

## Effects of Different Growing Media on Plant Growth and Nutrient Contents of Petunia (*Petunia hybrida*)

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**Abstract:** The objective of this study was to investigate the effects of different growing media on plant growth and nutrient contents of petunia (*Petunia hybrida*). The experiment was conducted in a chamber room under controlled conditions at the laboratory. Seven different media (soil, 3:1 soil: peat (P1), 2:1 soil: peat (P2), 3:1 soil: barnyard manure (BYM1), 2:1 soil: barnyard manure (BYM2), 3:1 soil: sugar beet pulp (SBP1), 2:1 soil: sugar beet pulp (SBP2)) were used as plant growing media. The experiment was ended after three months following transplanting of seedlings. Plant growth and flower parameters and macro-micro nutrient contents were determined in harvested plants. The highest stem diameter, branch number, flower diameter, flower stalk diameter, plant fresh weight and plant dry weight were in 2:1 ratio of soil: peat mixture as 7.00 mm, 6.33, 8.91 cm, 3.59 mm, 48.47 g and 4.52 g while the highest plant length, lateral branch number and flower number means were found as 27.43 cm, 24.67 and 24.67 in ratio of 3:1 soil: peat growing media respectively. The highest potassium, magnesium and zinc means of plants were obtained as 6.6%, 2.2% and 32.50 mg kg<sup>-1</sup> in soil: barnyard manure (2:1) growing media while the highest phosphorus and calcium means of plants were found as 0.27% and 4.5% in soil and peat growing media respectively. The highest iron and copper means of plants were determined as 231 mg kg<sup>-1</sup> and 32.50 mg kg<sup>-1</sup> in ratios of 2:1 and 3:1 of soil: sugarbeet pulp growing media respectively.

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## 1. INTRODUCTION

In the last decades ornamental plants are grown for decorative purposes in garden and landscape design projects, as house plant, for cut flowers. The commercial production of ornamental plants is growing and the related market is developing fast. Petunia (*Petunia hybrida*) belong to the Solanaceae family [1]. Petunias are perennials in warm climates and are used mainly as annual bedding and container plants in temperate regions [2]. Petunias are among the most popular bedding plants in the world because of their adaptability, variety and flower color range. Petunias are quantitative long-day plants flowering under any photoperiod but flowering faster under long days. Short photoperiods (8-10 hours) delay flowering, retard elongation of the main stem and support lateral branching. The average of daily temperature

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degree changes range of in 10-25 °C for flowering time, plant height and lateral branching [3]. Hybrid petunias are garden standbys from several South American petunia species. These sun and heat-loving annuals or tender perennials were among the first ornamentals grown in the bedding plant market since the 1950's. Petunia cultivated in flower beds and pots requires full sunlight to produce plants and flowers with bright attractive colors. They need abundant sun and grow best in rich soil with good drainage. They bloom best with regular fertilization and will continue to flower all seasons [4].

Increased flower production, quality of flower and perfection in the form of plants are recognised as important issues in bedding and flower production. According to Boodley [5], quality of flowers are considered as function of nutrient level. Nitrogen, phosphorus and potassium enormously influence the production and quality of flowers. Whereas using of synthetic fertilizers and chemicals in flower breeding increase cost of production. In addition these materials can lead environmental pollution problem with potential hazards to flora, fauna and human.

Under this circumstances, using of organic manures such as compost, vermicompost, barnyard manures and biofertilizers is ecofriendly, easily available and cost effective. It is reported that organic materials provide nutrient conversion of organic fertilizer and mineral fertilizer combination, protection of soil moisture, increasing of cation exchange capacity, improving soil physical and biological properties and providing control of erosion [6-10]. Among the organic materials peat often enhances aeration and water retention [11]. Ko et al. [12] reported that cattle manure compost can be used as a source of soil amendment and organic matter in agriculture which improves the quality of the crop and the environment.

The aim of this study was determine the effects of peat, barnyard manure and sugar beet pulp applications on growth and flowering parameters and nutrient contents of petunia.

