ACTA Acta Sci. Pol., Hortorum Cultus 8(1) 2009, 3-11

THE INFLUENCE OF MYCORRHIZAL VACCINE ON THE GROWTH OF MAIDEN SWEET CHEERY TREES OF SELECTED CULTIVARS IN NURSERY

Aleksander Stachowiak, Sławomir Świerczyński
University of Life Sciences in Poznań

Abstract. The experiment was conducted at the Experimental Station of the University of Life Sciences in Poznań, in the years 2005–2007. The aim of this study was to estimate the influence of a mycorrhizal vaccine on the growth of maiden sweet cherry trees of four cultivars: 'Burlat', 'Regina', 'Summit' and 'Vanda'. Results of the study proved that the mycorrhizal vaccine did not have significant effect on any of studied parameters of maiden sweet cherry trees growth. Budded cultivars of sweet cherry differentiated the percentage of obtained maiden trees and their branching. The highest percentage of maiden trees was obtained for 'Regina' cultivar and the lowest one was observed for 'Burlat'. Maiden trees of 'Summit' cultivar were characterized by much lower susceptibility to creating lateral shoots comparing with other cultivars taken into consideration. Significantly lower value of chlorophyll content was observed in leaves of 'Summit' cultivar.

Key words: mycorrhizal vaccine, nursery, maiden sweet cherry trees, growth

INTRODUCTION

The popularity of cultivation of sweet cherry is increasingly growing, both in Poland and whole world [Makosz 2007, Wociór 2008]. High quality one-year old maiden trees with lateral shoots that were set in an orchard are a basic condition of intensification of fruit-growing cultivation [Baryła and Kapłan 2006]. The advantage of branched trees over non-branched ones was proved by many researchers [Van Oosten 1978, Shepherd 1979, Poniedziałek et al. 1993, Chełpiński et al. 1998]. The quality of one-year old maiden trees is dependant upon many factors, among others, on the used rootstock [Słowiński and Sadowski 1996, Webster and Hollands 1999], genetic conditions of the propagated plant [Lipecki and Lipecki 1994], as well as, on the weather conditions during a vegetation period [Baryła 2005]. Good material can also be obtained by intensive fertilization, especially with nitrogen, however, economical and ecological argu-

Corresponding author – Adres do korespondencji: Aleksander Stachowiak, Sławomir Świerczyński Department of Dendrology and Nursery, University of Life Sciences in Poznań, ul. Szamotulska 28, 62-081 Przeźmierowo, e-mail: kdis@au.poznan.pl

ments limit it. Therefore new production methods, which would satisfy both, orchardmen and nurserymen, are sought.

One of such possibilities is the use of mycorrhizal vaccines by introducing mycorrhizal fungi into a plant root system. Ability of mycelium to gain the nutrient which is unaccessible, but necessary for plant growth and development, enables to reduce the fertilizers application just to 50% of presently used dosage recommended [Kubiak 2005]. One of many advantages of mycorrhiza is the induction of plant tolerance to biotic stresses [Dehne 1982, Barea et al. 1996] and abiotic stresses [Stahl et al. 1998, Schreiner et al. 2001, Borkowska 2002, Shi et al. 2002, Aleksandrowicz-Trzcińska 2004]. The fungi also neutralize toxic substances and the influence of heavy metals [Kubiak 2005]. Additionally, they can play an important role in the process of adaptation of plants in new habitat conditions after planting into final location [Księżniak 2007]. Results of present studies on mycorrhizal vaccines [Davies 1987, Fortuna et al. 1992, Cordier et al. 1996, Rapparini et al. 1996, Monticelli et al. 2000, Aleksandrowicz-Trzcińska 2004, Kipkoriony and Mizutani 2006, Kubiak 2007, Druzic-Orlic et al. 2008, Ishii et al. 2008, Raj and Sharma 2008] show that they must be continued due to growing fertilization costs, costs of plant and environmental protection.

The aim of the present studies was an evaluation of the usefulness of Mykoflor mycorrhizal vaccine in a nursery production of maiden sweet cherry trees.

