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THE EFFECT OF DIFFERENT TYPES OF ROOTSTOCK ON THE QUALITY OF MAIDEN TREES OF SWEET CHERRY (*Prunus avium* L.) cv. 'REGINA'

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Abstract

Over the period 2006–2009 in Lublin, a study was conducted to determine the effect of five types of rootstock: 'Colt', 'F12/1', sweet cherry (*Prunus avium* L.), 'GiSelA 5' and 'Piast' mahaleb cherry (*Prunus mahaleb* L.), on the growth and quality of maiden sweet cherry trees cv. 'Regina' in a commercial nursery. Based on the three-year average, rootstocks were shown to have a significant effect on the investigated quality characteristics of maiden sweet cherry trees. Trees budded on 'Colt' vegetative rootstock were characterized by strongest growth and best quality. In each year, they were thicker, higher and better branched than sweet cherries on the rootstock. Under the tested conditions, 'GiSelA 5' dwarf rootstock significantly reduced the growth and quality of budded sweet cherry trees in the nursery. During the period 2007–2009, no physiological incompatibility symptoms were observed 'Regina' sweet cherry cv. and 'Piast' seedling rootstocks. The growth of trees budded on 'Piast' mahaleb cherry was poorer than on 'Colt' clonal rootstock, but it was stronger than on 'F12/1' and *Prunus avium* L. rootstocks.

Key words: *Prunus avium* L., vegetative rootstock, seedling, growth, nursery

INTRODUCTION

A major problem in the production of sweet cherry (*Prunus avium* L.) is tree vigour [1,2]. Due to the large tree size, sweet cherry varieties grafted on traditional rootstocks are suitable mainly for extensive orchards. It is difficult to protect large trees, they create problems during fruit picking and usually reach the fruit-bearing stage quite late, thus increasing production costs. The intensification of sweet cherry growing should involve the production of trees on semi-dwarf and dwarf rootstocks or the use of dwarfing interstems [3–7]. An appropriately chosen rootstock has a significant effect not only on the growth of trees [8], but also on their quality [9], precocity [10,11], and fruit quality [12,13]. *Prunus avium* L. seedlings are the most frequently used rootstock for sweet cherry cultivars in Poland. Mahaleb cherry (*Prunus mahaleb* L.) [14–16], which can be propagated both from seed [17,18] and vegetatively [19,20], is of great importance in the production of sweet cherry trees in some countries. The share of mahaleb cherry in sweet cherry production in Poland is currently low. The major changes in sweet cherry growing methods which have been observed in recent years are a result of low-vigour vegetative rootstocks [21–24] whose main advantage, compared to seedlings, is their genetic homogeneity.

The aim of the present study was to determine the effect of five types of rootstock on the growth and quality of maiden trees of sweet cherry cv. 'Regina' in a nursery.

MATERIALS AND METHODS

The present study was carried out during the period 2006–2009 at the Felin Experimental Farm, belonging to the University of Life Sciences in Lublin. 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 × ha^{-1}). Bud grafting was performed on 1 August; buds of sweet cherry (*Prunus avium* L.) cv. 'Regina' were grafted on 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.

'Colt', 'F12/1' and 'Piast' rootstocks as well as sweet cherry seedlings came from the "Grzywa" Nursery Farm in Karczmiska, whereas 'GiSelA 5' clonal rootstock was purchased from 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, while plots in which 100 plants were grown were replicates.

Before digging up the trees at the beginning of October, trunk diameter at a height of 30 cm from the place of budding and the height of maiden trees from the place of budding to the terminal bud were measured. The degree of branching of maiden trees was estimated by measuring lateral shoots with a length of more than 5 cm and recording their number. The measurements obtained were the basis for the calculation of the total length of sylleptic shoots and shoot length. The results were statistically analysed using analysis of variance and Tukey's confidence intervals. The significance of differences was determined at $\alpha=0.05$.

