# Determination of Optimum Phosphorus Level on The Growth and Appearance Values of Petunia (Petunia Hybrida Vilm) Grown in Pot Culture

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***Abstract*—**In this study, the effects of phosphorus applied at different levels with nutrient solution to Petunia plants grown in pot culture on plant growth and appearance values were investigated. With increasing levels of phosphorus applied to the nutrient solution, dry weight, number of flowers, shoot length and flowering time and P contents of Petunia plants increased compared to the control streatment. In general, in order to obtain the highest ornamental plant quality values, it was determined that the phosphorus applied to the pot soil with nutrient solution should be at least 100 mg $L^{-1}$ P application level.

***Keywords*—** Petunia, Phosphorus, Pot Culture**.**

## I. Introduction

Petunia (Petunia hybrida Vilm.), which belongs to the Solanaceae family and is cultivated as an annual plant, is a preferred ornamental plant in open landscapes [1]. The life cycle of the petunia plant is usually completed within 170 days, depending on local climatic conditions, biological characteristics and environmental conditions [2]. Today, petunia cultivation is widely used in urban landscapes, along highways, and in private gardens [3], offering the potential for high economic returns for landscape producers and the flower industry [4].

Plant nutrition management is an important factor determining the ornamental value and marketability of potted plants [2]. In pot culture of ornamental plants, nutrient form, application rate and time of application during the plant development stage are of great importance in plant nutrition management. While the marketing value of the product obtained with the appropriate fertilization program increases, negative effects such as plant toxicity, product losses and environmental pollution are minimized. In ornamental plant production, it is known that parameters such as plant biomass, number and length of branches, total leaf area and number of flowers, which determine the marketing value of the plant according to the species, are directly affected by fertilization. In general, Petunia plants require high nutrient levels to sustain growth and development [5].

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Soil organic matter and mineral phosphorus (P) fractions, phosphorus fertilizer applications or phosphates released in the soil by the interaction of certain groups of organisms are the main sources used to meet the P requirement of plant growth. Depending on soil properties, the usefulness of phosphorus fertilizers applied to the soil and their uptake by plants may vary. In plant biochemistry, phosphorus is an important nutrient for plant growth and agricultural productivity [6]. P plays an important role in the nutrition of petunia plants and is one of the most important plant nutrients affecting the marketing value of the plant. Phosphorus deficiency results in low biomass and P deficiency in Petunia plants [7].

In this study, the effects of phosphorus applied at different levels in nutrient solution to Petunia plants grown in pot culture on growth and product parameters and nutrient contents were studied

## II. Materials and Methods

The experiment was carried out in a glass greenhouse with controlled temperature, humidity and lighting. Petunia (Petunia hybrida Vilm) seeds were sieved through a 0.1 mm sieve and germinated in perlite + peat mixed 1:1 by volume at appropriate humidity and temperature. Germinated petunia plants were transferred to pots at the 6-leaf stage of development. A substrate mixture of heather soil sieved through a 2 mm sieve and washed peat and perlite in a 1:1:1 ratio by volume was used as growing medium in pots. The physical and chemical analytical characteristics of the potting soil were within the range of acceptable values for ornamental plants (Table 1).

TABLE I: THE ANALYTICAL CHARACTERISTICS OF THE POTTING SOIL

| Parameters | |
|---|---|
| Bulk density (g $cm^{3-1}$) | Loam |
| Particle density (g $cm^{3-1}$) | 1,62 |
| Total Porosity (%) | 86 |
| Organic Matter, % | 1,2 |
| Air Capacity (%) | 24 |
| pH- $H_2O$ (1:5 w/v) | 7.14 |
| EC, dS $m^{-1}$ 25°C | 0,82 |
| NO3-N (mg $kg^{-1}$) | 38 |
| P (water soluble, mg $kg^{-1}$) | 15 |
| K (water soluble, mg $kg^{-1}$) | 44 |

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After the petunia plants were transplanted into pots, N and K treatments were applied at fixed levels and P treatments were applied at variable levels according to the experimental plan given below. Nutrients were applied in solution form to the plants grown in pots. N was prepared as 300 ppm (ammonium nitrate) and K was prepared as 200 ppm (potassium sulfate). P applications were prepared from triple super phosphate fertilizer containing 43% $P_2O_5$. The composition of nutrient solutions containing different P levels is given in Table 2. Nutrient concentrations, except for N, P and K, were adjusted according to the recommended nutrient concentration for ornamental plants [8].

TABLE II. PHOSPHORUS LEVELS APPLIED TO PETUNIA PLANTS

| Applications | Phosphorus, mg $L^{-1}$ |
|---|---|
| $NK+P_0$ | 0 |
| $NK+P_1$ | 50 |
| $NK+P_2$ | 100 |
| $NK+P_3$ | 200 |
| $NK+P_4$ | 300 |

The pH value of the nutrient solutions used in the experiment was adjusted to 6-6.5 and the EC value to 2.5 ms.cm-1 (25 C°). Petunia plants were fertigated at the rate of 50-200 ml/day with nutrient solutions prepared according to the procedures given above, based on their water consumption and practical leaching of the solution from the pots during the growth period. In order to prevent excessive salt accumulation in the pots, 500 ml of pure water was applied to all pots 1 day a week and then immediately its own solution was applied to drain the accumulated salts. Greenhouse temperature, humidity and illumination were kept at an appropriate level during the rooting and growth stages of the plants.