## 2. MATERIAL and METHODS

This experiment was conducted in a randomized experimental design with three replication in a chamber room under controlled conditions at Department of Soil Science and Plant Nutrient Laboratory. Petunia (*Petunia hybrida*) were used as experiment plant in this study. Seven different media (soil, 3:1 soil: peat (P1), 2:1 soil: peat (P2), 3:1 soil: barnyard manure (BYM1), 2:1 soil: barnyard manure (BYM2), 3:1 soil: sugar beet pulp (SBP1), 2:1 soil: sugar beet pulp (SBP2)) were used as plant growing media. Soil and organic materials were mixed according to volume basis. The experiment was ended after three months following transplanting of seedlings. Plant length, stem diameter, branch number, lateral branch number, flower number, flower diameter, flower stalk diameter, plant fresh weight, plant dry weight and macro-micro nutrient contents were measured harvested plants. The nutrient contents of the harvested plant samples were analyzed in dried and grinded plant samples according to following methods reported by Kacar [13]. The P level was analyzed by the spectrophotometric method, and K, Ca, Mg, Fe, Mn, Zn, and Cu levels were determined by using an atomic absorption spectrophotometer (Thermo ICE 3000 series). Soil properties and some properties of growing medias were determined using the standart analyses methods [14]. Physical and chemical properties of the growth media had loamy texture, non saline, slightly alkaline, low in organic matter, insufficient in phosphorus and zinc contents sufficient in calcium, magnesium, manganese and copper contents (Table 1).

**Table 1.** Properties of the experiment soil

Texture	pH	Salinity	Lime	OM	P	K	Ca	Mg	Fe	Mn	Zn	Cu
		( $\mu\text{S cm}^{-1}$ )	(%)	(%)		( $\text{mg kg}^{-1}$ )						
Loamy	7.81	360.7	3.86	1.32	5.50	298	3034	405	5.58	29.84	0.58	0.81

Some properties of the organic materials used in this study were given in [Table 2](#).

**Table 2.** Some properties of organic materials used in different growth media

Organic material	pH	EC (mS cm <sup>-1</sup> )	Moisture (%)
Peat	6.52	0.16	47.79
Barnyard manure	8.66	8.55	6.78
Sugar beet pulp	4.02	0.55	89.57

pH levels of organic materials were determined as close to neutral, alkaline and acide for peat, barnyard manure and sugar beet pulp respectively. When the salinity of organic materials were evaluated barnyard manure was found saline while peat and sugar beet pulp were non saline. Sugar beet pulp had the highest water content according to other organic materials. The lowest water content were determined in barnyard manure. Variance analyses of the experimental data were done by SPSS statistical program [15].

### 3. RESULTS and DISCUSSION

The variance analyses of results and the effects of different growth media on plant growth in petunia are given in [Table 3](#) and [4](#) respectively. According to the variance analyses different growing media significantly ( $p < 0.01$ ) influenced all of the plant growth parameters ([Table 3](#)).

**Table 3.** Variance analyses of the results for plant growth in petunia

V. Source	DF	Plant length	Stem diameter	Branch number	Lateral branch number	Flower number	Flower diameter	Flower stalk diameter	Plant fresh weight	Plant dry weight
Application	6	21.34**	6.692**	12.77**	41.02**	27.40**	17.88**	5.26**	74.624**	53.31**

\*\*significant at 0.01

When it was noticed that [Table 4](#), the highest means belong plant growth parameters were shown with peat applications. The highest plant length, lateral branch number, flower number were obtained as 27.45 cm, 24.67 and 24.67 in 3:1 ratio of soil: peat mixture (P1) while the highest stem diameter, branch number, flower diameter, flower stalk diameter, plant fresh weight and plant dry weight were in 2:1 ratio of soil: peat mixture as 7.00 mm, 6.33, 8.91 cm, 3.59 mm, 48.47 g and 4.52 g respectively. Generally plant growth parameters and flower parameters means obtained in barnyard manure and sugar beet pulp applications were lower according to those obtained in control and peat applications ([Figure 1](#) and [2](#)). The lowest means of plant length, stem diameter, lateral branch number, plant fresh weight and plant dry weight were found as 8.33 cm, 2.67 mm, 2.00, 0.93 g and 0.12 g in 2:1 ratio of soil: barnyard manure mixture (BYM2). In this study the means of plant growth parameters and flower parameter means obtained by different organic materials exhibit the following decreasing trend: peat > sugar beet pulp > barn yard manure. Generally the decreases in plant growth and flower growth were determined by increasing amounts of barnyard manure and sugar beet pulp in their mixtures by soil. Although increasing amounts of peat in its mixtures by soil increased plant and flower growth, the means of plant and flower growth parameters indifferent peat ratios were in same group according to Duncan's multiple comparison test. The high pH level and salinity in barnyard manure lead to decreases plant and flower growth. Similarly, sugar beet pulp having low pH level may have been caused decreasing in plant and flower growth. It was known that soil properties of plant growth media have very importance for nutrient uptake, grow and yield. It was reported that sugar beet pulp and cattle manure addition to soil improve

