

THE EFFECT OF FERTILISERS ON THE QUALITY OF *PETUNIA X HYBRIDA* „DOUBLE PIROUETTE PURPLE“

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Abstract

The survey was conducted in order to determine the quality of the seedlings of *Petunia x hybrida* „Double pirouette purple“. It was produced and treated with different fertilizers, including different concentration. Three different types of liquid fertilizers – Magnicvet with NPK 7-1-5 + ME, Magnihortal with NPK 10-5-5 + ME and Humifulvil, with three different concentrations were used in the experiment. According to the methodology of work and the objective of the examination, following biometric parameters were analysed: height of plants (cm), stem thickness (mm), number of branches, number of flower buds and number of flowers. These biometric parameters were measured 40 days after planting into pots. The highest stem thickness has the plants fertilized with Magnihortal with concentration of 0,3 %. The highest number of flower buds and number of branches has the plants fertilized with Magnihortal with concentration of 0,4 %. The highest plant height has plants fertilized with Magnicvet with concentration of 0,3 %. The highest number of flowers has plants fertilized with Magnicvet with concentration of 0,4 %. On the basis of the results of all the examined biometrical parameters, it is determined that the nutrition with Magnihortal has shown the best results.

Keywords: Magnicvet, Magnihortal, Humifulvil, biometric parameters, concentration.

Introduction

Petunia hybrida hort. belongs to the *Solanaceae* family. There are 35 species in the *Petunia* genus. *Petunia hybrid* hort. was created by cross breeding of *Petunia axillaris* Lam. and *Petunia integrifolia* Hook (Dole and Wilkins, 1999). *Petunia hybrida* is an annual flower, with height of 20-30 cm. Its period of blooming lasts from May to September. In open field it is planted from mid-May, and the distance between the plants should be 20-30 cm (Mayer, 2006). Cultivars of petunias are divided in four main groups or categories based on the flowers and breeding: *grandiflora* (with large flowers, early blooming), *multiflora* (with medium-large flowers, well branched), *floribunda* (with medium-large flowers) and *milliflora* (with small flowers and thick growth). Also there are hanging petunias with many different cultivars (Mayer, 2006). Numerous petunia cultivars are available in a wide range and combinations of colours (Dole and Wilkins, 1999). *Petunia hybrida* L. is used for flowerbeds, and it is also very suitable for containers, pots and hanging flower baskets (Hessayon, 2004, Karlović et al., 2005, Paradžiković, 2012). *Petunia hybrida* belongs to semi resistant annual flowers which are being sown in greenhouses and they are replanted in the open field when there is no danger of frost (Hessayon, 1997). Optimal pH is 6,0 and EC 0,5 – 1,0 mS/cm (Hamrick, 2003). Production of seedlings is one of the most significant aspects in flower production, along with protection against diseases and pests. Choosing the most appropriate fertilizer for production of seedlings in protected environment represents one of the most significant activities in the process of production (Davitkovska, 2014). *Petunia hybrida* L. does not require fertilization 7 to 10 days after sowing for better root development (Dimovska, 2008, according to Hamrick, 2003). Fertilization should be performed with liquid fertilizers that contain N, P and K in ratio 20-10-20 and 15-0-15

(Dimovska, 2008, according to Hamrick, 2003). The successfulness of seasonal flowers is in direct dependence with the quality of seedlings. It is known that the quality of seedlings depends on multiple factors like: the quality of the seed, microclimate conditions, production equipment (technical equipment) and the type of protected environment. Next to the above mentioned factors the quality of substrate used in seedlings production is equally relevant (Dimovska, 2008). The goal of this research is to examine the influence of different types of fertilizers on morphological characteristics of petunia seedlings. It is also a goal to establish the most appropriate concentration of fertilizer to get quality seedlings.

