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INFLUENCE OF SLOW DISINTEGRATING FERTILIZER RATES ON QUALITY OF GAZANIA (*Gazania rigens L.*) SEEDLINGS

Ana Vujošević[1], Nada Lakić[1], D. Beatović[1] and Slavica Jelačić[1]

Abstract: The work has examined the influence of slow disintegrating fertilizer rates of *Scotts* (*Osmocote Exact*) formulation 15:9:9:MgO + Me on quality of *Gazania rigens L.* seedlings. The seedlings of *Gazania rigens L.* was produced in polystyrene containers (*speedling system*) and polypropylene pots (*pot system*). During the production of seedlings the fertilizer has been applied in rates (0, 1, 2, 3, and 4g/l). The results show that the fertilizer rate of substrata 4g/l influences the qualitative properties of *Gazania rigens L.* seedlings.

Key words: slow disintegrating fertilizer, *Gazania rigens* L., seedling.

Introduction

The production of flowers in Serbia has been increasing for years. During 2005 the production comprised area of 1143 ha, of which 115 ha was in socially owned sector and 1028 ha in a private sector (Vujošević, A., 2007). According to the production structure or assortment in Serbia, the most favored is the production of seasonal flowers seedlings and pot flowers, the production of cut flowers is minor, Vujošević, A., 2005. The value of export during 2006 was 1.7 million of USD, which shows the increase by approximately 20% against 2005, while the value of import was 8.7 million of USD, which shows decrease by 3.3% against 2005 (Vujošević, A., 2007). The increased request for flowers seedlings suggests the need for intensive production of seedlings and one of the way is the production in containers and also to expand the assortment.

[1] Ana Vujošević, M.Sc., Assistant, Nada Lakić, PhD., Associate Professor, Damir Beatović, BSc., Researsch Associate , Slavica Jelačić, PhD., Assistant Professor, Faculty of Agriculture, 11081 Belgrade-Zemun, Nemanjina 6, P.O. Box 14, Serbia

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The modern production of flowers seedlings, besides various production systems in containers (Latimer, 1991), is also based on usage of various substrata and application of various slow disintegrating fertilizers (Nelson, P.V., 2003). The use of slow disintegrating fertilizers in production of seedlings in containers and pots has found its primary purpose in production of ornamental plants and flowers (Belger and Drach, 1989). Also, the domestic researchers have studied the influence of slow disintegrating fertilizer on quality of seedlings of medical, aromatic and spice plants (Beatović et al., 2007 a, b, c) and also on quality of flowers seedlings (Vujošević, A. et al., 2007). The advantage of these fertilizers' usage is a short term application that can satisfy all plants' needs for mineral nutrients. These fertilizers release elements of biogenes in relatively exact time, interval and very precisely. That is the way how they avoid their full activation at the moment of application, or planting, which is often the example in application of ordinary mineral fertilizer. By this, the production of high salts concentration in substrata is avoided and this is the main cause of plants' deterioration in containers and pots (Hanić, 2000).

Gazania rigens L is in the group of annual flowers and it is very attractive to domestic producers in past few years because of its ornamental properties. Besides other flower species, the Gazania rigens L. represents on important decorative material for public greens, gardens, flower stands, etc. (Ferrante et al., 2006; Vujošević et al., 2007b). This species is characterized by a long period of flowering, from May to late autumn. To ensure good conditions for performance of this species it is necessary to provide enough food during the whole period of vegetation.

The aim of this work was to gain insight into the influence of various rates of slow disintegrating fertilizer on quality of *Gazania rigens L.* seedlings.

Material and Methods

The researches were done during 2007 in a glasshouse of Belgrade Faculty of Agriculture. The annual species of gazania flowers was used in this research a series *Kiss Bronze Star – Goldsmith Seeds* work was done in two phases. In the first phase, sowing of seeds in polypropylene containers of 144 combs (870 plants per m²) was done. For sowing of seeds and production of seedlings, the commercial substrate was used which consisted of white peat (70%) and black peat (30%) with salt content of approximately 0.5 – 1.1 g/l and pH value of 5.2 up to 6.0. The sowing of seed was done on 14 February 2007.

