ACTA AGROBOTANICA
Vol. 65 (4), 2012: 163–168
DOI: 10.5586/aa.2012.034

THE EFFECT OF THE TIME OF BUDDING OF MAHALEB CHERRY (*Prunus mahaleb* L.) SEEDLINGS ON THE QUALITY OF MAIDEN TREES OF SOUR CHERRY (*Prunus cerasus* L.) 'ŁUTÓWKA'

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Received: 30.12.2011

Abstract

The present study was conducted at the Felin Experimental Farm, belonging to the University of Life Sciences in Lublin, during the period 2005–2008. The experimental material consisted of maiden trees of sour cherry 'Łutówka' budded on seedlings of mahaleb cherry (*Prunus mahaleb* L.) of unknown origin. The experiment evaluated the effect of four budding times: 15 July, 1 August, 15 August, and 1 September, on the quality of cherry trees in a nursery. The mean for the three years showed that budding time did not have a significant effect on the quality of cherry trees in the nursery. It was observed that the budding of mahaleb cherry performed on the two August dates (1st and 15th) had a more beneficial effect on the growth and branching of trees than the budding done on 15 July and 1 September. The quality of maiden cherry trees 'Łutówka' in the nursery was primarily dependent on weather conditions in a given growing season, which is evidenced by the significant differences between production cycles, high variation in the quantitative results in individual years, and the absence of significant differences in the mean for 2006–2008.

Key words: *Prunus cerasus* L., fruit trees, nursery, rootstock, growth

INTRODUCTION

The sour cherry is a fruit species of great economic importance in Poland. For many years, 'Łutówka' has been the dominant cultivar in commercial orchards (Klimek, 2005) and it is most frequently propagated on seedlings of mahaleb cherry (*Prunus mahaleb* L.) and sweet cherry (*Prunus avium* L.) (Grzyb, 2005). Mahaleb cherry is a rootstock that is commonly used for sour cherry propagation in central and northern Poland, while sweet cherry is used in the south of the country (Grzyb and Sitarek, 1998). A well-chosen rootstock affects both the growth and quality of trees (Baryła and Kapłan, 2006b), accelerates the time to reach the fruit-bearing stage (Hrotkó, 2007; Gratacos et al. 2008)), and improves commercially important fruit traits (Simon et al. 2004; De Salvador et al. 2005). A noble variety (Lipecki and Lipecki, 1994) and weather conditions, in particular during the growing period (Baryła, 2005), are the factors that determine the growth and quality of nursery trees. In the opinion of Howard (1974, 1977) and Wociór et al. (1998), the quality of maiden trees depends on the budding method. Currently, chip budding is one of the basic methods of nursery propagation of fruit trees. The usefulness of this method in the production of sour cherry trees has been confirmed by Czarnecki (1995) and Baryła (2006) in their research. Good results of bud grafting largely depend on the quality of rootstocks (Santos et al. 2007; Cordeiro and Santos, 2007) and the skill of the budder (Poniedziałek et al. 1997). Budding time also has a significant influence (Baryła and Kapłan, 2006a). In the climate of central, southern, and western Poland, budding should be started in the last decade of July, whereas in the northern and eastern parts of Poland this should begin in the middle of July (Ślaski and Sękowski, 1988).

The aim of the present study was to evaluate the effect of four times of budding of mahaleb cherry (*Prunus mahaleb* L.) seedlings on the quality of maiden trees of sour cherry 'Łutówka'.

MATERIALS AND METHODS

The research was carried out at the Felin Experimental Farm, belonging to the University of Life Sciences in Lublin, in 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. Maiden trees of sour cherry (*Prunus cerasus* L.) 'Łutówka' budded on seedlings of mahaleb cherry *(Prunus mahaleb* L.*)* of unknown origin were the subject of the present study. Rootstocks obtained from the "Grzywa" Nursery Farm were planted in a nursery in early spring at a spacing of 90 cm × 25 cm. During the study period, no herbicides were applied and mechanical weed control and hand weeding, if necessary, were used. No irrigation was used in the nursery, fertilization was applied based on soil analysis, while plant protection was carried out in accordance with the current plant protection programme.

The experiment was set up in a randomized block design. It included 4 treatments in 5 replications. The treatments were four budding times: 15 July, 1 August, 15 August, and 1 September, and on these dates grafting was performed using the chip budding method. Plots in which 40 plants were grown were replications. Measurements were made on twenty randomly selected maiden trees per plot.

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 =0.05; p=0.95.

