INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 8, No. 3, p. 75-83, 2016

RESEARCH PAPER OPEN ACCESS

Response of zinnia (*Zinniaelegans*) cultivars to different levels of phosphorus

Samia Mukhtar[1], Gohar Ayub[1], Mohammad Ilyas[1*], Manzoor Ahmad[2], Muhammad Umar[1], Azmat Ali Awan[1], Luqman[3],Gulzar Ullah[1]

[1]*Department of Horticulture, University of Agriculture, Peshawar, Pakistan*

[2]*Department of Agriculture, Bacha Khan University, Charsadda, Pakistan*

[3]*Department of Weed Science, University of Agriculture, Peshawar,-Pakistan*

Key words: Zinnia, Cultivars, Phosphorus, Growth, Flowering.

http://dx.doi.org/10.12692/ijb/8.3.75-83 Article published on March 23, 2016

Abstract

An experiment was conducted to study the response of zinnia cultivars to phosphorus levels at Ornamental Nursery, Department of Horticulture, University of Agriculture, Peshawar. The experiment was designed as Randomized Complete Block Design with split plot arrangement having three replications. Phosphorus levels (0, 100 kg ha^{-1}, 200 kg ha^{-1} and 300 kg ha^{-1}) were subjected to main plot and zinnia cultivars (Dreamland Red, Yellow, Pink and White) were kept in sub plots. The results of statistical analysis revealed that both phosphorus levels and cultivars showed significantly different response in all the growth parameters. Highest survival %(100%), flower number (22.61) $plant^{-1}$, flower diameter (9.09 cm), fresh flower weight (10.58 g), plant height (43.86 cm), fresh root weight (4.88 g), root length (18.73 cm) and less days to initiate flower (40.92) were observed in plots, supplied with phosphorus at the rate of 200 kg ha^{-1}. Among cultivars Red cultivar showed maximum survival % (100%), plant height (46 cm), flower numbers $plant^{-1}$ (21.21), fresh flower weight (12.28 g), flower diameter (9.25 cm), root weight (4.50 g), root length (17.21 cm) and minimum days to flowering (40.42). The interaction (phosphorus levels and cultivars) was non-significant in majority of parameters. Among different treatments used, zinnia cv. Red, treated with 200 kg P ha^{-1} should be recommended for maximum growth and flowering attributes under agro-climatic conditions of Peshawar.

* **Corresponding Author:** Mohammad Ilyas ✉ Ilyas_swati88@yahoo.com

Introduction

Floriculture is a branch of Horticulture which deals with the cultivation, development and marketing of flowering plants. Flower forming or floriculture can be a best option to enhance the income of common poor farmers in Pakistan. Favorable climatic conditions and low-priced labor is available to produce these crops, as they can be grown with limited resources (less land and water) as compared to other crops. The outcome of flowering crops is much higher than other agricultural crops and it can be a better source of foreign exchange and net profit gain. Annual flowering plants have an essential role in the success of the floral industry (Qasim *et al.*, 2011). Zinnias flower are champion of season among summer annual flowers (Cohoon, 2010). Zinnia (*Zinniaelegans*L.) is originated from Mexico; the Spanish referred it as "mal de ojos" (meaning sickness of the eyes). It was thought unattractive and small flower. In 18th century seeds were sent to Europe then got its name from a medical professor named Johann Gottfried Zinn, who provided the first written description of the flower in German. The native *Zinnia elegans*is a wild desert plant in Mexico. Modern zinnia have been developed from specie, *Zinnia elegans*Jaeq. Zinnia belongs to family *Asteraceae* and it is a genus of 20 species of annual and perennial plants (Stevens *et al.*, 1993).Zinnia is a dicot herbaceous plant and prefers warm climate. Zinnia range in height from 15-100 cm. Zinnia leaves are sandpapery in texture, contrary, generally stalk less (sessile), pale to middle green in colour and having different forms linear to ovate (Kirkbride and Wiersma, 2007).Zinnias may be used as cut flowers, in beds, container, border, and background or as cottage; garden plants attract birds, butterflies and other hummingbirds (Johsonn and Kessler, 2007). Zinnia can be used as mix-crop in tomatoes against nematodes (Yassin *et al*, 2010). Zinnia is also helpful for remedy of kidney. White zinnia is used in treatment of swelling or aches (Mantur, 1988).