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 higher than the long-term means. The highest difference was recorded in January (6.5oC) and in March (5.3°C). The lowest minimum air temperature (–13.6°C) was recorded in the last 10-day period of February. In April ground frost occurred sporadically. Ground-level temperature decreases below 0oC that occurred at the beginning of May did not cause significant damage in the nursery. In the months of February, April, August, October and December, the total precipitation was lower than the long-term mean. Favourable weather conditions 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 -13.2°C, while at ground level –15.9°C. 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 19.8°C. 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 most of 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 (4°C) and in September (2.4°C). The warmest month of the year was July (19.9°C), whereas the coldest one January (-2.7°C). The lowest minimum air temperature was recorded in January and it was –19.3°C, while at ground level –22.0°C. Ground frost occurred in the first and second 10-day periods of April as well as in the second 10-day period of May, but it did not result in damage in the nursery. As regards the amount of precipitation, the year of 2009 varied substantially. 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 recorded 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 (°C)				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

RESULTS

In 2007 and 2008 sweet cherries on 'Colt' rootstock had a significantly larger trunk diameter than trees on the other types of rootstock (Table 2). In the case of 'GiSelA 5' semi-dwarfing rootstock, the trunk thickness was lowest.

Table 2
The effect of rootstocks on trunk diameter of maiden sweet cherry trees cv. 'Regina' in 2007-2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles		
Diameter of maiden trees, mm							
Colt	22.3 a	25.5 a	21.3 a	23.0 a	B	A	B
F12/1	15.3 b	17.4 b	16.3 b	16.3 b	ns ni	ns ni	ns ni
Prunus avium L.	15.0 b	19.3 b	12.8 c	15.7 b	B	A	B
GiSelA 5	11.5 c	15.8 b	15.5 b	14.2 b	B	A	A
Piast	17.3 b	19.3 b	20.3 a	19.0 ab	B	AB	A

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.

In the last year of the experiment, trees budded on 'Colt' and 'Piast' rootstocks differed significantly in trunk thickness from trees grafted on sweet cherry seedlings as well as on 'GiSelA 5' and 'F12/1' clonal rootstocks.

In the case of 'F12/1' rootstock, no significant differences were found between production cycles. Maiden trees produced on 'Colt' clonal rootstock and *Prunus avium* L. seedling rootstocks in the second year of the study had a significantly larger tree trunk than trees in the other years. As far as 'Piast' seedlings are concerned, there were significant differences between the years 2007 and 2009, while in the case of 'GiSelA 5' rootstock such differences were found between the first production cycle and the last two ones.

The study showed a significant effect of rootstocks on trunk diameter of maiden sweet cherry trees cv. 'Regina'. On average for the three-year period, trees on 'Colt' clonal rootstock differed significantly in thickness from trees budded on the following rootstocks: 'GiSelA 5', 'F12/1' and *Prunus avium* L. seedlings (Table 2).

Table 3
The effect of rootstocks on the height of maiden sweet cherry trees cv. 'Regina' in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles		
Height of maiden trees, cm							
Colt	201.0 a	194.6 a	207.3 a	201.0 a	ns ni	ns ni	ns ni
F12/1	167.0 bc	169.7 b	145.6 b	160.7 b	A	A	B
Prunus avium L.	161.2 bc	164.3 b	147.4 b	157.6 b	ns ni	ns ni	ns ni
GiSelA 5	147.6 c	135.7 c	156.2 b	146.5 b	AB	B	A
Piast	176.2 ab	161.5 b	189.8 a	175.8 ab	AB	B	A

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.

In the first year of production, significant differences were shown between 'Colt' rootstock versus 'GiSelA 5' clone, 'F12/1' and sweet cherry seedlings (Table 3). Significant differences in the height of maiden trees were also found between trees budded on 'GiSelA 5' and 'Piast' rootstocks.

In 2008 trees budded on 'Colt' rootstock were significantly higher than those grafted on the other types of rootstock. Maiden trees on 'GiSelA 5' dwarf rootstock were significantly lowest.

In the last year of the study, significantly the highest sweet cherries were obtained on 'Colt' and 'Piast' rootstocks, whereas the lowest ones on 'F12/1', sweet cherry seedlings and 'GiSelA 5'.

In the case of two types of rootstock, 'Colt' and *Prunus avium* L., no significant differences were found between years. On ‘F12/1’ clonal rootstock, trees were significantly higher in the first two production cycles, whereas on ‘GiSelA 5’ and ‘Piast’ rootstocks there were significant differences in tree height between the years 2008 and 2009.

During the period 2007–2009, rootstocks were found to have a significant effect on the height of maidens in the nursery. On average, trees on ‘Colt’ rootstock were higher than trees budded on ‘GiSelA 5’, Prunus avium L. and ‘F12/1’ (Table 3).

