

Seed Germination of Some Flower Species Under Influence of Different Light Conditions

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Abstract

The aim of this study was to examine germination energy and seed germination rate of some flower species under influence of different light conditions. Seeds of *Zinnia elegans* Jacq., *Dianthus caryophyllus* L. and *Callistephus chinensis* (L.) Nees that were used in the research were purchased in local store. Experiment was set up in three replicates for each light treatment and each flower species. Petri dishes with seeds were placed in growth chamber under artificial white and blue light under 12hL/12hD photoperiod. Results showed no significant difference in germination energy and total germination of investigated flower species in respect of light. *Zinnia* seedlings were significantly longer on white light, while *Dianthus* seedlings were longer on blue light. Both, length and fresh weight of *Callistephus* seedlings were greater on white light. The absence of significant differences between measured parameters under examined light regimes suggests that germination of *Zinnia*, *Dianthus* and *Callistephus* is not photosensitive.

Key words: *Zinnia*, *Dianthus*, *Callistephus*, white and blue light

Introduction

Annual flower species are widely spread and very popular among people. Not just for their obvious beauty and colour diversity, but because they are easy to grow and maintain. They are fast growing and suitable for gardens, flowerbeds, outdoor containers as well as window boxes. Lifecycle of one growing season allows rearrangement of flowerbeds each season, bringing new colours and look to parks and gardens every year. Among various annual species *Zinnia elegans* Jacq., *Dianthus caryophyllus* L. and *Callistephus chinensis* (L.) Nees are very commonly grown in gardens. *Zinnia elegans* Jacq. and *Callistephus chinensis* (L.) Nees come in many varieties of colour, shape and size. They are characteristic for long bloom period, drought tolerance, easy propagation and minimal labour requirements (Pinto et al., 2005; Solaiman et al., 2008). Carnation (*Dianthus caryophyllus* L.) is native to Mediterranean region and since ancient Greek and Roman times it is known as a historically rich and meaningful flower choice. Market request for carnation cut-flowers makes carnations one of commercial leader in terms of number of stems sold worldwide (El-Ghorab et al., 2006). For the propagation of annual flower seedling or for direct sowing, seed quality is essential. Poor and uneven germination is an undesirable seed property. Fast and homogenous germination provide both economic and environmental benefits in agriculture and horticulture (Badek et al., 2006). Light plays a key role in plant growth and development. Different light wavelength induces different physiological response (Chory et al., 1996). Thus, the aim of this study was to examine germination energy and seed germination of some flower species under influence of different light conditions.

Material and Methods

Investigation was conducted in the Laboratory of vegetables, floriculture, medical and aromatic herbs at Faculty of Agriculture in Osijek during the year 2015. Seeds of *Zinnia elegans* Jacq., *Dianthus caryophyllus* L. and *Callistephus chinensis* (L.) Nees (Table 1.) were purchased at local store. Experiment was set up in Petri dishes sterilized with 96% ethanol and lined with filter paper.

Seeds of each investigated species were surface-sterilized for 10 minutes with 10% NaOCl (4% NaOCl commercial bleach), then rinsed five times with distilled water. Thirty seeds were counted and placed in Petri dish on filter paper that was moistened with 5 mL of distilled water representing one repetition.

Tab. 1. Producer, origin and seed germination of tested cultivars stated on declaration
 Произвођач, поријекло и клијавост сјемења према декларацији за дате сорте

Flower species <i>Врста цвијета</i>	Producer and origin <i>Прозвођач и поријекло</i>	Germination (%) <i>Клијавост (%)</i>
<i>Zinnia elegans</i> Jacq.	Semenarna Ljubljana, Slovenia	85%
<i>Dianthus caryophyllus</i> L.	Immergrün, Austria	-
<i>Callistephus chinensis</i> (L.) Nees	Diba-Charm D.O.O., Croatia	87%

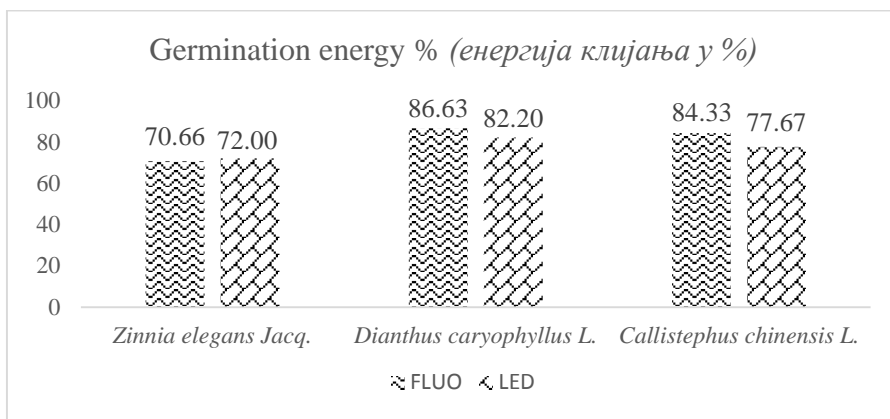
The experiment was set up in three repetitions for each light treatment and each flower species. Prepared Petri dishes with seeds were then placed in growth chamber under artificial white (FLUO light) and blue light (LED light) under 12hL/12hD photoperiod. Temperature during the research was constant (23 ± 1 °C). Petri dishes were observed daily and additional water was added to each one of them as needed. Seeds were kept under these conditions for 14 days, number of germinated seeds was recorded daily during first seven days of experiment. Germination energy and germination percentage were determined on the seventh day of experiment and at the end of experiment, respectfully. To evaluate the effect of different light conditions shoot length (cm) and fresh weight (g) were determined at the end of experiment.