Fertilizer plays a very important role to produce more number of shoots, leaves and have good effect on blossoming (Joiner and Gruis, 1961).The balanced doses of nitrogen, phosphorus and potassium had a key role in the increment of the vegetative growth, favorable for the synthesis of peptide bonds, protein and carbohydrates metabolism, necessary for the plant growth and flower development (Meyer *et al.*, 1973). For optimum production of flowers and healthy growth, plants may be supplied with a balanced controlled release fertilizer. However, do not over fertilize as over fertilization leads to different types of disorders (Norberto, 2010). The judicious and balanced fertilizers are known to result in overall improvement in flower quality and total yields in many flower crops (Mantrova *et al.*, 1976).Nitrogen, Phosphorus and Potassium are most important for plant growth and better quality of flower. Phosphorus is classified as a major nutrient, meaning that it is frequently deficient for crop production and is required by crops in relatively large amounts. Phosphorus plays an important role in root development, flower, seed production, early flowering and hardening. It has essential role in numerous physiological processes e.g energy storage, transformation of sugars and starches, nutrient movement within the plants, transfer of genetic characteristics from one generation to the next, respiration, photosynthesis, cell division and enlargement etc. Phosphorus is also a component of phytin, a major storage form of P in seeds. When P is limiting, the most striking effects are a reduction in leaf expansion and leaf surface area, as well as the number of leaves. Proper amount of phosphorus in the soil is required for plant growth and development, as in phosphorus deficient plants patches appear on lower side of leaves and become dark green in colour (Salsbury and Ross, 1969). Phosphorus deficiency causes delayed maturity, reduced quality of forage, fruit and vegetable and grain crops. So optimum phosphorus dose results in increasing the vegetative growth of plant and thus enhancing production of carbohydrate, which is stored in the roots as well as produce sufficient flowers.Deficiency of phosphorus may adversely affect the plant in maintaining full supply of nitrogen and potassium. Excess application of phosphorus may results in various nutritional problems including calcium and zinc deficiency

(Chaitra, 2006).

Materials and methods

A trial was carried out to study the response of zinnia cultivars to phosphorus levels at Ornamental nursery, Department Horticulture, The University of Agriculture, Peshawar during 2011. Zinnias seed were sown ten inches earthen pots with growing media of soil, silt and compost in ratio (1:1:1). Seeds were slightly covered with leaf compost and soil and then sprinkled with water. On requirement basis, irrigation was applied. Two to three true leaves were developed then seedlings were transplanted to well-prepared field in May. Uniform sized and healthy seedlings were chosen. The row-row distance was kept 45 cm whereas the plant-plant distance was maintained at 30 cm. In all treatments cultural practices were applied uniformly. Field was ploughed thoroughly and was applied with compost organic matter (F.Y.M) at 20 tons ha^{-1}. The recommended basal dose 300:200 kg NK ha^{-1} (Javid *et al.* 2005) was applied to all treatments. The source of nitrogen and potassium were urea and potassium sulphate respectively. Urea was applied in split doses to avoid leaching. Half dose was applied before transplantation at the time of land preparation and the remaining half dose was applied before floral bud formation. Randomized Complete Block design (RCBD) with split plot arrangement was used in this experiment, replicated three times. There were two factors i.e. phosphorus levels and cultivars. The phosphorus levels were subjected to main plot while the cultivars were kept in sub plot.

Factor A (Phosphorus levels)	Factor B (zinnia cultivars)
P_0 =Control	C_1 Red (dreamland F1)
P_1= 100 kg ha^{-1}	C_2Pink (dreamland F1)
P_2= 200 kg ha^{-1}	C_3White (dreamland F1)
P_3 = 300 kg ha^{-1}	C_4Yellow (dreamland F1)

Soil analysis

Soil sample up to 25 cm depth were taken randomly from experimental plot before fertilizer application and their composite sample was analyzed for both chemical and physical properties.

