

THE EFFICIENCY OF MOTHER CROWNS AND QUALITY OF SOFT CUTTINGS OF A FEW DAHLIA CULTIVARS

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Abstract. Dahlia, together with chrysanthemums and tulips, is one of the most beautiful and the most willingly cultivated perennials in green areas and home gardens. Therefore, the producers seek for more effective methods of its propagation. In the years 2011–2014 in the Felin Experimental Farm of the University of Life Sciences in Lublin the research was undertaken to estimate the crowns efficiency of four Polish border dahlia cultivars. The tubers were taken out from storage in early spring, then planted in trays filled with peat and placed on the tables in a glasshouse. The soft stem cuttings snipped off from the sprouts arising from tubers were used for experiments which aim was to evaluate the quality of four types of rooted soft cuttings. It was stated that the number of sprouts appearing in spring on a mother plant depended on a cultivar and a season. Tubers of ‘Krynica’ and ‘Halinka’ cultivars formed the most sprouts. The most effective were crowns from which apical cuttings were snipped off (90–115) pieces from the 10th of February till the 20th of April. The number of soft stems that were used to obtain cuttings ‘with heel’, ‘without heel’ and ‘2-node’ ones ranged on average from 50 to 80 per season. The best quality rooted cuttings, in terms of a fresh weight, number of leaves and a fresh weight and number of roots, were the heel cuttings.

Key words: *Dahlia cultorum*, cultivars, tuber efficiency, cuttings types, quality of rooted cuttings

INTRODUCTION

A long and abundant flowering, as well as richness of forms and colours of inflorescences makes the interest in dahlia in Europe, as well as in Poland, remain on the same, high level for many years. It is one of the most commonly cultivated perennials. Different

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types of dahlia, both high, medium high and miniature ones, are planted mainly in the gardens. A few cultivars may be cultivated as container plants or for cut flowers. The biggest producers of dahlia are the Netherlands and France in Europe as well as Japan [De Hertogh and Le Nard 1993].

A big popularity of dahlia and new cultivars that appear on the Polish market impose the need for fast and effective propagation. In production, dahlia is usually propagated from soft cuttings 'with heel' [Langeslag 1989, De Hertogh and Le Nard 1993, Clènet 1995, Pudelska 2000]. The number of new sprouting shoots from a tuber root crown ranges from 15 to 50 [Escher 1983]. In a large scale production of dahlia, producers expect the biggest possible number of cuttings that may be obtained from a single mother plant. New cultivars of dahlia characterize with a big diversity in intensity of forming new shoots suitable for cuttings. This diversity as well as the lack of information on this subject prompts to evaluate the effectiveness of mother crowns of cultivars that has become popular in the last few years in Poland. The phase of rooting the cuttings is important from the economical point of view. At present, despite controlling the conditions of rooting, this process is unsuccessful in case of many cuttings [De Klerk et al. 1999, Kander and Druege 2004]. A many years research show that both endo- and egzogenous factors, such as growth phase of a mother plant, quality of shoots for cuttings or physiological processes that occur in cuttings, like a balance between photosynthesis and transpiration, decide about rooting [Biran and Halevy 1973, Cuijpers 1995, Hartmann et al. 1997, Serek et al. 1998, Krajnc et al. 2002, Szabo et al. 2014]. There are also a few scientific papers on propagation of dahlia in tissue culture [Wei et al. 1990, Fatima et al. 2007, Al-Mizory 2013, Ibrahim and Daraj 2015], although this method is not commonly used in a large scale production. The *in vitro* propagation might be more useful to eliminate dahlia mosaic virus, spotted wilt or vein clearing by meristem tips culture in order to produce elite stock material for further propagation [Mullin and Schlegel 1978, Wang and Hu 1980, Sediva et al. 2006].

The aim of the conducted research was to evaluate the efficiency of parent tubers of four Polish cultivars of dahlia, which were taken out from storage in early spring and planted in a glasshouse, as well as checking if soft cuttings snipped off from different parts of shoots are a valuable plant material for propagation of these cultivars.

MATERIAL AND METHODS

The research was conducted in the years 2011–2014, from the end of February till the end of April. The experiment material were four cultivars of decorative type *Dahlia cultorum* of the Polish bred [W. Legutko Breeding and Seed Company Ltd. in Jutosin, Poland], classified in a decorative group: 'Krynica' and three cultivars from Dalinka series: 'Balbinka', 'Celinka' and 'Halinka'. They range from 30 to 50 cm in height and form inflorescences only from ligulate florets. Mother plants with 3–4 tuberous roots weighing from 120 to 200 g were selected for the research.