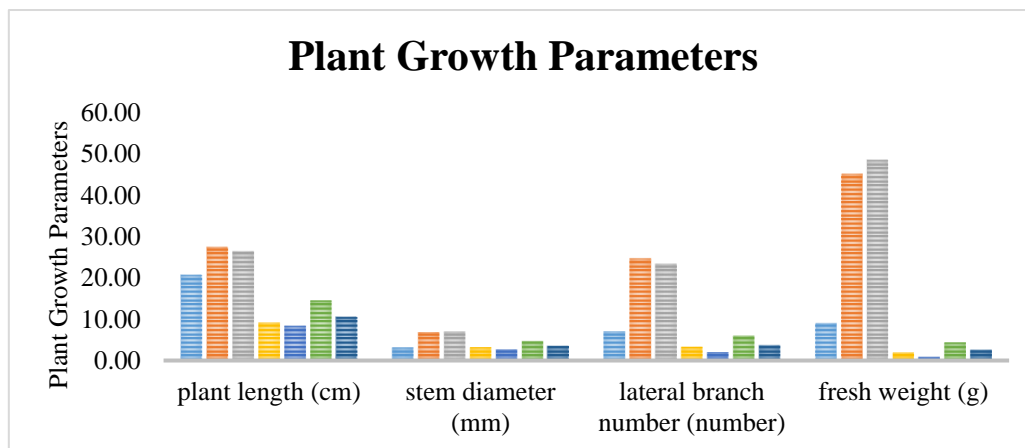
soil quality, soil organic matter, soil aggregat stability, water holding capacity and nutrient content (especially N, P and K) [12,16,17].

**Table 4.** Effects of different growth media on plant growth in petunia

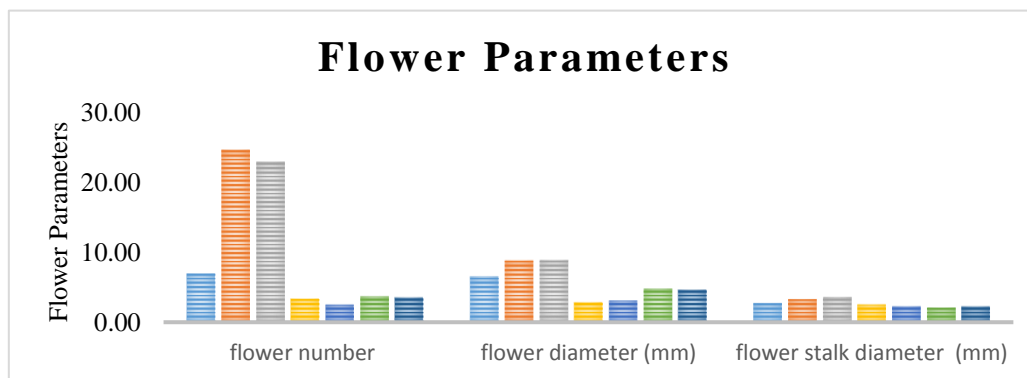
Application	Plant length (cm)	Stem diameter (mm)	Branch number	Lateral branch number	Flower number	Flower diameter (mm)	Flower stalk diameter (mm)	Plant fresh weight (g)	Plant dry weight (g)
Control	20.67b	3.17b	1.00b	7.00b	7.00b	6.60b	2.72bc	9.03b	0.85b
P1	27.43a	6.83a	4.67a	24.67a	24.67a	8.83a	3.27ab	45.10a	4.20a
P2	26.40a	7.00a	6.33a	23.33a	23.00a	8.91a	3.59a	48.47a	4.52a
BYM1	9.17cd	3.25b	1.00b	3.33b	3.33b	2.83d	2.50bc	1.93b	0.26b
BYM2	8.33d	2.67b	1.00b	2.00b	2.50b	3.10cd	2.25c	0.93b	0.12b
SBP1	14.50c	4.67b	2.67b	6.00b	3.67b	4.78c	2.08c	4.37b	0.50b
SBP2	10.50cd	3.50b	1.67b	3.67b	3.50b	4.63cd	2.22c	2.60b	0.34b

(P: Peat; BYM: Barnyard manure; SBP: Sugar beet pulp)

Effects of different growth media on plant growth parameters and flower parameters are also given in Figure 1 and 2.



