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THE EFFECT OF ROOTSTOCKS ON THE EFFICIENCY OF A NURSERY OF SWEET CHERRY (*Prunus avium* L.) TREES cv. 'Regina'

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A b s t r a c t

During the period 2006–2009 in Lublin, a study was conducted to determine the effect of five rootstocks: 'Colt', 'F12/1', sweet cherry (*Prunus avium* L.), 'GiSelA 5', and 'Piast', on bud take in the cultivar 'Regina', the quality of budded trees and the efficiency of a sweet cherry tree nursery. The highest percentage of bud take in cherry trees cv. 'Regina' and the best efficiency of the sweet cherry tree nursery were obtained for the rootstocks 'Piast' and 'Colt'. In two years during the three-year study period, the rootstock was found to significantly affect the efficiency of the sweet cherry tree nursery. When grafted on the rootstocks 'Colt' and 'Piast', a significantly higher percentage of trees met the requirements of the Polish Standard PN-R-67010 than on the clonal rootstock 'GiSelA 5'. Under the tested conditions, the quality of maiden sweet cherry trees cv. 'Regina' grafted on the dwarfing rootstock 'GiSelA 5' was lowest.

Key words: *Prunus avium* L., vegetative rootstock, seedling, maiden tree, quality

INTRODUCTION

An increased interest in sweet cherry has been observed in Poland in recent years. As a result of high prices of sweet cherry fruit and a high demand for it, fruit growers are increasingly more willing to establish sweet cherry orchards. According to the data of the State Plant Health and Seed Inspection Service, in 2011 there were about 463,600 sweet cherry trees in nurseries and in our country this species now ranks second after apple trees in nursery production. A major problem in the production of sweet cherry trees is tree vigour [1,2] and the physiological incompatibility of some rootstocks with particular cultivars [3–5]. The rootstock has a great influence on the growth and quality of trees, accelerates the time to reach the fruit-bearing stage [6,7] and improves commercially important fruit traits [8,9]. We can observe a slightly different effect of rootstock on the growth of trees in an orchard than in the case of budded trees in a nursery. This is associated with a short production cycle and with the varying ability of rootstocks to overcome stresses [10]. In Poland sweet cherry trees are produced mainly on high vigour rootstocks: *Prunus avium* L., 'F12/1', and 'Colt'. The proportion of low vigour rootstocks is small, but it increases from year to year.

The aim of the present study was to determine the effect of five rootstocks on bud take and nursery efficiency for the sweet cherry cultivar 'Regina'.

MATERIALS AND METHODS

The research was carried out at the Felin Experimental Farm, belonging to the University of Life Sciences in Lublin, over the period 2005–2008. A field experiment was established on grey-brown podzolic soil, developed from marl-loess deposits and classified as soil class II. Three types of vegetative rootstocks: 'Colt', 'F12/1', 'GiSelA 5', as well as sweet cherry (*Prunus avium* L.) seedlings and a selective type of 'Piast' mahaleb cherry (*Prunus mahaleb* L.) were the subject of the present study. Rootstocks were planted in a nursery in early spring at a spacing of 90 cm x 25 cm (44,400 rootstocks $\cdot$ ha^{-1}). Bud grafting was performed on 1 August; buds of sweet cherry (*Prunus avium* L.) cv. 'Regina' were grafted onto the rootstocks 15 cm above the ground using chip budding. During the study period, the soil in the nursery was maintained as black fallow. No irrigation was used in the nursery, fertilization was applied based on soil analysis, whereas plant protection was carried out in accordance with the current recommendations resulting from the orchard crop protection schedule.

The rootstocks 'Colt', 'F12/1', and 'Piast' as well as sweet cherry seedlings came from the "Grzywa"

Nursery Farm in Karczmiska, whereas the clonal rootstock 'GiSelA 5' was purchased at the Fruit Experiment Station in Brzezna.

The experiment was set up in a randomized block design. It included 5 treatments in 5 replicates. Rootstock types were the treatments, whereas plots in which 100 plants were grown were replicates.