MATERIAL AND METHODS

The studies were carried out in Experimental Station in Baranowo, in the years 2005–2007. The experiment was set up in random blocks design, in four replications, with 200 plants planted per plot. The object of the studies were *Prunus avium* L. seedling rootstocks, which were planted into the ground in early spring of 2005 and 2006, 90x30 cm of spacing. In the same years, in the middle of May, mycorrhizal vaccine in a dosage of 1.000 units per 1 plant was introduced into the root system of half of the rootstocks per plot. The process of budding was conducted in the last days of July by using T letter method, placing the buds of the following sweet cherry cultivars: 'Burlat', 'Regina', 'Summit' and 'Vanda', 5 cm above the ground. Finally, the experiment consisted of 8 combinations (totally 100 plants in each one). In the first half of August measurement of content of chlorophyll in the leaves of maiden cherry trees was conducted. 50 leaves from the middle part of long-shoots from each plot were collected. At the end of October on 15 randomly chosen maiden trees on each plot the following measurements were carried out: height (cm), diameter (mm) 30 cm above the ground, length of lateral shoots (cm). On the basis of the last mentioned feature the sum of length of lateral shoots' lengths on a maiden tree was calculated (cm). Also the percentage of obtained maiden trees, in comparison with the number of budded rootstocks, was estimated.

The statistical analysis of the obtained data was carried out with the application of two-factor variance analysis (the cultivar and mycorrhizal vaccine), using Duncan's test, with probability level $\alpha = 0.05$. Results shown in tables are mean values of two years.

RESULTS AND DISCUSION

The percentage of the obtained maiden trees in comparison with the number of budded trees did not depend on the used mycorrhizal vaccine. The budded sweet cherry cultivars, however, significantly differentiated the efficiency level of maiden sweet cherry trees. The highest percentage of maiden trees was obtained for 'Regina' cultivar and the lowest one was observed for 'Burlat' (tab. 1). Yet, the percentage of the obtained maiden trees for 'Burlat' cultivar was higher than the one observed by Ostrowska and Chełpiński [1999] (35.4 %) but lower than it was obtained for 'Regina' by Stachowiak and Świerczyński [1999] (84.2%).

Table 1. The percentage of the obtained maiden sweet cherry trees depended on mycorrhizal vaccine and cultivar
Tabela 1. Procent otrzymanych okulantów czereśni w zależności od szczepionki mikoryzowej i odmiany

Combination Kombinacja	Cultivar – Odmiana				Mean value for mycorrhizal vaccine Średnia wartość dla szczepionki mikoryzowej
	Burlat	Regina	Summit	Vanda	
With mycorrhizal vaccine Ze szczepionką mikoryzową	65.8 a*	76.6 c	72.1 abc	67.5 ab	70.6 a
Withaut mycorrhizal vaccine Bez szczepionki mikoryzowej	71.5 abc	71.5 abc	67.1 ab	74.4 bc	71.2 a
Mean value for cultivar Średnia wartość dla odmiany	68.7 a	74.1 b	69.6 ab	71.0 ab	

* The means followed by the same letters do not differ significantly at α = 0.05
* Średnie oznaczone tymi samymi literami nie różnią się istotnie przy α = 0,05

Both the used mycorrhizal vaccine and budded cultivars of sweet cherry trees did not affect significantly differentiation of the height of trees obtained in the experiment. The maiden trees of 'Burlat' and 'Regina' cultivars infected by fungi were slightly higher and the ones of 'Summit' and 'Vanda' were lower than a control, without micorizal vaccine. Taking into consideration mean values for each combination higher trees were obtained in the control and for 'Burlat' and 'Regina' cultivars, however, no important differences were observed (tab. 2). Kubiak [2007] obtained trees twice as high as in the control in the first year of growth after using mycorrhizal vaccine, however the experiment was set in especially unfavourable conditions for plant growth, in re-cultivated soil. The present experiment, on the other hand, was carried out in a productive nursery, where the soil showed good physico-chemical parameters. Maiden trees of 'Regina' cultivar obtained in this experiment were much higher than in the previous experiment – 162.7 cm [Stachowiak and Świerczyński 1999], mainly due to good weather conditions in the vegetative period, especially rainfalls in 2007.

Diameter of the maiden trees, obtained for each combination, did not differ significantly (tab. 2). Among the cultivars the smallest thickness was observed for maiden trees of 'Vanda' cultivar, however, no important differences in comparison, with other cultivars were noticed. The diameter of 'Regina' cultivar trees was similar to the one obtained earlier by Stachowiak and Świerczyński [1999].