Parameters studied

The data were recorded onSurvival percentage (%), Days to flowering, Number of flowers $plant^{-1}$, Flower diameter (cm), Flower weight (g), Plant height (cm), Root length (cm) and Root weight (g)

Statistical analysis

The measured data on vegetative and floral growth parameters were analyzed through ANOVA (Analysis of variance) process to confirm differences between treatments and their interactions. When a significant difference was found, then LSD (least significant difference) test was applied to know the differences among the individual mean values. MSTATC (Michigan State University, USA), a computer statistical software was used for manipulating both ANOVA and LSD (Steel *et al.*, 1997).

Results and discussion

Survival percentage (%)

The statistical analysis of variance showed that phosphorus significantly affected the survival percentage of zinnia cultivars. While zinnia cv. and their interaction showed a non-significant response to survival percentage.The mean values of data illustrated that highest survival percentage (100%) was observed in plants treated with phosphorus at 200 kg ha^{-1}, pursued by survival percentage (98.33%) in the plots that received 300 kg Pha^{-1}. Lowest survival percentage (90%) was noted in control treatment.The current findings are in correspondence of Hussain *et al.* (2011) who observed that maximum sprouting %age was recorded in freesia cormel at highest level of phosphorus. The results are also similar with conclusions measured by Gowda *et al.* (1988) who observed the maximum survival %age with higher dose of NP fertilizer.

Days to flowering

The analysis of data revealed that the phosphorus significantly affected days to flowering while zinnia cultivars and interaction are non-significant. Comparison of means indicated that maximum days to flowering (43.75) were recorded in the plants grown under control conditions and minimum days to flowering (40.92) were recorded in the plots

applied with 200 kg P ha^{-1}.The findings of recent observation are in concord with Adnan *et al.* (2006) who recorded minimum days to initiate flower (31.17), tallest plants (82.47 cm), number of branches plant^{-1} (13.43), number of leaves plant^{-1} (58.44) and highest flowers plant^{-1} (21.55) in dahlia cv. treated with N:P:K in a ratio of 6.5:6.5:0. The results are also in line with Khan *et al.* (2007) who observed best results regarding growth and yield parameters in plants treated with 25-15-15 g NPK. It was also noticed that highest days to flowering were found at 30 g of nitrogen and lowest days to flowering were recorded with 15 g of phosphorus.

Table 1. Effect of different levels of phosphorous on Survival %, Days to flowering, Number of flowers plant^{-1} and Flower diameter (cm) of zinnia cultivars.

Treatments	Survival %	Days to flowering	Number of flowers plant^{-1}	Flower diameter (cm)
Phosphorous levels				
P1	90 b	43.75 a	17.88 b	7.97 b
P2	96.67 ab	43.67 a	18.27 b	8.36 ab
P3	100 a	40.92 ab	22.61 a	9.09 a
P3	98.33 a	42.25 a	1971 ab	8.61 ab
LSD (P ≤ 0.05)	6.69	2.16	3.34	0.62
Cultivars				
Cv1	100	40.42	21.21 a	9.25 a
Cv2	95.00	43.42	18.95 b	8.25 bc
Cv3	93.33	42.12	18.93 b	7.98 c
Cv4	96.67	42.83	19.38 b	8.54 b
LSD (P ≤ 0.05)	NS	NS	1.78	0.513
Interactions				
P1×Cv1	100	45	19.30	8.5
P1×Cv2	86.67	44.34	17.23	7.9
P1×Cv3	86.67	43.74	18.90	7.5
P1×Cv4	86.67	41.67	16.10	7.97
P2×Cv1	100	43.67	20.33	8.83
P2×Cv2	100	43.66	16.82	8.33
P2×Cv3	86.67	43.60	16.77	8.23
P2×Cv4	100	44	19.00	8.03
P3×Cv1	100	34.67	22.87	10.00
P3×Cv2	100	41.67	22.00	8.50
P3×Cv3	100	41.67	21.80	8.20
P3×Cv4	100	43.33	23.77	9.67
P4×Cv1	100	38.33	22.33	9.67
P4×Cv2	93.33	44	19.60	8.27
P4×Cv3	100	39.67	18.23	8
P4×Cv4	100	42.33	18.67	8.5
LSD (P ≤ 0.05)	NS	NS	NS	NS