The research included two phases. In the first one, the effectiveness of mother crowns of chosen cultivars at the moment of cuttings excision was evaluated. Every year (2011–2014), at the end of February, the tubers were planted into trays filled with high moor



Phot. 1. Dahlia tubers placed in a glasshouse – 20 days after planting



Phot. 2. A stem of dahlia which was used to obtain two-node and apical cuttings



Phot. 3. Rooting cuttings in multipots

peat with addition of chalk ($2 \text{ g}\cdot\text{dm}^{-3}$). Peat was enriched with Azofoska compound fertilizer ($1 \text{ g}\cdot\text{dm}^{-3}$ of soil) containing 13.6% N, 6.4% P_2O_5 , 19.1% K_2O , 23% SO_3 , 4.5% MgO, 0.27% Mn, 0.18% Cu, 0.17% Fe, 0.045% Zn, 0.045% B and 0.04% Mo. The tubers were slightly dumped with soil so that the root crown bases were over the ground level. The trays with tubers were placed in beds in a glasshouse (phot. 1), in a constant temperature of 22–23°C. The soft stem cuttings were snipped off from the sprouts arising from tubers: 1) apical cuttings with two pairs of leaves cut with a piece of a tuber – with heel; 2) apical cuttings with two pairs of leaves cut without a piece of a tuber – without heel; 3) apical cuttings with two – three pairs of leaves cut from the stems with at least five-six pairs of leaves; 4) leaf-bud 2-node cuttings cut from stems with at least five-six pairs of leaves (phot. 2). There were 32 crowns of each cultivar, 8 per combination (a type of cutting). One crown was treated as a repetition. The cuttings were taken between March 10–12th and April 20th. The second phase of the research concerned the rooting quality of 4 types of cuttings. During the successive years of the research (2011–2014), a part of cuttings obtained from the 10th till the end of March was successively rooted in a mixture of peat and perlite (1:1; pH 5,8–6), in multipots which were then placed on the tables (phot. 3). The cuttings were dipped in a rooting hormone of PPH Himal company containing 0.2% of naphthaleneacetic acid. During rooting, the cuttings were covered with a foil tunnel and if needed they were shaded with fabric to protect them against heavy sunshine. The air temperature was 18–22°C and the soil temperature was 20–22°C. The cuttings were regularly misted and prophylactically sprayed with fungicides once a week. The experiment consisted of 16 combinations with 10 cuttings in each.

After 5 weeks of rooting, the number of rooted cuttings expressed in % and their quality, expressed in the fresh weight of a whole cutting, a fresh weight of a root system, a number of leaves and roots per cutting, were estimated.

The experiment was established according to a double and triple cross classification with the random blocks method. The significance of differences between the means was evaluated with the use of Tuckey's confidence half-intervals at the 0.05 level of significance.

RESULTS AND DISCUSSION

During four years of the research it was observed that almost a hundred of soft stems sprouted from crowns of examined dahlia cultivars in spring. They were used as a source of different types of cuttings (fig. 1). They were typically used cuttings 'with heel' as well as apical and leaf-bud cuttings of a young shoot. A large-scale production focuses on obtaining as many plants as possible in the shortest possible time, therefore the cuttings are commonly used. This method is especially useful for many ornamental and nursery plant species [Ochoa et al. 2000, Cameron et al. 2001, Krzywińska and Czekalski 2002, Kolasiński 2005]. It is also widely used in case of dahlia but assessed as ineffective [De Herthog and Le Nard 1993]. According to Escher [1983], a number of soft sprouts arising from root crown of dahlia tuber that are suitable for cuttings ranges from 15 to 50.

Months from February till May promote dahlia plants to produce new shoots and decide about the rate of cuttings rooting [Borah et al. 1995]. The results of the conducted

