

Growth and development of marshmallow (*Althaea officinalis* L.) depending on the method of plantation establishment

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Summary

In a 4-year field experiment the effect of plantation establishment methods (direct sowing in the field – control; direct sowing in the field with cover of polypropylene sheet; by seedlings from plastic house; by seedlings produced in multi-cell propagation trays) on the growth and development of marshmallow plants as well as the mucilage content in roots in the first and second year of vegetation were compared. It was found that cultivation from seedlings in the first year of vegetation contributed to increase in growth and development rate of marshmallow plants. As a consequence, higher fresh weight of the above-ground parts and roots were obtained when plants were propagated from transplants than from direct sowing in the field. The greatest height and number of stalks as well as the highest plant weight were observed on the plots with seedlings produced in multiplates. In the case of biennial plants, the method of plantation establishment slightly modified the growth and development of marshmallow. The highest mucilage content was found in roots obtained from cultivation under polypropylene sheet.

Key words: marshmallow, Althaea officinalis L., method of plantation establishment, mucilage content

The marshmallow is a rich source of mucilaginous substances that have an antitussive, softening and coating action. The roots and leaves are used in the manufacture of plant drugs, used for the treatment of upper respiratory tract infections, stomatitis, pharyngitis and esophagitis as well as digestive tract disorders and metabolism disorders [1, 2]. The recommended methods of marshmallow cultivation are sowing the seeds directly in the field or planting seedlings [3]. Studies conducted so far do not unequivocally indicate relationships between the growth, development of plants, active compound content and the cultivation methods.

The aim of this study was to determine the most efficient method of plantation establishment and perform a chemical assessment of the raw material obtained.

MATERIALS AND METHODS

Field experiments with one- and two-year-old plants were conducted in Zamość in the years 2002–2005 on brown soil of loess origin characterized by a medium humus and magnesium content, a very high phosphorus and potassium content, and a neutral reaction. The following methods of plantation establishment were compared: 1) direct sowing in the field (control); 2) direct sowing in the field with cover of polypropylene sheet; 3) planting seedlings obtained from plastic house; 4) planting seedlings produced in multi-cell propagation trays. The experiment was performed using random blocks in four repetitions, on plots of 20 m² each. The plots were divided into two halves, with one half assigned for a two-year plantation utilized in the following year. In the experiment, the following doses of mineral fertilizers were used (kg·ha⁻¹): 70 N, 25 P, 90 K. In order to obtain seedlings, seeds were sown in a heated plastic house in the middle of March, on a peat substrate as well as in multi-cell trays filled with the same peat substrate. Seeds were sown in the field in mid-April. Immediately after sowing, the designated plots were covered with polypropylene sheet that was later removed when the plants reached the height of 15 cm. The seedlings were transplanted to the field in early May. For all objects the row spacing of 50 x 40 cm was applied. During the vegetation period, observations of development stages were conducted and measurements of the plants' height were performed at 10-day intervals. After the harvest, at the beginning of September, the number of sprouts and leaves was determined, and also weight of the above- and underground parts of plants were recorded (based on 20 plants from each object). After drying the root samples (at a temperature of 40°C), the mucilage content was determined in the raw material using the gravimetric method [4]. The results were statistically analysed. The significance of differences was determined by means of Tukey's test with the level of significance $\alpha=0.05$.

RESULTS AND DISCUSSION

The plants' growth and development in the first year of cultivation depended on the method of plantation establishment. The emergence observed in the object where polypropylene sheet was used was occurring a few days sooner each year. In relation to control object, the covered plants also demonstrated a faster growth rate (Fig. 1), earlier commencement of the flowering stage (from 3 to 8 days) and greater height (by 9.3 cm, see Table 1). The observations made are confirmed in the study of Prośba-Białczyk and Mydlarski [5], according to which the use of polypropylene sheet in potato cultivation accelerates the emergence and

growth of plants as well as the development of the assimilation surface. Throughout the vegetation period, plants cultivated from seedlings were growing much faster, reaching a significantly larger height before the harvest in comparison with direct sowing in the field. The fastest growth rate was recorded in the object with seedlings produced in multi-cell trays, similarly to the experiment with artichoke conducted by Winiarska [6]. No distinct differences were observed in the course of the development stages of the plants depending on the method of seedling production. In the second year of vegetation, the growth (fig. 2) and development were similar in all objects and did not depend on the plantation establishment method. As a result, the ultimate height of the plants was similar and ranged from 227.0 to 234.9 cm (differences were not significant).