Number of flowers plant^{-1}

The analysis of data revealed that phosphorus had significant effect on number of flowers. Cultivars also showed significantly different response while the interaction of these two factors is non-significant.Comparison of means showed that maximum number of flowers (22.61) was observed in plots that have received 200 kg P ha^{-1} and followed by (19.71) number of flowers plant^{-1} in plots supplied with 300 kg P ha^{-1}. The minimum number of flowers (17.88) was noted in control treatment. Red cultivar showed the highest flowers number (21.21) followed by yellow cultivar that showed (19.38) and the lowest flower number (18.93) was found in white cultivar. The findings are in line with Balasubramanian*et al.* (1991) who reported that optimum supply of

potassium stimulated the uptake of phosphorus by plant roots. Increase in phosphorus uptake has promoted more flower clusters formation, as phosphorus directly promotes flowering (Balley, 1999). Furthermore, enhanced uptake of phosphorus promotes root growth, which ultimately resulted in better water and mineral absorption. The findings of recent observation are in concord with Javid*et al.* (2005) who recorded highest flowers number in zinnia plants treated with 20 g P_2O_5 m^{-2}.The results are also in similarity with Joiner and Gruis (1961) who stated that balance dose of fertilizer favor more number of shoots which have direct relationship with flower production. It is obvious from the data taken that there was a remarkable difference in cultivars with different phosphorus levels. The differences in flower number $plant^{-1}$ might be due to variation in genetic characteristic and adoptability of cultivars. Because of their genetic constituent, cultivars are significantly different in characteristics with respect to yield (Khan *et al.*, 2004).

Table 2. Effect of different levels of phosphorous on Flower weight (g), Plant height (cm), Root length (cm) and Root weight (g) of zinnia cultivars.

Treatments	Flower weight (g)	Plant height (cm)	Root length (cm)	Root weight (g)
Phosphorous levels				
P1	8.34 b	40.28	9.87 d	2.05 d
P2	9.2 b	41.01	16.77 b	3.21 c
P3	10.58 a	43.86	18.73 a	4.88 a
P3	9.18 b	40.53	13.94 c	4.46 b
LSD (P ≤ 0.05)	0.94	NS	0.83	0.41
Cultivars				
Cv1	12.28 a	46 a	17.21 a	4.50 a
Cv2	8.44 c	39.94 b	13.4 c	3.28 b
Cv3	7.41 d	39.51 b	12.55 d	2.53 c
Cv4	9.18 b	40.23 b	16.15 b	4.3 a
LSD (P ≤ 0.05)	0.65	3.19	0.75	0.47
Interactions				
P1×Cv1	10.9	49.33	11.8	2.34
P1×Cv2	8.37	36.77	8.73	1.99
P1×Cv3	6.2	35.9	8.6	1.53
P1×Cv4	7.90	39.13	10.33	2.36
P2×Cv1	12.73	44.33	18.56	3.67
P2×Cv2	8.13	38.67	14	2.83
P2×Cv3	7.6	44.8	16.06	2.44
P2×Cv4	8.37	36.23	18.46	3.92
P3×Cv1	13.30	45.77	21.66	6.35
P3×Cv2	8.87	43.67	17.53	3.96
P3×Cv3	8.63	39.9	15.23	3.22
P3×Cv4	11.53	46.1	20.5	5.99
P3×Cv1	12.17	44.57	16.8	5.63
P3×Cv2	8.4	40.67	13.33	4.33
P3×Cv3	7.2	37.43	10.33	2.93
P3×Cv4	8.93	39.43	15.3	4.93
LSD (P ≤ 0.05)	1.30	6.67	1.50	0.95

Flower diameter (cm)

The statistical analysis of data indicated that phosphorus significantly affected flower diameter (cm) and significantly different behavior of cultivars was noticed. The interaction of these factors was non-significant.The highest flower diameter (9.09 cm) was recorded in plots treated with 200 Kg P ha^{-1} pursued by flower diameter (8.61 cm) in plots applied with 300 kg P ha^{-1} and the lowest flower diameter (7.97 cm) was observed in control treatment. Red cultivar showed the highest flower diameter (9.25 cm) followed by (8.54 cm) flower diameter in yellow

cultivar and the lowest flower diameter (7.98 cm) was observed in white cultivar.The results of the current experiment indicated that Phosphorus concentration significantly maximized flower diameter.Boodly&and Meyer (1965) supported that concentration of nitrogen, phosphorus and potassium in proper proportion responsible for the enhancement of the vegetative growth. When vegetative growth is increased, it favors the synthesis of peptide bond, protein and carbohydrate metabolism. These compounds are necessary for development of flower.