The study evaluated bud take expressed as the ratio of successful bud takes in the spring of the second year of nursery culture to the number of budded rootstocks. Nursery efficiency is shown as the percentage ratio of the number of maiden trees obtained in relation to the number of planted and budded rootstocks. The number of trees obtained per 1 ha (with a planting density of 90 x 25 cm) is given as an approximation due to too low a number of plants and a high error rate. The quality of maiden trees is expressed as a percentage proportion of trees that meet the requirements of the Polish Standard PN-R-67010 in the total number of trees obtained. The results were statistically analysed using analysis of variance and Tukey's confidence intervals. The significance of differences was determined at α=0.05; p=0.95.

RESULTS

During the study period, there were large variations in weather conditions in particular years (Table 1). From January to September 2007, the mean monthly air temperatures were lower than the long-term means. The highest difference was recorded in January (6.5ºC) and in March (5.3ºC). The lowest minimum air temperature (–13.6ºC) was recorded in the last 10-day period of February. In April ground frost occurred sporadically. Ground-level temperature decreases below 0ºC were observed for five days at the beginning of May. In the months of February, April, August, October and December the total precipitation was lower than the long-term mean. Warm and humid weather during the growing period promoted intensive plant growth.

In 2008 the mean monthly air temperatures were higher than the long-term average, except for May and September. The winter was warm and mild. The lowest minimum air temperature was recorded in the middle of February and it was –13.2ºC, while at ground level –15.9ºC. Slight ground frost occurred at the end of April. No subzero temperatures were recorded in May. In 2008 the warmest month was August with the average monthly air temperature of 19.8ºC. The amount of rainfall in particular months varied. After a wet spring (in March, April and May the total rainfall was higher than the long-term average), lower rainfall levels were recorded in the summer months of June, July and August (below the long-term average for this period). September, October and December of 2008 were characterized by higher total precipitation than the long-term mean for these months.

In the last year of the study, the mean monthly air temperatures were much higher than the long-term means. The mean monthly air temperatures were lower than the long-term average only in October and December of 2009. The highest difference in temperature was found in April (4ºC) and in September (2.4ºC). The warmest month of the year was July (19.9ºC), whereas the coldest one January (-2.7ºC). The lowest minimum air temperature was recorded in January and it was -19.3ºC, while at ground level -22.0ºC. Ground frost occurred in the first and second 10-day periods of April as well as in the second 10-day period of May. As regards the amount of precipitation, the year of 2009 varied. In March and October the total rainfall was more than twice higher than the long-term average for these months. A large amount of rainfall was recorded in June (125.5 mm), nearly 58 mm more than the long-term average for this month. The total rainfall in April 2009 was only 2.9 mm and it was lower by 35.9 mm than the long-term mean. The amount of precipitation in January, July, August and September was also lower than the long-term means.

Table 1
Mean monthly air temperatures and precipitation totals in 2007–2009 relative to the long-term means

Month	Temperature (ºC)				Total precipitation (mm)			
	Monthly mean			Long-term mean	Monthly total			Long-term mean
	2007	2008	2009		2007	2008	2009	
January	2.6	0.4	-2.7	-3.9	51.5	36.2	20.2	25.4
February	-1.6	2.2	-1.2	-3.1	22.3	17.8	36.9	24.7
March	6.2	3.4	1.4	0.9	30.2	64.8	69.6	25.0
April	8.7	9.3	11.4	7.4	17.4	55.8	2.9	38.8
May	15.1	12.8	13.6	13.0	80.5	101.6	71.1	58.5
June	18.1	17.7	16.4	16.4	87.5	25.9	125.5	67.9
July	19.2	18.3	19.9	17.7	87.0	77.1	57.1	77.8
August	18.4	19.8	19.0	17.1	37.6	45.0	54.7	73.7
September	13.0	12.6	15.3	12.9	129.8	102.2	21.0	46.4
October	7.3	10.1	6.9	8.0	17.7	55.5	103.6	39.5
November	1.0	4.8	5.5	2.7	31.3	33.1	43.1	39.9
December	-1.2	0.9	-1.7	-1.3	14.9	43.8	37.8	34.5