Table 1.

The effect of the method of plantation establishment on some marshmallow plants features (mean for years 2002–2005).

object	plant height [cm]		number of stalks		number of leaves		fresh weight of above-grounds parts (g per plant)	
	1	2	1	2	1	2	1	2
sowing in the field – control	149.5	227.0	8.2	9.1	156.2	177.5	505	991
sowing in the field + cover of polypropylene	158.8	231.7	9.8	9.8	179.2	193.8	544	1104
seedlings from plastic house	176.1	234.9	10.3	10.4	209.6	165.8	669	1031
seedlings from multiplates	183.0	232.4	12.0	11.6	218.4	177.8	730	1102
mean	166.8	231.5	10.1	10.2	190.8	178.7	612	1057
NIR _{0.05}	8.6	ni	1.5	1.9	21.4	ni	67	ni

1. annual plants 2. biennial plants

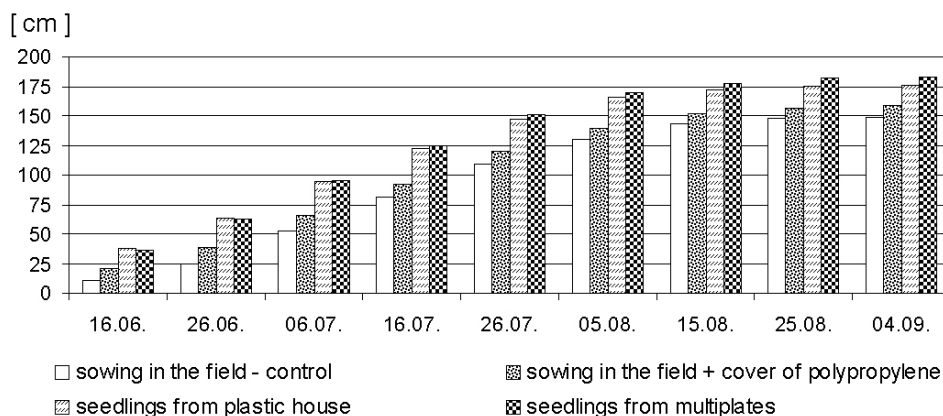


Fig. 1. Growth rate of one-year old marshmallow plants (mean for years 2002–2004).

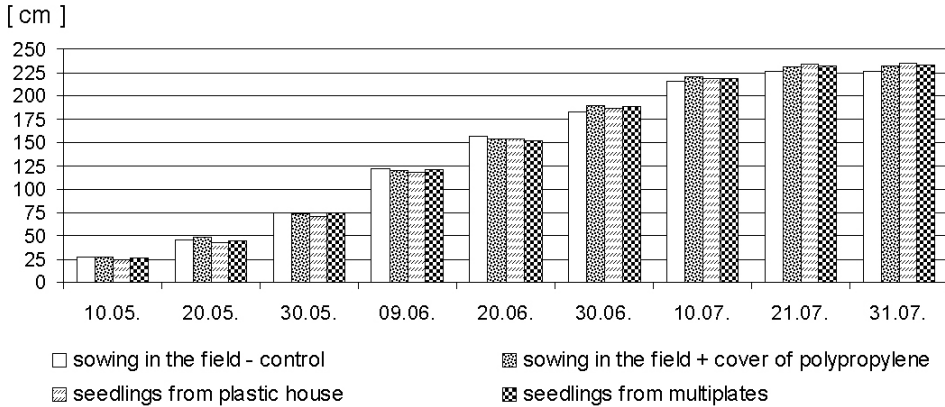


Fig. 2. Growth rate of two-year old marshmallow plants (mean for years 2003–2005).

