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EFFECT OF DIFFERENT DOSES OF SLOW-DISINTEGRATING FERTILIZER ON THE QUALITY OF IMPATIENS' SEEDLINGS (*Impatiens walleriana* L..)

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Abstract: The paper studies the effect of applying different doses of slow disintegrating fertilizer „*Scotts*" (*Osmocote Exact*) of the formulation 15:9:9:MgO + Me to the quality of impatiens seedlings. The impatiens' seedlings were produced in poly-styrene containers (*speedling system*) and poly-propylene pots (*pot system*). During the seedlings' production, the fertilizer was added in different doses (0, 1, 2, 3, and 4g/l). The obtained results have shown that the dose of 4 g/l of fertilizer significantly influences on the qualitative features of the impatiens' seedlings.

Key words: slow disintegrating fertilizer, impatiens, seedlings

Introduction

With respect to the flower production structure, i.e. flower assortment in Serbia, the production of seasonal flowers' seedlings has been the most extensive, with little less production of cut flowers, (Vujošević, 2002). An increased demand for flower seedlings, (Vujošević and Stevaneti, 2007) imposes the need of intensifying the seedlings' production, and one of the ways to accomplish this is the production in containers, as well as the assortment expansion.

Along with the different container production systems, a contemporary production of flower seedling (Latimer, 1991), is based on the use of different substrates and application of different slow disintegrating fertilizers, (Nelson, P.V.

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2003). The application of slow disintegrating fertilizers in the seedlings' production and pots has been the widest in the production of horticultural plants and flowers, Belger and Drach, 1989). Also, local researchers have studied the effect of slow disintegrating fertilizers on the quality of seedlings of medicinal, aromatic and spice plants, (Jelačić et al., 2006, 2007; Beatović et al., 2007 a,b,c) as well as on the quality of flowers seedlings, (Vujošević et al., 2007d,e).

The advantageous use of these fertilizers is in the fact that one-off application of the fertilizer completely satisfies a plant's need for minerals. In a comparatively precise time interval, these fertilizers release biogenetic elements. In this way at the very moment of fertilizer's application, and/or at the moment of planting, their complete activation has been evaded, which usually happens when applying simple mineral fertilizers. A high concentration of salts in the substrate is evaded in this way, which in case of producing seedlings in containers and pots usually accounts for plants' deterioration (Hani, 2000).

Impatiens (*Impatiens walleriana* L.), locally widely known as *„Lepi Jova"*, belongs to the group of annual plants and due to its decorative features occupies more than 30% of production assortment of local producers. This flower species is easily combined with a large number of other flowers' species such as fuchsia, begonia, ageratum, lobelia, henna, geranium, verbena, petunia, etc. It is an important decorative material for public green surfaces, house lots, gardens, balconies, flower-stands. It can be grown both in pots and flower-stands, (Ferrante et al., 2006, Vujošević et al., 2007c). As a type of shade, impatiens is also used for planting around a tree base and for flowers' patterns. This flower species is characterized by a long period of blossoming, starting in May and ending in late autumn. In order to ensure a continuous and rich blossoming, it is necessary that this flower species should be planted in the appropriate place (in shade), in the well-drained soil - substrate, as well as that there should be enough foodstuff during the whole vegetation period.

This paper aims at reviewing the effect of applying different doses of slow disintegrating fertilizer on the quality of impatiens seedlings.

Material and Methods

Researches were conducted in the greenhouse of the Faculty of Agriculture in Belgrade during 2007. The experiment used the annual flower species of impatiens, series *Xtreme Red - Goldsmith Seeds*. The experiment was carried out in two phases. During the first phase the seeds were sowed in poly-propylene containers with 144 combs (870 plants/m^2). A commercial substrate for sowing seeds and seedlings production was consisted of white peat (70%) and black peat (30%) with salt contents of about 0.5 – 1.1g/l and pH value was between 5.2 and 6.0. The sowing of seeds was carried out on 11th February 2007.

After first two pair of permanent leaves had appeared, the plants were moved to poly-propylene pots of 9 cm in a ready commercial substrate (*Floragard*), and the second phase of the experiment was initiated in which the effect of slow

decomposing fertilizer was studied in accordance with the application of following doses:

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

The experiment used slow disintegrating fertilizer *Scotts* (*Osmocot Exact*) with the formulation 15:9:9:MgO+Me. The fertilizer was applied to the plants after they had been moved, in the phase when they had two pairs of permanent leaves. The seedlings production was carried out in optimal and everyday monitored conditions which was a necessary precondition for a successful production (optimal day – night temperature, optimal relative air humidity, substrate humidity). During the seedlings' production, standard measures of attending the seedlings were used: watering, shading and aeration. The seedling production lasted until May 2007. The random sample method was used and 30 plants of each series were taken for further analysis

The following parameters of seedlings quality were analyzed: plants' height (cm), above-ground mass (g), number of side arms, number of buds and number of flowers.

