Scientific Papers. Series B, Horticulture. Vol. LXIV, No. 1, 2020
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

STUDY ON PHENOLOGICAL BEHAVIOURS OF *DAHLIA VARIABILIS* HORT. IN OVERWINTERING OF TUBEROUS ROOTS IN THE SOIL

Valeria IVANOVA[1], Nadejda ZAPRJANOVA[2]

[1]Agricultural University of Plovdiv, 12 Mendeleev Blvd., Plovdiv, Bulgaria
[2]Institute of Ornamental and Medicinal Plants, Negovan-Sofia, Bulgaria

Corresponding author email: valeriasi1@abv.bg

Abstract

Dahlia is used for landscaping parks and gardens as well as cut flower. Because the dahlia comes from Central America (Mexico), it does not tolerate the cold temperatures of the winter. That is why the tuberous roots are planted in April, and removed in October. The tuberous roots are stored for 6 months in a dark and ventilated place where the temperature does not fall below 0^0C. Recent changes in the agro-climatic environment and preliminary studies have naturally led to the conclusion that it is possible the tuberous roots of to be left without removal and storage. The purpose of this study is to identify damage or lack thereof in overwintering the tuberous roots in the soil. Three cultivars were used -'Vitus', 'White Ball', 'Dark Red'. In overwintering plant the sprouting started with 5-7 days earlier. The growth rate was faster with overwintering plants, the most pronounced being that of the Dark Red cultivar. The wintering plants enter the phenophase beginning and mass flowering 11 to 14 days earlier. Flowering of the individual flower and the whole plant is 38-45% longer in wintering plants.

Key words*: dahlia, tuberous roots, overwintering, phenological behaviours.*

INTRODUCTION

Dahlia is a common species used both for outdoor landscaping and for cut flower (Nikolova N., 1999). Mariña J. L. (2015) points out that dahlia has great potential as a cut flower species due to the huge variety of shapes and colors and relatively easy reproduction. It belongs to the group of perennial flowers (Tafradzhiyski O., Ivanova, V., 1999). In most studies, light is the main factor influencing its development and especially on flowering, but other environmental conditions also have a significant influence. In this regard, Malik, S.A. et al. (2017) study the effect of growth regulators on the growth and flowering of dahlia, finding that the diameter and number of inflorescences and the shelf-life of the cut state are maximal when treated with 4000 ppm chlormequat. The phenological manifestations of dahlia in connection with the use of growth regulators were also examined by Khan F.U. et al. (2003). The productivity of some late-planting varieties on calcareous soils is studied by Mishra, H. P. et al. (1990) and found that in terms of plant height, number of buds, days from planting to full flowering, quality and size of cut flowers, the 'Kenya' variety, followed by 'Kelvin Rose', 'Black Out', and 'Vigor', is most appropriate. Growing technology under our conditions provides for the planting of tuberous roots in the second half of April and removal at the end of September. The tuberous roots are stored for 6 months in a dark and airy place where the temperature does not fall below 0°C. Due to the recent changes in the agro-climatic climate and preliminary studies, it has been found that the tuberous roots damage in the autumn is not negligible. The main objective of this study is to investigate the wintering of dahlia tuberous roots in the soil.

MATERIALS AND METHODS

The study was conducted in the Dendrologycal Park of Agricultural University - Plovdiv, in the period 2017-2018. Three varieties of dahlia were used: from the low 'Vitus' variety; the medium ones are 'White Ball' and the tall ones are 'Dark Red'. At the beginning of the experiment, tuberous roots of nearly the same length and diameter were selected. Each lump had a part of the old stem. Planting took place in the second half of April. During the first

year, the plants were grown according to the technology adopted for the country, without taking into account the vegetative and generative manifestations. In the second half of October, the plants of the control variants were removed, cleaned and stored in a dark, ventilated area where the winter temperature did not fall below 0°C. In the second half of April of the following year, the cleaned tuberous roots were planted. The stem of plants of the experimental variants were cut to a height of 10 cm. In the second half of October, during the first year of cultivation, tuberous roots were left in the soil for the next growing season. During the second vegetation of plants, both control and experimental variants, vegetative and ornamental manifestations were studied. For the climatic conditions in Plovdiv, January is the month with the lowest temperature. For the studied period the average air temperature for 2017 was -6^0C, and for 2018 -4^0C. It would be good in future studies to monitor the soil temperature.

RESULTS AND DISCUSSIONS

The growth rate of the stem in plants grown by wintering or traditional technology is shown in Figures 1, 2 and 3. It is traced from the end of March (emergence) to the first week of September (when the growth processes gradually subside).