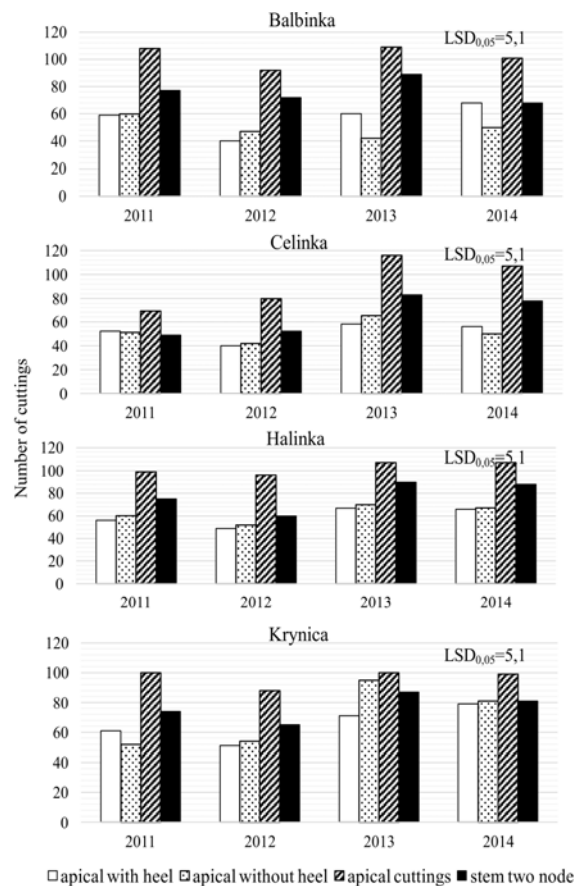


Fig. 1. The number of different types of soft cuttings obtained from parent plants of *Dahlia* in spring – from 10th of March to 20th of April (2011–2014)

research showed that with the use of ‘tip’ and ‘bud-leaf’ cuttings from the same stem it is possible to obtain more cuttings in comparison to traditional cuttings ‘with heel’. Soft cuttings ‘with heel’, which are tip cuttings with two pairs of leaves and a piece of root tuber, have been commonly used in a dahlia production [De Winter 1976, Langeslag 1989]. In a conducted experiment the shoots with five to seven pairs of leaves were used, from which both apical and two-node cuttings were used in the presented experiment, what allowed to obtain more cuttings.

On the basis of the conducted research it was observed that a cultivar and a season were the factors deciding about the number of soft stems sprouting from a mother plant and then used for cuttings. During four years of the research it was possible to obtain from 40 to 116 cuttings from a single dahlia plant with three-four tuberous roots (fig. 1). The highest number of cuttings snipped off a single crown of studied cultivars were apical cuttings (from 70 of the ‘Celinka’ cultivar in 2011 to 116 in 2013 from the same cultivar). A similar large number of cuttings was obtained in case of 2-node ones, espe-

cially when they were snipped off in the years 2013–2014. The number of apical cuttings ‘with heel’ or ‘without heel’ and leaf-bud 2-node ones, was significantly lower and ranged from 40 in case of ‘Balbinka’ and ‘Celinka’ cultivars (2012) to 95 in case of ‘Krynica’ cultivar (2013).

The cultivars studied in the present research belong to the border type. They grow up to 30–50 cm and are at present commonly planted in green areas and private gardens. They are Polish bred cultivars of a big decorative value and characterize with high resistance to changing weather conditions [Pudelska and Hetman 1998]. The obtained results prove that the most effective cultivars in forming new stems were ‘Krynica’ and ‘Halinka’ – during four years they produced from 60 to 102 apical cuttings (fig. 2). In the years 2011–2014 definitely more cuttings obtained were ‘apical cuttings’ (93–102 per crown) and ‘leaf-bud two-nodes’ (67–77 per crown). The average number of cuttings ‘with heel’ ranged between 52 and 66 and was similar to the results given by Escher [1983]. A lower number of cuttings ‘with heel’ that were obtained from the tested cultivars was strictly related to the method of their excision. Cuttings ‘with heel’ are soft stems cut with a piece of a tuber, so that the tuber was damaged each time a cutting was taken.

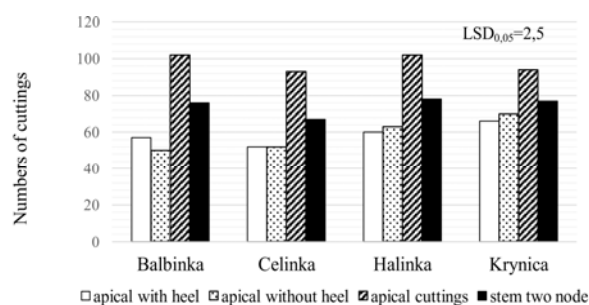


Fig. 2. A mean number of different types of soft cuttings obtained from tubers of the tested cultivars (2011–2014)

In case of dahlia, like other species of flowering plants or those with decorative leaves, as well as aromatic ones, a good quality plant material and good quality rooted cuttings decide about a success of a production [Carvelli et al. 2006, Pudelska and Hetman 2006, Pudelska 2008, Curry et al. 2012].