The experimental results were analyzed by means of descriptive and analytical statistics with the statistical package STATISTICA. The results of the research were reflected in descriptive statistics basic indicators (variation interval, arithmetic mean and its standard error, Mediana test and variation ratio).

With respect to the objective of the study, from the statistical point of view, the hypothesis that there was no difference between average values of studied features was studied. The variants homogeneity was analyzed by using the *Levene's* test. After it had been determined that non-parameter testing should be used due to existence of variable data, the hypothesis was tested by applying the *Kruskal Wallis* model of analysis and the *Mann-Whitney U*-test.

The quantification of effects of applying different doses was carried out by determining synthetic range, by using a total discrimination effect reflected by I-distance (Ivanovic distance), Laki and Stevanovi, 2003.

Results and Discussion

The highest value for the above-ground mass (72.74g), as well as maximum average value for the above-ground mass (51.17g) was obtained by applying the dose of 4g/l of slow disintegrating fertilizer, while the lowest was in individual (13,6g) and average value (28.52g) in the control sample (Table 1). The values were homogenous in all samples (Cv < 30%). The above-ground mass is the most homogenous after the application of 3g/l of fertilizer.

The number of side arms ranged between 3 and 13. The extreme values were obtained after the application of 3g/l dose of fertilizer. The greatest average number of side arms per plant (9.27) was obtained after the application of 4g/l dose of fertilizer, and the lowest number in the control sample (6.13g) The variation ratios for the analyzed parameter ranged in the interval between 14.03% and 25.64%, which meant that the values were homogenous. The experimental values were the most homogenous in the control sample (without fertilization), while the application of 3g/l dose of fertilizer accounted for the most heterogeneous values.

The number of buds ranged between 0 - 41. After the application of 4g/l dose of fertilizer (Table 1), the greatest average number of buds - 15.9 was obtained, while the lowest number of buds was obtained in the control sample (3.53). The analyzed samples were heterogeneous for this feature (41.78%≤Cv≤67.19%), thus mediana was a more valid indicator of average value. According to mediana valued, the average number of buds ranged between 3 in the control sample, and 15 in the sample to which 4 g/l dose of fertilizer had been applied. In all studied variants the plants had 6 to 11 buds per plant in average. In the experiment, the number of flowers per plant ranged between 1 and 29, while the average number of flowers per sample, on the basis of the arithmetic mean, ranged between 9.6 in control sample (Table 1) and 13.53 in the sample with the lowest applied dose of fertilizer (1g/l). With respect to heterogenity of data (38.35%≤Cv ≤50.34%), mediana is a more valid indicator of average, based on which the lowest average number of flowers – 9 is obtained when fertilizers are not used or when the highest studied dose of 4g/l of fertilizer is applied (10), while the greatest number of flowers – 14 is obtained after the application of the 3g/l dose of fertilizer. The obtained result is in accordance with the results of researched obtained in studying the effect of slow decomposing fertilizers in production of marigold seedlings (*Tagetes patula*) and gazania (*Gazania rigens*) Vujošević et al., (2007).

Table 1. Basic indicators of descriptive statistics for studied parameters of quality of impatiens seedlings after the application of different doses of slow disintegrating fertilizers

Parameters	**Dosage slow-disintegrating fertilizers**	**Iv Interval of variation**	$\bar{x}$ m $S_{\bar{x}}$ **Arithmetical mean Standard error**	**M_e Median**	**Cv (%) Coefficient of variation**
Plant weight (g)	0 (test)	13.64 – 33.85	28.52 0.826	30.41	15.86
	1 g/l	28.53 – 49.12	37.82 1.025	38.94	14.84
	2 g/l	31.01 – 58.05	43.69 1.246	42.60	15.62
	3 g/l	20.14 – 65.55	45.62 1.917	46.47	23.01
	4 g/l	17.91- 72.74	51.17 1.793	52.59	19.19