Experimental data were analysed by a statistical package ANOVA, mean values were considered significantly different if calculated P value was at least 5% ($P < 0.05$).

Results and Discussion

In a standard procedure of germination test, germination energy is determined first and then (in the same sample) the total germination. Both values are expressed as percentage of sown seeds. Different light conditions had no influence on the germination energy of *Zinnia elegans* Jacq. (Graph 1.). The average germination energy of *Zinnia* seeds on FLUO light was 70.66%, while on LED light 72%.

No differences in germination energy of *Dianthus caryophyllus* L. between FLUO and LED light were observed. The average germination energy of *Dianthus* seeds on FLUO light was 86.63%, while on LED light 82.20%. Likewise, germination energy of *Callistephus chinensis* L. didn't differ under the influence of different light conditions. On FLUO light average germination energy of 84.33% was recorded, while on LED light 77.67%. Germination energy of tested floral seeds was not significantly influenced by the lighting as the similar values on both lights were recorded.



Graph 1. Germination energy of tested flower species under influence of different light conditions

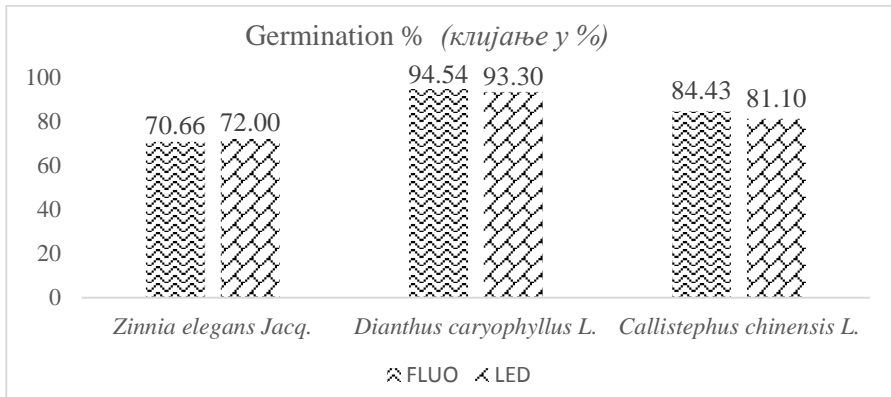
Енергија клијања тестираних цвјетних врста под утицајем различитог освјетљења

The overall average germination energy seeds: 71.33% of *Zinnia elegans Jacq.*, 84.4% of *Dianthus caryophyllus L.* and 81% of *Callistephus chinensis L.* is an indicator of good quality of purchased seeds, which, however does not fully correspond to declaration (Tab. 1).

Germination rate was calculated by using the formula: G (Germination, %) = (Germinated seed/Total seed) x 100 for each replication of each floral species after the 14 days (Graph 2). Germination rate of *Zinnia elegans Jacq.* was equal to the values of its germination energy. Overall average germination rate of *Zinnia elegans Jacq.* was 71.33%. According to the seeds manufacturers and distributors Semenarna Ljubljana declaration, germination rate of *Zinnia elegans Jacq.* should be 85%. Results obtained from laboratory seed germination test that was conducted under optimum environmental conditions for *Zinnia elegans Jacq.* were lower by 13.67%.

There was no influence of different light conditions on seed germination rate of *Dianthus caryophyllus L.* Average recorded germination rate on FLUO light was 94.54% and on the LED light 93.3%. Austrian distributor of *Dianthus* seeds didn't provide the information about seed germination rate on the seed declaration. However, overall *Dianthus caryophyllus L.* average germination rate of 93.92% indicates a good seed quality. Germination rate values of *Callistephus chinensis L.* show no difference between FLUO and LED light. Average recorded germination rate on FLUO light was 84.43% and on the LED light 81.10%. For the successful breeding of directly sown annual flower species it is very important to have seeds with high germination rate (Parađiković et al., 2008).

