The Pharma Innovation Journal 2022; 11(1): 80-83

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(1): 80-83

www.thepharmajournal.com
Received: 03-10-2021
Accepted: 09-11-2021

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Effect of N, P, K on plant growth and flower yield of *Zinnia elegans*

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Abstract
The present study was carried out at Horticultural Research Field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the summer season of 2021. The experiment was laid out in Randomized Block Design with twelve treatments and three replications. Twelve different levels of N, P, K were studied in this investigation. The study revealed that all the characters were significantly affected by the combination of N, P, K fertilizers. On the basis of present investigation it is concluded that, the application of T_9 N, P, K (45, 35, 45) (g/m^2) treatment was found to be the best in terms of plant growth and flower yield *viz*., plant height (49.42 cm), number of leaves per plant (59.63), number of branches per plant (10.82), plant spread (34.86 cm^2), days to emergence of 1st flower bud (31.61 days), days to opening of 1st flower (37.86 days), flower diameter (8.04 cm), flower weight (6.52 g), no. of flower per plant (12.52), no. of flower per plot (75.14), flower yield ha^{-1} (7.51) and vase life (6.83 days) of *Zinnia elegans.* Therefore, application of T_9 N, P, K (45, 35, 45) (g/m^2) on zinnia plants can be recommended for better growth and flowering under Prayagraj agro-climatic condition.

Keywords: Plant growth, flower yield, zinnia, NPK, vase life

Introduction
Zinnia, known as youth and age, is a genus of plants of the sunflower tribe (Asteraceae) within the daisy family (Linnaeus, 1759). It contains about 20 species of annual and perennial plants. They are native to scrub and dry grassland in an area stretching from the South-western to South America, with a centre of diversity in Mexico. The genus name honours German master botanist Johann Gottfried Zinn. Zinnia, the most popular summer annual used extensively in borders, beds and edges, is also grown as a specialty cut flower and is a good source of foreign exchange if grown extensively. Flowers are multi-colored having pink, rose, cherry lavender, purple, red, orange, salmon, golden, yellow, white, cream or light green colours (Reilly, 1978) [16]. Zinnia requires appropriate nutrition for its proper growth and development to be sufficiently green, vigorous and produce abundant flowers of adequate size and color intensity with good lasting qualities (Joiner and Gruis, 1961).

Nitrogen, Phosphorus and Potassium are most important for plant growth and to get good quality of flowers. Nitrogen, Phosphorus and Potassium also play role in production of higher seed yield of good quality. Scientific findings of various authors (Oberthova, 1980; Jana & Pal, 1991; Dhaka *et al*., 1999) [11, 7] also showed the beneficial effect of various combination of fertilizer on numerous growth parameters of Zinnia.

Nitrogen is considered to be the most crucial because it is a constituent of protein and nucleic acid, which is helpful in plant growth (Haque, 2001) [8] and also promotes rapid growth. Higher concentration of nitrogen has the tendency to increase leaf cell number and cell size with an overall increase in leaf production as reported by Meyer *et al*. (1973) [15]. Potassium enhances the synthesis and translocation of carbohydrate; whereas, phosphorus encourages cell walls and length of plant.

Materials and Methods
The present investigation entitled, "Effect of N, P, K on plant growth and flower yield of *Zinnia elegans*'' was carried out at the research field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the summer season of 2021. The experiment was laid out in Randomized Block Design with twelve treatments and three replications to determine the optimal treatment combination of NPK for plant growth, yield and flower quality of zinnia. Zinnia seedlings of 25 days old were

planted in well prepared field in the month of March. Well rotten FYM was applied at the time of field preparation. Urea was applied in two split doses as first dose was applied at the time of planting and second dose after 30 days of planting, while Single Super Phosphate and Murate of Potash was used in single dose as basal application. Observations were recorded on five tagged plants and mean were calculated.