Number of lateral branches	0 (test)	5 - 8	6.13 0.157	6	14.03
	1 g/l	5 - 10	7.13 0.190	7	14.60
	2 g/l	5 - 11	8.13 0.278	8	18.75
	3 g/l	3 - 13	8.70 0.407	9	25.64
	4 g/l	5 - 12	9.27 0.349	9	20.62
Number of buds	0 (test)	0 – 8	3.53 0433	3	67.19
	1 g/l	0 – 19	7.20 0.891	6	67.79
	2 g/l	0 – 17	8.40 0.829	8	54.02
	3 g/l	3 – 21	11.50 0.877	11	41.78
	4 g/l	4 – 41	15.90 1.416	15	48.78
Number of flowers	0 (test)	4 - 19	9.60 0.728	9	41.54
	1 g/l	8 - 26	13.53 0.948	11.5	38.36
	2 g/l	4 – 25	11.37 0.920	11	44.34
	3 g/l	5 – 29	13.33 1.226	14	50.34
	4 g/l	1 - 22	10.4 0.939	10	49.45

Since the values for the features „number of buds" and „number of flowers" are heterogeneous in samples and the results of the Levene's test (Table 2) have shown that the studied features in samples are heterogeneous, the significance of differences of average values has been tested by applying the non-parameter Kruskal-Wallis test (Table 2).

Table 2. The results of Levene's variance homogeneity test and Kruskal-Wallis test

Parameters	Levene-ov test		Kruskal-Wallis ANOVA	
	F	p	H	p
Plant weight (g)	3.864	0.005	81.603	0.000
Number of lateral branches	6.924	0.000	55.649	0.000
Number of buds	6.858	0.000	63.964	0.000
Number of flowers	2.477	0.046	10.973	0.026

$p<0.05$ significant
$p<0.01$ highly significant

The above-ground mass, number of side arms and number of buds statistically differ to a great extent due to application of different doses of slow disintegrating fertilizer (Table 2). The change of fertilizer dose statistically influences the number of flowers.

The comparison of differences of average values of seedlings quality after the application of two doses of fertilizer was carried out by means of the U-test.

The increase of fertilizer dose statistically increases the average above-ground mass (Table 3). The increase of dose of 3g/l of fertilizer to 4g/l dose significantly influences the average above-ground mass, while the increase of 2g/l dose to 3g/l dose of fertilizer statistically has no influence on the average above-ground mass.

Table 3. The levels of significance of differences of average above-ground masses on the basis of theU-test

Dosage fertilizers (g/l)	0	1	2	3	4
0		0.000	0.000	0.000	0.000
1			0.001	0.000	0.000
2				0.188	0.000
3					0.024
4					

The application of slow disintegrating fertilizer, as well as the increase of dose by more than 1g/l (Table 4) statistically increases to a great extent the average number of side arms per plant. The change of dose from 2g/l to 4g/l of fertilizer, the average number of side-arms is statistically greater. The 3g/l dose of fertilizer statistically has no influence on the increase of the average number of side arms in comparison to the application of doses of 2g/l and 4g/l of fertilizer (Table 4)

Table 4. The levels of significance of differences of average number of side arms on the basis of the U-test

Dosage fertilizers (g/l)	0	1	2	3	4
0		0.000	0.000	0.000	0.000
1			0.006	0.001	0.000
2				0.163	0.019
3					0.391
4					

In relation to the average number of buds (Table 5), the application of slow decomposing fertilizer, irrespective of a dose (1 – 4g/l) has significant effects in comparison to the control sample.

Table 5. The levels of significance of differences of average number of buds on the basis of the U-test

Dosage fertilizers (g/l)	0	1	2	3	4
0		0.002	0.000	0.000	0.000
1			0.266	0.001	0.000
2				0.017	0.000
3					0.020
4					

The increase of dose of applied fertilizer from 1g/l to 2g/l, the average number of buds statistically has not changed, but the change of dose from 1g/l to 3g/l dose of fertilizer significantly influences the number of buds in terms of number, as well as in case of changing the fertilizer dose from 2g/l to 4g/l. The increase of dose from 2g/l to 3g/l, as well as from 3g/l to 4g/l, statistically increases to a great extent the number of buds.

Since the effect of all studied doses of slow disintegrating fertilizer to the average number of flowers is statistically significant (Table 2) in individual comparisons (Table 6) there is a very significant difference after the application of 1g/l dose of fertilizer and a significant difference after the application of 3g/l dose of fertilizer. The increase of fertilizer dose from 1g/l to 4g/l significantly changes the average number of flowers.

Table 6. The levels of significance of differences of average number of flowers on the basis of the U-test

Dosage fertilizers (g/l)	0	1	2	3	4
0		0.003	0.148	0.039	0.523
1			0.192	0.553	0.018
2				0.299	0.361
3					0.152
4					

The conclusions from this experiment regarding the studied feature of flowers' number should not be taken as final since the experiment was interrupted before the end of vegetation period due to impossibility to provide optimal production conditions in the greenhouse.