RESULTS

During the study period, there were large variations in weather conditions in particular years (Table 1). The lowest temperatures were recorded at the beginning of 2006. Mean monthly air temperatures in January, February, and March were definitely lower than the long-term averages, while in the other months they were higher. July 2006 was the warmest, but also driest month during the study period, with mean air temperature of 21.9°C and total rainfall of only 6.8 mm. The highest rainfall was recorded in August – 198.3 mm. In the months of February, March, May, August, and November precipitation totals were higher than the long-term mean.

In the period from January to September 2007, mean monthly air temperatures were higher than the long-term average. The highest difference was recorded in January (6.5°C) and in March (5.3°C). In the months of February, April, August, October, and December, the amount of precipitation was lower than the long-term mean precipitation.

In the last year of the study, air temperatures were higher than the long-term mean, except for May and September. August, with mean monthly air temperature of 19.8°C, was the warmest month in 2008. Precipitation varied in particular months. After a wet spring (in March, April, and May total rainfall was higher than the long-term mean), lower rainfall was recorded in the summer months of June, July, and August (below the long-term average for this period). September, October, and December 2008 were characterized by higher precipitation compared to these months over the long-term period.

Table 1
Mean monthly air temperatures and precipitation totals in 1998–2000 compared to the long-term means

Month	Temperature (°C)				Total precipitation (mm)			
	Monthly mean			Long-term mean	Monthly total			Long-term mean
	2006	2007	2008		2006	2007	2008	
January	-7.6	2.6	0.4	-3.9	15.7	51.5	36.2	25.4
February	-4.3	-1.6	2.2	-3.1	26.7	22.3	17.8	24.7
March	-1.0	6.2	3.4	0.9	47.0	30.2	64.8	25.0
April	8.7	8.7	9.3	7.4	30.3	17.4	55.8	38.8
May	13.6	15.1	12.8	13.0	59.3	80.5	101.6	58.5
June	16.9	18.1	17.7	16.4	37.9	87.5	25.9	67.9
July	21.9	19.2	18.3	17.7	6.8	87.0	77.1	77.8
August	17.4	18.4	19.8	17.1	198.3	37.6	45.0	73.7
September	15.7	13.0	12.6	12.9	11.0	129.8	102.2	46.4
October	10.1	7.3	10.1	8.0	14.2	17.7	55.5	39.5
November	5.3	1.0	4.8	2.7	41.2	31.3	33.1	39.9
December	3.0	-1.2	0.9	-1.3	18.6	14.9	43.8	34.5

Table 2
The effect of budding time
on trunk diameter of maiden cherry trees 'Łutówka' in 2006–2008

Time of budding	Diameter of maiden trees, mm				Differences between production cycles			NIR LSD =0.05
	2006	2007	2008	Mean				
15 VII	18.2	16.5 b	11.5 b	15.5	A	B	C	1.1
1 VIII	17.5	17.1 a	14.2 a	16.3	A	A	B	1.3
15 VIII	18.0	17.4 a	13.4 ab	16.3	A	A	B	1.3
1 IX	17.0	14.1 c	15.5 a	15.5	A	B	AB	2.4
LSD NIR =0.05	n.s.-n.i.	0.4	2.6	n.s.-n.i.				

Explanation: Means followed by the same letter are not significantly different at =0.05

On average during the 3-year study period, no significant differences were found in the diameter of maiden trees depending on budding time (Table 2).

The statistical analysis for individual years showed that cherry trees in 2007 and 2008 significantly differed in thickness. In the second year of the study, trees budded on 1 and 15 August had a significantly larger trunk diameter than maiden trees in the other treatments.

Sour cherry trees obtained in 2008 as a result of budding of mahaleb cherry seedlings on 1 September and 1 August were significantly thicker than those that were budded on 15 July.

Significant differences were shown between production cycles. Maiden trees produced in the first year had a significantly larger trunk diameter than trees in the other years, except for cherry trees derived from the budding done on 15 August in the second year of the study and from late budding in the last production cycle.

Table 3
The effect of budding time
on the height of maiden cherry trees 'Łutówka' in 2006–2008

Time of budding	Height of maiden trees, cm				Differences between production cycles			NIR LSD =0.05
	2006	2007	2008	Mean				
15 VII	143.6	143.4 b	129.8 b	138.9	A	A	B	10.8
1 VIII	137.7	140.6 c	145.1 ab	141.1	-	-	-	n.s.-n.i.
15 VIII	141.5	147.4 a	143.2 ab	144.0	-	-	-	n.s.-n.i.
1 IX	141.8	124.6 d	146.2 a	137.5	A	B	A	5.7
LSD NIR =0.05	n.s.-n.i.	1.6	16.0	n.s.-n.i.				