With appearance of first couple of steady leaves the plants were replanted in polypropylene pots of 9 cm size, the commercial substrate (Floragard) was applied and the test was done in second phase where the influence of slow disintegrating fertilizers was examined according to the following treatments:

1. 0 (control)
2. 1g/l substrata
3. 2g/l substrata
4. 3g/l substrata
5. 4g/l substrata

The slow disintegrating fertilizer Scotts (Osmocot Exact) of formulation 15:9:9:MgO+Me was used. The fertilizer was added to plants after their replanting in the phase when they had two steady leaves. The production of seedlings was done in optimal and everyday controlled conditions which are a necessary precondition of successful production (optimal day-night temperature, optimal relative air humidity, substrate moisture). During production of seedlings the standard measures of care were applied: watering, shadowing and aeration. The production of seedling lasted till the end of May 2007. By the method of random sample, thirty plants were taken for further analysis of each variety.

The following parameters of seedlings' quality were analyzed: plant weight (g), number of buds and flowers.

The analysis of experimental results was done by descriptive and analytical statistics supported by statistic package STATISTICA. The results of research are shown by basic inputs of descriptive statistics (interval of variation, arithmetical mean and its standard error, median and coefficient of variation).

According to the aim of the work, from a statistic point of view, the fact that shows differences of arithmetical between mean of groups was examined. The check of hypothesis was done by parameter (ANOVA) and non parameter (Kruskal-Wallis) model of variant analysis, by mediana test, LSD test and Mann Whitney U test. Examination according to which these data fulfill the conditions for application of parameter methodology for testing was done by Levene test, Shapiro-Wilk, K-S and Lilliefors tests.

For determination of fertilizer dosage, whose use ekskres the best results in production of gazania seedlings, a particular common rank for all three examined characteristics was determined (plant weight, number of buds and flowers) by Ivanovic's interval (Lakić and Stevanović, 2003).

Results and Discussion

The largest value for plant weight was obtained by use of 4g/l rate of slow disintegrating fertilizer 35.256g, and the smallest 10.087g by 1g/l of slow disintegrating fertilizer (Table 1.). Max average value for plant weight of 25.09g was achieved by use of fertilizer rate of 4g/l and minimal average value of 13.406g in control variant. The values in all samples are homogeneous (Cv<30%). Plant weight is the most homogenous in a control sample and the most heterogeneous by usage of 3g/l of fertilizer.

By the use fertilizer 4g/l of (Table 1) the most of buds were formed 1.8, and the lowest average number of buds was formed in a controll variant (0.33). For this characteristic, the analyzed samples are heterogeneous (60.16%≤Cv≤164.,00%), so the median is more valid indicator ranges of average. According to the values of median, the average number of buds from zero in a control variant to two per sample in variant where the dosage of 4g/l fertilizer is applied. In other examined variants the plants had one bud, on average.

According to arithmetical mean the number of formed flowers on average fluctuates from 2.7 in variant where the smallest rate of fertilizer 1g/l is applied to 3.43 in a control variant. Regarding control, where the samples are homogeneous for the examined parameter (Cv < 30%), the value of median is a more valid indicator of average and on the basis of this the smallest number of flowers (3) is got by the usage of 1g/l or 4g/l fertilizer and the highest number is obtained (4) when the 2g/l of fertilizer is applied. The result is in accordance with the results of researches obtained in the production of *Tagetes patula* seedling, Vujošević et al., (2007).

The effect of slow disintegrating fertilizer application and positive influence of various rates were obtained in researches in the production of medicinal plant species too, Jelačić and et al., 2006 and Beatović et al., 2007 a,b,c.

Tab. 1. - The basic indicators of descriptive statistics for examined parameters of *Gazania rigens* seedlings quality by the usage of various rates of slow disintegrating fertilizers