Also, germination rate is a key factor for calculating seeding rates and thus achieving successful planting. Slightly lower germination rate than the one stated on declaration may be due to improper seed storage in stores.



Graph 2. Germination of tested flower species under influence of different light conditions
Клијање тестираних цвјетних врста под утицајем различитог освјетљења

Germination rate and germination energy of seeds are the two most important parameters that help detect the quality of seeds and calculate the seeding rates. Furthermore, it is known that the seeds with higher germination energy have a higher vigor and thus are more resistant to stress conditions during germination (Kastori, 1984). Since tested floral species are suitable for direct sowing, high seed germination rate is necessary for successful breeding.

At the end of the experiment, besides the calculation of the germination energy and germination rate, shoot length and shoot fresh weight were determined. Shoot length and fresh weight were measured on ten randomly selected shoots from each replication. Obtained results are presented in Table 2.

Shoot length of *Zinnia elegans Jacq.* and *Dianthus caryophyllus L.* were under influence of different light condition, while there were no recorded differences in shoot length of *Dianthus caryophyllus L.* (Table 1.). Similarly, in the research of Jala (2010) only the shoot length of *Nepenthes mirabilis* recorded on yellow light differed from those recorded on blue, red, green and white lights. Also, Raj Poudel et al. (2008) recorded no difference in shoot length of three grape genotypes between blue and white light. According to Werbrouck et al. (2012) shoots of *Ficus benjamina* were shorter on blue light in comparison to the red and white light. In the research of Kim et al. (2004) the largest stem length was recorded in plants grown under red and far red light whereas plants grown on blue light had the shortest stems.

Tab. 2. Influence of white and blue on shoot length and fresh weight of *Zinnia elegans* Jacq., *Dianthus caryophyllus* L. and *Callistephus chinensis* L.
Утицај бијелог и плавог свјетла на дужину изданка и тежину *Zinnia elegans* Jacq., *Dianthus caryophyllus* L. и *Callistephus chinensis* L.

	FLUO	LED	LSD _{0,05}
<i>Zinnia elegans</i> Jacq.			
Shoot length (mm) <i>Дужина клијанца</i>	8.21 ^a	5.31 ^b	1.7744
Shoot fresh weight (g) <i>Маса клијанца</i>	0.88 ^a	0.66 ^a	0.2598
<i>Dianthus caryophyllus</i> L.			
Shoot length (mm) <i>Дужина клијанца</i>	4.20 ^a	5.04 ^a	1.9237
Shoot fresh weight (g) <i>Маса клијанца</i>	0.18 ^a	0.18 ^a	0.0244
<i>Callistephus chinensis</i> L.			
Shoot length (mm) <i>Дужина клијанца</i>	3.20 ^a	2.71 ^b	0,4109
Shoot fresh weight (g) <i>Маса клијанца</i>	0.17 ^a	0.15 ^a	0,0293

Means marked with different letters ^{a, b} between rows significantly differ at $P = 0.05$.

Shorter shoot length with no difference in shoot weight indicates that blue light prevents shoot elongation and growth of fragile and poor quality plants. There were no significant differences in shoot fresh weight of all tested flower species in respect of a light treatment.

Conclusion

In this study, LED blue light had no influence on germination rate and germination energy of tested flower species indicating that seeds of these species are not photosensitive. Influence of light treatment was recorded on shoot length of *Z. elegans* and *C. chinensis*. Further research is needed through different stages of growth as assumption is that in further stages differences would be more distinctive.

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Испитивање клијавости неких цвјетних врста под утицајем различитог освјетљења

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Сажетак

Циљ истраживања био је утврдити енергију клијања и клијавост неких цвјетних врста под утицајем различитог освјетљења. Сјеменке цвјетних врста *Zinnia elegans* Jacq., *Dianthus caryophyllus* L. и *Callistephus chinensis* (L.) Nees кориштене у истраживању купљене су у специјализованој трговини. Истраживање је спроведено у три понављања за поједину цвјетну врсту те третман освјетљења. Припремљене су петријеве посуде са сјеменкама постављеним у клима комору на бијело и плаво освјетљење на режим 12 сати “дан” 12 сати “ноћ”. Резултати истраживања су показали како нема разлике у енергији клијања као ни у клијавости свих испитиваних цвјетних врста зависно од освјетљења. Клијанци *Zinnia*-е су били значајно дужи на бијелом освјетљењу, док су клијанци *Dianthus*-а били дужи на плавом освјетљењу. Дужина и маса клијанаца *Callistephus*-а били су већи на бијелом свијетлу. На основи непостојања разлике између мјерених параметара у фази клијања *Zinnia*-е, *Dianthus*-а и *Callistephus*-а закључује се да не постоји фотосензибилност.

Кључне ријечи: *Zinnia*, *Dianthus*, *Callistephus*, бијело и плаво светло

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