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# EFFECTIVENESS OF POTTING COMPOSTS AND FERTILIZATION ON GROWTH AND FLOWERING OF ZONAL PELARGONIUMS

**Babita Kanwar*, Jasbir Singh Wazir, Suman Bhatia, Shreedhar Beese, Rahul Negi, Rupali Thakur and Choudhary Nandini Chandermohan**

Department of Floriculture and Landscape Architecture, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan - 173 230 (H.P.), India.
*Corresponding author E-mail : babitakanwar45@gmail.com
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**ABSTRACT**

The study employed a Completely Randomized Design (Factorial) with three different growing media compositions: Soil + Sand + FYM (1:1:1) Control, Cocopeat + Soil + FYM + Leaf mould (2:1:1:1), and Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1), along with four different fertilizer schedules. Various parameters related to growth, flowering, and potting compost were recorded. The $F_3$ fertilizer schedule resulted in the highest recorded values for plant height (20.56 cm), number of shoots per plant (9.50), shoot length (16.92 cm), plant spread (18.79 cm), days to visible bud formation (87.69 days), days to first flowering (115.79 days), inflorescence stalk length (13.62 cm), inflorescence diameter (8.21 cm), flowering duration (122.55 days), number of open inflorescences per plant (9.49), and pot presentability (85.18). Additionally, the Cocopeat + Soil + FYM + Leaf mould (2:1:1:1) medium yielded favorable results with significant performance in several parameters compared to other media compositions. The $F_3$ fertilizer schedule maintained a neutral pH level (6.73), normal electrical conductivity, and exhibited high organic carbon (5.41%) content along with substantial levels of available nitrogen (492.73 kg ha$^{-1}$), phosphorus (13.18 kg ha$^{-1}$) and potassium (302.88 kg ha$^{-1}$). Consequently, the study concluded that using Cocopeat + Soil + FYM + Leaf mould (2:1:1:1) as a potting medium along with the $F_3$ fertilizer schedule is the most suitable approach for producing high-quality potted zonal pelargoniums.

***Key words :*** Growing media, Fertilizer schedule, Zonal pelargoniums, Pot presentability.

## Introduction

Pelargonium (*Pelargonium* × *hortorum*), commonly referred to as modern florist's geranium, is a hybrid species resulting from the crossing of *Pelargonium zonale*, *Pelargonium inquinans* and *Pelargonium grandiflorum*. This captivating flowering potted plant is well-suited for temperate regions and is renowned for its dazzling array of colors, shapes and textures in its blooms. It holds significant importance as a spring and summer flowering plant, suitable for both pot cultivation and bedding arrangements (Berninger, 1993). Originating from South Africa, it belongs to the Geraniaceae family. Varieties of geraniums, including zonal pelargoniums, regal pelargoniums, ivy leaf pelargoniums, scented leaf pelargoniums and miniature pelargoniums are all part of the pelargonium family. Propagation of pelargoniums primarily occurs through seeds and stem cuttings. Single-petaled pelargoniums are typically propagated from seeds, while the captivating semi-double and double varieties are predominantly grown from stem cuttings worldwide (Randhawa and Mukopadhyay, 1986). These plants thrive within a daytime temperature range of 22-28°C, with a minimum temperature requirement of 15-18°C for consistent growth and flowering. Pelargoniums flourish when exposed to the sunniest areas of the garden or greenhouse. Optimal growth and flowering are achieved under a light intensity of 4000–4500-foot candles, with a preference for avoiding hot and humid conditions. Ideally, relative humidity levels should be maintained between 55-60% to foster quality pelargonium growth. In temperate greenhouse conditions, pelargoniums exhibit profuse blooming during spring, summer and autumn. However, there exists potential for further enhancement in growth and flowering through the application of modern soluble/Controlled Release Fertilizers and SPNF (Subhash Palekar Natural Farming) nutrient sources. Adequate watering, a consistent fertilization regimen, well-ventilated surroundings, suitable temperatures, appropriate spacing, timing and pinching contribute to the rapid growth of pelargoniums. Deviations from these greenhouse cultivation requirements may lead to challenges for pelargonium growers (Brothers, 1972).

In the plains of North India, both seed-propagated and cutting-propagated pelargoniums typically bloom during the winter months, with the most vibrant flowers observed in February-March. However, they struggle to thrive during the intense heat and rainy seasons of summer months. Controlled-Release Fertilizers (CRFs) are fertilizers designed to gradually release essential minerals to enhance crop quality and yield (Li *et al*., 2019). NU-SLOW GR is a granular nitrogen fertilizer containing ammonium, urea and slow-release nitrogen, suitable for various crops, including sensitive ones, ensuring a steady supply of nitrogen throughout the growth cycle to foster balanced vegetative growth. The utilization of CRFs offers benefits such as improved nutrient utilization efficiency and reduced nitrogen leaching (Broschat, 1995). These fertilizers are particularly popular and effective in container plant cultivation, as they minimize labor and prevent nutrient loss through leaching (Sharma, 1979). There is a growing emphasis on reducing the reliance on chemical fertilizers in soil by enhancing the efficient utilization of soil nutrients and incorporating more organic matter. Excessive use of agrochemicals has adversely affected soil flora, fauna and enzyme activity, all critical components for maintaining soil fertility. Mature organic manure possesses a balanced nutrient profile (NPK) with low C:N and C:P ratios, indicating a slow release of nutrients. Utilizing appropriate growing media or substrates is crucial for producing high-quality flower crops, as it directly influences the development and sustenance of a robust root system. An ideal growing medium should provide adequate support for plant anchorage, serve as a reservoir for nutrients and water, facilitate oxygen diffusion to the roots, and enable gaseous exchange between roots. Cocopeat, derived from coconut husk fiber extraction, is considered an excellent growing medium component due to its favorable pH, electrical conductivity and other chemical properties. It is also environmentally friendly and supports the cultivation of various crops of satisfactory quality (Awang *et al*., 2009).

Given the significant commercial value of potted pelargoniums, the current study aims to evaluate the impact of various combinations of potting composts and fertilizer schedules on the overall growth and flowering responses of these plants. Thus, the research project titled was designed with the following objectives:

i) Identify the most effective potting compost(s) for promoting the growth and flowering of zonal pelargoniums.

ii) Determine the optimal fertilizer schedule(s) utilizing different nutrient sources to enhance the growth and flowering of zonal pelargoniums. These objectives aim to provide valuable insights into the cultivation practices that maximize the commercial potential of potted pelargoniums by optimizing their growth and flowering characteristics.