Table 4
The effect of rootstocks on the total length of lateral shoots of maiden sweet cherry trees cv. ‘Regina’ in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles		
Total length of lateral shoots per tree, cm							
Colt	480.1 a	384.2 a	239.7 a	368.0 a	A	AB	B
F12/1	221.4 bc	246.9 b	150.1 b	206.1 ab	AB	A	B
Prunus avium L.	276.4 bc	262.8 b	140.1 b	226.4 ab	A	A	B
GiSelA 5	142.9 c	201.6 b	137.6 b	160.7 b	B	A	B
Piast	325.1 ab	380.7 a	263.1 a	322.9 ab	AB	A	B

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.

In 2007 trees budded on ‘GiSelA 5’, ‘F12/1’ and *Prunus avium* L. rootstocks had a significantly smaller total length of lateral shoots than on ’Colt’ rootstock (Table 4). There were also significant differences between trees on ‘GiSelA 5’ clonal rootstock and on ‘Piast’ rootstock.

In the last two years, cv. ‘Regina’ sweet cherries grafted on ‘Piast’ seedlings and ‘Colt’ rootstock had a significantly greater total length of sylleptic shoots than on the other rootstock types.

Significant differences were shown between production cycles. Maiden trees produced in 2009 had a significantly smaller total length of lateral shoots than trees in the other years, except for sweet cherry trees on ‘F12/1’, ‘GiSelA 5’ and ‘Piast’ rootstocks in the first year of the study and on ‘Colt’ rootstock in the second production cycle.

The used rootstocks significantly affected the total length of lateral shoots. On average for the three-year period, sweet cherries on “Colt” rootstock were characterized by a significantly greater total length of sylleptic shoots than in trees on the ‘GiSelA 5’ clone (Table 4).

Table 5
The effect of rootstocks on the number of lateral shoots of maiden sweet cherry trees cv. ‘Regina’ in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles		
Number of lateral shoots per tree							
Colt	8.7 a	4.9 ab	3.2	5.6	A	B	B
F12/1	4.3 bc	3.9 ab	3.1	3.8	ns ni	ns ni	ns ni
Prunus avium L.	6.1 b	4.3 ab	2.7	4.4	A	B	C
GiSelA 5	2.8 c	3.5 b	3.4	3.2	ns ni	ns ni	ns ni
Piast	5.5 b	5.5 a	3.6	4.9	A	A	B

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.

In 2007 trees budded on ‘Colt’ rootstock produced significantly more lateral shoots than on the other rootstock types (Table 5). Significantly the lowest number of sylleptic shoots was found in sweet cherry trees budded on ‘GiSelA 5’ clonal rootstock.

In the second year of the study, there were significant differences in the number of lateral shoots between ‘Piast’ seedling rootstock and ‘GiSelA 5’ rootstock.

Significant differences between production cycles were revealed for three rootstock types. In the first year of the study, maiden trees grafted on the ‘Colt’ vegetative clone and *Prunus avium* L. seedlings produced a higher number of lateral shoots than in the other years. In the case of 'Piast' rootstock, significant differences were found in the first and second production cycles versus the last one.

The statistical analysis of the mean for the study period did not find rootstocks to significantly affect the number of lateral shoots in sweet cherry cv. 'Regina'. Significant differences were only shown in the first and second years of the experiment (Table 5).

Table 6
The effect of rootstocks on the average length of lateral shoots of maiden sweet cherry trees cv. 'Regina' in 2007–2009

Rootstock	2007	2008	2009	Mean	Differences between production cycles		
Shoot length, cm							
Colt	54.2	78.8 a	74.4 a	69.2 a	B	A	A
F12/1	52.1	65.8 a	48.9 b	55.6 ab	ns ni	ns ni	ns ni
Prunus avium L.	45.7	61.8 a	51.5 b	53.0 ab	B	A	AB
GiSelA 5	51.2	43.0 b	41.3 b	45.2 b	ns ni	ns ni	ns ni
Piast	59.5	69.2 a	72.4 a	67.0 ab	B	AB	A

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.

In the second year of the study, trees budded on 'GiSelA 5' dwarf rootstock produced significantly the shortest lateral shoots (Table 6).

In 2009 trees produced significantly longer sylleptic shoots on the 'Colt' and 'Piast' seedling rootstocks than on *Prunus avium* L. or on 'GiSelA 5' and 'F12/1' vegetative rootstocks.