Four months after all plants were transferred to the pots, they were cut from the surface of the pots and their fresh weight, shoot numbers and shoot lengths were determined and prepared for analysis after standard washing, drying and grinding procedures for plant nutrient analysis.

The flowering time of Petunia plants was determined based on the time from the transfer of the seedlings to the pots until flowering. The flowering time was determined by labeling the flowers formed on the Petunia plants immediately after bud opening by using adhesive paper tapes with the date of flowering written on it in 1x1 cm dimensions and the time until the flower shriveled. The total number of flowers was determined based on the number of labels used in each pot. All these procedures were carried out by keeping separate notes for each pot and making regular daily phenological observations.

Total nitrogen was determined by Kjeldahl method in dried and ground plant samples and P and K elements were determined by ICP-MS in plant samples wet ashed with $HNO_3$+$HClO_4$ acid mixture in accordance with the analytical procedure.

The analysis of variance of the findings obtained in the greenhouse experiment carried out according to the random blocks experimental design with 5 replicates was analysed using SPSS software (16.0) with the least significant difference (LSD) test ($P < 0.05$).

## III. Results and Discussion

Dry weight, number of shoots, number of flowers, shoot length, flowering time and phosphorus levels of Petunia plants increased with phosphorus applications to potting soil (Table 3). Regarding P treatments in petunia plants, duration to flowering time was shortened by 15-20 days on average compared to the control treatment. In the control treatment, except for flowering time, the developmental parameters were determined at the lowest value. This situation clearly shows that the development and flowering parameters of petunia plants are negatively affected due to insufficient phosphorus nutrition when nutrients are not applied to the substrate medium. There was no significant change in N content with increasing applications of P. In the studies conducted on this subject, it was reported that P applications had a positive effect on shoot dry weight and shoot length in petunia plants, while the marketing quality of the plants without P application decreased in terms of appearance values [9].

TABLE 3. SOME ORNAMENTAL PLANT QUALITY PARAMETERS AND MINERAL CONTENTS OF PETUNIA PLANT AT DIFFERENT P TREATMENTS

| Phosphorus Applications, mg $L^{-1}$ | Dry weight, g | Shoot length, cm | Duration for Flowering | Flowering day number | Flower number | N, % | P, % | K, % |
|---|---|---|---|---|---|---|---|---|
| 0 | 0,52 c | 14,5 b | 31,4 a | 4,4 c | 6,4 d | 3,30 | 0,17 e | 3,55 b |
| 50 | 2,22 b | 24,1 a | 27,6 a | 6,2 b | 12,8 c | 3,65 | 0,32 d | 4,17 a |
| 100 | 4,08 a | 26,5 a | 19,6 b | 6,8 b | 19,8 b | 3,81 | 0,61 c | 3,18 c |
| 200 | 4,04 a | 26,6 a | 18 b | 8,6 a | 25,6 a | 3,53 | 0,81 b | 3,30 c |
| 300 | 4,11 a | 27,4 a | 11,4 c | 8,4 a | 22,8 a | 3,64 | 1,13 a | 2,73 d |
| Significiency | ** | * | ** | ** | * | ns | ** | * |

**: P<0,01; *: P<0,05; ns: no significiency

The dry weight, number of flowers, shoot length, days to flowering and shoot length of petunia plants differed according to the treatments in which phosphorus was applied at increasing levels of nutrient solution. The highest dry matter content was

determined in 100 mg $L^{-1}$ P treatment and the highest shoot length was determined in 50 mg $L^{-1}$ P treatment. Flowering time increased with increasing levels of P applied to the nutrient solution. The highest number of days to flowering and number of flowers were determined in 200 mg $L^{-1}$ P treatment. Accordingly, the application level of 200 mg L-1 P can be considered as an ideal concentration in terms of plant growth and marketing quality in the pot culture of Petunia plant. However, in terms of general marketing value, it is understood that 100 mg L-1 P application dose also meets the requirements to a great extent. At this point, it is thought that the plant available P levels in the pot soil may also have an effect.

The P content of petunia plant was determined below the minimum nutrient sufficiency levels (0,45 mg L-1 P) at 50 mg L-1 P application level. Accordingly, it is understood that the critical application level [10] for P in the nutrient solution should be kept above 50 mg L-1 P.

The highest P content in flowering time and number of flowers in petunia plant was obtained in 300 mg L-1 P application. However, the fact that this application level has no significant effect on other parameters creates a luxury consumption in plant nutrition and increases production costs. These results show the importance of P nutrition of Petunia plants grown in pot culture and in increasing their marketing value

## IV. Conclusion

The experimental results showed the necessity of an optimum plant nutrition management to achieve high quality value in pot culture of ornamental plants. Flowers and stem fullness are the main attractive ornamental organs in petunia plants, and the formation of sufficient number of flowers with a sufficient biomass in the plant, as well as the length of flowering time are among the most important parameters that increase the marketing value of the plant. The experimental results showed that phosphorus applied at a minimum level of 100 mg L-1 to the modified standard nutrient solution in petunia cultivation in potted medium gave optimum results in terms of ornamental plant quality parameters in Petunia plant

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