## Materials and Methods

The study was conducted at the Regional Horticultural Research and Training Station in Mashobra, Shimla, Himachal Pradesh, within a controlled glasshouse environment. This facility is situated at an elevation of 2286 meters above sea level and positioned between 31º12" N latitude and 77º22" E longitude. The experimental area is situated in a temperate region, known for its cold winters and mild summers. The peak heat occurs in May and June, while the coldest months are January and February. Prior to initiating the experiment, a composite sample was prepared and examined to assess different characteristics of the potting compost. This was done to acquire data regarding the physical and chemical condition of the potting compost. The techniques utilized and the findings for key characteristics of the experimental area's potting compost have been condensed and presented in Table 1.

Rooted cuttings were created within a propagation chamber at RHR & TS, Mashobra, Shimla, HP. These cuttings were then transplanted into appropriate media consisting of a mixture of Cocopeat and Sand (60:40) by the end of August. By the last week of October, the rooted cuttings from the initial planting were transferred into 300cc root trainers filled with a sieved mixture of Soil, Sand, FYM and Leaf mould. These were placed in a warm environment within one of the propagation chambers to facilitate both hardening and further root establishment of the plantlets. During the experimental

**Table 1 :** Physico-chemical properties of potting composts before start of experiment.

| | Soil pH | Electrical conductivity ($dSm^{-1}$) | Organic Carbon (%) | Available Nitrogen (Kg $ha^{-1}$) | Available Phosphorus (Kg $ha^{-1}$) | Available Potassium (Kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| $M_1$:Soil + Sand + FYM (1:1:1) Control | 6.80 | 1.56 | 0.57 | 180 | 10 | 190 |
| $M_2$:Cocopeat + Soil + FYM + Leaf mould (2:1:1:1) | 6.86 | 1.74 | 1.97 | 320 | 14 | 257 |
| $M_3$:Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1) | 7.11 | 1.78 | 2.67 | 257 | 16 | 246 |

trial, three distinct potting compost mixtures were prepared. The first mixture, serving as the control, consisted of Soil, Sand and FYM in equal parts (1:1:1 ratio). The second mixture comprised Cocopeat, Soil, FYM and Leaf mould in a ratio of 2:1:1:1. The third mixture was a combination of Cocopeat, Perlite, Vermiculite and FYM in a ratio of 2:1:1:1. Ingredients such as Soil, Sand, FYM, Cocopeat, Leaf mould, Perlite and Vermiculite were gathered for this purpose. Soil, Sand and FYM underwent sieving prior to utilization, while cocopeat was meticulously washed to eliminate phenolic compounds and reduce electrical conductivity. Additionally, cocopeat was sun-dried before application. All ingredients were thoroughly mixed in equal proportions and then filled into 8-inch red terracotta plastic pots according to the requirements of the experiment.

During the second week of December, an experimental trial was initiated at RHR&TS, Mashobra, utilizing a Completely Randomized Design (CRD) within one of the sunny glasshouses. 8-inch red terracotta plastic pots were selected for this purpose. Initially, manual drainage holes were created at the base of each pot, followed by the placement of small pebble stones in a layer at the bottom of each pot. Subsequently, the pots were filled with three distinct types of potting mixtures. These pots were then planted with single large-sized plants that had been hardened, carefully removed from each hole of 300 cc root trainers, ensuring not to disturb the soil around each plug. After planting, each pot was thoroughly irrigated until runoff occurred, ensuring adequate moisture for the plants. Once the plants had established themselves after one month of transplanting, four different fertilizer schedules were implemented based on the experimental requirements. These included Nu slow GR applied at a rate of 5 g per pot, humic acid at a concentration of 2 ml per liter of water, NPK granular fertilizer (19:19:19) at a rate of 2 g per liter of water, boronated calcium nitrate ($CaNO_3$) at 2 g per liter of water, NPK (13:0:45), calcium nitrate and NPK (0:0:50) at 2 g per liter of water. Additionally, a mixture of ghanjeevamrit at 80 g per pot and Jeevamrit at 10% concentration was prepared and applied according to the experimental specifications. From the time of transplanting until the conclusion of the experiment, pots were manually irrigated at regular intervals using a watering can. Starting from April, plants were watered every third day until July 15$^{th}$. Subsequently, from July to August, watering frequency was adjusted to every 4 days, and from December to March, irrigation was carried out every 6 days. The frequency of watering was adjusted based on the specific needs dictated by the prevailing weather conditions. Weeds, including *Oxalis latifolia* and *Galinsoga parviflora*, were manually removed using a hand hoe. Hoeing commenced shortly after the establishment of seedlings and was conducted regularly whenever a hard crust formed on the soil surface. Pinching involves removing the top portion of the plant to disrupt its apical dominance, thereby stimulating the growth of lateral branches. This process was carried out one month after transplanting.

## Results and Discussion

Table 2 shows that none of the treatments significantly affected the pH levels. However, the fertilizer schedules were noted to raise the soil pH, ultimately stabilizing it at a neutral level. pH measurements across all treatments fell within the range of 6.73 to 6.99. The findings align with those of Badhulkar *et al*. (2000) and Selvi *et al*. (2004) regarding soybean cultivation, indicating that alterations in certain soil physico-chemical properties may only become apparent after prolonged experimentation rather than within a few months. These results are also in line with the conclusions drawn by Rana (2018), who suggested that extended testing periods can lead to changes in physico-chemical properties, contrasting with short-term effects. Table 2 indicated that no treatments produced a noteworthy impact on EC levels. Across all treatments, EC values varied between 0.65 dS $m^{-1}$ and 0.74 dS $m^{-1}$. The findings align with those of Badhulkar *et al*. (2000) and Selvi *et al*. (2004), indicating that alterations in certain soil physico-chemical properties may only become apparent after prolonged experimentation rather than within a few months. Similarly, Rana (2018) also supports this notion, suggesting that extended testing periods can lead to changes in physico-chemical properties, contrasting with short-term effects.