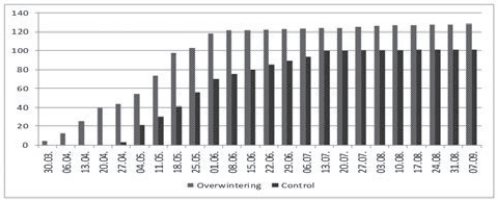

Figure 1. *Dahlia variabilis*, cv. 'Dark red' growth rate (cm)

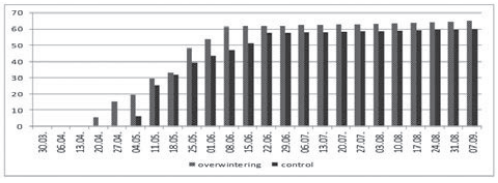

Figure 2. *Dahlia variabilis*, cv. 'White ball' growth rate (cm)

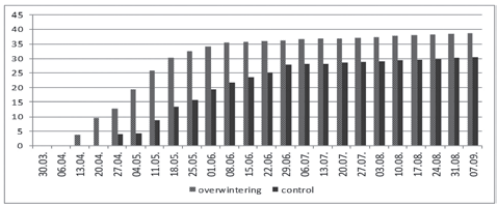

Figure 3. *Dahlia variabilis*, cv. 'Vitus' growth rate (cm)

In the 'Vitus' variety, winter-growing plants begin their development in the middle of April, while those grown under traditional technology - at the end of the same month, i.e. about two weeks later.

The data show that in the initial stages of their development the plants grow quite rapidly, with differences in the one-week reporting period ranging from 0.2 cm to 4.8 cm for the control and from 1.5 to 6.6 cm for the experimental plants. The rapid increase continues until the last week of June for plants grown using traditional technology and until the first week of the month for wintering plants, i.e. overwintering plants outperform this indicator by about two weeks with plants grown using traditional technology. This actually shows that overwintering plants accumulate vegetative mass faster, i.e. earlier they reach a decorative appearance, and that the period of decorativeness in them is longer.

With the 'White Ball' variety, the maximum of the growth processes reaches in the first week of June, with an increase ranging from 3.6 cm to 18.0 cm over a one-week period. For traditional-grown plants, the maximum increase is in the third week of June or about a week later. The increase in the one-week period ranges from 3.6 cm to 19.3 cm. In both types of plants, the growth processes decrease over the next 11-13 weeks and stop during the first week of September.

At the latest, the maximum occurs in the growth processes of plants grown using traditional technology of the 'Dark Red' variety - the second week of July, when the plants reach a height of 100.1 cm. For wintering plants, the first week of June is the period with the most intense growth - the plants reach a height of 121.5 cm, and the weekly growth is from 2.8 to 19.3 cm. For both experimental and control plants, the period up to the first week of September is 8 weeks and the other 13 weeks is a period of weak to stunted growth, with weekly increments of 0 to 1.3 cm.

Data on the phenological manifestations of dahlia plants grown differently are presented in Table 1.

Table 1. Phenological behaviours on emergence of *Dahlia variabilis* (date)

Variants cv. / Indicators	'Vitus'		'White Ball'		'Dark Red'	
	control	overwintering	control	overwintering	control	overwintering
Beginning	27.04.	13.04.	04.05.	20.04.	27.04.	30.03.
Mass	18.05.	27.04.	25.05.	04.05.	25.05.	13.04.
Simultaneously emergence (days)	22	15	22	15	29	14

The onset of emergence depends on both the variety and the type of cultivation. Of the three varieties studied, the earliest plants emerge from the 'Dark Red' variety - 30.03. winterized and 27.04. grown by traditional technology. After them emerge the 'Vitus' plants - 13.04. for the winter winners and 27.04. for control plants. And, at the latest, the 'White Ball' plants start sprouting - on 20.04 respectively. and 04.05. Wintering, on the other hand, has a strong positive effect on the onset of emergence. Overwintered plants of all three varieties enter this phase earlier - 'White Ball' with 15, 'Vitus' with 17, and 'Dark Red' 27 days earlier. There is a similar trend in the next phase - mass emergence. Here, the results are even more emphatic - the difference between wintering plants and plants grown using traditional technology is from 21 days in the 'White Ball' variety, 22 days in the 'Vitus' variety, to 43 days in the 'Dark Red' variety. The emergence friendship shows the duration of the period from onset to mass emergence. This period is of utmost importance both in the use of dahlia for landscaping parks and gardens and in planting for the production of cut flowers. In terms of this indicator, pre-winter plants have the advantage - germination friendship is 15 days for the 'Vitus' and 'White Ball' varieties and 14 for the 'Dark Red' variety. The emergence rate of plants grown using traditional technology for the 'Vitus' and 'White Ball' varieties is 46.6% lower, and 107.2% for the 'Dark Red' variety.

Data on the duration of budding and flowering in dahlia are presented in Table. 2.