In view of ranking the effects of applying different doses of slow disintegrating fertilizer to all studied features of quality of impatiens seedlings, the values of I -distance (Ivanovic distance) (Table 7) with the number of buds as the most significant indicator of quality of impatiens seedlings were calculated.

The obtained values show that the increase of dose of slow disintegrating fertilizer results in a better quality of seedlings.

Table 7. The values of I-distances for quality of impatiens seedlings

Dosage slow-disintegrating fertilizers	I-distance	Ranking
0	0.000	V
1	1.078	IV
2	1.581	III
3	2.460	II
4	2.847	I

Conclusion

The results of studies have shown a significant, positive and justified effect of applying different doses of slow disintegrating fertilizer „*Scotts*" (*Osmocote Exact*) of the formulation 15:9:9:MgO + Me in production of impatiens seedlings. The application of these fertilizers results in good quality seedlings, therefore their application is justified, which is the objective of the research.

The application of dose of 4g/l of slow disintegrating fertilizer during production of impatiens gives the best results in relation to the increase of above-ground mass of studied species**.** Also, the application of 2g/l and 3g/l doses also gives excellent results in the production of impatiens seedlings. There are qualitative differences between these two doses, on behalf of a higher dose, but these are not statistically significant for the studied parameter of the above-ground mass.

The increase of applied dose of slow disintegrating fertilizer by more than 1g/l positively influences on the increase of number of side arms. The higher the dose is, the number of side arms per plant is greater. The greatest number of side arms results from the application of the highest dose of fertilizer (4g/l).

The increase of fertilizer dose results in the greater number of buds per plant. The dose of 4g/l significantly increases the number of buds in comparison to smaller doses, therefore the 4g/l dose of fertilizer can be recommended as the best dose. The greatest number of flowers results from the application of doses of 1g/l and 3g/l of substrate. Each further increase of dose results in a reduced number of flowers.

The calculated values of Ivanovic distance show that the best quality of gazania seedlings results from applying the highest dose of fertilizer, 4g/l of substrate, therefore it can be regarded as a general conclusion. The study results show that this new approach in the production of seedlings of impatiens with the application of slow disintegrating fertilizers significantly improves the production technology to-date.

References

1. Beatović, D., Jelačić, S., Vujošević, A., Lazarević, S., Lakić, N. (2006): Primena različitih supstrata i prirodnih biostimulatora u proizvodnji rasada lekovitog, aromatinog i začinskog bilja, Naučno – stručno savjetovanje agronoma Republike Srpske. Proizvodnja hrane u uslovima Evropske zakonske regulative, Zbornik sažetaka, str 79-80.
2. Beatović, D., Jelačić, S., Vujošević, A. (2007a): Uticaj različitih doza spororazlagajućeg đubriva na kvalitet rasada lekovitog, aromatičnog i začinskog bilja, XVII Simpozijum Društva za fiziologiju biljaka SCG, Zbornik izvoda 23.
3. Beatović, D., Jelačić, S. (2007b): Primena spororazlagajuih đubriva u proizvodnji rasada lekovitog, aromatičnog i začinskog bilja, XII Naučno-stručno savjetovanje agronoma Republike Srpske. „Naučna podrška razvojnoj strategiji poljoprivrede Republike Srpske". Tesli 7-9. mart 2007. Zbornik saetaka, str. 90.
4. Beatović, D., Jelačić, S., Lakić, N., Vujošević, A. (2007c): Uticaj spororazlagajućeg đubriva na kvalitet rasada bosiljka, matičnjaka i ehinaceje, III Simpozijum sa međunarodnim učešćem »Inovacije u ratarskoj i povrtarskoj proizvodnji« 19-20. oktobar Beograd, Zbornik izvoda 96-97.
5. Belger, U., Drach, M. (1989): Triabon-a complete slow-release fertilizer containingcrotodur for pot and container plants, Special Issue of BASF No.2. 1-34
6. Erwin. J. (1992): Biuld a better plug. Presentation given at Internacional Plug Conference Orlando, Fla.
7. Ferrante, A., Mensuali-Sodi, A., Serra, G., Tognoni, T. (2006): Evaluation of postproduction performance of *Salvia splendens* potted plants for interiors use. Acta Horts(ISHS) 723:415-420
8. Haivukovi, S. (1977): Planiranje eksperimenta, Privredni pregled , Beograd
9. Hani, E. (2000): Znaaj supstrata, kontejnera i hormona u rasadniarskoj proizvodnji, Univerzitet »Demal Bijedi« Mostar, Studij za mediteranske kulture, 2000.
10. Jelačić, S., Beatović, D., Vujošević, A., Lakić, N. (2006): Uticaj prirodnih biostimulatora i spororazlagajuih đubriva na kvalitet rasada bosiljka (*Ocimum basilicum L.)* i matičnjaka *(Melissa officinalis* L.). Poljoprivredna tehnika, Godina XXXI, Broj 4. str.117-123.
11. Jelačić, S., Beatović, D., Lakić, N. (2007): Uticaj prirodnih biostimulatora i spororazlagajućih đubriva na kvalitet rasada žalfije pri različitim načinima gajenja, Zbornik naučnih radova Institut PKB Agroekonomik Vol.13., br. 1-2, str. 145-155.
12. Lakić, N and S. Stevanović (2003): Ranking of Vojvodina municipalites according to multidimensional denominator of livestock production commodities. J.Sci.Agric. Research 48 (2): 217-226.