Table 2
Percentage of bud take in sweet cherry trees in relation to the total number of budded rootstocks depending on the rootstock used in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles			LSD α=0.05
Colt	81.2 a	88.1 a	90.0 ab	86.4	ns	ns	ns	ns
F12/1	74.1 ab	65.9 b	87.4 ab	75.8	ns	ns	ns	ns
Prunus avium L.	57.1 b	65.3 b	65.3 b	62.6	ns	ns	ns	ns
GiSelA 5	57.3 b	58.3 b	90.8 a	68.8	B	B	A	15.9
Piast	78.9 a	88.0 a	96.7 a	87.8	ns	ns	ns	ns
LSD α=0.05	21.1	20.5	24.9	ns				

Explanation: Means within the column followed by the same letter are not significantly different at α=0.05; significant differences between production cycles at α=0.05 are marked with capital letters.

On average for the period 2007–2009, the rootstocks were not shown to have a significant effect on bud take in sweet cherry trees cv. 'Regina' (Table 2). The highest percentage of bud take was found for the rootstocks 'Piast' and 'Colt', whereas this percentage was lowest for sweet cherry seedlings and the 'GiSelA 5' clone.

In 2007 the percentage of bud take on the rootstocks 'Piast' and 'Colt' was significantly higher than on sweet cherry seedlings and 'GiSelA 5'. In 2008 the rootstocks 'Piast' and 'Colt' were found to show significant differences compared to the other rootstocks. In the last year of the study, the percentage of bud take on sweet cherry seedlings was significantly lower than on the rootstocks 'Piast' and 'GiSelA 5'.

In case of the clonal rootstock 'GiSelA 5', significant differences were shown between production cycles. In 2009 the percentage of bud take was significantly higher compared to the other years.

Table 3
The effect of rootstocks on the efficiency of a nursery of sweet cherry trees cv. 'Regina' in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles			LSD α 0.05
Percentage of maiden trees in relation to planted rootstocks								
Colt	72.5 a	72.9 ab	80.0	75.1	ns	ns	ns	ns
F12/1	65.0 ab	56.6 bc	81.8	67.8	AB	B	A	20.6
Prunus avium L.	53.0 ab	52.6 bc	58.5	54.7	ns	ns	ns	ns
GiSelA 5	50.6 b	50.3 c	82.6	61.2	B	B	A	18.0
Piast	71.6 ab	79.7 a	79.0	76.8	ns	ns	ns	ns
LSD α=0.05	21.1	20.5	ns	ns				
Percentage of maiden trees in relation to budded rootstocks								
Colt	80.1 a	78.1 ab	83.1	80.4	ns	ns	ns	ns
F12/1	73.3 ab	61.4 bc	86.7	73.8	AB	B	A	21.3
Prunus avium L.	53.0 c	56.8 c	61.8	57.2	ns	ns	ns	ns
GiSelA 5	54.0 bc	54.5 c	87.7	65.4	B	B	A	17.6
Piast	77.6 a	82.5 a	90.0	83.4	ns	ns	ns	ns
LSD α=0.05	19.7	20.9	ns	ns				
Number of maiden trees obtained per 1 ha								
Colt	35 600 a	34 656 ab	36 880	35 700	ns	ns	ns	ns
F12/1	32 536 ab	27 250 bc	38 486	32 757	AB	B	A	9460
Prunus avium L.	23 550 c	25 235 c	27 430	25 400	ns	ns	ns	ns
GiSelA 5	24 000 bc	24 179 c	38 930	29 030	B	B	A	7840
Piast	34 445 a	36 640 a	39 960	37 020	ns	ns	ns	ns
LSD =0.05	8753	9282	ns	ns				

Explanation: Means within the column followed by the same letter are not significantly different at α=0.05; significant differences between production cycles at α=0.05 are marked with capital letters.

On average for the three-year study period, the rootstocks were not found to significantly affect the efficiency of the sweet cherry tree nursery (Table 3). The highest number of cv. 'Regina' trees was obtained on the 'Piast' and 'Colt' rootstocks. The lowest nursery efficiency was found in the case of sweet cherry seedlings.