These may be due to accumulation of biosynthetic compounds which positively affect cell division and formation, which may increase number of petals and their expansion or both of them as a result flower diameter could be increased. At initial stage of flowering, phosphorus and potassium are required in higher quantity to produce a healthy flower. Phosphorus is essential to produce healthy flower and roots.Similar results were obtained by Jayanthi and Gowda (1988), who observed the larger flower diameter of chrysanthemum with increased level of NPK. Similarly, Gnyandev (2006) also noticed the more flower size of China Aster at higher fertilizer level of NPK.The differences in flower diameter might be due to variation in genetic capacity and adoptability of cultivars in environment. Because of their genetic constituent, cultivars are significantly different in characteristics with respect to yield (Khan *et al.*, 2004).

Flower weight (g)

The statistical analysis of data illustrated that fresh flower weight (g) significantly affected by phosphorus levels and zinnia cultivars also showed significantly different response in flower weight. Whereas interaction between these factors was also significant. Comparison of mean values of data showed that highest fresh flower weight (10.58 g) was obtained at the level of 200 kg P ha^{-1}, followed by flower weight (9.18 g) at the rate of 300 kg P ha^{-1}, while the lowest flower weight (8.34 g) was obtained in control treatment.Red cv. showed the highest flower weight (12.28 g) followed by (9.18 g) in yellow cv., while the lowest flower weight (7.41 g) was noticed in white cv. Interaction mean indicated that red cv. showed highest fresh flower weight (13.30 g) in plots treated with 200 kg P ha^{-1} followed by yellow cv. which gained (11.53 g) at the level of 200 kg P ha^{-1}. The lowest flower weight (6.2 g) in white cv. was observed in control treatment. The results of the following study are in close agreement with shafi *et al.* (2001) who observed that weight of the flower increases up to a balance level reduces by the increasing nitrogen further than balance dose with phosphorus and potassium. The results of current study are also in line with Panchal *et al.* (2010) who reported the maximum flower weight of chrysanthemum with the nutrient solution containing sufficient potassium and phosphorus. These results are also in partial agreement with Munshi (1994), who observed maximum flower numbers, fresh flower weight and yield of saffron in plots applied with NPK at the rate of 30:40:30 kg ha^{-1}.The differences in flower weight might be due to variation in genetic makeup of cultivars and suitability of environmental factors. Because of their genetic material, cultivars are significantly different in characteristics with respect to yield (Khan *et al.*, 2004).

Plant height (cm)

The statistical of data indicated that plant height was not significantly affected by phosphorus whereas cultivars showed significantly different response in plant height. The interaction between these factors was significant.The tallest plants (43.86 cm) were noticed in plots which were applied with 200 kg P ha^{-1} followed by (41.01 cm) in plots supplied with 100 kg ha^{-1} and the smallest plants (40.28 cm) were noted in control conditions. The mean value of results showed that red cultivar showed the maximum height (46 cm) pursued by yellow cultivar (40.23 cm) and white cultivar showed the minimum height (39.51 cm). Nitrogen is major nutrient and is helpful in nucleic acid, synthesis of protein and increase in respiratory rates which enhance plant growth and height (Verma and Verma, 2007). By maximizing nitrogen dose vegetative growth was maximized in *Nicodemia* sp. and at high dose tallest plants were observed by Istiaq

and Rahman (1997). However excess amount have adverse effect on growth. The differences in plant height might be due to genetic potential variation and favorable climatic factors. Because of their genetic constituent, cultivars are significantly different in characteristics with respect to yield (Khan *et al.*, 200).

