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EVALUATION OF ROOT SYSTEM OF SEEDLING OF BLACK CHERRY (*Padus serotina* L.) DEPENDING ON SEED QUQLITY

Anna Bieniek, Zdzisław Kawecki

Chair of Horticulture, University of Warmia and Mazury, Olsztyn

Abstract. The assessment of black cherry seedlings root system was carried out at the Didactic-Experimental Establishment of the UWM in Olsztyn in September 2002. The seeds from which the examined seedlings were obtained had been sown into the ground on 2 October 2001. The following seeds were used for the experiment: fresh, sown into the ground immediately after obtaining them from fruit, partly dried seeds and seed sown a month later than in the preceding case as well as physiologically immature seeds and whole fresh fruit. The root systems of seedlings obtained from seeds stored for 1 year and 2 years in open and closed "Twist" type jars at room temperature and in a freezer were also assessed. The largest proportions of seedlings were obtained from seeds stored for 1 year and 2 years in a freezer. The lowest proportions of seedlings were obtained from seeds sown a month later and from whole fresh fruit. In this experiment the most favorable development of the root system was observed in case of seedlings from seeds stored for 2 years in an open jar. The time from picking to sowing of seeds was of little importance. The seedlings from partly dried seeds and later sowing were characterized by the lowest mass of the root system.

Key words: black cherry, *Padus serotina,* seed quality, root system

INTRODUCTION

The black cherry is economically justified in development of areas with the environment polluted by industry [Białobok 1988]. Imurzyński [1969] classified black cherry as an auxiliary species in forest cultivation because of its precious phytomelioration properties. The favorable influence of *Padus serotina* on fertility of poor forest soils is confirmed by the results of studies by Kowalski [1989] and Plichta et al. [1997]. Vogel [1981] stated that black cherry is suitable for reclamation of degraded soils. The best results are obtained when planting one year or older seedlings. High decorative

Corresponding author – Adres do korespondencji: Anna Bieniek, Zdzisław Kawecki, Chair of Horticulture, University of Warmia and Mazury, 21 Prawocheńskiego Street, 10-757 Olsztyn, Poland, e-mail: katogr.@uwm.edu.pl

values of black cherry flowers and fruit result in planting it in parks along park vistas and as greenery in recreational gardens. It can be planted individually, in groups and also it can be used as uncut tree lines [Bugała 2000, Waźbińska and Kawecki 2002].

Reproduction of black cherry from seeds is the easiest solution. The proper seeds management is the basic condition for generative reproduction. It covers seeds picking and pre-sowing preparation. The time of picking and the further treatment are closely related to the biological properties of different species, intended use of seeds and planned sowing time [Janson and Załęski 1998].

The black cherry seedlings possess pile root system; the main root is slightly longer than the cotyledon part with relatively long side roots. Under favorable lighting conditions the roots reach the length of 15-20 cm on most types of soil during the first year [Król 1972].

The growth of root mass is conditioned by soil and climate conditions as well as the status of the plant itself. The muck soil on which the experiment was established is characterized by good aeration and exceptional in high contents of available phosphorus, copper and zinc, however, for some periods it is excessively dry [Bieniek 1994]. The drought stress has a complex influence on plants manifesting mainly in inhibition of growth, development irregularities and, as a consequence, very clear decrease of biomass production. A short period of drought does not cause permanent damages [Sadowska, Pukacki 1997].

The experiment aimed at explaining whether the time of seeds picking and storage influence growth and development of root system in seedlings of black cherry.

MATERIAL AND METHODS

The single factor experiment in the system of random blocks with four repetitions was established in September 2001 at the Didactic-Experimental Establishment of UWM in Olsztyn. The material for the experiment was collected in 1999, 2000 and 2001 from trees growing at "Kortowo" university campus and in the city of Olsztyn. Seeds were obtained from fruit manually. Seeds cleaned of parenchyma and slightly dried at room temperature were stored for 1 year and 2 years in open or closed "Twist" type jars at room temperature and in a freezer at -20°C. Also whole fruit, brownish-red in skin color and fresh seeds sown into the ground immediately after obtaining them from fruit (picked on 3 September 2001), partly dried seeds sown 2 weeks after picking and seeds planted a month later than those in the preceding option as well as physiologically immature seeds (picked on 6 August 2001 were used for the experiment).

Seeds of rum cherry were sown into soil at the depth of 1.5 cm in four repetitions of 100 seeds (400 seeds in a row). The distance between seeds was 5 cm and between the rows 30 cm. The seeds were covered with a layer of loose sand.