The information provided in Table 3 illustrates that the highest organic carbon content (5.41%) was found in the $F_3$ fertilizer schedule. This value was statistically similar to the organic carbon content (5.37%) observed in the $F_4$ fertilizer schedule, which involved drenching with ghanjeevamrit at a rate of 80g per pot along with foliar application of jeevamrit at 10%. Conversely, the lowest organic carbon content (5.10%) was recorded in the $F_1$ fertilizer schedule, which served as the control group with no fertilizer application. The $M_2$ potting media, composed of Cocopeat, Soil, Farmyard Manure (FYM), and Leaf mould in a ratio of 2:1:1:1, exhibited the highest organic carbon content at 5.86%. In contrast, the control group $M_1$ potting media, lacking any fertilizer, demonstrated the lowest organic carbon content at 4.49%. Interaction data reveals that the $F_3M_2$ treatment combination, consisting of the $F_3$ fertilizer schedule and $M_2$ potting media comprising Cocopeat, Soil, Farmyard Manure (FYM), and Leaf mould in a ratio of 2:1:1:1, displayed the highest organic carbon content at 6.23%. In contrast, the lowest organic carbon content at 4.03% was observed in the $F_1M_1$ treatment combination, which involved no fertilizer and $M_1$ potting media composed of Soil, Sand and FYM in a ratio of 1:1:1. Ojha *et al*. (2014) observed a notable rise in organic carbon content in broccoli with the incorporation of farmyard manure. Similarly, Patel *et al*. (2018) documented the advantageous impact of organic inputs like jeevamrit on soil organic carbon levels. These findings align with Rana (2018) research on the growth, yield and quality of French bean (*Phaseolus vulgaris* L.), indicating that jeevamrit enhanced soil organic carbon. The data presented in Table 3 shows that the nitrogen level was highest in the $F_3$ fertilizer schedule at 492.73 kg $ha^{-1}$. This level was statistically similar to the nitrogen level in the $F_4$ fertilizer schedule, which received ghanjeevamrit at 80g per pot followed by foliar application of jeevamrit at 10%. In contrast, the lowest nitrogen level of 445.37 kg $ha^{-1}$ was observed in the $F_1$ fertilizer schedule, which served as the control group with no fertilizer application. This nitrogen level was statistically similar to the nitrogen level in the $F_2$ fertilizer schedule, where Nu slow GR was applied at 5g per pot after plant establishment and repeated after 120 days of transplanting. According to the data on various potting media, the highest available nitrogen content of 525.13 kg $ha^{-1}$ was observed in $M_2$ potting media, consisting of Cocopeat, Soil, FYM and Leaf mould in the ratio 2:1:1:1. Conversely, the lowest available nitrogen content of 417.72 kg $ha^{-1}$ was noted in $M_1$ potting media, which served as the control group with no fertilizer application. Interaction analysis revealed that the combination of $F_3$ fertilizer schedule and $M_2$ potting media resulted in the highest available nitrogen content of 608.33 kg $ha^{-1}$. Conversely, the lowest available nitrogen content of 316.90 kg $ha^{-1}$ was observed in the treatment combination of $F_1$ fertilizer schedule and $M_1$ potting media. Acharya and Dashora (2004) suggested that applying 200 kg/ha of nitrogen led to maximum plant height, spread, flower diameter and early flowering, while 150 kg/ha of nitrogen resulted in the maximum number of branches and flowers per plant in African marigold cv. Pusa Basanti Gainda. This effect could be attributed to increased microbial activity, leading to rapid mineralization of soil nitrogen. Optimal levels of organic matter and nitrogen in the growing substrate influence plant growth and flower size, as supported by Riaz *et al*. (2008), who found that nitrogen availability in the growing substrate positively correlated with flower diameter. Adequate nutrient supply, particularly in mediums containing leaf mould and peat moss, is essential for quality flower production. Studies by George (2012) on gerbera and Sharma (2018) on marigold showed higher levels of available nitrogen in treatment modules involving various combinations of drenching and foliar spray with jeevamrit.

Upon examination of the data presented in Table 4, it is evident that the $F_3$ fertilizer schedule exhibited the highest available phosphorus content at 13.18 kg $ha^{-1}$. In contrast, the $F_1$ fertilizer schedule, serving as the control group with no fertilizer application, showed the lowest available phosphorus content at 9.52 kg $ha^{-1}$. Analysis of the data reveals that the highest available phosphorus content, measuring 12.32 kg $ha^{-1}$ was observed in the $M_2$ potting media consisting of Cocopeat, Soil, FYM and Leaf mould in the ratio 2:1:1:1. Conversely, the lowest phosphorus content, measuring 9.13 kg $ha^{-1}$ was recorded in the $M_1$ potting media, which served as the control group without any fertilizer application. Regarding interaction data, the combination of $F_3$ fertilizer schedule and $M_2$ potting media exhibited the highest available phosphorus content, measuring 16.05 kg $ha^{-1}$. In contrast, the lowest available phosphorus content, measuring 8.27 kg $ha^{-1}$ was found in the treatment combination of $F_1$ fertilizer schedule and $M_1$ potting media. Analysis of the data indicates a significant impact of various fertilizer schedules on the available potassium content in the soil. The highest available potassium level, measuring 302.88 kg $ha^{-1}$ was observed in the $F_3$ fertilizer schedule. Conversely, the

**Table 2 :** pH and EC of potting compost at the end of experiment.

| | pH | | | | EC | | | |
|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | |
| $F_1$ | 6.56 | 6.98 | 6.98 | 6.84 | 0.68 | 0.73 | 0.73 | 0.71 |
| $F_2$ | 6.99 | 6.98 | 6.51 | 6.83 | 0.51 | 0.70 | 0.73 | 0.65 |
| $F_3$ | 6.64 | 6.67 | 6.89 | 6.73 | 0.68 | 0.78 | 0.76 | 0.74 |
| $F_4$ | 6.96 | 7.16 | 6.85 | 6.99 | 0.72 | 0.68 | 0.72 | 0.71 |
| Mean | 6.79 | 6.94 | 6.81 | | 0.65 | 0.72 | 0.73 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | NS | | | | | NS | | |
| Media: | NS | | | | | NS | | |
| Fertilizer x Media: | NS | | | | | NS | | |

$F_1$(Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting;$F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1)

