter of 2008/2009 regeneration pruning was performed in Pūre. Therefore, flowering intensity of trees in 2009 was very weak. It is likely that wintering ability of buds was also negatively influenced by low temperatures in January 2009. In this month temperature after a relatively warm December dropped to –25.6 ^{o}C in Brest and –21.9 ^{o}C in Pūre. It must be noted that it is typical for plums and other fruit trees to decrease wintering ability after years of a

heavy yield. In Estonia, 'Victoria' is classified as a winter susceptible cultivar (Jänes and Kahu, 2008).

In conclusion, flowering intensity differed between years of investigation in all locations for both cultivars. Meteorological conditions have a strong effect on the flowering intensity of plum trees. The most intensive flowering of plum trees, irrespective of rootstock, was recorded in Brest. Thus, among the locations, tested this is the most suitable area for plum growing. The results obtained showed also that flowering intensity of plum trees depended on the cultivar–rootstock combination. In Pūre for cv. 'Kubanskaya Kometa' the highest blooming intensity was observed on the rootstocks GF 655/2 and Wangenheims Zwetche; in Brest on Brompton seedlings, Julien d` Orleans G5/22 and Ackermann; and in Polli on GF 8/1 and Brompton seedlings. In Pūre 'Victoria' plum trees had the highest intensity of flowering on rootstocks Pixy and Wangenheims Zwetche; in Brest on St. Julien INRA 2 and Ackermann; and in Polli on GF 655/2 and Ackermann.

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POTCELMU IETEKME UZ PLŪMJU ZIEDĒŠANAS INTENSITĀTI DAŽĀDOS AUDZĒŠANAS REĢIONOS

Pētījuma uzdevums ir novērtēt dažādu potcelmu ietekmi uz hibrīdplūmes 'Kubanskaya Kometa' un mājas plūmju šķirnes 'Victoria' ziedēšanas intensitāti dažādās audzēšanas vietās. Tika izmantoti 16 Eiropā plaši zināmi potcelmi: astoņi veģetatīvi vairotie (*St. Julien A, Brompton, Ackermann, Pixy, GF8/1, G5/22, GF655/2, Hamyra*) un astoņi ģeneratīvi vairotie (*St. Julien INRA2, St. Julien d Orleans, St. Julien Noir, Brompton, Wangenheims Zwetche, St. Julien Wädenswil, Myrobalan,* P. cerasifera *var.* divaricata). Pētījums tika veikts eksperimentālos dārzos, kas ierīkoti 2001. gada pavasarī, Latvijā, Igaunijā un Baltkrievijā. Izmēģinājums stādīts pēc shēmas 5 × 3 m, četros atkārtojumos, pa trim kokiem katrā lauciņā. Publikācijā prezentēti dati, kas apkopoti no 2008. gada līdz 2012. gadam. Plūmju ziedēšanas intensitāte bija atkarīga no šķirnes – potcelma kombinācijas. Potcelmu ietekme uz ziedēšanas intensitāti pavasarī bija atšķirīga gan pa gadiem, gan audzēšanas reģioniem. Tai bija cieša korelācija ar meteoroloģiskajiem apstākļiem koku ziemošanas periodā.