The area on which the experiment was established was flat, with muck soil on slightly loamy and loose sand with humidity status slightly dry for some periods. The humus layer of the soil was alkaline (pH_{KCl} = 7.7), containing 7.18% of organic matter and it fulfilled the criteria of melanic. It contained high levels of available phosphorus, copper and zinc, medium of potassium, magnesia and manganese as well as natural

levels of heavy metals (Pb, Ni and Cd). The soil was classified as good rye complex (5), fertility class R IVb.

Before assessment of the root system, the percentage of seedlings was determined for all experimental setups (tab. 1). Seedlings were collected from the ground in September 2002 and measurements were carried out. The following features were considered in assessment of the seedlings: root system length, number of skeletal roots, diameter of skeletal roots, number of capillary roots, diameter of root neck, root system mass and the mass of the above ground seedling part. For that purpose 10 plants were picked at random from each repetition.

Table 1. The number of seedlings of black cherry in 2002 year
Tabela 1. Liczba siewek czeremchy późnej w 2002 roku

Type of seeds Sposób przygotowania nasion	The number of seedlings Liczba siewek %
Fresh seeds Nasiona świeże	20.50b
Pre-dried seeds Nasiona podsuszone	28.25b
Physiologically immature seeds Nasiona niedojrzałe fizjologicznie	19.00b
Seeds stored in a closed jar for one year Nasiona przechowywane 1 rok w zamkniętym słoiku	16.50b
Seeds stored in a closed jar for 2 years Nasiona przechowywane 2 lata w zamkniętym słoiku	25.25b
Seeds stored in an open jar for one year Nasiona przechowywane 1 rok w otwartym słoiku	17.50b
Seeds stored in an open jar for 2 years Nasiona przechowywane 2 lata w otwartym słoiku	19.00b
Seeds stored in a freezer for one year Nasiona przechowywane 1 rok w zamrażalniku	53.75a
Seeds stored in a freezer for 2 years Nasiona przechowywane 2 lata w zamrażalniku	52.00a
Whole fresh fruits Całe owoce świeże	7.00c
Pre-dried seeds sown one month later Nasiona podsuszone, wysiane miesiąc później	2.25c

The values denoted with the same letters are not significantly different by p = 0.05
Wartości, którym przypisano takie same litery nie różnią się istotnie od siebie przy p = 0,05

The results were statistically processed using the typical variation analysis for the method of experiment establishment [Januszewicz and Puzio-Idźkowska 2002]. In case of features characterizing field formation of seedlings, the variance analysis on transformed data was applied [Wójcik et al. 1984] according to the formula $y = \text{arc} \cdot \sin\sqrt{x}$ (Bliss transformation). Assessment of differences between the average values from objects was done using multiple Duncan test at p = 0.05.

RESULTS AND DISCUSSION

In 2002, the largest numbers of seedlings were obtained from seeds stored for 1 year and 2 years in a freezer (53.75% and 52.00%); those were significant differences as compared to the other experimental options (tab. 1). The lowest percentage of seedlings was obtained from seeds sown a month later (2.25%) and from whole fresh fruit sown (7.00%). The statistical analysis did not show significant differences between the numbers of seedlings obtained from seeds that were sown fresh, partly dried, physiologically immature and stored for 1 year and 2 years at room temperature in closed and open jars. The percentages of seedlings in the above experimental options were at the level of from 16.50% (seedlings from seeds stored for 1 year in closed jars) to 28.50% (seedlings from partly dried seeds).

Seedlings of black cherry from all experimental setups did not differ significantly in the length of root system which was from 22.0 cm in seedlings from seeds stored for 1 year in a closed jar to 28.85 cm for seedlings from seeds stored for 2 years in a closed jar (tab. 2). The largest root system (and above ground part) mass was obtained for seedlings from seeds stored for 2 years in open jars: 12.63 g. The lowest root system mass was obtained for seedlings from seeds sown a month later than in the other experimental options: 3.54 g. The largest significant differences in the number of skeletal roots were recorded for seedlings from seeds stored in an open jar for 1 year – 2,5 roots and seedlings from seeds stored for 1 year in a closed jar – 4.5 roots. The root systems of seedlings from other experimental setups did not differ significantly in this characteristic. The largest numbers of capillary roots were recorded in seedlings from fresh seeds – 13 roots and the lowest in seedlings from seeds stored for 2 years in closed jars – 8 roots. Seedlings from whole fresh fruit were characterized by the root neck with the largest diameter: 8.72 mm, the lowest diameter root neck was characteristic for seedlings from partly dried seeds – 4.93 mm. Seedlings obtained from seeds surrounded by parenchyma were characterized by good quality as they were exceptional in high mass of the above ground part and the root system while the number of seeds producing seedlings in this case was significantly lower than in the other cases (tab. 1).