Table 2. Phenological behaviours during flowering of *Dahlia variabilis* (days after emergence)

Variants cv. / Indicators	'Vitus'		'White Ball'		'Dark Red'	
	control	winterized	control	Winterized	control	winterized
Beginning of budding	66.7	60.5	94.8	89.7	74.5	70.7
Mass budding	71.8	63.8	99.1	92.5	81.4	75.6
Beginning of flowering	77.8	64.7	101.2	93.9	79.7	74.5
Mass of flowering	108.8	97.8	133.2	124.5	118.9	104.5
End of flowering	178.3	211.5	163.2	199.5	142.5	178.8

Phenophase 'onset of budding' occurs at the earliest in the 'Vitus' variety - 60.5 days after emergence in wintering plants and 66.7 days in plants grown using traditional technology.'Dark Red' is the next variety to form flower buds - 70.7 days after emergence in winter and 74.5 days in control plants. The 'White Ball' variety is the variety that most recently forms flower buds - 89.7 and 94.8 days after emergence, respectively. A similar trend is observed in the phenophase 'mass budding' - the 'White Ball' variety, followed by the 'Dark Red' and finally the 'Vitus' variety, first entered this phenophase. Regarding the wintering of tubers in the soil, plants grown using traditional technology enter this phenophase 5.8 days, 6.6 days and 8.5 days later than the wintering plants, respectively, for the 'Dark Red', 'White Ball' and 'Vitus' varieties.

The beginning of flowering starts first with overwintered plants of the 'Vitus' variety - 64.7 days after emergence, and at the latest in control plants of the 'White Ball' variety - 101.2 days after emergence. Overwintered plants enter this phenophase earlier than those grown under traditional technology in all three varieties tested - the biggest difference is in the 'Vitus' variety - 13.1 days in favor of the winterers, 7.3 days in the 'White Ball' variety and 5.2 days at 'Dark Red'.

Overwintering of tubers in soil and on mass flowering has a strong positive effect. This phenophase occurred 14.4 days earlier in the 'Dark Red' variety, 11.2 days earlier in the 'Vitus' variety and 8.17 days earlier in the 'White Ball' variety.

The end of the flowering period in dahlia depends on both the variety and the environmental conditions, as the plant usually blooms in the fall until the first frosts fall. The longest flowering plants are winter plants of the 'Vitus' variety - 211.5 days, with 33.2 days more than the plants grown according to traditional technology. 36.3 days later, the flowering of 'Dark Red' and 'White Ball' varieties for wintering plants is over.

The duration of flowering is an important indicator for both the individual flower and the whole plant (Table 3).

Table 3. Duration of flowering period for *Dahlia variabilis*

Variants cv. / Indicators	'Vitus'		'White Ball'		'Dark Red'	
	control	winterized	control	winterized	control	winterized
Separate color (days)	3.7	5.4	5.9	11.3	4.1	6.8
Whole plant (days)	35.9	94.5	33.6	81.6	33.1	73.5

It is crucial for the decorative qualities of the plant. The flowering time of the individual blossoms varies from 3.7 days in traditional cultivated 'Vitus' plants to 11.3 days in winterized 'White Ball' plants. The individual flowers of the wintering plants bloom by 1.7 days, 5.4 days, 2.7 days more

than those grown using traditional technology in the three varieties studied - 'Vitus', 'White Ball' and 'Dark Red'. The duration of flowering of the whole plant in the 'Dark Red' variety is 45% longer. The 'Vitus' and 'White Ball' varieties are 37.9% and 41.2% respectively.

CONCLUSIONS

1. Plants obtained by overwintering tuberous roots in the soil have a faster growth rate. The maximum in their growth is at the beginning of June. Plants grown using traditional technology grow fastest in late June and early July.
2. 'Dark Red' overwintering plants emerge and develop at the earliest, and at the latest - grown traditional technology 'White Ball' plants. Emergence is best with overwintering plants - they sprout massively within 14-15 days. With 46.6-107.2%, the emergence rate is less in plants grown using traditional technology.
3. The duration of budding is not affected by the mode of cultivation of the plants. This is probably due to the fact that the dahlia belongs to the plant group of the short day. However, the formation of flower buds depends on the variety - it forms the 'Vitus' flower buds, and the 'White Ball' variety at the earliest. Phenophase onset and mass flowering occur 1-2 weeks earlier in plants derived from wintering tubers. The flowering period is 18.6 - 22.4% longer for overwintering plants.
4. There is a very strong positive effect of wintering on the flowering duration of both the individual flower and the whole plant. The duration of the individual flower is 1.7 to 5.4 days longer, while that of the whole plant - by 37.9-45% more.

REFERENCES

Nikolova, N. (1999). Cvetarstvo, Dionis, Sofia.

Tafradjiiski, O., Ivanova, V. (1999). Rukovodstvo za uprajnenia po cvetarstvo, V. I sin, Pd.

Mariña, L. J. (2015). Cultivation of the Dahlia., Cultivos Tropicales, 2015, vol. 36, no. 1, pp. 103-110.

Malik, S. A.; Rather, Z. A.; Wani, M.A.; Din A., Nazki, I. T. (2017). Effect of Growth Regulators on Plant Growth and Flowering in Dahlia cv. Charmit. J. of E. Agriculture International, 15(3), 1-7.

Khan F. U., Tewari G. N. (2003). Effect of growth regulators on growth and flowering of dahlia (*Dahlia variabilis* L.). Indian Journal of Horticulture, Volume 60, 192-194.

Mishra, H. P., Singh, K. P., Mishra, G. M., Prasad, B. (1990). Performance of some dahlia (*Dahlia variabilis*) varieties under late planted condition in calcareous soil of plains. Haryana Journal of Horticultural Sciences, Vol. 19, No. 3-4, 284-290.