Originalan naučni rad
Original scientific paper
UDK: 634.1/.7:631.547.4
DOI: 10.7251/AGREN1201073T

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Influence of temperature and sowing depth on growth and development of annual flowering species

Monika Tkalec[1], Nada Parađiković[1], Jasna Kraljičak[1], Marina Tepeš[1], Svjetlana Zeljković[2]

[1] *Faculty of Agriculture Osijek, Hrvatska*
[2]*Faculty of Agriculture Banja Luka, Republika Srpska, BiH*

Summary

Annuals are plants that germinate, mature, bloom, set seed and die in one growing season. They are sometimes referred to as bedding plants because they provide colour and fill in garden beds. This research was conducted in the laboratory of the Department for Plant Production at the Agricultural Faculty in Osijek. The aim of this study was to determine the effect of two different temperatures (18 and 24°C) and sowing depth (2 and 3 cm) on germination of annual flower species. For the purpose of this study, two types of annual flower seeds were used, seeds of floral species Dahlia and Zinnia. Seeds were sown in trays at two different depths (2 and 3 cm) and kept in a chamber under controlled conditions at two different temperatures (18 and 24ºC). After three weeks of controlled conditions, the stems and root of young plants were measured. Root length of both flower species was significantly influenced by sowing depth and temperature ($p = 0.01$). Dahlia stem length was affected by sowing depth and temperature ($p=0.05$) while the length of Zinnia stems was not influenced by either temperature or planting depth.

Key words: annuals, temperature, daylight, germination

Introduction

Annuals are plants that germinate, mature, bloom, set seed and die in one growing season. They are sometimes referred to as bedding plants because they provide colour and fill in garden beds. Many of these flowers are excellent choices for the garden as they can be grown during different seasons. Annual flowers differ in their tolerance to cold weather and frost, thus they are classified as hardy annuals, semi-hardy annuals and tender annuals. Zinnias are natives of the New World which were named after and in honour of Johann Zinn, a German professor of

botany and medicine, in 1763 by Linnaeus (Shepherd, 2012.). Dahlia cultivars are referred to by more than 14,000 names. This number represents an astonishing average of over 100 newly named cultivars during each of the 143 years since 1791 when dahlias were first brought into cultivation in the gardens of Spain following their arrival from Mexico (Sorensen, 1969). When considering water availability for the germination and growth of annual plants, it is also important to take into account other soil factors such as depth, parental material, and texture (Rivas-Arancibia, 2006). Temperature also interacts with light and this can modify sensitivity of seeds to light (Taylorson and Hendricks, 1972).

The aim of this study was to determine the effect of two different temperatures (18 and 24°C) and sowing depth (2 and 3 cm) on germination of annual flower species.

Materials and methods

The investigation was conducted during 2011 in the laboratory of the Department for Plant Production at the Agricultural Faculty in Osijek. The seeds of two types of annual flowers Zinnia and Dhalia were used in this study. Each flower species represented a variant of the experiment with the factors: temperature (A) and sowing depth (B). Sowing was done on 3 March in a 4L polystyrene container using substrate (Terra Brill, Gebr. Brill Substrate GmbH & Co. KG, Germany). The seeds were sown in four repetitions, 10 seeds per repetition at a depth of 2 cm and four repetitions at a depth of 3 cm for each flower type. Polystyrene containers were then placed in a chamber with controlled conditions at a temperature of 24°C and under artificial light, twenty-four hours of light ("day"). Sprouting of plants began 5-6 days after the sowing date. Measurements of root length and plant height were carried out on 17 March 2011. The same day when measurements were performed, the seeds of the same type of flower were planted again in the same arrangement and at the same depth, but placed in a chamber with controlled conditions at a temperature of 18°C and under artificial light, sixteen hours ("day") and eight hours of darkness ("night"). The measurements for this part of research were carried out on 31 March 2011.

The study was conducted as a split-plot experiment with the following factors: sowing depth (A) and temperature (B). The data obtained were statistically analysed using analysis of variance (F- test) by applying VVSTAT (Vukadinović, 1994.).

Results and discussion

The statistical analysis of data showed that the length of Dahlia roots was significantly influenced by both investigated factors. Dahlia root length was significantly higher in seedlings that were emerging at lower temperature conditions at 18°C, and sown at a depth of 3 cm ($p = 0.01$).