Table 2. The height (cm) and diameter (mm) of maiden sweet cherry trees depended on mycorrhizal vaccine and cultivar
Tabela 2. Wysokość (cm) i średnica (mm) okulantów czereśni w zależności od szczepionki mikoryzowej i odmiany

Plant feature Cecha rośliny	Combination Kombinacja	Cultivar – Odmiana				Mean value for mycorrhizal vaccine Średnia wartość dla szczepionki mikoryzowej
		Burlat	Regina	Summit	Vanda	
Height Wysokość cm	with mycorrhizal vaccine ze szczepionką mikoryzową	240.0 ab*	233.3 ab	199.9 a	202.9 ab	212.5 a
	withaut mycorrhizal vaccine bez szczepionki mikoryzowej	230.4 b	231.2 b	221.8 ab	214.4 ab	224.5 a
	mean value for cultivar średnia wartość dla odmiany	227.2 a	227.2 a	210.9 a	208.7 a	
Diameter Średnica mm	with mycorrhizal vaccine ze szczepionką mikoryzową	21.9 a*	22.7 a	21.5 a	19.7 a	21.4 a
	withaut mycorrhizal vaccine bez szczepionki mikoryzowej	21.8 a	20.9 a	22.1 a	21.1 a	21.5 a
	mean value for cultivar średnia wartość dla odmiany	21.9 a	21.8 a	21.8 a	20.5 a	

* For explanation, see table 1
* Wyjaśnienie, patrz tabela 1

Both, the results of the height and diameter of the studied maiden trees did not confirm a positive influence of the use mycorrhizal vaccine on the growth of the trees. A kind of regularity could be observed, however. The trees of strongly growing 'Burlat' and 'Regina' cultivars with the use of the vaccine grew stronger than the control and the trees of weaker growing 'Vanda' and 'Summit' grew poorer than the control.

Growth and vigour obtained in the experiment did not fully confirm pomological descriptions of these cultivars made by Rozpara [1999]. The strength of growth of individual cultivar trees can differ in a nursery and in an orchard, depending on later fructification period.

The number of lateral shoots counted for sweet cherry trees was differentiated only depending on a cultivar. Significantly the smallest number of lateral shoots was counted for 'Summit' cultivar. Independently from the used cultivar, the same result, on average, was obtained for the trees with mycorrhizal vaccine and for the control, without the vaccine (tab. 3). In the experiment carried out by Kubiak [2007] after using the first mycorrhizal vaccine the plants had a similar number of shoots as the control, and in the case of a second vaccine 2.5 times higher number of lateral shoots.

The number of the obtained lateral shoots in the present experiment, however, does not confirm for the advantage of the used mycorrhizal vaccine. It only shows the tendency of creating lateral shoots by individual sweet cherry cultivars. Maiden trees of

'Summit' cultivar were characterized by much lower susceptibility to creating lateral shoots comparing with other cultivars taken into consideration. The number of lateral shoots obtained in this experiment for 'Regina' cultivar was higher than in the earlier one – 2.8 [Stachowiak and Świerczyński 1999].

Table 3. Average number and length (cm) and sum of length (cm) of lateral shoots for one maiden sweet cherry trees depended on mycorrhizal vaccine and cultivar
Tabela 3. Średnia liczba i długość (cm) oraz suma długości (cm) pędów bocznych dla jednego okulanta w zależności od szczepionki mikoryzowej i odmiany

Plant feature Cecha rośliny	Combination Kombinacja	Cultivar – Odmiana				Mean value for mycorrhizal vaccine Średnia wartość dla szczepionki mikoryzowej
		Burlat	Regina	Summit	Vanda	
Number of lateral shoots Liczba pędów bocznych	with mycorrhizal vaccine ze szczepionką mikoryzową	5.9 c*	4.7 abc	2.6 a	6.4 c	4.9 a
	withaut mycorrhizal vaccine bez szczepionki mikoryzowej	6.3 c	4.7 abc	3.3 ab	5.2 bc	4.9 a
	mean value for cultivar średnia wartość dla odmiany	6.1 b	4.7 b	3.0 a	5.8 b	
Average length of lateral shoot Średnia długość pędu bocznego cm	with mycorrhizal vaccine ze szczepionką mikoryzową	59.9 a*	66.6 ab	83.4 b	64.5 a	68.6 a
	withaut mycorrhizal vaccine bez szczepionki mikoryzowej	67.0 ab	69.2 ab	68.2 ab	68.4 ab	68.2 a
	mean value for cultivar średnia wartość dla odmiany	63.5 a	67.9 ab	75.8 b	66.4 ab	
Sum of length of lateral shoots Suma długości pędów bocznych cm	with mycorrhizal vaccine ze szczepionką mikoryzową	325.3 ab*	307.9 ab	227.0 a	407.1 b	316.8 a
	withaut mycorrhizal vaccine bez szczepionki mikoryzowej	409.2 b	319.5 ab	235.0 a	345.2 ab	327.2 a
	mean value for cultivar średnia wartość dla odmiany	367.2 b	313.7 ab	231.0 a	376.2 b	