Material and methods

The examination was set in the farm “Flower-Garden” in the village Vladevci, Strumica, Republic of Macedonia. The experiment was conducted on *Petunia x hybrida* “Double Pirouette Purple”. The seed was from a Dutch factory Syngenta. The process of seedlings production from seed was carried out at a private farm “Flower-Garden”. Substrate used for seedlings production of *Petunia x hybrida* is known as “Profimix 2 Surfinia” and the manufacturer is JSC “DURPETA” from Lithuania. This substrate is universal for production of flower seedlings. Three different types of liquid fertilizers – Magnicvet with NPK 7-1-5 + ME, Magnihortal with NPK 10-5-5 + ME and Humifulvil, with three different concentrations were used in the experiment. Seedlings of *Petunia hybrida* were grown from seeds which were from Netherlands, factory Syngenta. The seeds were planted in containers and grown in containers up to germination and formation of the first two to three leaves. The seedlings were manually taken out of the container and replanted in plastic pots with 9,5 cm diameter. The experiment contained nine variants. Every variant was consisted of 15 plants or a total of 135 plants in experiment. Fertilization was started when the seedlings had 3 to 4 leaves. 100 ml of solution was applied manually on one plant, i.e. one seedling. They were fertilized once a week, i. e. during the experiment 5 fertilizations were conducted. Types of fertilizers, their concentrations and solution are shown in the following table.

Table 1. Fertilization regime in the experiment

Variant	Type of fertilizer	Concentration	Solution	Number of plants
Variant I	Magnicvet	0,2%	3 ml / 1,5 l	15
Variant II	Magnicvet	0,3 %	4,5 ml / 1,5 l	15
Variant III	Magnicvet	0,4 %	6 ml / 1,5 l	15
Variant IV	Magnihortal	0,2 %	3 ml / 1,5 l	15
Variant V	Magnihortal	0,3 %	4,5 ml / 1,5 l	15
Variant VI	Magnihortal	0,4 %	6 ml / 1,5 l	15
Variant VII	Humifulvil	0,5 %	7,5 ml / 1,5 l	15
Variant VIII	Humifulvil	0,7 %	10,5 ml / 1,5 l	15
Variant IX	Humifulvil	1,0 %	15 ml / 1,5 l	15

When the plants have been replanted from the containers to plastic pots irrigation was immediately carried out. After that irrigation was conducted twice a week. Every plant was irrigated manually with 100 ml of clean water. Measurements of biometric parameters were conducted in the laboratory of Department of vegetable and flower crop production, at the Faculty of Agricultural Sciences and Food in Skopje, University „Sv. Cyril and Methodius“in Skopje. 15 plants of every variant were measured, after 40 days of transplanting in the plastic pots. Following biometric parameters were analysed: plant height (cm), stem thickness (mm), number of branches, number of flower buds and number of flowers. The received results were statistically processed according to the method of analysis of variance and test with LSD (Least Significant Difference) test.

Results and discussion

The highest average value for the height of plants (19,34 cm) was obtained in the plants from variant II. The plants from variant III showed similar results as variant II with an average value of 19,24 cm.

Lowest average value for the height of plants (14,78 cm) was obtained in the variant VIII. Plants from variant V had the most heterogeneous height (CV 27,44%). The height of plants from variants VII and VIII showed significant statistical difference at a level of 0.05 compared with the height of plants from the variant II and variant III. The height of plants from variant VIII showed significant statistical difference at a level of 0.05 compared with height of plants from the variant V. Between the remaining variants there was no statistically significant difference (Table 3).

Table 2. Height of plants (cm)

Variant	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation
I	18.87	1.51	7.98	12.8-27.0
II	19.34	4.38	22.66	13.0-28.0
III	19.24	3.91	20.30	12.7-27.7
IV	17.91	3.38	18.90	11.0-22.5
V	18.97	5.21	27.44	13.0-27.7
VI	16.19	4.40	27.20	11.0-26.0
VII	15.01	3.75	24.96	8.9-24.0
VIII	14.78	3.03	20.48	10.0-21.0
IX	17.60	3.57	20.29	9.5-22.0