**Figure 1.** Effects of different growth media on growth parameters in petunia



**Figure 2.** Effects of different growth media on quality parameters in petunia

Our results were correspond with the referred literature knowledges about sugar beet pulp and cattle manure. Nkongolo et al. [18] and Gülser [19] reported that peat addition to soil improved plant growth in *Tagetes*. Chamani et al. [20] reported that flower number, leaf length, plant fresh and dry weight increased by vermicompost and peat applications according to control application. Increasing flower production, flower quality and perfection in the forms of plant are the important goals in bedding and flower production. The flower quality was considered as a function of nutrient level [5]. Although nitrogen, phosphorus and potassium considerably influence flower quality and production they lead directly on cost of production. In addition, application of synthetic fertilizers and chemicals in high level lead environmental problem and damage to flora, fauna, and human. In recently, depletion of non renewable resources and environmental deterioration together with their high prices lead utilization of alternative materials as peat, zeolite, perlite animal manure, compost and various organic wastes. In this study, addition of peat to growth media increased plant and flower growth while sugar beet pulp and barnyard manure had non ameliorative effect according to control. It was thought that changes in plant and flower growth in different growth media caused by properties of organic materials. James [21] reported that petunia and begonia can grow in growth media having EC levels in range of 1.7- 6.1 and 2.1- 5.4 dS m<sup>-1</sup> respectively. It was thought that high EC level of baryard manure and low level of sugar beet pulp influenced negatively plant and flower growth of petunia. The variance analyses of results and the effects of different growth media on nutrient contents in petunia are given in Table 5 and 6 respectively.

**Table 5.** Variance analyses of the results for nutrient contents in petunia

V. Source	DF	P	K	Mg	Ca	Fe	Mn	Zn	Cu
Application	6	6.325**	38.45**	6.21**	8.07**	6.22**	7.02**	14.63**	1.80**

\*\*significant at 0.01

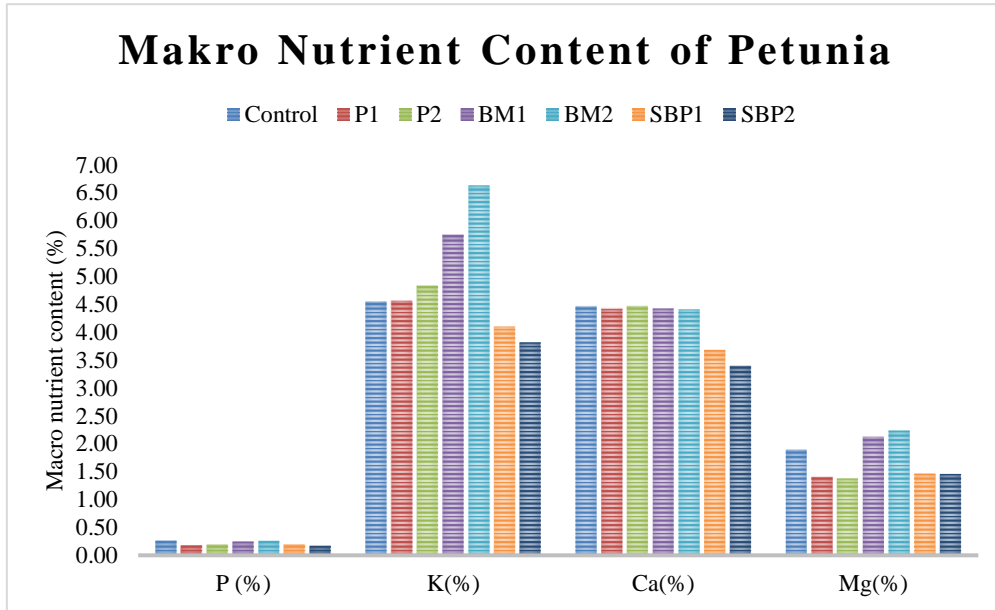
**Table 6.** Effects of different growth media on nutrient contents in petunia

Application	P (%)	K (%)	Ca (%)	Mg (%)	Fe (mg kg <sup>-1</sup> )	Cu (mg kg <sup>-1</sup> )	Zn (mg kg <sup>-1</sup> )	Mn (mg kg <sup>-1</sup> )
Control	0.27a	4.55cd	4.47a	1.90ab	174.00ab	25.00a	28.26ab	158.91bc
P1	0.19c	4.56cd	4.42a	1.41c	59.60c	17.58ab	17.80c	135.82c
P2	0.20bc	4.84c	4.47a	1.38c	44.65c	16.79ab	18.96c	131.30c
BM1	0.25ab	5.74b	4.42a	2.13a	113.63bc	13.94b	31.28ab	163.73bc
BM2	0.27a	6.63a	4.41a	2.25a	100.19bc	17.71ab	32.50a	140.77c
SBP1	0.21bc	4.10de	3.68b	1.47bc	160.57ab	32.50a	27.37b	181.77b
SBP2	0.17c	3.82e	3.40b	1.46bc	230.78a	21.29ab	28.31ab	232.93a