In 2007 a significantly higher number of maiden trees (by about 22%), as compared to the number of rootstocks planted, was obtained on the 'Colt' clone compared to 'GiSelA 5'. In the second year of the study, a significantly higher percentage of trees were obtained on the 'Piast' rootstock than on sweet cherry seedlings or the clonal rootstocks 'F12/1' and 'GiSelA 5'.

In the first year of the study, a significantly higher number of maiden trees were obtained from the 'Colt' and 'Piast' rootstocks compared to the number of budded rootstocks and on a per hectare basis than in the case of sweet cherry seedlings and 'GiSelA 5'. In 2008 the nursery efficiency for the 'Piast' rootstock was significantly higher compared to the rootstocks 'GiSelA 5', sweet cherry, and 'F12/1'.

In 2009 no differences in the investigated traits were found between the rootstocks.

In the case of two rootstocks, significant differences were shown between production cycles. The 'F12/1' clone differed between the years 2008 and 2009, whereas in the case of the 'GiSelA 5' rootstock the first second and second production cycles differed from the last one. The highest efficiency of the sweet cherry tree nursery was achieved in 2009.

Table 4
Percentage of maiden sweet cherry trees cv. 'Regina' that meet the requirements of the Polish Standard PN-R-67010 in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles			LSD α=0.05
Colt	95.2 a	98.8 a	92.7	95.5 a	ns	ns	ns	ns
F12/1	84.0 a	75.9 c	70.1	76.6 abc	ns	ns	ns	ns
Prunus avium L.	52.6 b	81.4 bc	70.6	68.2 bc	B	A	AB	19.1
GiSelA 5	44.3 b	52.5 d	68.9	55.2 c	ns	ns	ns	ns
Piast	93.7 a	93.2 ab	89.1	92.0 ab	ns	ns	ns	ns
LSD α=0.05	22.9	16.4	ns	24.9				

Explanation: Means within the column followed by the same letter are not significantly different at α=0.05; significant differences between production cycles at α=0.05 are marked with capital letters.

The percentage of sweet cherry trees that met the requirements of the standard PN-R-67010 during the study period was dependent on the type of rootstock (Table 4). Significantly the highest number of budded trees that met the requirements of the Polish Standard PN-R-67010 was obtained on the 'Colt' rootstock (more than 95%), whereas this number was lowest in the case of budding on the vegetative rootstock 'GiSelA 5'.

In 2007 significantly more qualitatively good budded trees were obtained on the rootstocks 'Colt', 'Piast' and 'F12/1' than on the clone 'GiSelA 5' and sweet cherry seedlings. In the second year, the 'Colt' rootstock was found to produce significantly the highest percentage of trees that met the requirements of the standard PN-R-67010. In 2009 no significant differences were found.

Differences between production cycles were shown only for one rootstock. Significantly qualitatively better maiden trees cv. 'Regina' grafted on sweet cherry seedlings were obtained in the second year compared to the first year of the study.

DISCUSSION

Rootstocks differ between each other in many genetic traits which manifest themselves in various effects on the cultivar [11]. The mutual interactions of particular components last throughout the lifetime of trees and it is a complex process that has not been fully elucidated.

One of more important factors determining the usefulness of a particular rootstock is its effect on the outcome of bud grafting [12]. In nursery studies, Czech-bred dwarfing rootstocks 'P-HL' are evaluated as good due to a high percentage of bud take [13–15]. In the present experiment, bud take in sweet cherry trees was significantly dependent on the rootstock used. A high percentage of bud take was obtained on the 'Piast' and 'Colt' rootstocks. In 2009 the 'GiSelA 5' clone also produced a good result in bud grafting. In the opinion of Grzyb [4], one of the advantages of Polish types of mahaleb cherry selected at the Research Institute of Pomology and Floriculture in Skierniewice is successful bud take in a nursery. This thesis was confirmed in this study. Maćkowiak [16] obtained the best results when grafting sweet cherry trees on the following rootstocks: 'Colt', 'F12/1' and 'SL-64'. Successful bud grafting largely depends on weather conditions [17]. The poorest bud take was obtained on sweet cherry seedlings on which significant bud freezing damage was observed. In their studies, Kuzniecov [18] and Grzyb et al. [19] draw attention to quite low resistance of sweet cherry. A low percentage of bud take was obtained on the 'GiSelA 5' clone during two years, but no bud freezing damage was found in the case of this rootstock. In the opinion of Sitarek and Grzyb [20], one of the reasons for poor bud take can be the physiological incompatibility between the scion cultivar and the rootstock. In their research, the above cited authors observed that the cultivar 'Heidegger' grafted on the 'GiSelA 5' rootstock showed some symptoms of physiological incompatibility. Studying the effect of 12 rootstock types on the growth and fruiting of the cultivar 'Lapins', Godini et al. [21] found a poor survival rate of trees on the 'GiSelA 5' rootstock; after 9 years it was barely 15%.