13. Latimer, J.G. (1991): Contaiener size and shape influence growth and land shape perfornnance of Marigold seedlings. Hortscience, Vol. 26., (2): 124-126.
14. Nelson, P.V. (2003): Greenhouse Operation&Managment. Sixth Edition; Slow-Release Fertilizers, Growth-Regulating Compounds. Library of Congress Cataloging. Prentice Hall, p. 335, 434.
15. Marković, V., A. Taka i A. Voganjac (1992) : Kontejnerska proizvodnja rasada, Savremena poljoprivreda, Vol 40, broj 1-2, str. 11-14
16. Roger, C. Styer and David S. Koranski (1997): Plug & transplant production : a grower`s Guide, ball Publishing, Batavia, Ilionis USA
17. Van Lersel, MV., Beverly, RB., Thomas, PA., Latimer, JG**.** (1998): Fertilizer effects on the growth of impatiens, petunia, salvia and vinca plug seedlings. HortScience 22:875-876.
18. Vujošević, A. (2002): Stanje i očekivanje cvećarske industrije u svetu i mogućnosti njenog razvoja u Jugoslaviji. Međunarodni načuni skup, Proizvodnja hrane – činilac regionalne integracije na Balkanu, Tematski zbornik, Beograd 2002, str. 201-205.
19. Vujošević, A., Stevanetić, S. (2007a): Izvozne mogućnosti srpske cvećarske i rasadničarske proizvodnje XII Načuno-stručno savjetovanje agronoma Republike Srpske, „Naučna podrška razvojnoj strategiji poljoprivrede Republike Srpske", Tesli 7-9. mart 2007. Zbornik sažetaka, str. 97.
20. Vujošević, A., Lakić, N., Lazarević S., Beatović D., Jelačić S. (2007b): Effect of aplication of natural biostimulators and slow disintergrating fertilizer in commercial production on Begonia (*Begonia semperflorens* L.) seedlings, Journal of Agricultural Sciences. Belgrade, Vol.52 , No 1, 33-42.
21. Vujošević, A., Adamović, M., Beatović, D. (2007c): Uticaj supstrata na kvalitet rasada jednogodišnjeg cveća, XII Naučno-stručno savjetovanje agronoma Republike Srpske, »Naučna podrška razvojnoj strategiji poljoprivrede Republike Srpske«, Tesli 7-9. mart 2007. Zbornik sažetaka, str. 95.
22. Vujošević, A.. Lakić, N.. Beatović, D.. Jelačić, S,. Lazarević, S (2007d): Uticaj razliitih doza spororazlagajućih đubriva na kvalitet rasada kadifice (*Tagetes patula* L.) i ukrasne alfije (*Salvia splendens* L.) III Simpozijum Inovacije u ratarskoj proizvodnji, Beograd 2007, str.225.
23. Vujošević, A., Lakić, N.. Beatović, D.. Jelačić, S,. (2007e): Uticaj različitih doza spororazlagajućeg đubriva na kvalitet rasada gazanije *(Gazania rigens* L.) Journal of Agricultural Sciences. Belgrade, Vol.52 , No 2 (in print)

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UTICAJ RAZLIČITIH DOZA SPORORAZLAGAJUĆEG ĐUBRIVA NA KVALITET RASADA IMPATIENSA *(Impatiens wallerana* L.)

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Rezime

U radu je ispitivan uticaj različitih doza sporoorazlagajućeg đubriva *Scotts* (*Osmocote Exact*) formulacije 15:9:9:MgO + Me na kvalitet rasada impatiensa. Rasad impatiensa 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 impatiensa jove.

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