Results and Discussion

Plant height: The height, number of leaves and number of branches of plant were affected by different levels of NPK over control. However, the maximum plant height (49.42 cm) was observed in the treatment T_9 N, P, K (45,35,45) (g/m^2). The plant height was found to be minimum (28.71 cm) in the treatment T_1 Control. The increase in plant height is due to the fact that nitrogen is a constituent of protein and nucleic acid, which is helpful in plant growth (Haque, 2001) [8] Potassium enhances the synthesis and translocation of carbohydrate; whereas, phosphorus encourages cell walls and length of plant (Henry, 1982) [9]. Potassium has also been reported to be involved in synthesis of peptide bond, and protein and carbohydrate metabolism, and also participates in rapid cell division and differentiation (Belorkar *et al*., 1992) [3]

No. of leaves per plant: The maximum number of leaves per plant (59.63) was observed in the treatment T_9 N, P, K (40,35,35) (g/m^2). The number of leaves per plant was found to be minimum (40.70) in the treatment T_1 Control. The maximum number of leaves is because of higher concentration of nitrogen, which has tendency to increase leaf cell number and cell size with an overall increase in leaf production as reported by Meyer *et al*. (1973) [15]. High nitrogen with appropriate dose of phosphorus and potassium seemed to have increased vegetative growth as earlier also reported by Denisen (1982) [6]. Hence, the balanced application of these nutrients resulted in higher number of leaves.

No. of branches per plant: The number of branches per plant was found to be maximum (10.82) in the treatment T_9 N, P, K (45,35,45) (g/m^2). The number of branches per plant were found to be minimum (3.44) in the treatment T_1 Control. The increase in number of branches is because nitrogen is a constituent of protein and nucleic acid, which is helpful in plant growth (Haque, 2001) [8] and also promotes rapid growth. Potassium has also been reported to be involved in synthesis of peptide bond, and protein and carbohydrate metabolism, and also participates in rapid cell division and differentiation (Belorkar *et al*., 1992) [3]. As high rates of fertilizers resulted in more branches, high rate of fertilizer also induced more number of bloom per plant (Samoilkenkoi, 1983) [17].

Plant spread: The plant spread (cm^2) was found to be maximum (34.86) in the treatment T_9 N, P, K (45,35,45) (g/m^2). The plant spread (cm^2) were found to be minimum (18.30) in the treatment T_1 Control. The maximum number of plant spread is due to the fact that nitrogen is a constituent of protein and nucleic acid, which is helpful in plant growth (Haque, 2001) [8] and also promotes rapid growth. This is because of higher concentration of nitrogen, which has tendency to increase leaf cell number and cell size with an overall increase in leaf production as reported by Meyer *et al*. (1973) [15] High nitrogen with appropriate dose of phosphorus and potassium seemed to have increased vegetative growth as earlier also reported by Denisen (1982) [6].