The main factor determining the efficiency is plant density in the nursery [22]. In the opinion of Stehr [23], the rootstock can also have a large influence on the number of trees obtained. In the present study, on average the highest efficiency of the sweet cherry tree nursery was obtained for the 'Piast' and 'Colt' rootstocks, whereas in the case of sweet cherry seedlings this efficiency was the lowest, not more than 60%. Nursery efficiency was significantly dependent on the rootstock used only in two years during the 3-year study period. When grafting sweet cherry on the 'Colt' rootstock, Stachowiak and Świerczyński [24] obtained 75% of maiden trees. In the study in question, on average 80.4% of trees were obtained in relation to the number of budded rootstocks. Stehr [23] achieved very good results for the 'GiSelA 5' rootstock, notably 90% of cv. 'Regina' trees. In this study, a similar value was obtained only in 2009 (87.7%). Comparing the effect of two rootstocks on the growth and productivity of budded trees of the sweet cherry cultivars 'Jahana', 'Kordia' and 'Regina', Stachowiak and Świerczyński [25] achieved a slightly higher percentage for cv. 'Regina' trees on 'F12/1' than on the 'Colt' rootstock. Under the tested conditions, the nursery efficiency was lower for 'F12/1' compared to the 'Colt' rootstock.

An appropriately selected rootstock and scion variety affect tree quality [26]. As shown by the study of Bielicki and Czynczyk [27], one of the factors determining the quality of budded trees in a nursery is rootstock vigour. The rootstocks compared over the study period 2007–2008 significantly affected the quality of cv. 'Regina' trees. The highest percentage of budded trees that met the requirements of the Polish Standard PN-R-67010 was obtained on the 'Colt' clone (95.5%), whereas this percentage was lowest for 'GiSelA 5' (55.2%) and sweet cherry seedlings (68.2%). In the study of Stachowiak and Świerczyński [28], respectively 99.2% and 98.8% of good quality sweet cherry trees were produced on the rootstocks 'Colt' and *Prunus avium* L. In the opinion of Robinson [29] as well as Bujdoso and Hrotkó [30], 'GiSelA 5' is considered to be one of the most valuable rootstocks useful in the production of sweet cherry trees. In the present study, on average for the three-year study period, the least satisfactory results were achieved on the dwarfing rootstock 'GiSelA 5'. High quality sweet cherry trees were produced on the selected Polish type of mahaleb cherry 'Piast'.

CONCLUSIONS

1. The present study showed a significant effect of rootstock on bud take in sweet cherry trees cv. 'Regina'. On average, the highest percentage of bud take was found for the rootstocks 'Piast' and 'Colt', while this percentage was lowest in the case of sweet cherry seedlings and 'GiSelA 5'.
2. In two years during the three-year study period, the rootstock used was found to significantly affect the efficiency of the sweet cherry tree nursery.
3. Under the tested conditions, the average percentage of maiden sweet cherry trees cv. 'Regina' that met the requirements of the standard PN-R-67010 was significantly lower on the dwarfing rootstock 'GiSelA 5' than on the rootstocks 'Colt' and 'Piast'.

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Authors' contributions

The following declarations about authors' contributions to the research have been made: concept of the study: PB; field research: PB, MK, MK, PK; data analyses: PB, MK; references: PB, MK; writing: PB, PK.

