Journal of Agricultural, Food and Environmental Sciences Vol 75 No 2 (2021) 46-52
DOI: https://doi.org/10.55302/JAFES21752045d

Original scientific paper

QUALITY EXAMINATION OF *PRIMULA ACAULIS* HILL. TREATED WITH TWO DIFFERENT FERTILIZERS

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ABSTRACT

This research was carried out to analyse the effect of two types of fertilisers on the morphological features of *Primula acaulis* Hill., as well as to decide on the most appropriate concentration of fertiliser in order to obtain the highest plants quality. Two different types of liquid fertilisers were used in this experiment - Magnicvet and Magnihortal with six treatments. Each treatment comprised 30 plants or a total of 180 plants in the experiment were used. 30 plants per treatment were measured randomly, four months after planting into pots. The following biometric parameters were analysed: plant height (mm), number of leaves, number of flower buds and number of flowers. Measurements of biometric parameters showed that the liquid mineral fertiliser Magnicvet with NPK 7-1-5 + micro elements is more appropriate as compared with the liquid mineral fertiliser Magnihortal with NPK 10-5-5 + micro elements concerning the reinforced nutrition and eventually the enhanced quality of *Primula acaulis* Hill. Treatment with Magnicvet 0.4% showed the highest average number of leaves and average number of flower buds, while the treatment with Magnicvet 0.2% showed the highest average plant height and the treatment with Magnicvet 0.3% showed the highest average number of flowers.

Key words: biometric parameters, fertiliser, *Primula acaulis* Hill., quality.

INTRODUCTION

Primula acaulis Hill. belongs to the Primulaceae family. There are approximately 550 species in the *Primula* genus. Species of this genus originate from Europe, Asia and North America (Hadzi Pecova, 2017). They are one of the earliest spring flowering plants. They are grown for arranging flower beds, planters, rock gardens, alone or in combination with other spring flowers. Some species can be planted in pots and used for interior decoration in America (Hadzi Pecova, 2017). *Primula acaulis* Hill. forms a rosette of wrinkled and elongated leaves. The flowers are located on short stalks: white, yellow, pink, red or purple. It blooms in early spring in April and May (Dorbić et al., 2018). During flowering the plants are 10-15 cm tall (Šilianova, 2005). *Primula acaulis* Hill. is produced by seed and division.

The seeds are sown immediately after ripening in boxes (Dorbić et al., 2018). Seeds germinate at lower temperatures of 10 to 18 ^{o}C, rarely 20 ^{o}C and germination is longer, 10-35 days, up to 40 days (Đurovka et al., 2006). The plants are pricked once and planted in a permanent place at a distance of 20 to 25 cm. Plant division is in the spring (Nikolova, 1999). The specificity of seedling production, especially in protected areas where a large number of horticultural plants are often grown in different conditions, often of different geographical origin, imposes the need to provide these plants with climatic and optimal conditions in terms of nutrition, whether in the germination, in seedling period or further development. This goal is achieved by growing plants in substrates or soil mixtures adapted to the requirements of plants at certain stages of development (Karasek, 2002). The substrate should be with a pH of 5.5 to 6.2, allow to dry thoroughly between irrigations (Hamrick, 2003). In order to obtain high quality seedlings, it is necessary to use substrates, which are on the market of many different qualities, which is important to be known when choosing (Todorović, 2019). Primrose requires semi-shaded areas, permeable and nutritious soil and moderate moisture (Hadzi Pecova, 2017). During the vegetative growth the optimal temperature ranges from 15 to 20 ^{o}C. Primrose tolerate damp sites in shade (Hawthorne & Maughan, 2001). Initiation of flower buds requires a temperature of about 10 ^{o}C, but the temperature is closely related to the length of the light. The short day and the lower temperatures initiate the flowering of the primroses. The optimum temperature for flowering is 10-15 ^{o}C. Primula are not 'high feed' requiring crops (Erwin, 1999). Erwin (1999) suggests most primula should be fertilized with 60 ppm N and K starting 2 weeks after seeding, 200 ppm immediately before transplanting, followed by regular 90-100 ppm N and K after transplanting. All primula should be fed with a nitrate-based (as opposed to an ammonium-based fertilizer). The nutrition of primrose is a complex problem due to the need for low temperatures. Under these conditions the release of nutrients is slower and the microbiological activities in the substrate are reduced. Due to the low temperatures, the release of nutrients during production is slowed down, and the conversion of ammonia nitrogen into nitrate form is limited. Ammonium-based fertilizers should not be used at these cool temperatures, especially during the winter, to prevent excessive ammonium accumulation (Dole & Wilkins, 1999). The addition of magnesium sulphate eliminates chlorosis and improves growth. In the production of flower seedlings, the dose of fertilizer application must be in accordance with the size of the container, the stage of plant development and the pH values of the substrate (Vujošević, 2015). The substrate in which the primrose is produced should be well drained. A mixture of sand or perlite, peat and clay in a ratio of 1: 1: 1 can be used (Dole & Wilkins, 1999).