Table 3. Height of plants (cm) – Comparison between variants

Variant	Comparison with Var. I	Comparison with Var. II	Comparison with Var. III	Comparison with Var. IV	Comparison with Var. V	Comparison with Var. VI	Comparison with Var. VII	Comparison with Var. VIII	Comparison with Var. IX
I	Var. I	-0.47	-0.37	0.96	-0.1	2.68	3.86	4.09	1.27
II	0.47	Var. II	0.1	1.43	0.37	3.15	4.33	4.56	1.74
III	0.37	-0.1	Var. III	1.33	0.27	3.05	4.23	4.46	1.64
IV	-0.96	-1.43	-1.33	Var. IV	-1.06	1.72	2.9	3.13	0.31
V	0.1	-0.37	-0.27	1.06	Var. V	2.78	3.96	4.19	1.37
VI	-2.68	-3.15	-3.05	-1.72	-2.78	Var. VI	1.18	1.41	-1.41
VII	-3.86	-4.33	-4.23	-2.9	-3.96	-1.18	Var. VII	0.23	-2.59
VIII	-4.09	-4.56	-4.46	-3.13	-4.19	-1.41	-0.23	Var. VIII	-2.82
IX	-1.27	-1.74	-1.64	-0.31	-1.37	1.41	2.59	2.82	Var. IX

LSD 0.05 =4.19; LSD 0.01 =5.77

The average stem thickness ranges from 4,67 mm in the variant III to 5,80 mm in the variant V. Plants from variant I had the most heterogeneous stem thickness (CV 19,52%). The stem thickness from variant II showed significant statistical difference at a level of 0.05 compared with the stem thickness from the variant I. The stem thickness from variant III showed significant statistical difference at a level of 0.01 compared with the stem thickness from the variant I. The stem thickness from variant IX showed significant statistical difference at a level of 0.05 compared with the stem thickness from the variant II. The stem thickness from variants V and VI showed significant statistical difference at a level of 0.01 compared with the stem thickness from the variant II. The stem thickness from variants IV and VIII showed significant statistical difference at a level of 0.05 compared with the stem thickness from the variant III. Variants V, VI and IX showed significant statistical difference at a level of 0.01 compared with variant III. Variant VII showed significant statistical difference at a level of 0.05 compared with variant V. Also, variant VII showed significant statistical difference at a level of 0.05 compared with variant VI. There was statistically significant difference among variant IX and variant VII at the level of 0.05.

Table 4. Stem thickness (mm)

Variant	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation
I	5.59	1.09	19.52	5.0-6.5
II	4.91	0.86	17.54	3.0-6.0
III	4.67	0.79	16.84	3.0-5.7
IV	5.25	0.97	18.41	4.0-6.6
V	5.80	0.97	16.73	4.0-7.6
VI	5.72	0.79	13.76	4.5-7.2
VII	5.11	0.82	16.11	4.0-6.6
VIII	5.41	0.80	14.76	4.1-7.0
IX	5.68	0.85	15.04	4.5-7.4

Table 5. Stem thickness (mm) – Comparison between variants

Variant	Comparison with Var. I	Comparison with Var. II	Comparison with Var. III	Comparison with Var. IV	Comparison with Var. V	Comparison with Var. VI	Comparison with Var. VII	Comparison with Var. VIII	Comparison with Var. IX
I	Var. I	0.68	0.92	0.34	-0.21	-0.13	0.48	0.18	-0.09
II	-0.68	Var. II	0.24	-0.34	-0.89	-0.81	-0.2	-0.5	-0.77
III	-0.92	-0.24	Var. III	-0.58	-1.13	-1.05	-0.44	-0.74	-1.01
IV	-0.34	0.34	0.58	Var. IV	-0.55	-0.47	0.14	-0.16	-0.43
V	0.21	0.89	1.13	0.55	Var. V	0.08	0.69	0.39	0.12
VI	0.13	0.81	1.05	0.47	-0.08	Var. VI	0.61	0.31	0.04
VII	-0.48	0.2	0.44	-0.14	-0.69	-0.61	Var. VII	-0.3	-0.57
VIII	-0.18	0.5	0.74	0.16	-0.39	-0.31	0.3	Var. VIII	-0.27
IX	0.09	0.77	1.01	0.43	-0.12	-0.04	0.57	0.27	Var. IX

LSD 0.05 =0.57; LSD 0.01 =0.79

The number of branches was largest in variant VI (8,38 branches). The lowest number of branches had plants of variant III, with the average value of 6,21 branches. The most heterogeneous coefficient of variation had plants from variant I with CV 28,71%.