* For explanation, see table 1
* Wyjaśnienie, patrz tabela 1

The average length of lateral shoots for a combination with the mycorrhizal vaccine and the control did not differ (tab. 3). The longest lateral shoots were obtained for the maiden trees of 'Summit' cultivar, which length differed only from the trees of 'Burlat' cultivar. Maiden trees of 'Summit' cultivar had the longest lateral shoots, which resulted from their smaller number, compared with other cultivars. The maiden trees of 'Regina' cultivar had longer long-shoots than in the previous experiment [Stachowiak and Świerczyński 1999].

The biggest mean sum of the lengths of lateral shoots had trees of 'Vanda' and 'Burlat' cultivars, which differed only from 'Summit' cultivar. Sweet cherry maiden trees from the control had a higher mean value of the sum of the lengths of lateral shoots in comparison with trees, which underwent the vaccine treatment but the difference did not appear to be statistically important (tab. 3). The sum of the lengths of lateral shoots obtained by Kubiak [2007] was more than 2 or 4.5 times higher in the case of trees after the use of a mycorrhizal vaccine. In the present studies the use of the vaccine did not make the maiden sweet cherry trees ramify better. Only the budded cultivar differentiated the number and sum of the lengths of lateral shoots.

Mycorrhizal fungi introduced into the root system did not affect the content of chlorophyll in the leaves of the studied maiden trees (tab. 4). There were, however, some differences among sweet cherry cultivars. Significantly lower value of chlorophyll content was observed in leaves of 'Summit' cultivar, compared with other discussed cultivars.

Table 4. Average content of chlorophyl in leaves on maiden sweet cherry trees depended on mycorrhizal vaccine and cultivar

Tabela 4. Średnia zawartość chlorofilu w liściach okulantów czereśni w zależności od szczepionki mikoryzowej i odmiany

Combination Kombinacja	Cultivar – Odmiana				Mean value for mycorrhizal vaccine Średnia wartość dla szczepionki mikoryzowej
	Burlat	Regina	Summit	Vanda	
With micorrizal vaccine Ze szczepionką mikoryzową	48.6 bc*	47.9 abc	44.8 ab	47.7 abc	47.2 a
Withaut micorrizal vaccine Bez szczepionki mikoryzowej	50.1 c	47.4 abc	43.8 a	49.0 bc	47.6 a
Mean value for cultivar Średnia wartość dla odmiany	49.3 b	47.6 b	44.3 a	48.4 b	

* For explanation, see table 1

* Wyjaśnienie, patrz tabela 1

Taking into consideration all results obtained in the experiment it must be stated that only genetic conditions of separate cultivars of sweet cherry trees affected final results of the studied features. Lack of positive influence of the mycorrhizal vaccine on the growth of the maiden trees could result from several reasons. Firstly, in the early stage of fungi-plant symbiosis some part of nutrients is consumed and used by fungi for their growth instead of supplying the plants. Also positive climatic conditions, especially a lot of atmospheric falls in 2007 were not good for fungi which can show their advantages when a plant is exposed to stressful conditions e.g, drought. Strongly growing rootstocks, such as *Prunus avium* may not need such help of mycorrhizal fungi as weaker growing ones. Further studies seem to be useful, especially in the context of adaptation of trees after planting in to an orchard and in the context of checking the influence of mycorrhizal vaccine on a further growth and fructification of trees.

CONCLUSIONS

1. Mycorrhizal vaccine used in the experiment did not affect significantly any of the studied parameters of maiden sweet cherry trees.
2. The analysed cultivars of sweet cherry differentiated results connected with the percentage of the obtained maiden trees and their ramification. The highest percentage of maiden trees was obtained for 'Regina' cultivar and the lowest one was observed for 'Burlat'. Maiden trees of 'Summit' cultivar were characterized by much lower susceptibility to creating lateral shoots.
3. The content of chlorophyll in leaves depended on the budded cultivar. Significantly lower value of chlorophyll content was observed in leaves of 'Summit' cultivar.