**Table 3 :** OC (%) and Available Nitrogen (Kg $ha^{-1}$) of potting compost at the end of experiment.

| | OC (%) | | | | Available Nitrogen (Kg $ha^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | |
| $F_1$ | 4.03 | 5.75 | 5.52 | 5.10 | 316.90 | 523.88 | 495.33 | 445.37 |
| $F_2$ | 4.56 | 5.76 | 5.55 | 5.29 | 425.33 | 485.33 | 431.66 | 447.44 |
| $F_3$ | 4.66 | 6.23 | 5.34 | 5.41 | 424.00 | 608.33 | 445.86 | 492.73 |
| $F_4$ | 4.72 | 5.71 | 5.68 | 5.37 | 504.66 | 483.00 | 483.66 | 490.44 |
| Mean | 4.49 | 5.86 | 5.52 | | 417.72 | 525.13 | 464.13 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 0.08 | | | | | 4.00 | | |
| Media: | 0.07 | | | | | 3.46 | | |
| Fertilizer x Media: | 0.14 | | | | | 6.92 | | |

$F_1$(Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting; $F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1).

lowest available potassium level, measuring 280.66 kg $ha^{-1}$ was recorded in the $F_1$ fertilizer schedule, which served as the control group without any fertilizer application. Acharya and Dashora (2004) suggested that applying 200 kg/ha of phosphorus resulted in maximum plant height, spread, flower diameter and early flowering in African marigold cv. Pusa Basanti Gainda, while 150 kg/ha of phosphorus led to the maximum number of branches and flowers per plant. Adequate phosphorus availability in the growing media significantly influences growth and flowering parameters. Nowak and Strojny (2004) observed that optimal phosphorus levels in inorganic residues resulted in maximum flowering when grown in media comprising Silt, Top soil and Leaf mould, which aligns with the findings of Kiran *et al*. (2007) regarding increased flower numbers in Dahlia (*Dahlia* *pinnata*) under the same combination. The examination of different potting media revealed varying levels of available potassium in the soil. The highest available potassium content, measuring 334.00 kg $ha^{-1}$ was observed in the media composed of Cocopeat, Soil, FYM and Leaf mould in the ratio 2:1:1:1, while the lowest content, measuring 217.16 kg $ha^{-1}$ was recorded in $M_1$ potting media, serving as the control group without any fertilizer. In terms of interaction data, the combination of $F_3$ fertilizer schedule and $M_2$ potting media exhibited the highest available potassium content, measuring 356.33 kg $ha^{-1}$. Conversely, the lowest available potassium content, measuring 208.00 kg $ha^{-1}$ was found in the treatment combination of $F_1$ fertilizer schedule and $M_1$ potting media without any fertilizer. The presence of adequate potassium in the growing media significantly influenced growth and flowering parameters. Nowak and Strojny (2004) observed that an optimal amount of potassium in inorganic residues resulted in maximum flowering when cultivated in media comprising Silt, Top soil and Leaf mould, a finding consistent with Kiran *et al*. (2007) observation of increased flower numbers in Dahlia (*Dahlia pinnata*) under the same combination.

The data depicted in Table 5 indicates significant variations in plant height across different treatment combinations. The highest plant height, reaching 20.56 cm, was recorded in the $F_3$ fertilizer schedule. In contrast, the $F_1$ fertilizer schedule, where no fertilizer was applied, exhibited the lowest plant height at 16.44 cm, which was statistically similar to the plant height of 16.55 cm observed in the $F_4$ fertilizer schedule when plants were treated with ghanjeevamrit at 80g per pot and foliar application of jeevamrit at 10%. Different potting media exerted significant effects on plant height. The highest plant height, measuring 19.26 cm, was observed in $M_2$ potting compost, consisting of Cocopeat, Soil, FYM and Leaf mould in the ratio 2:1:1:1. This height was statistically similar to the plant height of 18.83 cm observed in $M_3$ potting media, which contained Cocopeat, Perlite, Vermiculite and FYM in the ratio 2:1:1:1. Conversely, the lowest plant height of 16.14 cm was recorded in $M_1$ potting media composed of Soil, Sand and FYM in the ratio 1:1:1.

Regarding interaction data, the combination of $F_3$ fertilizer schedule and $M_2$ potting media resulted in the maximum plant height of 22.90 cm. This height was statistically similar to the plant height of 21.94 cm observed in the $F_3M_3$ treatment combination. However, the minimum plant height of 15.19 cm was recorded in the control group without any fertilizer, grown in media containing Soil, Sand and FYM, which was statistically similar to the plant height of 15.38 cm in the $F_4M_1$ treatment combination, treated with ghanjeevamrit and jeevamrit in the same potting media. These findings are consistent with (Thumar *et al.,* 2020), who found maximum plant height in media containing Soil, Cocopeat and Leaf mould. They noted that cocopeat and leaf mould had a significant positive effect on plant height due to their high nutritional levels. Gupta *et al*. (2004) also observed maximum plant height in gerbera when grown in a mixture of Cocopeat, Sand and Sawdust. Similarly, Singh *et al*. (2016) reported improved plant growth in chrysanthemum when grown in a mixture of Cocopeat and Sewage sludge. The addition of cocopeat to soil and FYM improved soil texture, porosity, and water holding capacity, leading to enhanced growth and increased plant height. This aligns with Mehmood *et al*. (2013), who found maximum plant height in *Antirrhinum majus* L. 'Floral Shower' when grown in a mixture of Leaf mould, Silt and Topsoil. Lopez *et al*. (1998) also observed positive effects on plant growth and development in pelargonium when using potting media made from peat supplemented with mineral fertilizers. Additionally, humic acid supplements were found to have a substantial effect on plant growth and development, as confirmed by Nikbakht *et al*. (2008), who noted improvements in nutrient uptake and overall plant development in gerbera with the application of humic acid. Data indicates that the highest number of shoots per plant, reaching 9.50, was observed in the $F_3$ fertilizer schedule. Conversely, the lowest number of shoots, measuring 7.49, was found in the $F_1$ control group. This count was statistically similar to the number of shoots observed in the $F_4$ fertilizer schedule, where plants were treated with ghanjeevamrit at 80g per pot and foliar application of jeevamrit at 10%, with a count of 7.78.