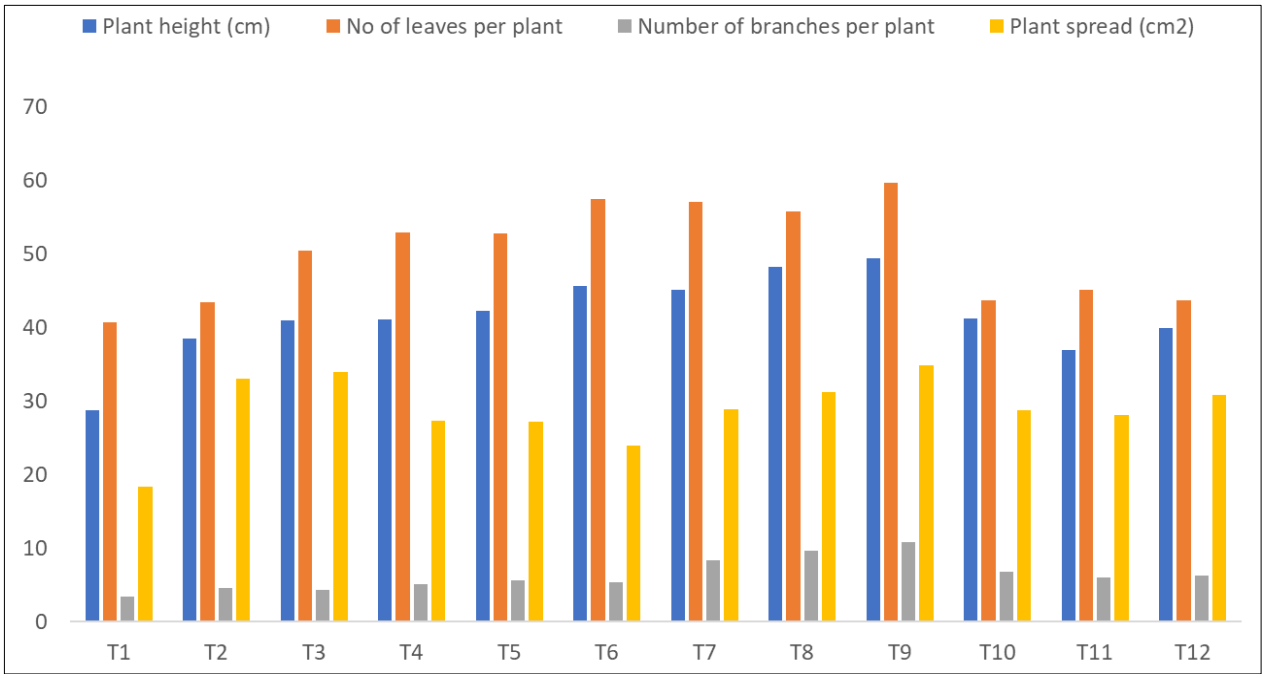

Fig 1: Effect of N, P, K on vegetative parameters of *Zinnia elegans*

The Flower diameter (cm): The Flower diameter was found to be maximum (8.04) in the treatment T_9 N, P, K (45, 35, 45) (g/m^2). The Flower diameter (cm) were found to be minimum (4.61) in the treatment T_1 Control. Balanced dose of nitrogen, phosphorus and potassium seemed to have increased the vegetative growth, favorable for the synthesis of peptide bond, protein and carbohydrate metabolism that are essential for flower development **(**Boodly & Meyer, 1965) [4].

The Flower weight (g): The Flower weight was found to be maximum (6.52) in the treatment T_9 N, P, K (45, 35, 45) (g/m^2). The Flower weight was found to be minimum (3.34)

in the treatment T_1 Control. The reason for maximum flower weight in the best treatment T_9 is due to the fact that nitrogen is a constituent of protein which is essential for formation of protoplasm thus affecting the cell division and cell enlargement and ultimately better vegetative growth and flower formation. Thus, resulting in maximum flower weight. Balanced dose of nitrogen, phosphorus and potassium seemed to have increased the vegetative growth, favorable for the synthesis of peptide bond, protein and carbohydrate metabolism that are essential for flower development (Boodly & Meyer, 1965) [4].

No. of flower per plant: The no. of flower per plant was found to be maximum (12.52) in the treatment T_9 N, P, K (45,35,45) (g/m^2). No of flower per plant were found to be minimum (4.86) in the treatment T_1 Control. The reason for maximum no of flower per plot is due to the fact that applied nitrogen significantly increased the growth parameter like number of branches, plant height which have synthesized more plant metabolites and ultimately led to increased number of flowers (Chan, 1995). Similar results were found by Chawala *et al*., (2007) [5] in chrysanthemum. As high rates of fertilizers resulted in more branches, high rate of fertilizer also induced more number of bloom per plant (Samoilkenkoi, 1983) [17]. The highest level of nitrogen has pronounced effect on number of flowers (Khan *et al*., 1999) [13].

The No. of flower per plot: The No. of flower per plot was found to be maximum (75.14) in the treatment T_9 N, P, K (45,35,45) (g/m^2). The No. of flower per plot were found to be minimum (29.14) in the treatment T_1 Control. The reason for maximum no of flower per plot is due to the fact that applied nitrogen significantly increased the growth parameter like number of branches, plant height which have synthesized more plant metabolites and ultimately led to increased number of flowers (Chan, 1995). Similar results were found by Chawala *et al*., (2007) [5] in chrysanthemum. As high rates of fertilizers resulted in more branches, high rate of fertilizer also induced more number of bloom per plant (Samoilkenkoi, 1983) [17]. The highest level of nitrogen has pronounced effect on number of flowers (Khan *et al*., 1999) [13].

The Flower yield ha^{-1}: The Flower yield was found to be maximum (7.51) in the treatment T_9 N, P, K (45,35,45) (g/m^2). The Flower yield ha^{-1} were found to be minimum (2.91) in the treatment T_1 Control. The reason for maximum no of flower is due to the fact that applied nitrogen significantly increased the growth parameter like number of branches, plant height which have synthesized more plant metabolites and ultimately led to increased number of flowers (Chan, 1995). Similar results were found by Chawala *et al*., (2007) [5] in chrysanthemum. As high rates of fertilizers resulted in more branches, high rate of fertilizer also induced more number of bloom per plant (Samoilkenkoi, 1983) [17]. The highest level of nitrogen has pronounced effect on number of flowers (Khan *et al*., 1999) [13].

The vase life (days)

The vase life was found to be maximum (6.83 days) in the treatment T_9 N, P, K (45,35,45) (g/m^2). The vase life (days) was found to be minimum (4.41 days) in the treatment T_1 Control. The maximum number of days for vase life was noticed in T_9 due to increase in fertilization of macro nutrients from the required level. Similar results were obtained by Hunmili and Paswan (2003) in gerbera.

