

Examination of Seedlings Quality of *Pelargonium x hortorum*
L. H. Bail. Treated with Fertilizers with Different
Concentration of Ca (NO₃)₂

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Abstract

The objective of this examination was to determine the quality of the seedlings of *Pelargonium x hortorum* L. H. Bail. Hybrid "Ringo 2000 deep scarlet" by using fertilizers with different Ca (NO₃)₂ concentration. Easily soluble fertilizers were used as follows: NPK 9-10-34+M.E. + Ca (NO₃)₂. In all treatments the dosage of NPK 9-10-34+M.E. was the same (1.6 g/l), but the dosages of Ca (NO₃)₂ were different as follows: 1.6 g/l, 3 g/l and 4.6 g/l. The plants of the control variant were irrigated with plain water. According to the results of all examined biometrical parameters, it was determined that the nutrition with fertilizer NPK 9-10-34+M.E. + Ca (NO₃)₂ in dosage of 1.6 g/l had the best results compared to the control variant for about 52% more mass of stem, 76% more mass of root, 83% higher number of brunches, 30% higher number of leaves and 15% higher number of inflorescence.

Key words: nutrition, biometric parameters

Introduction

Pelargonium genus has about 400 species (Шилиянова, 2005). These species are usually divided into five groups according to the main characteristics of the plants: zonal, zonal dwarf and miniature, royal ("regal"), "ivy" and fragrant leaves. Traditionally grown in Macedonia are the zonal pelargoniums. They feature a long blooming during the whole summer, until the appearance of autumn frost. Carpenter & Carlson (1970) found that the zonal geraniums initiated and developed flowers under wide range of temperatures. With seed of geraniums, as temperatures increased from 10 to 24°C, the rate of growth and flowering progressively increased. At 32°C the rate of development slowed. Floral initiation is dependent on total cumulative light energy for *Pelargonium x hortorum* (Dole & Wilkins, 1999). Supplemental lighting has been found to accelerate floral initiation only when used during the early stages of seedling growth (Armitage & Tsujita, 1979; Carpenter & Rodriguez, 1971). Consequently, supplemental lighting of at least 350 fc is most important for the first 4 to 6 weeks after germination for at least 4 weeks (Bethke & Carlson, 1985). *Pelargonium* species are genetically adapted to dry conditions and to well-drained soils. Many root rot problems can be traced to excess water, low oxygen, improper leaching and excess soluble salt accumulation (Dole & Wilkins, 1999). Bethke (1993) reviewed various factors involved in the selection of a medium for the zonal or seed *Pelargonium*. Optimum pH is 5.6 to 6.0. Geraniums have a high requirement for magnesium and calcium. Many nutrient regimes are based on KNO₃ and Ca (NO₃)₂ combinations, provided phosphorus is added to the medium as superphosphate or in the water as phosphoric acid to maintain proper pH (Dole & Wilkins, 1999). The purpose of this research is to examine the impact of treatment with fertilizers that have different concentration of Ca (NO₃)₂ on the quality of seedlings of floral species *Pelargonium hortorum* LH Bail and to determine the most appropriate concentration of fertilizer in the seedling production of *Pelargonium hortorum* LH Bail.

Materials and Methods

The examinations were made in the years 2010, 2011 and 2012, at the farm "Flower-Garden" in the village of Vladevci, Strumica, the Republic of Macedonia. The examination material used was *Pelargonium x hortorum* L. H. Bail., Hybrid "Ringo 2000 deep scarlet", commercial substrate that is primarily used to produce seedlings of flowering and vegetable crops and easily soluble crystalline fertilizer with composition of: NPK 9-10-34+M.E. + Ca (NO₃)₂.

In all treatments the dosage of NPK 9-10-34+M.E. was the same (1,6 g/l), but the dosage of Ca (NO₃)₂ was different as follows: 1,6 g/l, 3 g/l and 4,6 g/l. The seedlings of *Pelargonium x hortorum* L. H. Bail. were obtained from the Dutch company Syngenta. It was produced from seed and for the research the seedling

was used with formed cotyledons leaves. Transplanting was made immediately after the purchase of seedlings, in the traditional way. Each plant was individually removed from the cells and transplanted in pots with a 9.5 cm diameter . The flowerpots were previously filled with a substrate with trade name Tref. Immediately after the transplanting, irrigation was made with 155 ml water in each pot. The nutrition of the seedlings of *Pelargonium* x *Hortorum* LH Bail. was initiated when the first two to three true leaves appeared. The nutrition was performed once a week. Each plant from the control variant was irrigated only with 80 ml pure water. By the first two feedings, the variants were fertilized with dose shown in Table 1.