No significant differences between production cycles were found in the case of 'F12/1' and 'GiSelA 5' clonal rootstocks. In the first year, trees budded on 'Colt' rootstock had significantly shorter lateral shoots than trees in the other years. In the case of trees budded on sweet cherry seedlings there were significant differences between 2007 and 2008, whereas for 'Piast' rootstock significant differences were found between the first and last production cycles.

On average for the period 2007–2009, sweet cherry trees budded on 'Colt' rootstock significantly differed in lateral shoot length from trees on 'GiSelA 5' clonal rootstock (Table 6).

DISCUSSION

Fruit trees most frequently consist of two elements: a rootstock and a scion grafted on it. In the case of sweet cherry, which is characterized by strong growth, a third element in the form of a dwarfing interstem is sometimes introduced and it is designed to weaken tree vigour [3–7]. The interactions of all these elements are a complex process and not fully known. The effect of rootstock on the growth of trees in an orchard is different than in the case of budded trees in a nursery. This phenomenon is associated with a different capacity of rootstocks to overcome stresses and with a short production cycle in a nursery [25].

An appropriately chosen rootstock affects both the growth [8,26] and quality of trees [9,27]. For the purpose of comparison, the experiment tested rootstocks commonly used in Poland for the production of sweet cherry trees: *Prunus avium* L. seedlings, 'Colt' and 'F12/1' rootstocks [6,26] as well as the 'GiSelA 5' which is considered to be one of the most valuable rootstocks for sweet cherry [21,28]. The study also used mahaleb cherry; in the case of this cherry, the opinions on its usefulness as rootstock for sweet cherry cultivars vary and this divergence of opinion arises from the possibility of occurrence of physiological incompatibility [6,17,29].

Prunus avium L. seedling rootstock as well as 'F12/1' and 'Colt' clonal rootstocks belong to the most vigorous rootstocks used in the production of sweet cherry trees [4,6,30]. On average for the three-year period, trees budded on 'Colt' rootstock were significantly thicker and significantly higher than trees on sweet cherry seedlings as well as on 'F12/1' and 'GiSelA 5' rootstocks. Studying the effects of two rootstocks on the growth parameters and efficiency of budded trees of the following sweet cherry cultivars: 'Johana', 'Kordia' and 'Regina', Stachowiak and Świerczyński [26] obtained different results. They demonstrated that cv. 'Regina' trees on 'F12/1' rootstock had a significantly larger trunk diameter and height than trees budded on the 'Colt'. In the opinion of the above-cited authors, the level of impairment of vigour in trees budded on 'Colt' rootstock was dependent on the cultivar. In his experiment, Maćkowiak also observed [31] a stronger growth of sweet cherry trees cvs. 'Hedelfińska', 'Bütnera Czerwona' and 'Rivan' budded on 'F12/1' compared to 'Colt' rootstock. Sweet cherry is commonly considered to be a more vigorous rootstock than mahaleb cherry. According to Grzyb [6], it is possible to grow sweet cherry trees on mahaleb cherry seedling rootstocks on the condition that trees with physiological incompatibility symptoms are eliminated from the nursery. During the period 2007–2009 in the nursery, no incompatibility symptoms were observed in cv. 'Regina' sweet cherry trees budded on 'Piast' mahaleb cherry rootstock. On average for the three-year period as well as in the first and second years of the study, no significant differences were found in the quality of budded trees on *Prunus avium* L. seedlings and 'Piast' rootstock. Significant differences were shown in 2009, since trees on 'Piast' mahaleb cherry rootstock had a significantly larger trunk diameter and height than trees budded on sweet cherry seedling rootstocks. Two types of mahaleb cherry selected in Poland, 'Piast' and 'Popiel', are characterized by strong growth [17]. The use of these seedlings in sour cherry production substantially improves tree quality [32]. Different selective types of mahaleb cherry are used in sweet cherry production across the world [5,6,18]. As shown by numerous studies [3–7], in growing sweet cherries the future belongs to dwarf and semi-dwarf rootstocks as well as to semi-dwarfing interstems. 'GiSelA 5', among others, is included in rootstocks that most strongly reduce tree growth [28,33]. In the present experiment, cv. 'Regina' sweet cherry trees grafted on 'GiSelA 5' rootstock were characterized by the poorest growth in the nursery and their quality was lowest. It should be stressed that the poorer growth of sweet cherry trees on 'GiSelA 5' rootstock in the nursery, compared to other types of rootstock, cannot be a ground for discontinuing the production of maiden trees on this rootstock. Sweet cherry production on 'GiSelA 5' rootstocks yields good results in orchards; 'GiSelA 5' is considered to be one of the most valuable rootstocks [21,28] and plays an important role in the intensification of sweet cherry growing across the world.