In the one-year-old plantation, more sprouts were formed by plants cultivated from seedlings than those from direct sowing. It should be emphasized, however, that the production of seedlings in multi-cell trays significantly increased the number of sprouts compared to seedlings obtained from plastic house. Furthermore, the objects with seedlings exhibited a significantly greater number of leaves and higher fresh mass of above-ground parts of plants, as compared to object with direct sowing, but the method of seedling production had no significant influence on these features. The use of polypropylene sheet after sowing the seeds stimulated the formation of sprouts and leaves. As a result, the covered plants formed a significantly larger number of these organs than plants in the control object. The use of covering also increased fresh weight of the above-ground parts, but the observed differences with regard to the control object were not significant. In the second year of vegetation, the studied factor only slightly determined the number of leaves and the weight of the above-ground parts, but significantly modified the number of the sprouts. Plants cultivated from seedlings demonstrated a higher capacity to form these organs than those from direct sowing (statistically significant differences were found only between the control object and the object with seedlings from multi-cell trays).

It was proved that the method of plantation establishment had a significant influence on the weight of one-year-old fresh roots (a lack of significant differences was observed only between objects with direct sowing in the field, see Fig. 3). The largest root weight increase, in comparison with the control object, was achieved when seedlings were produced in multi-cell trays (by 73%), whereas in the case of seedlings obtained from the plastic house, the increase was by 53%. The results obtained were confirmed by research conducted by Sugier [7], where she demonstrated that cultivation of dandelion from seedlings gave much better results than direct sowing in the field. The use of polypropylene sheet caused 13% significant increase of the marshmallow root mass, as compared to the object with no cover.

In the experiments performed by Wadas [8] and Słodkowski [9], the use of covers caused the weight of a potato bulb and a carrot plant to increase by 16% and 24%, respectively. In the second year of vegetation, the method of plantation establishment modified the root weight to slightly smaller degree, whereas the best results were achieved in the object with seedlings produced in multi-cell trays (the fresh root weight was significantly higher compared to other experimental objects and amounted to 513 g per plant).

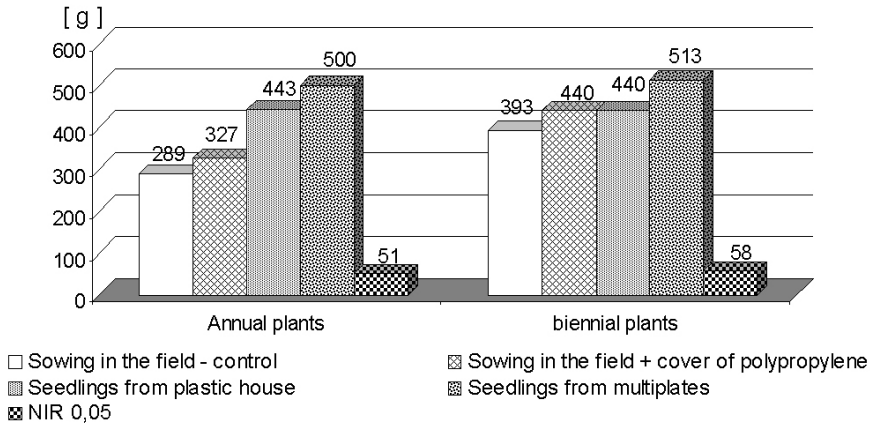


Fig. 3. Fresh weight of 1 marshmallow root (mean for years 2002–2005).

Both in the first and second year of vegetation, the greatest amount of mucilage was accumulated by roots in the object with polypropylene sheet (Fig. 4). Two-year-old roots had a slightly higher mucilage content (on average 8.91% compared to 8.31% in the first year of cultivation). These results are in conformity with the findings of Kostujak and Steindel [10], according to which the mucilage content in the raw material increases with the age of the plants.