Tab. 1. Variants regime using easy soluble fertilizer
Режим огледа са лако-растворљивим ђубривом за варијанте

Variant <i>Варијанта</i>	Fertilizer <i>Ђубриво</i>
I	Without fertilizer \emptyset / <i>Без ђубрења</i> \emptyset
II	Crystal NPK 9-10-34+M.E. (1,6 g/l) + Ca (NO ₃) ₂ (1,6 g/l)
III	Crystal NPK 9-10-34+M.E. (1,6 g/l) + Ca (NO ₃) ₂ (3 g/l)
IV	Crystal NPK 9-10-34+M.E. (1,6 g/l) + Ca (NO ₃) ₂ (4,6 g/l)

The dose of fertilizer was doubled (Table 2) in all variants after the second fertilization, i.e. in the phase of full rooted seedlings. The double dose was based on the increased vegetative mass and consequently the increased need for nutrients. With a double dose the variants were fed six times.

Tab. 2. Variants regime using easy soluble fertilizer after the second fertilization
Режим огледа са лако-растворљивим ђубривом за варијанте након 2. ђубрења

Variant <i>Варијанта</i>	Fertilizer <i>Ђубриво</i>
I	Without fertilizer \emptyset / <i>Без ђубрења</i> \emptyset
II	Crystal NPK 9-10-34+M.E. (3 g/l) + Ca (NO ₃) ₂ (3 g/l)
III	Crystal NPK 9-10-34+M.E. (3 g/l) + Ca (NO ₃) ₂ (6 g/l)
IV	Crystal NPK 9-10-34+M.E. (3 g/l) + Ca (NO ₃) ₂ (9 g/l)

Seedlings were produced at optimal conditions necessary for the production and standard measures of care were applied: watering, ventilation, protection from diseases and pests.

After 70 days from the transplantation in pots, with method of random selection, 30 plants of each variety were measured. For determining the quality of seedlings, the following biometric parameters were examined: mass of stem, mass of root, number of branches, number of leaves and number of inflorescence. The

received results were processed by variant, statistically according to the method of analysis of variance and tested with the LSD (Least Significant Difference) test.

Results and Discussion

The highest average value for the mass of stem (10.43 g) was obtained in the plants from the variant II. The plants from variant III showed good results with an average value of the mass of the stem of 9.63 g, which is about a 0.2 g (2%) higher value in comparison with variant IV. The lowest average value for the mass of stem (6.85 g) was obtained in the control variant and these plants had the most heterogeneous mass (CV 25.53%). The mass of stems from variant II showed a significant statistical difference at the level of 0.01 compared with the mass of the plant stems from the control variant. The mass of stems from variant III and variant IV showed significant statistical difference at a level of 0.05 compared with the mass of stems from the control variant. Among the fertilized variants there was no statistically significant difference (Table 3).

Tab. 3. Mass of stem (g)

Маса стабљике (g)

Variant <i>Варијанта</i>	Arithmetic Mean <i>Аритметичка средина</i>	Standard Error <i>Стандардна грешка</i>	Standard Deviation <i>Стандардна девијација</i>	Coefficient of Variation <i>Коефицијент варијације</i>	Interval of Variation <i>Интервал варијације</i>	Comparison with Var. 1 <i>Поређење са вар. 1</i>	Comparison with Var. 2 <i>Поређење са вар. 2</i>	Comparison with Var. 3 <i>Поређење са вар. 3</i>	Comparison with Var. 4 <i>Поређење са вар. 4</i>
I	6.85	0.18	1.75	25.53	3.7-11.7	∅	-3.58	-2.78	-2.57
II	10.43	0.26	2.49	23.92	6-14.9	3.58	Var. 2	0.80	1.01
III	9.63	0.15	1.45	15.02	6.9-12.5	2.78	-0.80	Var. 3	0.21
IV	9.42	0.25	2.37	25.14	6-14.5	2.57	-1.01	-0.21	Var. 4

LSD 0.05 = 2.22 and LSD 0.01 = 3.08

Vujošević et al. (2009) examined the impact of fertilizers on the mass of the stem of *Pelargonium hortorum* seedling, series *Maverick (red) - Goldsmith Seeds*. The research was conducted with various doses (1 g/l, 2 g/l, 3 g/l, 4 g/l, 5 g/l) of slow releasing fertilizer Scotts (Osmocote Exact) with the formulation 15:9:9:MgO + Me. The research has shown that the dosage of 2 g/l Scotts (Osmocote Exact) provides the biggest mass of the stem.

The average mass of root ranges from 1.06 g in the control variant to 1.87 g in the variant II. Plants from the variant III and variant IV showed results with an average value of the root mass of 1.66 g and 1.46 g, consequently. The mass of root from variant II and variant III showed a significant statistical difference at a level

of 0.01 compared with the mass of root from the control variant. The mass of root from variant IV showed a significant statistical difference at a level of 0.05 compared with the mass of root from the control variant. Among the variants II and III there was no statistically significant difference, but among the variants II and IV there was a statistically significant difference at a level of 0.05. Among the variants III and IV there was no statistically significant difference (Table 4).