Explanation: Means followed by the same letter are not significantly different at =0.05

On average, the highest trees were obtained from the budding of mahaleb cherry seedlings performed on the two August dates, while the lowest ones when the rootstocks were budded on 15 July and 1 September, but the differences were insignificant (Table 3).

The budding times applied significantly affected cherry tree height only in the second and third year of the experiment. In 2007 maiden trees derived from the budding on 15 August were significantly higher than the other ones, while in the last production cycle trees obtained from late budding (1 September) differed significantly from cherry trees budded on 15 July.

No significant differences were found between years in the case of the August budding times. Maiden trees obtained from the budding done on 15 July were significantly higher in the first two production cycles, whereas those budded on 1 September were higher in 2006 and 2008.

The statistical analysis of the mean for the study period did not show a significant effect of budding time on branching of cherry trees in the nursery (Table 4).

Table 4
The effect of budding time on branching of maiden cherry trees 'Łutówka' in 2006–2008

Time of budding	2006	2007	2008	Mean	Differences between production cycles			NIR LSD =0.05
Total length of lateral shoots per tree, cm								
15 VII	531.1 ab	440.6 a	348.2	440.0	A	B	C	86.2
1 VIII	531.5 ab	421.0 a	448.4	466.9	-	-	-	n.s.-n.i.
15 VIII	633.1 a	453.0 a	345.8	477.3	A	B	B	140.0
1 IX	425.8 b	299.7 b	361.5	362.4	A	B	AB	96.2
LSD NIR =0.05	166.1	44.8	n.s.-n.i.	n.s.-n.i.				
Number of lateral shoots per tree								
15 VII	10.0 ab	10.4 a	7.2	9.2	A	A	B	1.6
1 VIII	10.7 ab	9.5 a	7.7	9.3	A	AB	B	2.1
15 VIII	12.0 a	9.8 a	7.8	9.9	A	B	C	1.7
1 IX	8.8 b	7.1 b	6.3	7.4	A	AB	B	2.1
LSD NIR =0.05	2.2	1.1	n.s.-n.i.	n.s.-n.i.				
Shoot lenght, cm								
15 VII	52.9	42.5	48.9 ab	48.1	A	B	AB	7.9
1 VIII	49.4	44.7	60.0 a	51.4	AB	B	A	13.3
15 VIII	52.3	46.3	44.4 b	47.7	A	AB	B	7.1
1 IX	48.8	42.5	57.2 ab	49.5	B	C	A	6.2
LSD NIR =0,05	n.s.-n.i.	n.s.-n.i.	13.3	n.s.-n.i.				

Explanation: Means followed by the same letter are not significantly different at =0.05

In the first year of the study, maiden cherry trees 'Łutówka' obtained as a result of budding on 1 September had a significantly lower total length and number of lateral shoots than cherry trees budded on 15 August, while in 2007 the values of these traits were also lower compared to trees in the other treatments. Significant differences in shoot length were found only in the last production cycle. Trees budded on 1 August produced significantly longer sylleptic shoots than cherry trees budded onto seedlings in the middle of August.

The degree of branching of cherry trees significantly varied between years. In the first year of the study, maiden trees were characterized by the significantly greatest total length of sylleptic shoots. In the case of budding on 1 August, no significant differences were found. In the last production cycle, cherry trees had a significantly lower number of lateral shoots than in the first year of the study. Maiden trees in 2007 (except for trees budded on 15 August) as well as cherry trees obtained from the budding done on 15 August in the third year and on 1 September in the first production cycle had the significantly shortest sylleptic shoots.

DISCUSSION

The time of grafting depends on climate and microclimate in a given region (Ślaski and Sękowski, 1988). Poland is in the zone of temperate transitional climate which is characterized by large variations in weather conditions and precipitation. As a result of that, over a 10-year period there are on average three very dry years and four years in which droughts occur periodically during the growing season (Treder, 2002). In the period 2006–2008, there were great variations in weather conditions, in particular during the growing period of maiden trees.

In the opinion of many nursery growers, the best time for budding is the peak of the summer (end of July – middle of August) during the time of intensive divisions of cambium cells. As reported by Hołubowicz et al. (1993), budding of sour cherry should be started from sweet cherry after 22 July, and only later buds are grafted onto mahaleb cherry which maintains the active division of cambium longer.