Root length (cm)

Analysis of data revealed that phosphorus and cultivars showed significantly different response in fresh root weight. The interaction between these factors was also significant.The maximum root length (18.73 cm) was recorded in plots supplied with 200 kg P ha^{-1} followed (16.77 cm) in plants received 100 kg P ha^{-1} and minimum root length (9.87 cm) was observed in control treatment. The longest roots (17.21 cm) were recorded in red cultivars pursued by yellow cultivar (16.15 cm) and the shortest roots (12.55 cm) were observed in white cultivar. The enhanced uptake of phosphorous by potassium application improves the root growth. Phosphorus uptake is more in well aerated and warm soil so when soil temperature is more phosphorus promotes root growth (Mcafee, 2003).These results were in line with different scientists (Mantur, 1988; Doddagoudar *et al.*, 2004; Khan *et al.*, 2007) who recorded maximized root length with optimum level of NPK.

Fresh root weight (g)

Statistical analysis of variance demonstrated that phosphorus significantly affected root weight (g) and cultivars also showed significantly different behavior. Whereas the interaction between these two factors was also significant. The mean value of data indicated that the highest root weight (4.88 g) was gained in plots applied with 200 kg P ha^{-1} followed by (4.46 g) in plots treated with 300 kg P ha^{-1} and the minimum root weight (2.05 g) was gained in control treatment. Red cultivar showed the best root weight (4.50 g) followed by yellow cultivar (4.3 g) and the lowest root weight (2.53 g) was observed in white cultivar. These results are also in line with Munshi (1994) who observed the maximum cormel and flower numbers in plots applied with NPK at the rate of 30:40:30 kg ha^{-1}. Furthermore enhanced uptake of phosphorus promotes root growth, which ultimately resulted in better water and mineral absorption. The findings of recent observation are in concord with Javid*et al.* (2005) who recorded best root growth and flower production in zinnia plants treated with 20 g P_2O_5 m^{-2}

Conclusion

On the account of results acquired, it is concluded that phosphorus at the rate of 200 kg ha^{-1} is more effective in enhancing growth and early flowering in zinnia. Correspondingly the response of red cultivar followed yellow cultivar was best as compared to other cultivars in most of growth and yield parameters. Hence 200 kg of phosphorus ha^{-1} and red and yellow cultivars respectively are recommended under agro-Climatic condition of Peshawar for better results regarding growth and flower production.

References

Balasubramanian R, Balakrishnan K Manoharan S. 1991. Effect of potassium on chilli. Spice India **4(5),** 5-6.

Balley LH. 1999. Principles of vegetable cultivation. Discovery Publishing House. New Dehli. 910.

Boodly JW, Meyer JR. 1965. The nutrient content of Bonnaffomdeltue chrysanthemum from juvenile to mature growth. American Society of Horticulture Science **87**, 472–8.

Cahoon S. 2010. Zinnia champions of summer. Sunset. Sunset Publising Corp. High Beam Res. 2 http://www.beam.com/

Chaitra R. 2006. Effect of integrated nutrient management on growth, Yield and quality of china aster (*callistephuschinensis*l.) M Sc. Thesis, Dept. Hort. College of Agriculture, Dharwad University of Agricultural Sciences, Dharwad.

Doddagoudar SR, Vyakaranahal BS, Shekhargouda M. 2004. Effect of mother plant nutrition and chemical spray on seed germination and seedling vigour index of China aster cv. Kamini.

Karnataka Journal of Agriculture Science **17(4),** 701-704.

Gnyandev B. 2006. Effect of pinching, plant nutrition and growth retardants on seed yield, quality and storage studies in china aster (*Callistephuschinensis*L.) M.Sc. (Agri.) Thesis. Univ. Agri. Sci. Dharwad, Karnataka India.

Gowda JVN, Jayanthi R, Raju B. 1988. The effect of nitrogen and phosphorus on flowering in Gladiolus cv. Debonair. University of Agriculture Sciences Banglore **17(6),** 80-81. (CAB Absts. 1987-89).

Hussain IA, Khattak M, Amin NU, Rahman HU, Munsif F. 2011. Response of cormels of different freesia cultivars to phosphorus levels. Sarhad Journal Agriculture **27(1)**.

Ishtiaq M, Rahman S. 1997. Effect of different levels of nitrogen on the growth of Nicodemia madagascareinsis. Sarhad Journal of Agriculture **12(3),** 235-239.

Javid QA, Abbasi NA, Hafiz IA, Mughal AL. 2005. Performance of zinnia *(Zinnia elegans*) "Dahlia flowered" crimson shade by application of NPK fertilizer. Intrenational Journal of Agriculture & Biology **7(3),** 474-476.