Maximum root length, 1.89 cm, was observed in seedlings grown at 24°C and sown at a depth of 3 cm, while the smallest root mass, 0.470 cm, was recorded

in plants grown at 24°C and sown at a depth of 2 cm, which was confirmed by the statistics showing that seedlings from A2B1 variant had significantly longer roots than in the A2B2 variant (p = 0.01). Statistical significance between A1B1 and A1B2 variant is absent (Table 1.). The seedlings sown at a depth of 3 cm had 68.12% longer roots compared with seedlings sown at a depth of 2 cm.

Tab. 1. Effect of temperature and depth of sowing on the length of root and stem of Dhalie

Uticaj temperature i dubine sadnje na dužinu korijena i stabljike dalije

Variant (A)	*Rooth lenght* (cm)			*Stem lenght* (cm)		
	Sowing depth (B1)	Sowing depth (B2)	Mean	Sowing depth (B1)	Sowing depth (B2)	Mean
Temperature (A1)	1,683	1,720	1,701	1,750	2,390	2,070
Temperature (A2)	0,470	1,898	1,184	1,467	1,783	1,625
Mean	1,076	1,809	1,4425	1,609	2,086	1,8475

Rooth lenght

LSD	Temperature (A)	Sowing depth (B)	*Interactions*
			A x B
0,01	0,3142	0,4261	0,4972
0,05	0,1712	0,2813	0,3197

Stem lenght

LSD	Temperature (A)	Sowing depth (B)	*Interactions*
			A x B
0,01	0,7644	ns	ns
0,05	0,4164	ns	ns

The interaction between the properties of temperature and sowing depth showed statistical significance (p = 0.01). According to Read (2009), containers should be placed in a warm location (not in direct sunlight) to allow seeds to germinate. Dahlias normally germinate in 5–7 days at temperatures between 21-24ºC.

In this study, Dahlia stem length was significantly influenced by temperature (p = 0.05). Maximum stem length was observed in seedlings grown at 18°C and was 2.39 cm, while the minimum stem length, 1.46 cm, was recorded in seedlings grown at 24°C. The seedlings grown at lower temperature had 27.38% greater root length compared with seedlings grown at 24°C. Although the statistical analysis of data showed that the depth of planting did not significantly affect the properties of stem length, significantly longer stems were observed in the sprouts of variant A1B1 in relation to the A1B2 variant (p = 0.05).

Table 2. Effect of temperature and depth of sowing on the length of root and stem of
Zinnie
Uticaj temperature i dubine sadnje na dužinu korijena i stabljike cinije

Variant (A)	*Rooth lenght* (cm)			*Stem lenght* (cm)		
	Sowing depth (B1)	Sowing depth (B2)	Mean	Sowing depth (B1)	Sowing depth (B2)	Mean
Temperature (A1)	3,053	2,460	2,756	3,255	3,740	3,497
Temperature (A2)	5,198	4,115	4,656	3,465	3,985	3,725
Mean	4,125	3,288	3,7062	3,360	3,863	3,6112

Rooth lenght

LSD	Temperature (A)	Sowing depth (B)	*Interactions*
			A x B
0,01	ns	0,4234	ns
0,05	ns	0,2795	ns

Stem lenght

LSD	Temperature (A)	Sowing depth (B)	*Interactions*
			A x B
0,01	0,6899	0,3758	ns
0,05	0,5630	0,3716	ns

Zinnia seedling root length was significantly influenced by temperature and sowing depth (p=0.01). The seedlings grown at 24°C had 68.94% longer roots compared with seedlings grown at 18°C, while the root length of seedlings sown at 2 cm had 25.45% greater root length than the seedlings sown at a depth of 3 cm. Most plants grow best between 21-26ºC (Toogood, 1999.). Maximum root length, 5.19 cm, was observed in seedlings grown at 24°C, and sown at a depth of 2 cm, while the smallest root mass, 2.460 cm, was recorded in plants grown at 18°C and sown at a depth of 3 cm. The statistical significance of interactions between the properties of temperature and sowing depth did not appear (Table 2.).

As for the stem length of Zinnia, this property has been significantly influenced by sowing depth (p=0.01), while the property of temperature did not show any statistical difference. Maximum stem length 3.985 cm was observed in seedlings grown at 24°C, and sown at a depth of 3 cm, while the minimum stem length, 3.255 cm, was recorded in seedlings grown at 18°C, and sown at a depth of 2 cm. The seedlings grown at 24°C had 6.51% longer roots than seedlings grown at 18°C, while the root length of seedlings sown at 3 cm had 14.97% greater root length than the seedlings sown at a depth of 2 cm.