The conducted research showed, that both a cultivar and a type of cuttings decided about the number of rooted cuttings of dahlia, while the morphological features depended on a type of cuttings. During four years of research, the cuttings ‘with heel’ rooted the best – over 92% (fig. 3). In case of ‘Krynica’ (2011) and ‘Halinka’ (2014) this type of cuttings rooted in 100%, while apical cuttings obtained from the studied cultivars, rooted in 80 to 97% and 2-node ones from 81 to 98%. The 4-years means show that the most cuttings that formed roots, in case of all cultivars, were those ‘with heel’. The 2-node cuttings obtained from ‘Balbinka’, ‘Halinka’ and ‘Krynica’ also rooted well (91–95%) (fig. 4). The apical cuttings snipped off ‘Balbinka’ cultivar rooted in 94%.

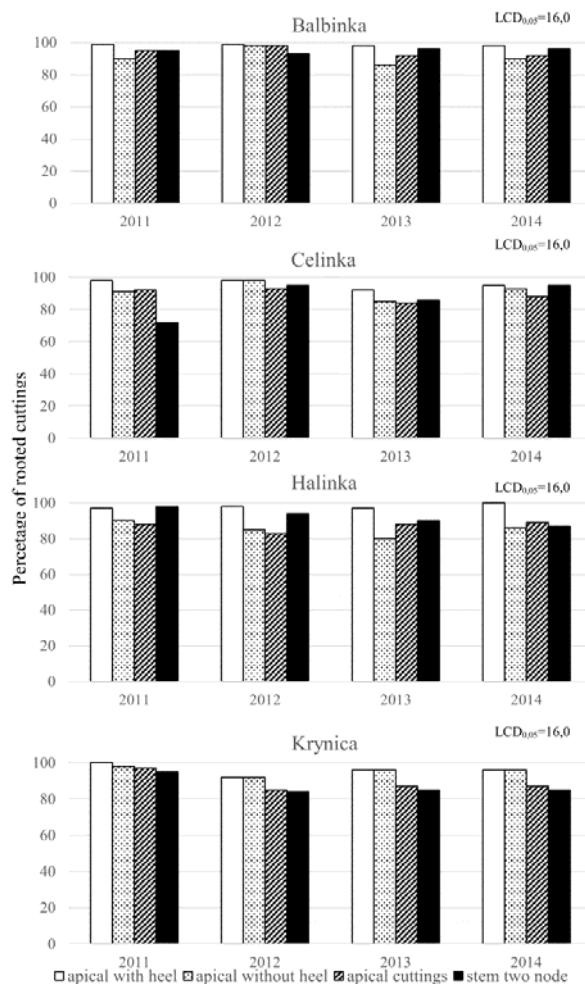


Fig. 3. Rooting percentage of Dahlia cultivars cuttings (in years 2011–2014)

A type of a cutting influenced morphological features of cuttings of evaluated dahlia cultivars in a different way. For the most of tested cultivars, the best quality, expressed in a fresh weight of a cutting, a fresh weight of a rooting system and a number of roots, characterized cuttings 'with heel'. Among the tested cultivars, significantly higher fresh weight was observed when the cuttings 'with heel' were obtained from 'Krynica' and 'Balbinka' (fig. 5). The cuttings with heel obtained from 'Halinka' also formed a big rooting system with a large number of roots (phot. 4), while the ones from 'Krynica' characterized with the highest fresh weight (phot. 5). No matter the cultivar, the best quality cuttings were the ones 'with heel' and 'without heel'. Their fresh weight ranged between 4 to 5.6 g, a number of leaves was 9–10, and a number of roots was 4–5 per cutting.

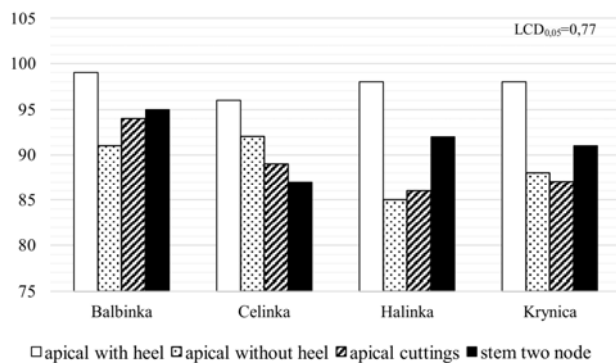


Fig. 4. Rooting percentage of *Dahlia* cultivar depending on the of cutting (2011–2014)