Tab. 4. Mass of root (g)
Маса коријена (g)

Variant Варијанта	Arithmetic Mean Аритметичка средина	Standard Error Стандардна грешка	Standard Deviation Стандардна девијација	Coefficient of Variation Коефицијент варијације	Interval of Variation Интервал варијације	Comparison with Var. 1 Поређење са вар. 1	Comparison with Var. 2 Поређење са вар. 2	Comparison with Var. 3 Поређење са вар. 3	Comparison with Var. 4 Поређење са вар. 4
I	1.06	0.02	0.23	21.5	0.5-1.5	∅	-0.81	-0.60	-0.40
II	1.87	0.03	0.28	14.9	1.3-2.5	0.81	Var. 2	0.21	0.41
III	1.66	0.04	0.34	20.62	1-2.5	0.60	-0.21	Var. 3	0.20
IV	1.46	0.02	0.18	12.68	1.1-2	0.40	-0.41	-0.20	Var. 4

$LSD\ 0.05 = 0.35$ and $LSD\ 0.01 = 0.49$

The variant II had the largest number of branches, which averaged 4.1 branches. The plants of control variant had the lowest number of branches, with the average value of 2.2 branches. These plants were most heterogeneous (CV 30.75%). Plants from the variant II and variant III showed a significant statistical difference at a level of 0.01 in the number of branches compared with plants of control variant. The number of branches from variant IV showed a significant statistical difference at a level of 0.05 compared with the number of branches from the control variant. Among the variants II and III there was no statistically significant difference, but among the variants II and IV there was a statistically significant difference at a level of 0.01. Among the variants III and IV there was statistically significant difference at a level of 0.05 (Table 5). In the research of Vujošević et al. (2009) it is found that the dose of 2 g/l Scotts (Osmocote Exact) is optimal for the development of the branches of *Pelargonium hortorum*, series *Maverick (red)- Goldsmith Seeds*.

The average number of leaves ranged from 23.6 g in the control variant to 30.6 in the variant II. The number of leaves in variant II compared to the control variant, according to the value of the LSD test, had statistically significant difference at a level of 0.01. There was a statistically significant difference among variant III and control variant at the level of 0.05. Among the variant IV and the

control variant there was no statistically significant difference (Table 6). Among the variants II and III there was a statistically significant difference at a level of 0.05, but among the variants II and IV there was a statistically significant difference at a level of 0.01. Among the variants III and IV there was no statistically significant difference. Vujošević et al. (2009) are stating that dosages of 2 g/l and 5 g/l Scotts (Osmocote Exact) have the most favorable impact on the number of the formed leaves of *Pelargonium hortorum*, series *Maverick (red)-Goldsmith Seeds*.

Tab. 5. Number of branches
Број грана

Variant <i>Варијанта</i>	Arithmetic Mean <i>Аритметичка средина</i>	Standard Error <i>Стандардна грешка</i>	Standard Deviation <i>Стандардна девијација</i>	Coefficient of Variation <i>Коефицијент варијације</i>	Interval of Variation <i>Интервал варијације</i>	Comparison with Var. 1 <i>Поређење са вар. 1</i>	Comparison with Var. 2 <i>Поређење са вар. 2</i>	Comparison with Var. 3 <i>Поређење са вар. 3</i>	Comparison with Var. 4 <i>Поређење са вар. 4</i>
I	2.2	0.07	0.68	30.75	1-3	∅	-1.83	-1.34	-0.62
II	4.1	0.07	0.71	17.48	3-5	1.83	Var. 2	0.49	1.21
III	3.6	0.06	0.6	16.84	3-5	1.34	-0.49	Var. 3	0.72
IV	2.8	0.09	0.89	31.14	1-5	0.62	-1.21	-0.72	Var. 4

$LSD\ 0.05 = 0.61$ and $LSD\ 0.01 = 0.85$

Tab. 6. Number of leaves
Број листова

Variant <i>Варијанта</i>	Arithmetic Mean <i>Аритметичка средина</i>	Standard Error <i>Стандардна грешка</i>	Standard Deviation <i>Стандардна девијација</i>	Coefficient of Variation <i>Коефицијент варијације</i>	Interval of Variation <i>Интервал варијације</i>	Comparison with Var. 1 <i>Поређење са вар. 1</i>	Comparison with Var. 2 <i>Поређење са вар. 2</i>	Comparison with Var. 3 <i>Поређење са вар. 3</i>	Comparison with Var. 4 <i>Поређење са вар. 4</i>
I	23.6	0.49	4.60	19.53	14-35	∅	-7.04	-3.84	-2.14
II	30.6	0.42	3.99	13.05	23-39	7.04	Var. 2	3.20	4.90
III	27.4	0.5	4.77	17.39	21-39	3.84	-3.20	Var. 3	1.70
IV	25.7	0.51	4.83	18.8	16-38	2.14	-4.90	-1.70	Var. 4