Examined Parameters	Rates of slow-disintegrating fertilizers	Iv Interval of variation	$\bar{X} \mp S_{\bar{x}}$ Arithmetical mean ∓ Standard error	M_e Median	Cv (%) Coefficient of variation
Plant weight (g)	0 (test)	10.637-17.974	13.406 ∓ 0.329	13.162	13.46
	1 g/l	10.08-22.177	16.107 ∓ 0.578	15.907	19.66
	2 g/l	11.514-29.619	21.25 ∓ 0.833	21.83	21.48
	3 g/l	13.184-33.869	25.05 ∓ 1.069	25.72	23.38
	4 g/l	10.902-35.256	25.09 ∓ 0.97	26.07	21.36
Number of flowers	0 (test)	1-5	3.43 ∓ 0.163	4	26.14
	1 g/l	0-4	2.7 ∓ 0.209	3	42.56
	2 g/l	0-5	3.166 ∓ 0.249	4	43.15
	3 g/l	1-5	3.133 ∓ 0.207	3.5	36.27
	4 g/l	0-5	2.8 ∓ 0.241	3	47.26
Number of buds	0 (test)	0-2	0.33 ∓ 0.099	0	164.00
	1 g/l	0-2	0.833 ∓ 0.118	1	77.72
	2 g/l	0-2	0.7 ∓ 0.118	1	93.03
	3 g/l	0-2	1.1 ∓ 0.120	1	60.16
	4 g/l	0-4	1.8 ∓ 0.2	2	60.85

The result of Levene's test (Table 2) indicates that in *Gazania rigens* homogeneous variances belong to the ptoperty of the number of flowers, while heterogeneous variances belong to the property of plant wight and number of buds. Consequently, the significance of differences between average values was also tested by parameter model of variance analysis (ANOVA) and non-parameter test (Kruskal-Wallis) (Tab.2).

T a b.2. - The results of Levene's variance homogeneity test, ANOVA, Kruskal-Wallis test and median tests for the use of slow-disintegrating fertilizers in Gazania rigens.

Examined parameters (Parameters)	Levene's test		ANOVA		Kruskal-Wallis ANOVA		Median test	
	F	p	F	p	H	p	χ^2	p
Plant weight (g)	7.148	0.000	43.036	0.000	80.663	0,000	79.467	0.000
Number of buds	4.809	0.001	16.202	0.000	42.922	0,000	28.046	0.000
Number of flowers	1.238	0.297	1.878	0.117	8.259	0,083	10.016	0.040

p<0,05(*) the difference is significant
p<0,0(1**) the difference is very significant

The average values for the characteristics of plant weight and number of buds significantly change according to statistics by the application of various rates of slow integrating fertilizer (Table 2). According to the results of parameter (ANOVA) and non- parameter (Kruskal - Wallis) methods of variance analysis (Tab. 2), the average number of flowers doesn't depend on used rate of fertilizer. However, the result of median test (Table 2) shows that the change of fertilizer rates has statistically significant effect on average number of flowers. The conclusions on the basis of parameter LSD test and non- parameter U test (Table 3,4 and 5) about the differences between two average values are similar.

T a b. 3. - The levels of significance of between average plant weight on the basis of LSD test

Test	LSD					
U -test	Fertilizer's rate (g)	0	1	2	3	4
	0		0.019	0.000	0.000	0.000
	1	0.001		0.000	0.000	0.000
	2	0.000	0.000		0.001	0.000
	3	0.000	0.000	0.005		0.975
	4	0.000	0.000	0.002	0.824	

By adding of fertilizers the average plant weight is significantly increased (Table 3) only if the dosage of 4g/l is used rather than 3g/l.

By increasing the fertilizer rate from 1g/l up to 2 or 3g/l ,the number of buds is not significantly changed according to statistics in the results of U test,

and according to the results of LSD test, the increase of average number of buds is significantly changed according to the statistics.

T a b. 4. - The levels of significance of differences between average number of buds on the basis of LSD test and U test

Tests	LSD					
U -test	Fertilizer's rate (g)	0	1	2	3	4
	0		0.0104	0.059	0.000	0.000
	1	0.002		0.490	0.168	0.000
	2	0.019	0.414		0.040	0.000
	3	0.000	0.120	0.023		0.000
	4	0.000	0.000	0.000	0.010	

Also, some differences have lower level of significance if the results of U test are taken into consideration. But, by the application of 4g/l fertilizer the average number of buds statistically increases against the average number of buds formed in other examined variants.

The results of LSD test for the characteristics of flowers number (Table 5) show that the average number of formed flowers is significantly decreased if the 1g/l of fertilizer is applied as 4g/l. The results of U test show significant decrease of average number of flowers if the 4g/l of fertilizer is applied and very significant decrease by the application of 1g/l.