Different potting media significantly influenced the number of shoots per plant. The highest number of shoots, reaching 9.58, was observed in plants grown in $M_2$ media, which comprised a combination of Cocopeat, Soil, FYM and Leaf mould in the ratio 2:1:1:1. Conversely, the lowest number of shoots per plant, measuring 6.25, was observed in media containing Soil, Sand and FYM in equal proportions. Regarding interaction data, the highest number of shoots per plant 11.88, was recorded in the $F_3M_2$ treatment combination, where plants were grown in media containing Cocopeat, Soil, FYM and Leaf mould in the ratio 2:1:1:1. In contrast, the $F_1M_1$ treatment combination, representing the control group with no fertilizer application, exhibited the fewest number of shoots per plant, measuring 5.58, when grown in media containing Soil, Sand and FYM in equal proportions. The application of fertilizer enhances nutrient uptake and microbial

**Table 4 :** Available phosphorus (Kg ha $^{-1}$) and Available potassium (Kg ha$^{-1}$) of potting compost at the end of experiment.

| | **Available Phosphorus (Kg ha $^{-1}$)** | | | | **Available Potassium (Kg ha$^{-1}$)** | | | |
|---|---|---|---|---|---|---|---|---|
| | **$M_1$** | **$M_2$** | **$M_3$** | **Mean** | **$M_1$** | **$M_2$** | **$M_3$** | |
| $F_1$ | 8.27 | 10.03 | 10.26 | 9.52 | 208.00 | 312.00 | 322.00 | 280.66 |
| $F_2$ | 9.06 | 10.25 | 11.41 | 10.24 | 222.00 | 330.00 | 315.66 | 289.22 |
| $F_3$ | 9.25 | 16.05 | 14.24 | 13.18 | 216.33 | 356.33 | 336.00 | 302.88 |
| $F_4$ | 9.93 | 12.96 | 12.23 | 11.71 | 222.33 | 338.00 | 340.00 | 300.11 |
| Mean | 9.13 | 12.32 | 12.04 | | 217.16 | 334.00 | 328.41 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 0.02 | | | | | 2.15 | | |
| Media: | 0.02 | | | | | 1.86 | | |
| Fertilizer x Media: | 0.04 | | | | | 3.73 | | |

$F_1$(Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting; $F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1).

**Table 5 :** Effect of potting composts and fertilization on plant height (cm) and number of shoots of zonal pelargoniums.

| | **Plant height (cm)** | | | | **Number of shoots** | | | |
|---|---|---|---|---|---|---|---|---|
| | **$M_1$** | **$M_2$** | **$M_3$** | **Mean** | **$M_1$** | **$M_2$** | **$M_3$** | |
| $F_1$ | 15.19 | 16.93 | 17.16 | 16.44 | 5.50 | 9.17 | 7.80 | 7.49 |
| $F_2$ | 17.14 | 20.08 | 19.05 | 18.75 | 7.02 | 8.61 | 9.97 | 8.53 |
| $F_3$ | 16.86 | 22.90 | 21.94 | 20.56 | 6.16 | 11.88 | 10.48 | 9.50 |
| $F_4$ | 15.38 | 17.10 | 17.19 | 16.55 | 6.34 | 8.67 | 8.32 | 7.78 |
| Mean | 16.14 | 19.26 | 18.83 | | 6.25 | 9.58 | 9.14 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 0.91 | | | | | 0.46 | | |
| Media: | 0.79 | | | | | 0.40 | | |
| Fertilizer x Media: | 1.57 | | | | | 0.80 | | |

$F_1$ (Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting;$F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1).

activity in the soil. Fulvic acid and humic acid supplements also contribute to increased plant nutritional development. In a study by Esrin *et al*. (2015) on *Impatiens walleriana* L., the application of fulvic acid and humic acid resulted in increased number of main shoots, number of secondary shoots and overall plant growth compared to control plants. Nutrient levels significantly influence the increase in the number of branches per plant, primarily due to the high nutrient content supplemented by fertilizer doses at regular intervals, aiding in plant growth. Nitrogen application, in particular, plays a crucial role in increasing the number of branches per plant, consistent with findings by Sharma (2002) in Gaillardia, Ahmad *et al*. (2017) in *Zinnia elegans* and Pal and Ghosh (2010) in African marigold. Additionally, Mehmood *et al*. (2013) reported that the maximum number of shoots per plant, totaling 13.93 was recorded in *Antirrhinum majus* L. 'Floral Shower' when grown in media containing Leaf mould, Silt and Topsoil in equal proportions.

According to the data presented in Table 6, the greatest plant spread of 18.79 cm was observed with the $F_3$ fertilizer schedule, while the smallest spread of 15.68 cm was recorded with the $F_1$ fertilizer schedule. The plant spread of $F_1$ was statistically similar (15.73 cm) to that of $F_2$, where Nu slow GR was applied at a rate of 5g per pot after the plants were established and then repeated after 120 days of transplanting. Similarly, the plant spread for $F_4$, which involved drenching with ghanjeevamrit at 80g per pot and foliar application of jeevamrit at 10%, was 16.74 cm.