REFERENCES

Aleksandrowicz-Trzcińska M., 2004. Kolonizacja mikoryzowa i wzrost sosny zwyczajnej (*Pinus silvestris* L.) w uprawie założonej z sadzonek w różnym stopniu zmikoryzowanych. Acta Sci. Pol. Silv. Colendar. Rat. Ind. Lignar 3(1), 5–15.

Barea J.M., Calvet C., Estaun V., Camprubi A., 1996. Biological control as key component in sustainable agriculturae. Plant and Soil. 185, 171–172.

Baryła P., 2005. Zależność między czynnikami klimatycznymi a wzrostem okulantów wiśni w szkółce. Acta Agroph., 125, 31–42.

Baryła P., Kapłan M., 2006. The effect of stocks on the quality of young trees and the nursery efficiency of cherry trees cv. 'Łutówka'. Acta Sci. Pol., Hortorum Cultus 5(1), 45–52.

Borkowska B., 2002. Growth and photosynthetic activity of mikropropagated strawberry plants inoculated with endomicorrhizal fungi (AMF) and growing under drought strees. Acta Physiol. Plantarum. 24(4), 365–370.

Chełpiński P., Ostrowska K., Czarnik J., 1998. Zależność między wskaźnikiem wzrostu młodych drzew wiśni i śliwy. Zesz. Nauk, AR w Krakowie, 333, 401–406.

Cordier C., Trouvelot A., Gianinazzi S., Gianinazzi-Pearson V., 1996. Arbuscular mycorrhizal-technology applied to micropropagated *Prunus avium* and to protection against *Phytophthora cinnamoni*. Agronomie, 16, 679–688.

Davies F. T. Jr., 1987. Effect of VA – mycorrhizal fungi on growth and nutrien uptake of cuttings of Rosa multiflora in two container media with three levels fertilizer application. Plant and Soil. 104, 31–35.

Dehne H.W., 1982. Interaction between vesicular-arbuscular fungi and plant pathogens. Phytopathology 72, 1115–1119.

Druzic-Orlic J., Cmelik Z., Redzepovic S., 2008. Influence of abuscular mycorrhyzal fungi on fruit rootstocks. Acta Hort. 767, 393–396.

Fortuna P., Citernesi S., Morini S., Giovannetti M, Loreti F., 1992. Infectivity and effectiveness of different species of arbuscular mycorrhizal fungi in micropropagated plants of Mr s 2/5 rootstock. Agronomie 12, 825–829.

Ishii T., Aketa T., Motosugi H., Cruz A.F., 2008. Mycorrhizal development in a chestnut orchard introduced by a sod culture system with *Vulpia myuros* L.C.C. Gmel. Acta Hort. 767, 429–434.

Kipkoriony L.R., Mizutani F., 2006. Peach seedling growt in replant and non-replant soils after inoculation wit arbuscular mycorrhizal fungi. Soil Biol. and Bioch. 38(9), 2536–2542.