T a b. 5. - The levels of significance of differences between average number of flowers on the basis of LSD test and U test

Tests	LSD					
U -test	Fertilizer's rate (g)	0	1	2	3	4
	0		0.018	0.385	0.329	0.040
	1	0.0096		0.130	0.159	0.745
	2	0.695	0.071		0.914	0.233
	3	0.411	0.104	0.737		0.278
	4	0.042	0.847	0.193	0.254	

Very important decrease of average number of flowers by the application of 1g/l fertilizer can be a consequence of non homogeneity of data in a particular sample (Cv=42,65%), and the difference in some new experiment or population can be at a lower level of significance. The group tests applied to experimental data lead to on various conclusions about the performance of fertilizers rate factors in average number of flowers. Having on mind the results of individual testing for number of flowers, for the purpose of valid general conclusion, the

conclusion of median test needs to be used which showed that the changes of fertilizer rate had statistically significance effect on average number of flowers.

The results of value of Ivanovic's interval (Table 6) for ranging of fertilizer's rate on the basis of positive effects on qualitative examined characteristics (plant weight, number of buds and flowers) show that the best quality of gazania seedlings is achieved by the use of fertilizer rate of 4g/l substrata. If the dosage is smaller the quality of the seedlings is decreased (Table 6).

T a b. 6. - The values of I-distances for quality of gazania seedlings

Rate of slow-disintegrating fertilizers	I-distance	Rang
0	0.611	IV
1	0.547	V
2	1.219	III
3	1.748	II
4	1.964	I

C o n c l u s i o n

The results of research show the important, positive and justifiable underpinned effect of various rate of slow integrating fertilizer use in the production of gazania seedlings. By their application a good quality of seedling is achieved, so their use is justifiable which was the aim of the research.

The assumptions which are ruined and consequences of that act have not been justifiable examined yet and they are the basis of the parameter model of variance analysis. The marks of method's sensitivity on ruined assumptions range from extreme insensitivity to the fact that insensitivity is just a myth (Lovric).

The best way to increase the plant weight is to apply the rate of slow disintegrating fertilizer of 4g/l during the production. By the application of 3g/l rate of fertilizer, excellent results in production of gazania seedling are also achieved. There are qualitative differences in the application of above mentioned dosages and they are better for higher rate but are not statistically important for examined parameter of plant weight. By the increase of fertilizer rate the number of buds per plant is equal. The dosage of 4g/l significantly increases the average number of formed buds against smaller rates, so the higher rate can be recommended as best.

The highest number of flowers is achieved by fertilizer rate of 2g/l of substrata. Further increase of rate leads to decrease of average number of formed flowers. Calculated values of Ivanovic's interval have shown that the best quality of gazania seedlings, quantified through plant weight, number of buds and flowers, is obtained by the use of the highest rate of fertilizer, 4g/l of substrata.

The results of research show that this new approach in production of gazania seedling by the application of slow disintegrating fertilizers represents an important improvement of to day technology of production.

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UTICAJ RAZLIČITIH DOZA SPORORAZLAGAJUĆEG ĐUBRIVA NA KVALITET RASADA GAZANIJE *(Gazania rigens* L.)

Ana Vujošević[1], Nada Lakić[1], D. Beatović[1] i Slavica Jelačić[1]

R e z i m e

U radu je ispitivan uticaj različitih doza spororazlagajućih đubriva *Scotts* (*Osmocote Exact*) formulacije 15:9:9:MgO + Me na kvalitet rasada gazanije. Rasad gazanije je proizveden u polistirenskim kontejnerima (*speedling system*) i polipropilenskim saksijama (*pot system*). U toku proizvodnje rasada dodavano je đubrivo u dozama (0, 1, 2, 3, i 4g/l). Dobijeni rezultati ukazuju da doza đubriva od 4g/l supstrata značajno utiče na kvalitativne osobine rasada gazanije.

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[1] mr Ana Vujošević, asistent, dr Nada Lakić, vanredni profesor, Damir Beatović, stručni saradnik, dr Slavica Jelačić, docent, Poljoprivredni fakultet, 11081 Beograd - Zemun, Nemanjina 6, Srbija

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