Regarding different potting media, the highest plant spread (18.97 cm) was observed in a mixture containing Cocopeat, Soil, FYM, and Leaf mould in a ratio of 2:1:1:1. Conversely, the lowest spread (14.42 cm) was noted in a mixture of Soil, Sand and FYM in a 1:1:1 ratio. Interaction data reveals that the greatest plant spread (24.44 cm) occurred in the combination of $F_3$ fertilizer schedule and $M_2$ potting media, which consisted of Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. In contrast, the smallest spread (13.17 cm) was found in the combination of $F_1$ fertilizer schedule and $M_1$ potting media, which served as the control group without any fertilizer schedule and contained Soil, Sand and FYM in a 1:1:1 ratio. This result was statistically similar to the combinations of $F_2M_1$ (14.53 cm) and $F_3M_1$ (14.37 cm). The study highlights that incorporating cocopeat led to improved plant spread, consistent with the findings of (Wazir et al., 2009) in alstroemeria, where a growing medium consisting of Sand, Soil and Cocopeat in a 1:1:1 ratio resulted in maximum plant spread. This observation was supported by Gupta and Dilta (2015). Supplements like nitrogen, phosphorus and potassium have the potential to enhance plant nutrition and overall growth and development. Nitrogen is crucial for protein synthesis and promotes lateral shoot growth. Phosphorus is essential for root development, phospholipid formation and nutrient transport, all contributing to increased plant spread (Chadha *et al*, 2012). Research by Patel *et al*. (2020) on *Coreopsis tinctoria* demonstrated that treating plants with 5ml/L of NPK (19:19:19) resulted in maximum plant spread. This could be attributed to the rapid absorption of nutrients through leaf stomata, leading to enhanced chlorophyll formation, photosynthesis, and overall plant growth. Examination of the data reveals that the shortest duration for visible bud formation, at 87.69 days was observed with the $F_3$ fertilizer schedule. Conversely, the longest duration, at 90.02 days, was noted with the $F_1$ fertilizer schedule, which served as the control group without any fertilizer application. This duration was statistically similar to the duration of 89.50 days observed with the $F_2$ fertilizer schedule. In the $F_2$ schedule, Nu slow GR was applied at a rate of 5g per pot after plant establishment, and this application was repeated after 120 days of transplanting. Regarding potting compost, the shortest duration for visible bud formation, at 86.01 days was observed when plants were cultivated in a medium consisting of Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This duration was statistically similar to the duration of 86.40 days noted with $M_3$ potting media, which comprised Cocopeat, Perlite, Vermiculite and FYM in a 2:1:1:1 ratio. Conversely, the longest duration, at 94.77 days was recorded when plants were grown in a medium containing Soil, Sand and FYM in a 1:1:1 ratio. Interaction data revealed that the shortest duration for visible bud formation, at 84.19 days, occurred in the $F_3M_2$ treatment combination, which involved the $F_3$ fertilizer schedule and $M_2$ potting media comprising Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This duration was statistically similar to the duration of 84.77 days observed in the $F_3M_3$ treatment combination, which involved the same fertilizer schedule with $M_3$ potting media. In contrast, the longest duration, at 95.47 days, was found in the $F_1M_1$ treatment combination, representing the control group without any fertilizer schedule and using Soil, Sand and FYM in a 1:1:1 ratio. These findings align with those of Thumar *et al*. (2020) in rose, who recorded the shortest duration to bud initiation in a medium consisting of Soil, Cocopeat and Leaf mould in a 1:1:1 ratio. This could be attributed to the robust growth of plants in such media, facilitating rapid nutrient and water uptake and resulting in early bud production. Furthermore, these results are consistent with those of Gupta *et al*. (2004) in gerbera and Jawaharlal *et al*. (2001) in anthurium.

Data from Table 7 shows that the shortest duration to first flowering, at 115.79 days was observed with the $F_3$ fertilizer schedule. This duration was statistically similar to the durations of 116.82 days with the $F_2$ fertilizer schedule, where Nu slow GR was applied at 5g per pot after plant establishment and repeated after 120 days of transplanting and 116.42 days with the $F_4$ fertilizer schedule, which involved drenching with ghanjeevamrit at 80g per pot and foliar application of jeevamrit at 10%. Conversely, the longest duration to first flowering, at 118.67 days was noted with the $F_1$ fertilizer schedule. Different potting media had a notable impact on the duration until first flowering. The shortest duration, at 114.49 days was observed with $M_2$ potting media consisting of Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This duration was statistically similar to the duration of 114.61 days with $M_3$ potting media, which

**Table 6 :** Effect of potting composts and fertilization on plant spread (cm) and number of days taken for visible bud formation of zonal pelargoniums.

| | Plant spread (cm) | | | | Number of days taken for visible bud formation | | | |
|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | |
| $F_1$ | 13.17 | 17.61 | 16.27 | 15.68 | 95.47 | 86.81 | 87.79 | 90.02 |
| $F_2$ | 14.53 | 16.70 | 15.96 | 15.73 | 95.42 | 85.37 | 87.70 | 89.50 |
| $F_3$ | 14.37 | 24.44 | 17.55 | 18.79 | 94.11 | 84.19 | 84.77 | 87.69 |
| $F_4$ | 15.60 | 17.12 | 17.50 | 16.74 | 94.09 | 87.66 | 85.33 | 89.02 |
| Mean | 14.42 | 18.97 | 16.82 | | 94.77 | 86.01 | 86.40 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 1.21 | | | | | 0.58 | | |
| Media: | 1.05 | | | | | 0.50 | | |
| Fertilizer x Media: | 2.10 | | | | | 1.01 | | |

$F_1$ (Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting; $F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1).

**Table 7 :** Effect of potting composts and fertilization on number of days taken to first flowering and length of inflorescence stalk (cm) of zonal pelargoniums.

| | Number of days taken to first flowering | | | | length of inflorescence stalk (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | |
| $F_1$ | 125.43 | 115.46 | 115.13 | 118.67 | 8.07 | 11.10 | 11.80 | 10.30 |
| $F_2$ | 120.05 | 115.38 | 115.02 | 116.82 | 9.53 | 12.75 | 12.01 | 11.43 |
| $F_3$ | 121.48 | 112.45 | 113.44 | 115.79 | 9.46 | 16.14 | 15.26 | 13.62 |
| $F_4$ | 119.77 | 114.66 | 114.84 | 116.42 | 10.54 | 13.25 | 13.73 | 12.51 |
| Mean | 121.68 | 114.49 | 114.61 | | 9.40 | 13.31 | 13.20 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 1.56 | | | | | 0.87 | | |
| Media: | 1.35 | | | | | 0.75 | | |
| Fertilizer x Media: | 2.71 | | | | | 1.50 | | |

$F_1$ (Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting;$F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1).

comprised Cocopeat, Perlite, Vermiculite and FYM in the same ratio. Conversely, the longest duration, at 121.68 days was noted with $M_1$ potting media, representing the control group without any fertilizer. Interaction data revealed that the shortest duration, at 112.45 days, was found in the $F_3M_2$ treatment combination when grown in media containing Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This duration was statistically similar to several other treatment combinations: $F_1M_3$ (115.13 days), $F_2M_3$ (115.02 days), $F_3M_3$ (113.44 days), $F_4M_3$ (114.84 days), and $F_4M_2$ (114.66 days). In contrast, the longest duration, at 125.43 days, was noted in the $F_1M_1$ treatment combination when grown in media consisting of Soil, Sand, and FYM in a 1:1:1 ratio. Using Cocopeat as a growing

**Plate 1 :** Emergence of floral bud.

**Plate 2 :** Effect of $F_3M_2$ treatment on growth and flowering of zonal pelargoniums.

medium has been associated with producing flowers of acceptable quality, as noted by Treder (2008) in lilies. This could be attributed to faster plant development facilitated by a robust root system and the favorable thermal properties of Cocopeat. Similar findings were reported by Treder and Nowak (2002) regarding early flowering in pelargonium grown in a medium containing Cocopeat. Examination of the data shows that the longest length of inflorescence stalk, measuring 13.62 cm, was observed with the $F_3$ fertilizer schedule. In contrast, the shortest inflorescence stalk, measuring 10.30 cm, was found in the $F_1$ fertilizer schedule, which served as the control group without any fertilizer application. Analyzing the data from Table 7, it becomes evident that the greatest length of inflorescence stalk, measuring 13.31 cm, was observed when plants were cultivated in a medium containing Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This length was statistically similar to the length of 13.20 cm recorded with $M_3$ potting media consisting of Cocopeat, Perlite, Vermiculite and FYM in the same ratio. Conversely, the minimum length of inflorescence stalk, measuring 9.40 cm, was observed with media containing Soil, Sand and FYM in a 1:1:1 ratio.