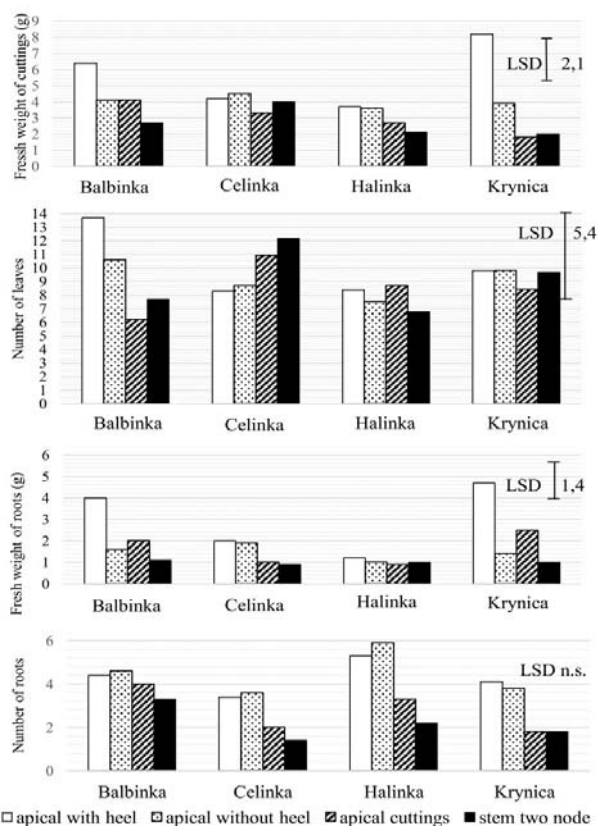


Fig. 5. A chosen morphological features of four examined *Dahlia* cultivars rooted cuttings (average of four years of research – 2011–2014)



Phot. 4. A rooted cutting 'with heel' of 'Halinka'



Phot. 5. A rooted cutting 'with heel' of 'Krynica'

CONCLUSIONS

An important aspect in a production of dahlia is obtaining the highest possible number of soft stems, that might be used as a source of cuttings. It is especially important when new cultivars are introduced into ornamental plants market. The results of the conducted research proved, that there is a possibility to increase the effectiveness of propagation of dahlia during spring by using different types of stem cuttings. On average 52–66 cuttings ‘with heel’ were excised from a single crown, depending on the cultivar. Apart from this type of cuttings, the apical cuttings and leaf-bud two-nodes cuttings were also used, what allowed to increase the number of cuttings by an average of 40%, in comparison to the ones with heel. Apical cuttings and two-node ones formed roots just as well (80–98%, depending on the cultivar) as those ‘with heel’ (96–99%). They characterized with a lower fresh weight and smaller rooting system in comparison to heel cuttings, but nevertheless they made a good quality plant material for further cultivation.

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WYDAJNOŚĆ KARP MATECZNYCH I JAKOŚĆ SADZONEK ZIELNYCH KILKU ODMIAN DALII OGRODOWEJ

Streszczenie. Dalia, obok chryzantem czy tulipanów, jest jedną z najpiękniejszych i najczęściej uprawianych bylin. Ponieważ roślina ta coraz częściej wykorzystywana jest do nasadzeń w terenach zieleni miejskiej, producenci poszukują bardziej wydajnych sposobów jej rozmnażania. W latach 2011–2014 w Gospodarstwie Doświadczalnym Felin Uniwersytetu Przyrodniczego w Lublinie przeprowadzono badania, w których oceniono wydajność karp czterech polskich odmian dalii rabatowych. Karpy wczesną wiosną wystawiano z przechowalni, sadzono do skrzynek i ustawiano na stołach w szklarni. Z pędów wyrastających na karpach pozyskiwano zielne sadzonki pędowe do dalszych doświadczeń, celem których była ocena jakości czterech typów ukorzenionych sadzonek zielnych. Wykazano, że liczba pojawiających się wiosną pędów zielnych na roślinie matecznej zależała od odmiany i sezonu prowadzonych badań. Najwięcej pędów tworzyły karpy odmian ‘Krynica’ i ‘Halinka’. Najbardziej wydajne były karpy, z których cięto od 10 lutego do 20 kwietnia sadzonki wierzchołkowe (90–115 sadzonek). Liczba pędów zielnych, z których pozyskiwano sadzonki z piętka, bez piętki i dwuwęzłowe wynosiła w sezonie średnio od 50 do 80. Najlepszą jakością ukorzenionych sadzonek (świeża masa sadzonki, liczba liści na sadzonce, świeża masa i liczba korzeni) charakteryzowały się te z tzw. piętka.

Słowa kluczowe: dalia ogrodowa, odmiany, wydajność karp, typy sadzonek, jakość ukorzenionych sadzonek

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