Under field conditions, germination of seeds depends to a significant extent on the development of external factors where the same factor may have stimulating or inhibiting influence on different species, or even varieties of plants [Król 1972]. Tylkowski [1999] observed a negative influence of the temperature at -3ºC on the later germination potential of seeds of ordinary fir, ordinary maple, field maple and European hornbeam. In case of this experiment the delay in sowing date of black cherry seeds by 1 month influenced a decrease in the number of seedlings developed. Low temperatures in November and December 2001 did not favor field germination of late sown black cherry.

Grześkowiak et al. [1983] studied the influence of storage of seeds of *Prunus avium*, *Prunus mahaleb* and *Prunus divaricata* as well as 'Antonówka' apple tree and Caucasian pear on productivity of seedlings in a nursery after sowing of earlier stratified seeds. As a result of those studies they recommend, as a general principle, storage of seeds in tight flasks at temperatures ranging from -1ºC to -3ºC. The temperature of -18ºC was slightly less favorable for *Prunus* seeds. This study showed, however, that the largest number of seedlings was obtained from seeds stored in closed jars in a freezer.

Table 2. Certain morphological features of seedlings of black cherry
Tabela 2. Niektóre cechy morfologiczne systemu korzeniowego siewek czeremchy późnej

Type of seeds Sposób przygotowania nasion	The length of root system Długość systemu korzeniowego cm	The number of skeletal root Liczba korzeni szkieletowych szt.	The length of skeletal root Długość korzeni szkieletowych cm	The diameter of the skeletal root Średnica korzeni szkieletowych mm	The number of capillary root Liczba korzeni włoskowatych szt.	The diameter of root's neck Średnica szyjki korzeniowej mm	The weight of root system Masa systemu korzeniowego g	The weight of above-ground part Masa części nadziemnej g
1	25.60	2.75ab	15.13ab	4.02bc	13.00b	7.95bcd	8.45ab	9.78a
2	24.70	3.00ab	14.65ab	3.49abc	9.75ab	4.93a	5.41ab	6.19a
3	23.90	4.50b	13.96ab	3.51abc	12.25ab	7.27bc	9.20ab	9.74a
4	22.00	3.75ab	16.22b	2.33a	10.25ab	7.40bc	8.27ab	9.96a
5	25.92	3.50ab	12.83ab	4.10bc	8.00a	7.10abc	9.84ab	12.89ab
6	25.57	2.50a	10.03ab	2.99ab	8.50ab	6.50abc	6.24ab	5.03a
7	26.70	3.50ab	14.48ab	4.42c	12.00ab	7.96cd	12.63b	21.55b
8	25.57	3.25ab	15.06ab	3.37abc	10.25ab	7.15abc	7.62ab	9.02a
9	28.85	3.00ab	15.57ab	4.12bc	11.00ab	7.10abc	6.68ab	7.24a
10	25.87	3.00ab	13.16ab	4.67c	12.25ab	8.72d	9.79ab	13.24ab
11	24.27	3.00ab	9.96ab	2.90ab	11.25ab	5.92ab	3.54a	3.97a
LSD p = 0.05 NIR p = 0,05	n.ist. n.s.	1.548	5.320	1.209	4.057	2.013	7.230	10.008

Explanations – Objaśnienia:

1 – Fresh seeds – Nasiona świeże.
2 – Pre-dried seeds – Nasiona podsuszone na powietrzu przez 2 tygodnie.
3 – Physiologically immature seeds – Nasiona niedojrzałe fizjologicznie.
4 – Seeds stored in a closed jar for one year – Nasiona przechowywane w zamkniętym słoiku 1 rok.
5 – Seeds stored in a closed jar for 2 years – Nasiona przechowywane w zamkniętym słoiku 2 lata.
6 – Seeds stored in an open jar for one year – Nasiona przechowywane w otwartym słoiku 1 rok.
7 – Seeds stored in an open jar for 2 years – Nasiona przechowywane w otwartym słoiku 2 lata.
8 – Seeds stored in a freezer for one year – Nasiona przechowywane w zamrażalniku 1 rok.
9 – Seeds stored in a freezer for 2 years – Nasiona przechowywane w zamrażalniku 2 lata.
10 – Whole fresh fruit – Całe owoce świeże.
11 – Pre-dried seeds sown one month later – Nasiona podsuszone wysiane miesiąc później.