Regarding interaction data, the maximum length of inflorescence stalk, measuring 16.14 cm, was observed in the $F_3M_2$ treatment combination, which involved the $F_3$ fertilizer schedule and Cocopeat, Soil, FYM, and Leaf mould potting media in a 2:1:1:1 ratio. This length was statistically similar to the length of 15.26 cm observed in the $F_3M_3$ treatment combination, where plants were grown in media containing Cocopeat, Perlite, Vermiculite and FYM in the same ratio. Conversely, the minimum length of inflorescence stalk, measuring 8.07 cm, was found in the $F_1M_1$ treatment combination when grown in potting media consisting of Soil, Sand and FYM in a 1:1:1 ratio. The increase in inflorescence stalk length was attributed to the enhanced nutrient uptake facilitated by fertilizer application at short intervals, which contributed to overall plant development. These findings align with those recommended by Hameed and Sekar (1999), who reported maximum flower stem length in African marigold when treated with specific fertilizer levels, resulting in early flowering. Similarly, the current study's findings are consistent with those of Muraleedharan *et al*. (2020), who found that anthurium plants exhibited maximum flower stalk length when grown in a medium containing Cocopeat and FYM due to its favorable physical characteristics. Additionally, Bhalla *et al*. (2007) reported maximum flower stem length in carnation when grown in media containing Sand, FYM and Vermicompost. Regular fertilizer application enhances nutrient availability to plants over an extended period, promoting development and flowering. Azzaz *et al*. (2007) found that the flowering date was significantly influenced by the application of humic acid, with higher rates resulting in earlier flowering compared to untreated controls in pot marigold, indicating the role of fertilizer in influencing flowering time.

According to the data in Table 8, the largest inflorescence diameter, measuring 8.21 cm, was observed with the $F_3$ fertilizer schedule. This diameter was statistically similar to the diameter of 7.89 cm recorded with the $F_4$ fertilizer schedule, which involved drenching with ghanjeevamrit at 80g per pot and foliar application of jeevamrit at 10%. Conversely, the smallest inflorescence diameter, measuring 7.54 cm was observed with the $F_1$ fertilizer schedule, representing the control group without any fertilizer application. This diameter was statistically similar to the diameter of 7.70 cm recorded with the $F_2$ fertilizer schedule, where Nu slow GR was applied at 5g per pot after plant establishment and repeated after 120 days of transplanting. Different potting media significantly affect inflorescence diameter. The maximum diameter, at 8.23 cm, was observed with $M_2$ potting media containing Cocopeat, Soil, FYM and Leaf

**Table 8 :** Effect of potting composts and fertilization on inflorescence diameter (cm) and duration of flowering of zonal pelargoniums.

| | Inflorescence diameter (cm) | | | | Duration of flowering | | | |
|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | |
| $F_1$ | 6.94 | 7.48 | 8.20 | 7.54 | 106.33 | 119.66 | 121.00 | 115.66 |
| $F_2$ | 6.99 | 8.11 | 8.01 | 7.70 | 113.00 | 122.66 | 120.33 | 118.66 |
| $F_3$ | 7.03 | 9.09 | 8.51 | 8.21 | 117.00 | 127.33 | 123.33 | 122.55 |
| $F_4$ | 7.23 | 8.25 | 8.18 | 7.89 | 114.66 | 121.66 | 120.66 | 119.00 |
| Mean | 7.05 | 8.23 | 8.22 | | 112.75 | 122.83 | 121.33 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 0.34 | | | | | 1.97 | | |
| Media: | 0.29 | | | | | 1.71 | | |
| Fertilizer x Media: | 0.59 | | | | | 3.42 | | |

$F_1$ (Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting; $F_3$ (Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$ (Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_3$: Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1).

mould in a 2:1:1:1 ratio. This diameter was statistically similar to the diameter of 8.22 cm recorded with $M_3$ potting media consisting of Cocopeat, Perlite, Vermiculite and FYM in the same ratio. Conversely, the minimum diameter, at 7.09 cm, was observed with $M_1$ potting media, representing the control group without any fertilizer. Among the interaction data, the maximum diameter, at 9.09 cm, was found in the $F_3M_2$ treatment combination, which involved the $F_3$ fertilizer schedule and Cocopeat, Soil, FYM and Leaf mould growing media in a 2:1:1:1 ratio. This diameter was statistically similar to the diameter of 8.51 cm observed in the $F_3M_3$ treatment combination, where the same fertilizer schedule was combined with Cocopeat, Perlite, Vermiculite and FYM in the same ratio. In contrast, the minimum diameter, at 6.94 cm, was recorded in the $F_1M_1$ treatment combination, representing no fertilizer application and Soil, Sand and FYM growing media in a 1:1:1 ratio. According to the data, the $F_3$ fertilizer schedule exhibited the longest flowering duration, lasting for 122.55 days, whereas the $F_1$ fertilizer schedule had the shortest flowering duration, which lasted for 115.66 days. In terms of various potting compost combinations, the longest duration of flowering, lasting for 122.83 days, was observed in $M_2$ potting media composed of Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This duration was statistically similar to the flowering duration of 121.33 days observed with $M_3$ potting media, consisting of Cocopeat, Perlite, Vermiculite and FYM in the same ratio. Conversely, the shortest flowering duration, at 112.75 days, was noted in $M_1$ potting media, which served as the control group without any fertilizer application. In the interaction data, the maximum duration of flowering, lasting for 127.33 days, was recorded in the $F_3M_2$ treatment combination, which involved the $F_3$ fertilizer schedule and Cocopeat, Soil, FYM and Leaf mould potting media. On the other hand, the minimum duration of flowering, lasting for 106.33 days, was recorded in the $F_1M_1$ treatment combination, representing no fertilizer application and Soil, Sand and FYM potting media. Younis *et al*. (2008) found that the maximum blooming period was achieved in a medium containing Leaf manure for *Dahlia coccinea*. Thakur and Grewal (2019) also reported maximum blooming period in chrysanthemum when using Cocopeat and FYM in a 2:1 ratio, attributing it to the excellent aeration, durability, lightness and water holding characteristics of the medium. Similarly, Dutt *et al*. (2002) confirmed these results in chrysanthemum, achieving maximum flowering duration when using Cocopeat and Soil rite in a 1:1 ratio.