Four times of budding onto mahaleb cherry rootstocks: two recommended ones – 1 and 15 August; 15 July; and untypical late time – 1 September, were applied in the experiment in order to compare them. On the basis of the mean obtained for 2006–2008, no significant differences were found in the height of cherry trees in the nursery depending on budding time. It was observed that maiden trees obtained from the budding done in August were higher, thicker, and better branched than sour cherries budded on 1 September and 15 July. According to Grzyb (1999), the use of selective types of rootstock in the production of sour cherry trees substantially improves their quality.

In his study, this author demonstrated that seedlings of mahaleb cherry 'Popiel' clearly improved the qualitative characters of maiden trees of sour cherry 'Łutówka' (height, diameter as well as number of shoots in the crown and shoot length), compared to seedlings of mahaleb cherry of unknown origin. Numerous authors have already earlier drawn attention to the need to select *Prunus mahaleb* L. in order to obtain the basic commercial variety of sour cherry (Funk, 1969a, 1969b; Czynczyk et al. 1988; Grzyb and Gronek, 1991).

The quality of nursery trees depended to a greater extent on weather conditions in a given year than on budding time, as is evidenced by the significant differences between years and between production cycles. In 2006 maiden trees had a larger trunk diameter and were better branched than those in the last year of the study. The significantly highest height of sour cherry trees was found in 2007 in the case of budding done on 15 August and in the last production cycle with the time of budding on 1 September. Late budding time (1 September) resulted in poorer branching of maiden trees in the nursery in each year of the study. A similar dependence of the quantitative and qualitative results on weather conditions during the growing period was observed by Baryła in his research (2005, 2006).

Czarnecki (1995) showed that the best time for sour cherry budding onto sweet cherry was the middle of July. In the case of mahaleb cherry, later times are generally recommended. In his study on the time and method of budding on the growth of maiden cherry trees, Baryła (2006) obtained qualitatively better trees on mahaleb cherry than on sweet cherry as a result of budding done on 15 July. The present experiment has demonstrated that, with favourable conditions, budding both on 15 July and 1 September can be used in the production of sour cherry trees. This is evidenced by the good results obtained in the case of budding on 15 July in the first and second year of the study as well as in the case of budding of mahaleb cherry seedlings on 1 September in 2006 and 2008. Baryła (2006) obtained similar results for late budding in the period 1998–2000. This author showed that late budding of both mahaleb cherry and sweet cherry did not change significantly the quality of maiden trees of sour cherry 'Łutówka.

CONCLUSIONS

The mean for the study period shows that budding time did not have a significant effect on the quality of maiden cherry trees in the nursery. However, it was observed that budding of rootstocks in August had a more beneficial effect on the growth and branching of sour cherry trees in the nursery than budding done on 15 July and 1 September.

The quality of maiden cherry trees 'Łutówka' in the nursery primarily depended on weather conditions in a given growing season, which is evidenced by the significant differences between production cycles, high variation in the qualitative results in individual years, and the absence of significant differences in the mean for 2006–2008.

Acknowledgements

Research supported by the Ministry of Science and Higher Education of Poland as the part of statutory activities of Department of Seed Production and Nurseries, University of Life Sciences in Lublin.

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Wpływ terminów okulizacji siewek antypki (*Prunus mahaleb* L.) na jakość okulantów wiśni (*Prunus cerasus* L.) odmiany Łutówka

Streszczenie

Badania przeprowadzono w latach 2005–2008 w Gospodarstwie Doświadczalnym Felin należącym do Uniwersytetu Przyrodniczego w Lublinie. Materiał doświadczalny stanowiły okulanty wiśni odmiany 'Łutówka' okulizowane na siewkach antypki (*Prunus mahaleb* L.) nieznanego pochodzenia. W doświadczeniu oceniano wpływ czterech terminów okulizacji wykonanych: 15 lipca, 1 sierpnia, 15 sierpnia i 1 września na jakość drzewek wiśni w szkółce. Na podstawie średniej z trzech lat badań wykazano, że termin okulizacji nie miał istotnego wpływu na jakość okulantów wiśni w szkółce. Zaobserwowano, że okulizacja antypki w dwóch sierpniowych terminach (1 i 15) korzystniej wpływała na wzrost i rozgałęzianie się drzewek wiśni niż okulizacja 15 lipca i 1 września. Jakość okulantów odmiany 'Łutówka' w szkółce zależała głównie od przebiegu pogody w danym okresie wegetacyjnym, o czym świadczą istotne różnice pomiędzy cyklami produkcyjnymi, duża zmienność wyników ilościowych w poszczególnych latach oraz brak istotnych różnic dla średniej z lat 2006–2008.