REFERENCES

1. Kurlus R. Rootstock effects on growth, yield and fruit quality of two sweet cherry cultivars in Western Poland. Acta Hortic. 2008; 795: 293–298.
2. Hrotkó K, Magyar L, Gyeviki M. Effect of rootstocks on growth and yiled of 'Carmen'® sweet cherry. Bulletin UASVM Hortic. 2009; 66(1): 143–148.
3. Grzyb ZS. New rootstocks of stone fruit trees selected in Skierniewice, Poland. Acta Hortic. 2004;658:487–489.

4. Goncalves B, Correia C, Silva AP, Bacelar EA, Santos A, Ferreira H, Moutinho-Pereira JM. Variation in xylem structure and function in roots and stems of scion-rootstock combinations of sweet cherry tree (*Prunus avium* L.). Trees. 2007; 21: 121–130. http://dx.doi.org/10.1007/s00468-006-0102-2
5. Vegvari GY, Hrotkó K, Magyar L, Hajagos A, Csigai K. Histological investigation of cherry rootstocks. Acta Hortic. 2008; 795: 339-344.
6. Hrotkó K. Advances and challenges in fruit rootstock research. Acta Hortic. 2007; 732: 33–42.
7. Gratacos E, Cores A, Kulczewski BM. Rootstock effects in two sweet cherry cultivars in Central Chile. Acta Hortic. 2008; 795: 227–237.
8. Simon G, Hrotkó K, Magyar L. Fruit quality of sweet cherry cultivars grafted on four different rootstocks. Acta Hortic. 2004; 658: 365–370.
9. De Salvador FR, Di Tomaso G, Bonofiglio P, Piccioni C. Performance of new and standard cherry rootstocks in different soils and climatic conditions. Acta Hortic. 2005; 667: 191–200.
10. Poniedziałek W, Szczygieł A, Porębski S, Górski A. Wpływ terminu okulizacji i podkładki na przyjęcie się oczek i wzrost okulantów dwóch odmian jabłoni. Zesz. Nauk. AR w Krakowie, Ogrodnictwo. 1997; 23: 5–18. (in Polish).
11. Gruca Z. Podkładki i jakość drzewek do intensywnych sadów jabłoniowych. Sem. Sad., Biul. 2, AR w Poznaniu. 1995; 43–47. (in Polish).
12. Gąstoł M, Poniedziałek W. Wpływ trzech podkładek na wzrost okulantów śliw w szkółce. Mat. XXXVII Ogólnopol. Nauk. Konf. Sad., Sesja Posterowa, Skierniewice. 1998; 574–578. (in Polish).
13. Ostrowska K, Chełpiński P. Efektywność okulizacji pięciu podkładek dla czereśni. Mat. VIII Ogólnopol Zjazd Nauk Lublin. 1999; 249–252. (in Polish)
14. Baryła P, Kapłan M. The estimation of the growth and the branching of the six stocks under the cherry and sweet cherry trees. Acta Sci Pol Hortorum Cultus. 2005; 4(1): 119–129.
15. Chełpiński P. Wpływ wybranych podkładek na wzrost i plonowanie oraz skład chemiczny liści i owoców czereśni na Pomorzu Zachodnim. Rozprawa nr 242, AR w Szczecinie. 2007; 86. (in Polish)
16. Maćkowiak M. Obserwacje przydatności podkładek dla odmian czereśni. Rocz. AR w Poznaniu, CCLXXXIII Ogrodnictwo. 1993; 21: 71–77. (in Polish)
17. Baryła P, Kapłan M. Wpływ terminów i sposobów okulizacji na jakość okulantów i wydajność szkółki wiśni odmiany ‘Łutówka’ / Effect of the times and the budding methods on the quality of young trees and the nursery efficiency of cherry trees cv. ‘Łutówka’. Acta Agrobot. 2006; 59(2): 207–214. (in Polish) http://dx.doi.org/10.5586/aa.2006.076
18. Kuzniecov PA. O srokach okulirovki. Sadovodstwo. 1962; 7: 23–24.