According to Parađiković (2008), 18°C temperature ensures the quality growth of *Zinnia elegans* seedlings, but slightly higher temperature can affect the root collar elongation of Zinnia seedlings.

Conclusion

The experimental results showed better development of Dahlia seedlings at the temperature of 18°C which resulted in greater length of roots and stems. Greater sowing depth ensured better development of the stem. Zinnia seedlings showed better growth at 24°C temperature and sowing depth of 3 cm which resulted in development of longer roots, while deeper sowing ensured development of longer stem.

The research indicates that the temperature and sowing depth are limited factors that should be followed by professional growers of Dahlias and Zinnia. Particularly important is the temperature during the period of germination of plants. If the temperature is higher during this period and germination is provoked by the addition of moisture, such plants will certainly be elongated from the start which in the end reflects on growth and flowering of the plant.

References

1. *Parađiković, Nada* (2008.): www.pfos.hr/~dsego/ispitna.../ web%20osnove%20cvjecarstva.pdf
2. *Read, Paul E.* (2009.): Growing Dahlias, Regents of the University of Minnesota. WW-01115, Reviewed 2009.
3. *Rivas-Arancibiaa, S.P.; Montañab, C.; Velasco Hernándezc, J.X.; Zavala-Hurtadoa, J.A.* (2006.): Germination responses of annual plants to substrate type, rainfall, and temperature in a semi-arid inter-tropical region in Mexico, Journal of Arid Environments, Volume 67, Issue 3, 416–427
4. *Shepherd, Renee* (2012.): Renee's garden:Heirloom and gourment vegetable, flowersand herb seeds, Renee's Garden Seeds 6060 Graham Hill Rd, Felton, California 95018
5. *Sorensen, Paul D., "Revision of the genus Dahlia (Compositae, Heliantheae Coreopsidinae)*," Rhodora 71: 309~16, 1969.
6. *Taylorson, R. B.; Hendricks, S. B.*(1972): Interactions of Light and a Temperature Shift on Seed Germination. Plant Physiology, 49(2): 127–130.
7. *Toogood; A.* (1999): Plant Propagation: The fully illustrated plant-by-plant manual of practical techniques. American Horticultural Society. DK Publishing, Inc., New York.
8. *Vukadinović, V.*, 1994. VVSTAT - računalni program za statističku obradu podataka. Poljoprivredni fakultet Osijek.

Uticaj temperature i dubine sadnje na rast i razvoj jednogodišnjih cvjetnica

Monika Tkalec[1], Nada Parađiković[1], Jasna Kraljičak[1], Marina Tepeš[1], Svjetlana Zeljković[2]

[1] *Poljoprivredni fakultet Osijek, Hrvatska*
[2] *Poljoprivredni fakultet Banja Luka, Republika Srpska, BiH*

Apstrakt

Jednogodišnje biljke su one koje klijaju, sazrijevaju, cvjetaju, razvijaju sjeme i uginu u jednoj sezoni rasta. Ponekada se nazivaju i sezonskim cvjetnicama zato što popunjavaju i daju boju vrtnim lejama. Ovo istraživanje je sprovedeno u laboratoriji Odsjeka za biljnu proizvodnju Poljoprivrednog fakulteta u Osijeku. Cilj ovog istraživanja bio je da se odredi uticaj dvije različite temperature (18 i 24°C) i dubine sadnje (2 i 3 cm) na klijanje jednogodišnjih cvjetnica. U svrhu ovog istraživanje korištene su dvije vrste sjemena jednogodišnjih cvjetnica, dalija i cinija. Sjeme je sađeno u plitke kutije sa pregradicama na dvije različite dubine (2 i 3 cm) i držano u komori pod kontrolisanim uslovima na dvije različite temperature (18 i 24ºC). Nakon tri sedmice boravka u kontrolisanim uslovima, izmjereni su stabljika i korijen mladih biljaka. Na dužinu korijena obe cvjetnice znatno je uticala dubina sadnje i temperatura ($p = 0.01$). Dubina sadnje i temperatura ($p=0.05$) uticali su na dužinu stabljike kod dalije dok na dužinu stabljike cinije nisu uticale niti temperatura niti dubina sadnje.

Ključne riječi: jednogodišnje biljke, temperatura, dnevno svjetlo, klijanje

Monika Tkalec
E-mail Address:
monikat@pfos.hr