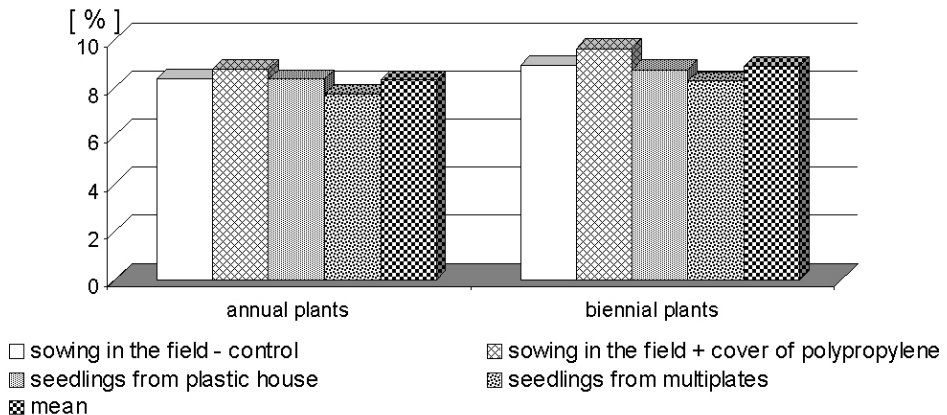


Fig. 4. Mucilage content in marshmallow roots (mean for years 2002–2005).

CONCLUSIONS

1. Cultivation from seedlings in the first year of vegetation contributed to the acceleration of the plants' growth and development. Therefore, in consequence, to significantly larger number of sprouts as well as higher root weight formation, as compared to cultivation from direct sowing in the field.
2. The method of plantation establishment had a small influence on the growth and development of the plants in the second year of vegetation.
3. The planting of seedlings produced in multi-cell propagation trays significantly increased the fresh root weight compared to the object with seedlings from plastic house.
4. Use of polypropylene sheet after the seeds were sown accelerated the emergence, further growth and development of the plants. As a result, the covered plants exhibited a significantly greater height and number of stalks and leaves, as compared to the cultivation with no cover.
5. The highest mucilage content (regardless of the plants' age) was achieved in roots from a plantation with direct sowing in the field and a polypropylene sheet cover.

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WZROST I ROZWÓJ PRAWOŚLAZU LEKARSKIEGO (*ALTHAEA OFFICINALIS* L.) W ZALEŻNOŚCI OD METODY ZAKŁADANIA PLANTACJI

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Streszczenie

W czteroletnim doświadczeniu polowym badano wpływ sposobu zakładania plantacji (z wysiewu nasion wprost do gruntu – obiekt kontrolny; z wysiewu nasion wprost do gruntu z przykryciem agrowłókniną; z rozsady uzyskanej w tunelu foliowym; z rozsady wyprodukowanej w tacach wielokomórkowych w tunelu foliowym) na wzrost i rozwój prawoślazu lekarskiego oraz na zawartość śluzu w korzeniach w pierwszym i drugim roku wegetacji roślin. Stwierdzono, że uprawa z rozsady w pierwszym roku wegetacji przyczyniła się do przyspieszenia tempa wzrostu i rozwoju roślin, a w konsekwencji do wytworzenia większej masy części nadziemnych i korzeni w porównaniu z uprawą z wysiewu nasion wprost do gruntu. Największą wysokością i liczbą pędów, jak również największą masą części nadziemnych i korzeni odznaczały się rośliny uzyskane z rozsady wyprodukowanej w tacach wielokomórkowych. W drugim roku uprawy metoda zakładania plantacji miała niewielki wpływ na wzrost i rozwój roślin. Analizy chemiczne wykazały, iż najwięcej śluzu (niezależnie od wieku roślin) zawierały korzenie pochodzące z uprawy z zastosowaniem agrowłókniny.

Słowa kluczowe: prawoślaz lekarski, *Althaea officinalis* L., sposób zakładania plantacji, zawartość śluzu