Janson and Załęski [1998] report that if the seeds are intended for immediate sowing, they may be picked early, before reaching physiological maturity, generally without harm for their vitality and in case of species requiring stratification that could even be favorable.

Germination of seeds from whole fresh fruit was poorer than those from physiologically immature seeds. Presence of parenchyma caused a delay in germination. Black cherry fruit contain high quantities of phenolic compounds. Those compounds limit access of oxygen to embryo tissues located deeper causing a decrease in germination capacity [Krwiarz 1972].

The experimental field on which the seedlings developed was watered as needed and as a consequence there probably was no drought stress for the studied plants. Those seedlings were characterized by longer root system than reported by Król [1972].

Initially the seedlings develop a root system with a large number of capillary roots increasing the absorption surface, i.e. the root system develops earlier and is followed by the extensive development of leaves [Kolesnikow 1982]. The largest numbers of capillary roots were recorded for seedlings from fresh seeds, physiologically immature seeds and from whole fresh fruit while the lowest numbers of such roots were recorded for seedlings from seeds stored for 2 years in a closed jar and seeds stored in an open jar for 1 year.

In case of this experiment the most favorable development of root system was observed in seedlings from seeds stored in an open jar for 2 years (highest mass and length). From those seeds a low percentage of seedlings was obtained and as a consequence a more extensive development of the part above ground occurred. In this experiment, good development of root system in all setups, except seedlings obtained from seeds stored in an open jar for 1 year, was positively correlated with good development of the above ground part. Roots supply large quantities of mineral components and some phytohormones, mainly cytokinins to the sprout. The sprout, in exchange, supplies the products of assimilation, vitamins and other important organic substances to the roots [Kopcewicz and Lewak 1998].

CONCLUSIONS

1. The largest numbers of seedlings were obtained from seeds stored in a freezer for 1 year and 2 years; the lowest numbers of seedlings were obtained from seeds sown a month later than the others and from while fresh fruit. Statistical analysis did not show significant differences between the number of seedlings obtained from fresh seeds, partly dried seeds, physiologically immature seeds and seeds stored for 1 year and 2 years at room temperature in a closed and an open jar.

2. The mass of root system of the examined seeds was positively correlated to the mass of the over the ground part of seedlings.

3. Seedlings from seeds stored for 2 years in an open jar and seedlings from whole fresh fruit as well as those from seeds stored for 2 years in a closed jar were characterized by the best development of the root system (mass, diameter of skeletal roots and the root neck, cumber of capillary roots).

4. The time from collection of seeds to sowing had no significant influence on later growth and root system development of black cherry seedlings. Seedlings from partly dried seeds and seeds sown later were characterized by a lowest root system mass.

5. The quality of sown black cherry seeds had no significant influence on the length of the root system of the examined seedlings.

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OCENA SYSTEMU KORZENIOWEGO SIEWEK CZEREMCHY PÓŹNEJ (*Padus serotina* L.) W ZALEŻNOŚCI OD JAKOŚCI NASION

Streszczenie. Ocenę systemu korzeniowego siewek czeremchy późnej przeprowadzono we wrześniu 2002 r. w Zakładzie Dydaktyczno-Doświadczalnym UWM w Olsztynie. Nasiona, z których otrzymano badane siewki, wysiano do gruntu 2 października 2001 r. Do doświadczenia użyto następujących nasion: świeżych, wysianych do gruntu bezpośrednio po wydobyciu z owoców, podsuszonych oraz nasion wysianych miesiąc później od poprzedniego wariantu, a także nasion niedojrzałych fizjologicznie i całych owoców świeżych. Oceniano również system korzeniowy siewek z nasion przechowywanych 1 rok i 2 lata w otwartych lub zamkniętych słoikach „twist" w temperaturze pokojowej i w zamrażalniku. Największą liczbę siewek otrzymano z nasion przechowywanych 1 rok i 2 lata w zamrażalniku. Najmniejszy odsetek wschodów zanotowano z nasion wysianych miesiąc później oraz z całych owoców świeżych. W niniejszych badaniach najkorzystniejszy rozwój systemu korzeniowego obserwowano u siewek z nasion przechowywanych 2 lata w otwartym słoiku. Termin od zbioru do wysiewu nasion miał małe znaczenie. Siewki z nasion podsuszonych i późniejszego siewu charakteryzowały się najmniejszą masą systemu korzeniowego.

Słowa kluczowe: czeremcha późna, *Padus serotina,* jakość nasion, siewki, system korzeniowy

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