This research was carried out to analyse the effect of two types of fertilisers on the morphological features of primrose, as well as to decide what is the most appropriate concentration of fertiliser for highest quality of *Primula acaulis* Hill.

MATERIALS AND METHODS

The experiment was conducted in the greenhouse of the farm "Flower-Garden" in the village Vladevci, Strumica, Republic of North Macedonia. The experiment was conducted on *Primula acaulis* Hill.. Substrate used for production of *Primula acaulis* Hill.. is known as "Poinsetia". The structure of the substrate "Poinsetia" is as follows: 65% white peat, 30% black peat and 5% perlite (Davitkovska et al., 2020). The most common organic substrate used for plant growth is peat moss and most of the crop technology available has been calibrated according with it (Gandolfo et al., 2016). Two different types of liquid fertilizers – Magnicvet with NPK 7-1-5 + micro elements and Magnihortal with NPK 10-5-5 + micro elements, with three different concentrations were used in the experiment. The company which produce this fertilizers is Alkaloid AD Skopje (Davitkovska et al., 2020). Seedlings of *Primula acaulis* Hill. were produced from seeds. The seeds were sown in containers and grown in containers up to

germination and formation of the first two to three leaves. The seedlings were manually transplanted in plastic pots with 9,5 cm diameter. The experiment contained six treatments. Every treatment was consisted of 30 plants or a total of 180 plants in experiment. Fertilization was started when the seedlings developed 5 to 6 leaves. 80 mL of the fertilizer solution was applied manually once a week on each plant. Types of fertilizers, their concentrations and solution are shown in Table 1.

Table 1. Types of fertilizers, their concentrations, solution and number of plants

Treatment	Type of fertilizer	Concentration	Solution	Number of plants
Treatment I	Magnicvet	0.2%	3 mL / 1.5 L	30
Treatment II	Magnicvet	0.3 %	4.5 mL / 1.5 L	30
Treatment III	Magnicvet	0.4 %	6 mL / 1.5 L	30
Treatment IV	Magnihortal	0.2%	3 mL / 1.5 L	30
Treatment V	Magnihortal	0.3 %	4.5 mL / 1.5 L	30
Treatment VI	Magnihortal	0.4 %	6 mL / 1.5 L	30

30 plants of every treatments were measured, after four months of transplanting in the plastic pots. Following biometric parameters were analysed: plant height (mm), number of leaves, number of flower buds and number of flowers. The obtained 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 plants height (117.4 mm) was reached in the plants from Treatment I. The plants from Treatment IV with an average value of 106.3 mm showed similar results as Treatment V (106 mm) and Treatment VI (106.5 mm). Lowest average value for the plants height (101.6 mm) was obtained in the Treatment III. Plants from Treatment I had the most heterogeneous height (CV 18.75%).