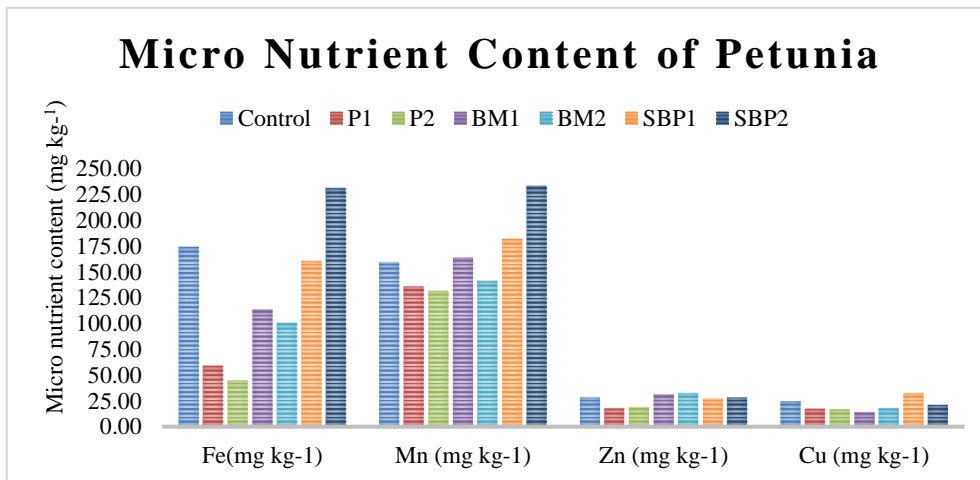
(P:Peat; BM: Barnyard manure; SBP: Sugarbeet pulp)

According to the variance analyses different growing media significantly ( $p < 0.01$ ) influenced P, K, Ca, Mg, Fe, Mn, Zn and Cu contents. The highest macro nutrient contents means were obtained in BM growth media except Ca. While the highest micro nutrient contents means in SBP growth media except zinc. The highest Ca and Zn contents means were found as 4.47% and 32.50 mg kg<sup>-1</sup> in P2 and BM2 growth media (Figure 3 and 4). In this study obtained nutrient contents were correspond with the nutrient contents reported for the other plants belong Solanaceae family such as tomato, potato, eggplant [22]. When nutrient contents levels were evaluated according to reported limit values for eggplant (*Solanum melongena*) were not found deficiencies except iron ( $< 50$  mg kg<sup>-1</sup>) and zinc ( $< 20$  mg kg<sup>-1</sup>) contents obtained in P2 and P1

growth media respectively (Figure 4). The pH has a major role in the availability of nutrient ions. It was known that Marschner [23] macronutrients and micronutrients are more available at levels of  $\geq 7$  pH and  $\leq 7$  pH respectively. Sugar beet pulp has lower pH level than those in the other materials. So micronutrients contents were obtained in high amounts in this growth media compare to the other materials.



**Figure 3.** Effects of different growth media on macro nutrient contents in petunia



**Figure 4.** Effects of different growth media on micro nutrient contents in petunia

Our results were correspond with the reffered literature knowledges. [24] reported that addition of sugar beet pulp to soil increased organic matter level. Cattle manure compost addition to soil improve soil quality, soil organic matter, soil aggregat stabilty, water holding capacity and nutrient content (especially N, P and K) [16,17,25]. Raviv et al. [26] reported that peat moss serves as the main component of transplant growth media, mainly due to the following physical and chemical properties: adequate Free Air Space (FAS) at 0-10 cm water suction; high water content at low tension at 10-100 cm water suction; high Cation Exchange Capacity (CEC) which minimizes loss of nutrients and facilitates adequate mineral nutrition. Inbar et al. [27] reported that during last two decades due to improved popularity for protected agriculture, evolution of plant growth techniques has increased demand for container substrates such as peat, zeolite and perlite but supply have been decreasing. Depletion of non

renewable resources and environmental deterioration with high price of those substrates have favored the utilization of alternative materials as growth substrates [28].

#### 4. CONCLUSION

As a result, using of peat can be useful for petunia growth in bedding and flower production. In addition, it can be suggested investigates about separated mixtures of barnyard manure and sugar beet pulp with soil in different ratios in growth media for petunia breeding. Additionally, it was thought that peat may be beneficial in the stuation of application as combined with barnyard manure and sugar beet pulp for optimum nutrition in petunia.

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#### Conflicts of Interests

Authors declare that there is no conflict of interests.

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