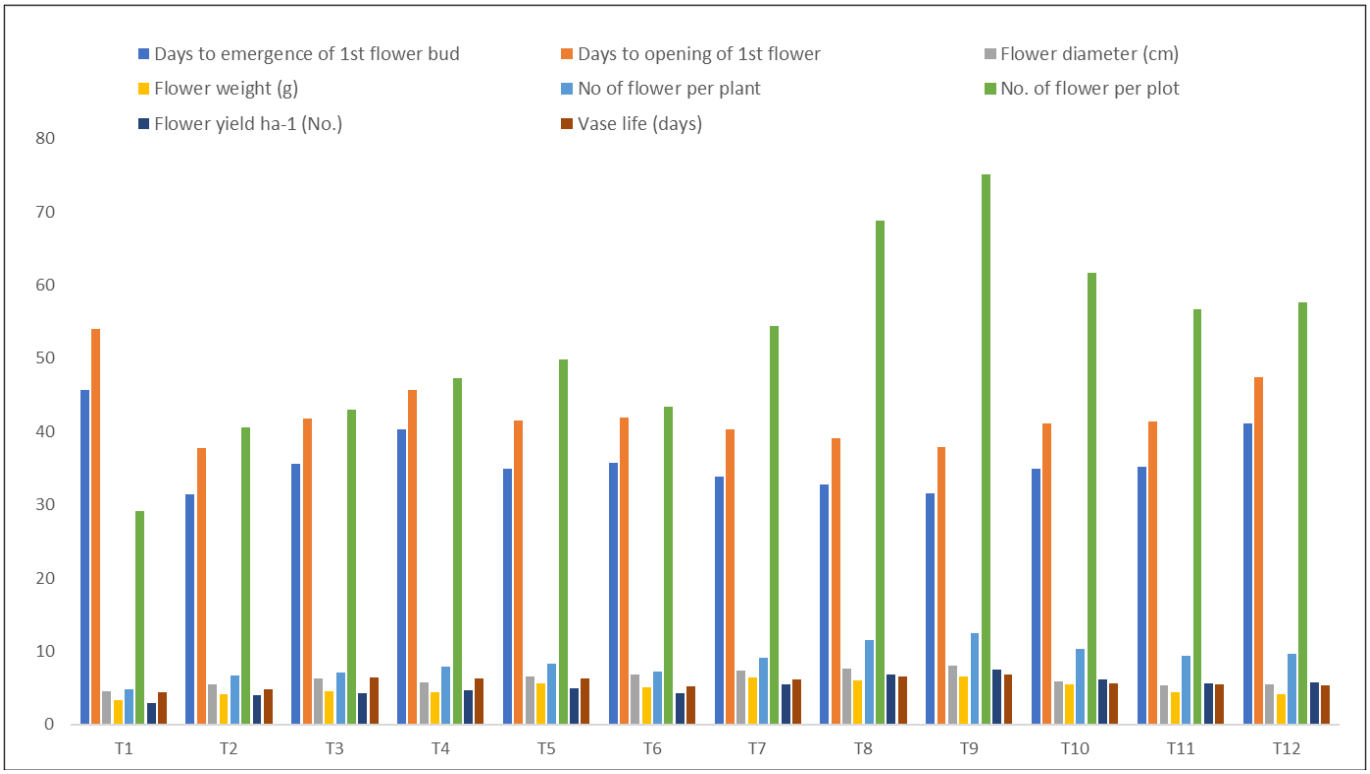

Fig 2: Effect of N, P, K on floral parameters of *Zinnia elegans.*

Conclusion

It can be concluded from the findings of the present investigation that application of T_9 N,P,K (45,35,45) (g/m^2) treatment was significantly superior in terms of plant growth and flower yield *viz*., plant height (49.42 cm), number of leaves per plant (59.63), number of branches per plant

(10.82), plant spread (34.86 cm^2), days to emergence of 1st flower bud (31.61), Days to opening of 1st flower (37.86), Flower diameter (8.04 cm), Flower weight (6.52 g), No of flower per plant (12.52), No. of flower per plot (75.14), Flower yield ha^{-1} (7.51) and vase life (6.83 days) of *Zinnia elegans*. Therefore, application of T_9 N, P, K (45,35,45) (g/m^2) on zinnia plants can be recommended for better growth and flowering under Prayagraj agro- climatic conditions.

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