The increase in floral size can be attributed to the higher nutrient content present in the growing media. Mehmood *et al*. (2013) found maximum flower diameter in *Antirrhinum majus* L. 'Floral Shower' when grown in media containing Leaf mould, Silt, and Topsoil in a 1:1:1 ratio. Kiran *et al*. (2007) demonstrated that plants grown in medium containing Sand, Silt and Leaf mould exhibited superior growth and development characteristics, achieving maximum flower diameter. Similarly, Gupta *et al*. (2004) observed maximum flower

**Table 9 :** Effect of potting composts and fertilization on number of inflorescences per plant open at a time and pot presentability of zonal pelargoniums

| | Number of inflorescences per plant open at a time | | | | Pot presentability | | | |
|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | Mean | $M_1$ | $M_2$ | $M_3$ | |
| $F_1$ | 5.38 | 7.10 | 7.91 | 6.80 | 71.29 | 77.32 | 81.85 | 76.82 |
| $F_2$ | 6.14 | 7.67 | 8.66 | 7.49 | 78.23 | 83.16 | 82.88 | 81.42 |
| $F_3$ | 7.09 | 11.38 | 9.99 | 9.49 | 78.29 | 90.99 | 84.09 | 84.46 |
| $F_4$ | 7.49 | 8.80 | 8.34 | 8.21 | 76.04 | 81.21 | 82.82 | 80.02 |
| Mean | 6.53 | 8.74 | 8.73 | | 75.96 | 83.17 | 82.91 | |
| $CD_{0.05}$ | | | | | $CD_{0.05}$ | | | |
| Fertilizer: | 0.83 | | | | | 1.23 | | |
| Media: | 0.72 | | | | | 1.07 | | |
| Fertilizer x Media: | 1.44 | | | | | 2.14 | | |

$F_1$ (Irrigation water without any fertilizer- Control); $F_2$ (Nu slow GR @ 5g per pot after plant establishment, repeated after 120 days of transplanting;$F_3$(Humic acid drenching @ 2ml/L after plant establishment NPK granular (19:19:19) @ 2g/L (after 7 days) and boronated $CaNO_3$ drenching @ 2g/L (after 7 days) done in alteration at weekly intervals till flower bud initiation followed by foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) each @ 2g/L done in alteration at 5 days interval up to peak flowering); $F_4$(Ghanjeevamrit drenching @ 80g/pot + jeevamrit spray @10% at 10 days interval till peak flowering ); $M_1$ (Soil +Sand + FYM (1:1:1) Control; $M_2$ (Cocopeat + Soil + FYM + Leaf mould (2:1:1:1); $M_{3:}$ Cocopeat + Perlite + Vermiculite + FYM (2:1:1:1)

**Plate 3 :** Overview of trial at peak flowering.

diameter in gerbera when grown in medium containing Cocopeat, Sand and Sawdust in a 1:1:1 ratio. Naggar and Nasharty (2009) noted that maximum flower diameter in amaryllis was achieved with composted leaf medium mixed with sand and two rates of NPK fertilizer, compared to clay medium without NPK fertilization.

The analysis of data in Table 9 indicates that the $F_3$ fertilizer schedule achieved the highest pot presentability score, reaching 84.46, whereas the $F_1$ fertilizer schedule, serving as the control group without any fertilizer application, attained the lowest pot presentability score of 76.82. Different potting media significantly influence pot presentability. The highest pot presentability score, reaching 83.17 was observed with $M_2$ potting media composed of Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio. This score was statistically similar to the score of 82.91 recorded with $M_3$ potting media consisting of Cocopeat, Perlite, Vermiculite and FYM in the same ratio. Conversely, the control group with no fertilizer application exhibited the lowest pot presentability score of 75.96 ($F_1$). Among interactions, the highest pot presentability score, reaching 90.99, was recorded in the $F_3M_2$ treatment combination, where plants were treated with the $F_3$ fertilizer schedule and grown in Cocopeat, Soil, FYM, and Leaf mould potting media. In contrast, the lowest pot presentability score, at 71.29 was observed in the $F_1M_1$ treatment combination, which received no fertilizer application and was grown in potting media consisting of Soil, Sand and FYM in a 1:1:1 ratio. Pot presentability scores are directly influenced by various vegetative and flowering characteristics. The highest score (84.46) was achieved with the $F_3$ fertilizer schedule, which resulted in optimal plant height, spread, shoot number, length, days to bud formation, days to first flowering, inflorescence characteristics and flowering duration. This was attributed to the high nutrient content and frequent application from planting to flowering. Thakur and Grewal (2019) reported similar findings in chrysanthemum when grown in Cocopeat and FYM in a 2:1 ratio, while Deogade *et al.* (2020) found superior pot presentability in calendula with a medium containing garden Soil, FYM, Vermicompost and Cocopeat in a 2:1:1:1 ratio. Cocopeat enhances root growth and potting mixture porosity, contributing to loose soil, consistent with the results of Wazir *et al*. (2009) in alstroemeria using Soil, Cocopeat, Vermicompost and Sand in a 1:1:1:1 ratio.

## Conclusion

The $F_3$ fertilizer schedule, involving a sequence of drenching with humic acid, NPK granular (19:19:19) and boronated $CaNO_3$ at specific intervals after plant establishment, followed by repeated applications until flower bud initiation, along with foliar sprays of NPK (13:0:45), $CaNO_3$ and NPK (0:0:50) in alternation every five days until peak flowering, proved to be superior to other fertilizer schedules concerning vegetative, flowering and potting compost parameters. The success of the $F_3$ fertilizer schedule can be attributed to its high nutrient content and the continuous supply of nutrients from planting to flowering. Additionally, the combination of Cocopeat, Soil, FYM and Leaf mould in a 2:1:1:1 ratio emerged as the best potting medium for achieving quality pot plant production of zonal pelargoniums.

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