Table 2. Height of plants (mm)

Treatment	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation (min-max)
I	117.4	22.02	18.75	95-170
II	110.4	10.52	9.53	95-125
III	101.6	6.77	6.66	95-115
IV	106.3	8.88	8.36	92-120
V	106.0	13.08	12.34	90-125
VI	106.5	11.07	10.39	80-120

The height of plants from Treatment III showed significant statistical difference at a level of 0.05 compared with the height of plants from the Treatment I. Between the remaining Treatments there was no statistically significant difference (Table 3).

The number of leaves was largest in Treatment III, with 33 leaves. The lowest number of leaves had plants of Treatment V, with the average value of 25 leaves. The most heterogeneous coefficient of variation had plants from Treatment V with CV 27.84%.

Table 3. Height of plants (mm) – Comparison between treatments

Treatment	Comparison with Treat. I	Comparison with Treat. II	Comparison with Treat.III	Comparison with Treat.IV	Comparison with Treat.V	Comparison with Treat.VI
I	Treat.I	7	15.8*	11.1	11.4	10.9
II	-7	Treat.II	8.8	4.1	4.4	3.9
III	-15.8*	-8.8	Treat.III	-4.7	-4.4	-4.9
IV	-11.1	-4.1	4.7	Treat. IV	0.3	-0.2
V	-11.4	-4.4	4.4	-0.3	Treat.V	-0.5
VI	-10.9	-3.9	4.9	0.2	0.5	Treat.VI
LSD 0.05 =12.70*						
LSD 0.01 =18.06**						

Table 4. Number of leaves

Treatment	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation (min-max)
I	25.7	7.09	27.58	14-39
II	28.4	3.72	13.09	24-35
III	33.2	5.27	15.86	25-43
IV	28.3	4.69	16.58	22-35
V	25.0	6.96	27.84	15-38
VI	26.9	5.76	21.42	19-35

Plants from the Treatment III showed significant statistical difference at a level of 0.01 in the number of leaves compared with plants of Treatment I. The number of leaves from Treatment III showed significant statistical difference at a level of 0.01 compared with the number of leaves from the Treatment II. Between the Treatment V and II there was statistically significant difference at a level of 0.05. Treatment IV, V and VI showed significant statistical difference at a level of 0.01 compared with Treatment III. Treatment V showed significant statistical difference at a level of 0.05 compared with Treatment IV (Table 5).

Table 5. Number of leaves – Comparison between treatments

Treatment	Comparison with Treat. I	Comparison with Treat. II	Comparison with Treat.III	Comparison with Treat.IV	Comparison with Treat.V	Comparison with Treat.VI
I	Treat.I	-2.7	-7.5**	-2.6	0.7	-1.2
II	2.7	Treat.II	-4.8**	0.1	3.4*	1.5
III	7.5**	4.8**	Treat.III	4.9**	8.2**	6.3**
IV	2.6	-0.1	-4.9**	Treat. IV	3.3*	1.4
V	-0.7	-3.4*	-8.2**	-3.3*	Treat.V	-1.9
VI	1.2	-1.5	-6.3**	-1.4	1.9	Treat.VI
LSD 0.05 =3.28*						
LSD 0.01 =4.66**						

The highest average number of flower buds (41.8 flower buds) was obtained in plants from Treatment III. Plants from the Treatment V had the lowest values, with an average value of 31 flower buds. Plants from Treatment V had the most heterogeneous number of flower buds (CV 33.52%).

Table 6. Number of flower buds

Treatment	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation (min-max)
I	31.8	4.94	15.53	26-41
II	39.4	6.33	16.06	27-46
III	41.8	10.29	24.63	25-57
IV	38.2	5.90	15.45	25-45
V	31.0	10.39	33.52	10-46
VI	36.5	8.67	23.75	21-49

The number of flower buds in plants from Treatment II, III and IV showed significant statistical difference at a level of 0.01 compared with the number of flower buds from plants of the Treatment I. Treatment VI showed significant statistical difference at a level of 0.05 compared with Treatment I. Treatment V showed significant statistical difference at a level of 0.01 compared with Treatment II. Treatment V and VI showed significant statistical difference at a level of 0.01 compared with Treatment III. Treatment V showed significant statistical difference at a level of 0.01 compared with Treatment IV. Treatment VI showed significant statistical difference at a level of 0.01 compared with Treatment V (Table 7).