Javid QA, Abbasi NA, Saleem N, Hafiz IA, Mughal AL. 2005. Effect of NPK fertilizer on performance of zinnia (*Zinnia elegans*) Wirlyging shade. Intrernational Journal of Agriculture & Biology **7(3),** 471-473.

Jayanthi R, Gowda JVN. 1988. Effect of nitrogen and phosphorus on growth and flowering of chrysanthemum. Cv. Local White. Current Research. **17,** 104-106.

Johnson CN, Kessler JR. 2007. Greenhouse production of bedding plant zinnia Alabama cooperative extension system. ANR-1311. www.aces.edu

Joiner JN, Gruis JT. 1961. Effect of nitrogen and potassium levels on growth flowering and chemical composition of zinnia and marigold. Florida State Hon Soc. 445-448.

Khan GA, Sajid M, Amanulah. 2007. Response of dhalia (*Dhaliapinnata*) to different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium. American Eurasian Journal of sustainable Agriculture **1(1),** 25-32.

Khan MA, Ziaf K, Ahmad I. 2004. Influence of nitrogen on growth and flowering of *Zinnia elegans*cv. Meteor. Asian Journal of plant science, **3 (5),** 571-573.

Kirkbride JH, Wiersma JH. 2007. Proposal to conserve the name Zinnia elegans against Z. Violacea. Taxon, **56(3),** 958-959.

Mantrova EZ, Mikitima GN, Zdasuyak V. 1976. Some characteristics of the mineral nutrition greenhouse conditions. Canadian Horticulture and Home Magazine, 67.

Mantur SM. 1988. Studies on nutrition, growth regulators and soil salinity on flower and seed production in China aster. Ph.D. thesis.Uni. Agri. Sci. Dharwad, Karnataka (India).

Mcafee J. 2003. Potassium, A key nutrient for plant growth. 1, 2.

Meyer BSD. Banderson Bohning RH Fratianne DG. 1973. Introduction to plant physiology. D. Van NostrandCompany New York. 193-322.

Munshi AM. 1994. Effect of N, P and K on the floral yield and corm production in saffron (*Crocus sativus* L.) under rainfed conditions ind-Cocoa, Areanut and Species Journal **18(2),** 41-44.

Norberto B. 2010. The Urban Gardener **3(1),** 2094-1765.

Panchal RV, Parehk NS, Parmar AB, Patel HC. 2010. Effect of biofertilizers and nitrogenous fertilizer on growth, flowering and yield of annual white chrysanthemum (*Chrysanthemum coronarium*L.). Asian Journal of Horticulture **5(1),** 22-25.

Qasim M, Ahmad T, Ahmad I. 2011. Model Farming. How to develop floriculture. Pakisan.com.

Salsbrury FB, Ross CW. 1969. Plant physiology mineral nutrition 3rd edition, Wadsworth publishing Company, Belomennet, California. 108-109.

Shafi M, Ishtiaq M, Rehman N. 2001. Response of *Gaillardia pulchella* (cv. Picta) to different levels of Nitrogen with constant doses of phosphorous and potassium. M.Sc(Hons) thesis Deptt. Horti. KPK Agri. Uni. Peshawar.

Steel RGD, Torrie JH, Deekey DA. 1997. Principles and Procedures of Statistics. A Biometrical Approach. 3rd Edt. McGraw Hill Book Co. Inc. New York. 400-428.

Stevens S, Stevens AB, Gast KLB, Mara JAO, Tisserat NA, Bauernfeind R. 1993. Commercial specialty cut flower production. Cooperative Extension Service, Kansas State Uni. Manhattan, Kansas. M F-1079.

Verma SK, Verma M. 2007. A textbook of plant physiology, biochemistry and biotechnology. Chap. Mineral Nutrition in Plants. pp. 110-112. S. Chand & Company Ltd. New Delhi.

Yassen AA, Habib AM, Sahar M, Zaghloul M, Khaled SM. 2010. Effect of different sources of potassium fertilizers on growth yield and chemical composition of *Calendula Officinalis*. Journal American Science **6(12),** 1044-1048.