$LSD\ 0.05 = 2.83$ and $LSD\ 0.01 = 3.93$

The highest average number of inflorescences (2 inflorescences) was obtained in plants from variant II. Plants from the control variant had the lowest values, with an average value of 1.7 inflorescences. These plants were most heterogeneous regarding the parameter (CV 26.64%).

Tab. 7. Number of inflorescences
Број цвасти

Variant <i>Варијанта</i>	Arithmetic Mean <i>Аритметичка средина</i>	Standard Error <i>Стандардна грешка</i>	Standard Deviation <i>Стандардна девијација</i>	Coefficient of Variation <i>Коефицијент варијације</i>	Interval of Variation <i>Интервал варијације</i>	Comparison with Var. 1 <i>Поређење са вар. 1</i>	Comparison with Var. 2 <i>Поређење са вар. 2</i>	Comparison with Var. 3 <i>Поређење са вар. 3</i>	Comparison with Var. 4 <i>Поређење са вар. 4</i>
I	1.7	0.05	0.46	26.64	1-2	∅	-0.26	-0.15	-0.07
II	2	0.02	0.18	9.18	1-2	0.26	Var. 2	0.11	0.19
III	1.9	0.04	0.35	19.05	1-2	0.15	-0.11	Var. 3	0.08
IV	1.8	0.04	0.42	23.52	1-2	0.07	-0.19	-0.08	Var. 4

LSD 0.05 = 0.18

LSD 0.01 = 0.25

The number of inflorescences in plants from variant II showed a significant statistical difference at a level of 0.01 compared with the number of inflorescences from plants of the control variant. There was no statistically significant difference among variants III and control variant and among variant IV and control variant. Among the variants II and III there was no statistically significant difference, but among the variants II and IV there was a statistically significant difference at a level of 0.05. Among the variants III and IV there was no statistically significant difference (Table 7). The research of Vujošević et al. (2009) has shown that the dose of 3 g/l Scotts (Osmocote Exact) is the optimal for development of the flowers of *Pelargonium hortorum*, series *Maverick (red)*- *Goldsmith Seeds*.

Conclusion

The objective of this examination was to determine the quality of the seedlings of *Pelargonium x Hortorum* L. H. Bail. hybrid "Ringo 2000 deep scarlet" by using fertilizers with different Ca (NO₃)₂ concentration. The quality of seedlings of *Pelargonium x hortorum* L. H. Bail. was determined by the examination of the following biometric parameters: mass of stem, mass of root, number of brunches, number of leaves and number of inflorescence. All biometric

parameters showed the best results in plants that were fertilized with the following combination:

- By the first two feedings, the plants were fertilized with dosage of 1,6 g/l NPK 9-10-34+M.E. and 1,6 g/l Ca (NO₃)₂.
- The dose of fertilizer was doubled after the second fertilization, i.e. in the phase of full rooted seedlings. With a double dose the variants were fed six times.
- This research showed that the quality of seedlings depends on the dosage of nitrogen and calcium in fertilizer used to produce seedlings.

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Испитивање квалитета сијанаца *Pelargonium x hortorum*
L. H. Bail. третираних ђубривима са различитом
концентрацијом Ca (NO₃)₂

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Сажетак

Циљ овог рада представља утврђивање квалитета сијанаца *Pelargonium x hortorum* L. H. Bail. хибрида “Ringo 2000 deep scarlet” при чему су кориштена ђубрива са различитом концентрацијом Ca (NO₃)₂. Сљедећа лако-растворљива ђубрива су кориштена: NPK 9-10-34 + М.Е. + Ca (NO₃)₂. Примјењена доза NPK 9-10-34+М.Е. је била иста за све третмане, док је доза Ca (NO₃)₂ била различита, са сљедећим вриједностима: 1,6 g/l, 3 g/l и 4,6 g/l. Биљке из контролне варијанте су наводњаване обичном водом. Према резултатима свих испитиваних биометричких параметара, закључено је да је примјена ђубрива NPK 9-10-34 + М.Е. + Ca (NO₃)₂ у дози од 1,6 g/l показала најбоље резултате у поређењу са контролном варијантом и то за око 52% већу масу стабла, 76% већу масу корјена, 83% већи број грана, 30% већи број листова и 15% већи број цвасти по биљци.

Кључне ријечи: исхрана биљака, биометрички параметри

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