Table 7. Number of flower buds – Comparison between treatments

Treatment	Comparison with Treat. I	Comparison with Treat. II	Comparison with Treat.III	Comparison with Treat.IV	Comparison with Treat.V	Comparison with Treat.VI
I	Treat.I	-7.6**	-10**	-6.4**	0.8	-4.7*
II	7.6**	Treat.II	-2.4	1.2	8.4**	2.9
III	10**	2.4	Treat.III	3.6	10.8**	5.3**
IV	6.4**	-1.2	-3.6*	Treat. IV	7.2**	1.7
V	-0.8	-8.4**	-10.8**	-7.2**	Treat.V	-5.5**
VI	4.7*	-2.9	-5.3**	-1.7	5.5**	Treat.VI
LSD 0.05 = 3.66*						
LSD 0.01 = 5.20**						

The highest average value for the number of flowers was obtained in the plants from the Treatment II (28.2 flowers). Lowest average value for the number of flowers (24.8 flowers) was obtained in the Treatment IV and Treatment VI. Plants from Treatment V had the most heterogeneous number of flowers (CV 25.72%).

Table 8. Number of flowers

Treatment	Arithmetic Mean	Standard Deviation	Coefficient of Variation	Interval of Variation (min-max)
I	25.6	5.50	21.49	19-37
II	28.2	6.53	23.15	20-39
III	26.3	5.74	21.81	19-38
IV	24.8	5.61	22.63	13-31
V	26.8	6.89	25.72	15-37
VI	24.8	3.88	15.65	19-30

The number of flowers from Treatments IV and VI showed significant statistical difference at a level of 0.05 compared with the number of flowers from the Treatment II. Between the remaining Treatments there was no statistically significant difference (Table 9).

Table 9. Number of flowers – Comparison between treatments

Treatment	Comparison with Treat. I	Comparison with Treat. II	Comparison with Treat.III	Comparison with Treat.IV	Comparison with Treat.V	Comparison with Treat.VI
I	Treat.I	-2.6	-0.7	0.8	-1.2	0.8
II	2.6	Treat.II	1.9	3.4*	1.4	3.4*
III	0.7	-1.9	Treat.III	1.5	-0.5	1.5
IV	-0.8	-3.4*	-1.5	Treat. IV	-2	0
V	1.2	-1.4	0.5	2	Treat.V	2
VI	-0.8	-3.4*	-1.5	0	-2	Treat.VI
LSD 0.05 = 3.21*						
LSD 0.01 = 4.57**						

CONCLUSIONS

Primula acaulis Hill is mostly used for arranging flower beds, planters, rock gardens, alone or in combination with other spring flowers. It is one of the earliest spring flowering plant. Based on the analyzes of the statistic data acquired by measuring the morphological characteristics, the plants fertilized with liquid mineral fertilizer Magnicvet with NPK 7-1-5 + micro elements is more appropriate as compared with the liquid mineral fertiliser Magnihortal with NPK 10-5-5 + micro elements. Treatment with Magnicvet 0.4% showed the highest average number of leaves and average number of flower buds, while the Treatment with Magnicvet 0.2% showed the highest average plant height, and the treatment with Magnicvet 0.3% showed the highest average number of flowers. For better quality of *Primula acaulis* Hill the liquid mineral fertilizer Magnicvet (NPK 7-1-5 + micro elements) is recommended.

Acknowledgements
The authors would like to express gratitude to Alkaloid enterprise for supporting this research as a part of the project "Scientific, professional and applied cooperation in the application of liquid mineral fertilizers from the assortment of AD Alkaloid, Skopje, 2019".

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