The vigour and branching of budded trees are determined by the rootstock and cultivar characteristics [34]. According to Sczepański and Rejman [35], the total length of annual shoots and their average length are one of better indicators for the growth of young trees. Three-year measurements of branching in budded trees showed differences between individual rootstock types. On average, trees on high-vigour 'Colt' rootstock were characterized by significantly the greatest total length of lateral shoots and their average length, whereas these parameters were lowest for 'GiSelA 5' clonal rootstock. In their study, Stachowiak and Świerczyński observed 'Colt' rootstock to have a significant effect on branching of maiden sweet cherry trees grown in a nursery [36]. In each year of the experiment, 'Regina' trees on 'Piast' seedling rootstocks were better branched than trees budded on sweet cherry seedlings, 'F12/1' and 'GiSelA 5'. In the opinion of Lipecki [37], in apple the rootstock has a greater effect on the formation of sylleptic shoots than the cultivar. Rootstocks were shown to significantly affect the number of lateral shoots only in two years during the three-year study period. In 2007 trees on 'Colt' rootstock produced significantly the greatest number of shoots, while in 2008 those on on 'Piast' seedling rootstock. Stachowiak and Świerczyński [26] obtained a significantly higher number of long shoots in cv. 'Regina' sweet cherry trees budded on 'Colt' than on 'F12/1'.

In the present study, in some cases different results were obtained than those reported in the currently available literature, which might be caused by different site and weather conditions.

CONCLUSIONS

1. Based on the three-year average, rootstocks were shown to have a significant effect on the investigated quality characteristics (trunk diameter, height, total length of lateral shoots, average shoot length) of maiden sweet cherry trees cv. 'Regina' in the nursery.
2. Trees budded on 'Colt' vegetative rootstock were characterized by strongest growth and best nursery quality; in each year, they were thicker, higher and better branched than sweet cherries on the other rootstock.
3. Under the tested conditions, 'GiSelA 5' dwarf rootstock significantly reduced the growth and length of laterals shoots of budded sweet cherry trees in the nursery. Breeders that decide to grow sweet cherries on 'GiSelA 5' rootstocks should take into account the poor growth of trees in the nursery and apply appropriate aftercare in the first years after the establishment of an orchard.
4. During the period 2007–2009, no physiological incompatibility symptoms were observed between sweet cherry cv. 'Regina' and 'Piast' seedling rootstocks. The growth of trees budded on 'Piast' mahaleb cherry was poorer than on 'Colt' clonal rootstock, but it was stronger than on 'F12/1' and *Prunus avium* L. rootstocks.

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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; data analyses: PB, MK; references: PB, MK; writing the manuscript: PB.

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Wpływ różnych typów podkładek na jakość okulantów czereśni (*Prunus avium* L.) odmiany 'Regina'

Streszczenie

W latach 2006–2009 w Lublinie wykonano badania, których celem była ocena wpływu pięciu typów podkładek: 'Colt', 'F12/1', czereśnia ptasia (*Prunus avium* L.), 'GiSelA 5' i antypka (*Prunus mahaleb* L.) 'Piast' na wzrost i jakość okulantów czereśni odmiany 'Regina' w szkółce produkcyjnej. Na podstawie średniej z trzech lat wykazano istotny wpływ podkładek na badane cechy jakościowe okulantów czereśni. Na podkładce wegetatywnej 'Colt' drzewka charakteryzowały się najsilniejszym wzrostem i najlepszą jakością. W każdym roku były grubsze, wyższe i lepiej rozgałęzione od czereśni na pozostałych typach podkładek. W badanych warunkach karłowa podkładka 'GiSelA 5' istotnie ograniczała wzrost i jakość okulantów czereśni w szkółce. W latach 2007–2009 nie zaobserwowano objawów niezgodności fizjologicznej u czereśni odmiany 'Regina' na siewkach 'Piast'. Wzrost drzewek na antypce 'Piast' był słabszy niż na klonie 'Colt' natomiast silniejszy, niż na podkładkach 'F12/1' i *Prunus avium* L.

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