Księżniak A., 2007. Endomikoryzy i ich zastosowanie w urządzaniu ogrodów. Mat. Konf. Mikoryza w architekturze krajobrazu, Poznań, 11–12.
Kubiak J., 2005. Mikoryzacja roślin i aplikacja szczepionek mikoryzowych. Prob. Inż. Rol. 13(2), 25–32.
Kubiak J., 2007. Zalesienia z mikoryzą. Mat. Konf. Mikoryza w architekturze krajobrazu, Poznań, 19–22.
Lipecki J., Lipecki M., 1994 Obserwacje nad wzrostem okulantów kilku odmian jabłoni. Annales UMCS, Horticultura, 2, 13–16.
Makosz E., 2007. Szanse rozwoju polskiego sadownictwa. Plantpress Kraków, 50–51.
Monticelli S., Puppi G., Damiano C., 2000. Effects of in vivo mycorrhization on micropropagated fruit tree rootstocks. Applied Soil Ecology 15(2), 105–111.
Ostrowska K., Chełpiński P., 1999. Efektywność okulizacji 5 podkładek dla czereśni. Mat. Konf. Hodowla Roślin Ogrodniczych u progu XXI wieku, Lublin, 249–252
Poniedziałek W., Nosal K., Porębski S., 1993. Wpływ rozgałęziania się drzewek jabłoni w szkółce na ich wzrost i owocowanie w sadzie. Zesz. Nauk. AR w Krakowie 21, 59–67.
Raj H., Sharma S.D., 2008. Integration of soil solarization and chemical sterilization with beneficial microorganisms for the control of white root rot and growth of nursery apple. Scientia Hort. 119(2), 126–131.
Rapparini F., Baraldi R., Bertazza G., 1996. Growth and carbohydrate status of *Prunus communis* L. plantlets inoculated with *Glomus* sp. Agronomie 16, 653–661
Rozpara E., 1999. Nowoczesna uprawa czereśni. Hortpress, 37, 39, 49, 71.
Shepherd H. R., 1979. Effect of three quality at planting time on orchard performance. Ann. Rep. East Malling Res. Sta. for 1978, 40.
Schreiner P.R., Ivors K.L., Pinkerton J.N., 2001. Soil solarization reduces arbuscular mycorrhizal fungi as a consequence of weed suppression. Mycorrhiza. 1(6), 273–277.
Shi L., Guttenberg M., Kottke I., Hampp R., 2002. The effect drought on mycorrhizas of beech (*Fagus sylvatica* L.) changes in community structure and the content of carbohydrates and nitrogen storage bodies of the fungi. Mycorrhoiza. 12(6), 303–311.
Słowiński A., Sadowski A., 1996. Wzrost i rozgałęzianie się drzewek trzech odmian jabłoni w szkółce w szkółce w zależności od użytej podkładki. XXXIV Ogólnopol. Nauk. Konf. Sad., Skierniewice, 137–142.
Stachowiak A., Świerczyński S., 1999. Efektywność wzrostu nowych odmian czereśni na podkładce Colt w szkółce. Mat. Konf. Hodowla Roślin Ogrodniczych u progu XXI wieku, Lublin, 253–255.
Stahl P., Schuman G. E., Frost S, M, Williams S. E., 1998. Arbuscular mycorrhizae and water stress tolerance of wyoming big sagebrush seedlings. Soil Sci. Am. J. 62, 1309–1313.
Webster A. D., Hollands M. S., 1999. Apple rootstock studies: Comparision of Polish, Russian, USA and UK selections as rootstocks for the apple cultivar Cox's Orange Pippin (*Malus domestica* Borkh.). J. Hort. Sci. Biotech. 74(3), 367–374.
Wociór S., 2008. The effect of rootstock on the growth and yielding of cultivar 'Kordia' sweet cherry trees. Acta Sci. Pol., Hortorum Cultus 7(1), 21–26.
Van Oosten H. J., 1978. Effect of initial tree quality at planting on yield. Acta Hort. 65, 123–125.

WPŁYW SZCZEPIONKI MIKORYZOWEJ NA WZROST OKULANTÓW WYBRANYCH ODMIAN CZEREŚNI W SZKÓŁCE

Streszczenie. Doświadczenie przeprowadzono w Stacji Doświadczalnej, Uniwersytetu Przyrodniczego w Poznaniu, w latach 2005–2007. Celem tego doświadczenia była ocena wpływu szczepionki mikoryzowej na wzrost okulantów czterech odmian czereśni: 'Burlat', 'Regina', 'Summit', 'Vanda'. Na podstawie uzyskanych wyników stwierdzono, że szczepionka mikoryzowa nie miała istotnego wpływu na żaden z badanych parametrów wzrostu okulantów czereśni. Natomiast okulizowane odmiany czereśni zróżnicowały procent otrzymanych okulantów czereśni oraz ich rozgałęzienie się. Największy procent okulantów otrzymano dla odmiany 'Regina', a najmniejszy zaobserwowano dla odmiany 'Burlat'. Okulanty odmiany 'Summit' charakteryzowały się zdecydowanie mniejszą podatnością do zakładania pędów bocznych od pozostałych rozpatrywanych odmian. Istotnie niższą zawartość chlorofilu stwierdzono w liściach odmiany 'Summit'.

Słowa kluczowe: szczepionka mikoryzowa, szkółka, okulanty czereśni, wzrost

Accepted for print – Zaakceptowano do druku: 29.01.2009