Table 6. Number of branches

Variant	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation
I	7.57	2.17	28.71	3-11
II	7.21	1.93	26.73	5-11
III	6.21	1.31	21.10	4-9
IV	7.00	1.85	26.45	3-10
V	7.73	1.94	25.14	4-13
VI	8.38	1.98	23.62	6-12
VII	6.62	1.85	27.97	3-10
VIII	6.92	0.79	11.46	6-8
IX	6.67	1.83	27.39	3-9

Plants from the variant III showed significant statistical difference at a level of 0.05 in the number of branches compared with plants of variant I. The number of branches from variant V showed significant statistical difference at a level of 0.05 compared with the number of branches from the variant III. Between the variants VI and III there was statistically significant difference at a level of 0.01. Between the variants VI and IV there was statistically significant difference at a level of 0.05. Between the variants VIII and VI there was statistically significant difference at a level of 0.05. Variants VII and IX showed significant statistical difference at a level of 0.01 compared with variant VI (Table 7).

Table 7. Number of branches – Comparison between variants

Variant	Comparison with Var. I	Comparison with Var. II	Comparison with Var. III	Comparison with Var. IV	Comparison with Var. V	Comparison with Var. VI	Comparison with Var. VII	Comparison with Var. VIII	Comparison with Var. IX
I	Var. I	0.36	1.36	0.57	-0.16	-0.81	0.95	0.65	0.9
II	-0.36	Var. II	1.0	0.21	-0.52	-1.17	0.59	0.29	0.54
III	-1.36	-1.0	Var. III	-0.79	-1.52	-2.17	-0.41	-0.71	-0.46
IV	-0.57	-0.21	0.79	Var. IV	-0.73	-1.38	0.38	0.08	0.33
V	0.16	0.52	1.52	0.73	Var. V	-0.65	1.11	0.81	1.06
VI	0.81	1.17	2.17	1.38	0.65	Var. VI	1.76	1.46	1.71
VII	-0.95	-0.59	0.41	-0.38	-1.11	-1.76	Var. VII	-0.3	-0.05
VIII	-0.65	-0.29	0.71	-0.08	-0.81	-1.46	0.3	Var. VIII	0.25
IX	-0.9	-0.54	0.46	-0.33	-1.06	-1.71	0.05	-0.25	Var. IX

LSD 0.05 =1,23; LSD 0.01 =1,70

The highest average number of inflorescences was obtained in plants from variant VI (13,54 inflorescences). Plants from the variant I had the lowest values, with an average value of 4,5 inflorescences. Plants from variant III had the most heterogeneous number of inflorescences (CV 62,86%).

Table 8. Number of inflorescences

Variant	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation
I	4.50	1.51	33.48	2-7
II	6.36	2.65	41.67	4-13
III	5.57	3.50	62.86	2-16
IV	7.73	2.34	30.31	4-12
V	10.07	3.67	36.49	6-18
VI	13.54	4.31	31.86	5-22
VII	9.54	3.95	41.41	3-18
VIII	10.42	2.02	19.40	8-16
IX	8.08	3.90	48.19	3-17

The number of inflorescences in plants from variant IV and IX showed significant statistical difference at a level of 0.05 compared with the number of inflorescences from plants of the variant I. Variants V, VI, VII and VIII showed significant statistical difference at a level of 0.01 compared with variant I. Variants V, VII and VIII showed significant statistical difference at a level of 0.05 compared with variant II. Between the variants VI and II there was statistically significant difference at a level of 0.01. Between the variants VII and III there was statistically significant difference at a level of 0.05. Variants V, VI and VIII showed significant statistical difference at a level of 0.01 compared with variant III. Between the variants VI and IV there was statistically significant difference at a level of 0.01. Between the variants VI and V there was statistically significant difference at a level of 0.05. Variants VII and VIII showed significant statistical difference at a level of 0.05 compared with variant VI. Variant IX showed significant statistical difference at a level of 0.01 compared with variant VI.