19. Grzyb ZS, Wojniakiewicz A, Zagaja SW, Czynczyk A. Uszkodzenia mrozowe niektórych podkładek drzew owocowych w czasie zimy 1968/1969. Pr. Inst Sadow Kwiac Skierniewice. 1972; Ser.A 16: 29–34. (in Polish)
20. Sitarek M, Grzyb ZS. Nursery results of bud-take and growth of six sweet cherry cultivars budded on four clonal rootstocks. Acta Hortic. 2007; 732: 345–349.
21. Godini A, Palasciano M, Camposeo S, Pacifico A. A nine-year study on the performance under non--irrigated conditions in Apulia (Southern Italy). Acta Hortic. 2008; 795: 191–198.
22. Baryła P. Wpływ gęstości sadzenia na wzrost i jakość okulantów wiśni odmiany ‘Łutówka’ na podkładce czereśnia ptasia (*Prunus avium* L.) / Effect of planting density on the growth and quality of cherry young trees of cultivar ‘Łutówka’ on the stock of sweet cherry (*Prunus avium* L.). Ann UMCS. 2005; sect. EEE15: 35–42. (in Polish)
23. Stehr R. Further experiences with dwarfing sweet cherry rootstocks in Northen Germany. Acta Hortic. 2008; 795: 185–190.
24. Stachowiak A, Świerczyński S. Efektywność wzrostu nowych odmian czereśni na podkładce Colt w szkółce. Mat. VIII Ogólnopol. Zj. Nauk. „Hodowla Roślin Ogrodniczych u progu XXI wieku”, Lublin. 1999; 253–255. (in Polish)
25. Stachowiak A, Świerczyński S. The effect of Colt and F12/1 rootstocks on growth and efficiency of young sweet cherry trees cultivars: ‘Johana’, ‘Kordia’ and ‘Regina’. Rocz AR w Poznaniu. 2001; 34: 93–99.
26. Milošević T, Milošević N. Growth and branching of pear trees (*Pyrus domestica, Rosaceae*) in nursery. Acta Sci Pol Hortorum Cultus. 2010; 9(4): 193–205.
27. Bielicki P, Czynczyk A. Wstępne wyniki z doświadczenia nad wpływem jakości podkładek słaborosnących na liczbę i jakość otrzymanych drzewek jabłoni w szkółce. Pr Inst Sadow Kwiac Skierniewice. 1992; Ser. C3-4 (115/116): 164–167. (in Polish)
28. Stachowiak A, Świerczyński S. Growth of six sweet cherry cultivars on Colt and on *Prunus avium* L. rootstocks in a nursery. Rocz AR w Poznaniu. 2004; 38: 149–156.
29. Robinson TL. Performance of Cornell-Geneva rootstocks in the multi location NC-140 rootstock trials across North America. Acta Hortic. 2004;658:241–246.
30. Bujdoso G, Hrotkó K. Achievement of rootstock--scion interactions on dwarfing cherry rootstocks in Hungary. Hortic Sci. 2005; 32(4): 129–137.

Wpływ podkładek na wydajność szkółki czereśni (*Prunus avium* L.) odmiany ‘Regina’

Streszczenie

W latach 2006–2009 w Lublinie przeprowadzono badania mające na celu ocenę wpływu pięciu podkładek: ‘Colt’, ‘F12/1’, czereśnia ptasia (*Prunus *avium* L.), 'GiSelA 5' i 'Piast' na przyjęcia oczek odmiany 'Regina', jakość okulantów oraz wydajność szkółki czereśni. Największy procent przyjętych oczek odmiany 'Regina' oraz najlepszą wydajność szkółki czereśni otrzymano na podkładkach 'Piast' i 'Colt'. W dwóch z trzech lat badań stwierdzono istotny wpływ zastosowanej podkładki na wydajność szkółki czereśni. Na podkładce 'Colt' i 'Piast' istotnie większy procent drzewek spełniało wymagania Polskiej Normy PN-R-67010 niż na klonie 'GiSelA 5'. W badanych warunkach jakość okulantów czereśni odmiany 'Regina' na skarlającej podkładce 'GiSelA 5' była najniższa.

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