Table 9. Number of inflorescences – Comparison between variants

Variant	Comparison with Var. I	Comparison with Var. II	Comparison with Var. III	Comparison with Var. IV	Comparison with Var. V	Comparison with Var. VI	Comparison with Var. VII	Comparison with Var. VIII	Comparison with Var. IX
I	Var. I	-1.86	-1.07	-3.23	-5.57	-9.04	-5.04	-5.92	-3.58
II	1.86	Var. II	0.79	-1.37	-3.71	-7.18	-3.18	-4.06	-1.72
III	1.07	-0.79	Var. III	-2.16	-4.5	-7.97	-3.97	-4.85	-2.51
IV	3.23	1.37	2.16	Var. IV	-2.34	-5.81	-1.81	-2.69	-0.35
V	5.57	3.71	4.5	2.34	Var. V	-3.47	0.53	-0.35	1.99
VI	9.04	7.18	7.97	5.81	3.47	Var. VI	4.0	3.12	5.46
VII	5.04	3.18	3.97	1.81	-0.53	-4.0	Var. VII	-0.88	1.46
VIII	5.92	4.06	4.85	2.69	0.35	-3.12	0.88	Var. VIII	2.34
IX	3.58	1.72	2.51	0.35	-1.99	-5.46	-1.46	-2.34	Var. IX

LSD 0.05 =2,99; LSD 0.01 =4,12

The highest average value for the number of flowers (2,43 flowers) was obtained in the plants from the variant III. The plants from variant VIII showed similar results as variant III with an average value of 2,33 flowers. Lowest average value for the number of flowers (1,46 flowers) was obtained in the variants VI and VII. Plants from variant VI had the most heterogeneous number of flowers (CV 91,01%).

Table 10. Number of flowers

Variant	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation
I	1.50	1.09	72.80	0-3
II	1.57	0.85	54.19	0-3
III	2.43	0.85	35.07	1-4
IV	1.67	1.18	70.51	0-4
V	1.67	1.35	80.71	0-4
VI	1.46	1.33	91.01	0-4
VII	1.46	1.27	86.62	0-4
VIII	2.33	1.56	66.73	1-5
IX	2.00	1.28	63.96	0-5

Results in Table 11 shows that there was no significant statistical difference between all the variants.

Table 11. Number of flowers – Comparison between variants

Variant	Comparison with Var. I	Comparison with Var. II	Comparison with Var. III	Comparison with Var. IV	Comparison with Var. V	Comparison with Var. VI	Comparison with Var. VII	Comparison with Var. VIII	Comparison with Var. IX
I	Var. I	-0.07	-0.93	-0.17	-0.17	0.04	0.04	-0.83	-0.5
II	0.07	Var. II	-0.86	-0.1	-0.1	0.11	0.11	-0.76	-0.43
III	0.93	0.86	Var. III	0.76	0.76	0.97	0.97	0.1	0.43
IV	0.17	0.1	-0.76	Var. IV	0.0	0.21	0.21	-0.66	-0.33
V	0.17	0.1	-0.76	0.0	Var. V	0.21	0.21	-0.66	-0.33
VI	-0.04	-0.11	-0.97	-0.21	-0.21	Var. VI	0.0	-0.87	-0.54
VII	-0.04	-0.11	-0.97	-0.21	-0.21	0.0	Var. VII	-0.87	-0.54
VIII	0.83	0.76	-0.1	0.66	0.66	0.87	0.87	Var. VIII	0.33
IX	0.5	0.43	-0.43	0.33	0.33	0.54	0.54	-0.33	Var. IX

LSD 0.05 =1,06, LSD 0.01 =1,46

Conclusions

The survey was conducted in order to determine the quality of the seedlings of *Petunia x hybrida* „Double pirouette purple“ which were produced and treated with different fertilizers, including different concentration. Three different types of liquid fertilizers – Magnicvet with NPK 7-1-5 + ME, Magnihortal with NPK 10-5-5 + ME and Humifulvil, with three different concentrations were used in the experiment. The quality of seedlings of *Petunia x hybrida* „Double pirouette purple“ was determined by examination of following biometric parameters: height of plants (cm), stem thickness (mm), number of branches, number of flower buds and number of flowers. The highest average value for the height of plants (19,34 cm) was obtained in the plants fertilized with Magnicvet with concentration of 0,3 %. The highest stem thickness (5,80 mm) has the plants fertilized with Magnihortal with concentration of 0,3 %. The number of branches was largest in the plants fertilized with Magnihortal with concentration of 0,4 %, with 8,38 branches. The highest average number of inflorescences (13,54 inflorescences) was obtained in plants fertilized with Magnihortal with concentration of 0,4 %. The highest average value for the number of flowers (2,43 flowers) was obtained in the plants fertilized with Magnicvet with concentration of 0,4 %.

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