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Effect of Preharvest Phosphorus and Potassium Fertilizers and Postharvest $AgNO_3$ Pulsing on the Postharvest Quality and Shelf Life of Zinnia (*Zinnia elegans* cv. Blue point) Cut Flowers

ABBASI, N.A., S. ZAHOOR AND K. NAZIR
Department of Horticulture, University of Arid Agriculture, Rawalpindi–Pakistan

ABSTRACT

The effect of preharvest application of Phosphorus and Potassium fertilizer @ 0, 10, 20 and 30 g m^{-2} and postharvest pulsing of $AgNO_3$ @ 400 ppm for 24 h on Zinnia (*Zinnia elegans* cv. Blue Point) was observed. The maximum postharvest flower opening time (4.95 days), flower size (7.06 cm) and longevity (6.76 days) was found with preharvest treatment of 30+30 g P and K m^{-2} alongwith post harvest pulsing of $AgNO_3$ @ 400 ppm. The results revealed that minimum postharvest flower opening time (2.1 days), size of flower (5.10 cm) and longevity of flower (3.63 days) was noted with no fertilizer application and pulsing with distilled water. The highest doses of preharvest P and K fertilizers application significantly increased the size and shelf life of cut flowers. Pulsing with $AgNO_3$ enhanced the shelf life of the cut flowers as compared to distilled water.

Key Words: *Zinnia elegans*; Postharvest; Cut flowers; Fertilizer

INTRODUCTION

Flowers not only beautify our surroundings but also express our sentiments. Use of cut flowers on various social gatherings viz. weddings; birthday parties and funerals have been increasing steadily in Pakistan. Further, flowers are being used for oil extraction and medicines

During summer season in Pakistan, a limited choice of cut flowers is available. Zinnia is an important cut flower and can be utilized both for bedding and cut flower purposes. Keeping in view the delicacy of flowers and shortened postharvest life it is important to devise such methods to increase the vase life of cut flowers during transit and for their enhanced utilization on various occasions.

One of the most important aspects in cut flower production is proper supply of nutrition during the growing period. P fertilizer after its uptake is incorporated in a variety of organic compounds including sugar, phosphates, phospholipids and nucleotides. Similarly, K has an important role in regulation of the osmotic potential of the plant cells. It also helps in activation of many enzymes involved in respiration and photosynthesis. K also improves the strength of cell wall, hence strengthening the tissues (Taiz & Zeiger, 1991). It is because of these characters of the two nutrients that might contribute in the extension of postharvest life of cut flowers. Chemical treatments have revealed that $AgNO_3$ also proved to enhance the longevity of cut flowers, probably by increasing the sap movement in the xylem by clearing the bacterial plugging (King, 2003).

The present study was designed to standardize the P and K fertilizer doses for better quality Zinnia cut flowers and to determine the effect of $AgNO_3$ pulsing for the extension in post harvest life of Zinnia cut flowers.

MATERIALS AND METHODS

Zinnia (*Zinnia elegans* cv. Blue Point) was planted in the Research area of the Department of Horticulture, University of Arid Agriculture, Rawalpindi, during 2002. Plants were supplied with Nitrogen fertilizer @ 111 kg N ha^{-1}. While various doses of P and K fertilizers applied were as under:

Pre-harvest Treatments of P and K.

Treatments	$P_2O_5+K_2O$ (g m^{-2})	$P_2O_5+K_2O$ (kg ha^{-1})
T_1	0+0	0 + 0
T_2	10+10	37 +37
T_3	10+20	37 + 74
T_4	10+30	37 + 111
T_5	20+10	74 + 37
T_6	20+20	74 + 74
T_7	20+30	74 + 111
T_8	30+10	111 + 37
T_9	30+20	111 + 74
T_{10}	30+30	111 + 111

Six flowers from each treatment were harvested at the semi-open stage along with stalk measuring 10-cm and were brought immediately to the laboratory. Flower stalks were washed with distilled water to remove the dust particles from the cut stem ends and three flowers from each treatment were subjected to tests in the following chemical solutions.

C_1 Distilled water Control
C_2 Silver nitrate 400 mg/L

Flowers which were pulsed with $AgNO_3$ solution for 24 h were then transferred to distilled water. The layout was according to Completely Randomized Design (CRD) with three replication of each treatment. Data were recorded on opening period, size of the flower (cm) and longevity of the flowers.

RESULTS AND DISCUSSION

Opening period of flowers (days). Statistical analysis of data in Table I regarding opening period of flowers showed significant difference among different treatment means. It showed that maximum period (4.95 days) required for opening of flowers under fertilizer treatment of 30 + 30 g P_2O_5+K_2O m^{-2} and pulsed with $AgNO_3$ 400ppm, having significant difference from all other treatments. While, minimum time (2.10 days) required for flowers opening was observed in flowers produced under control treatment.

The maximum rate of P and K delayed the opening period of flowers. The Postharvest treatment with $AgNO_3$ @ 400 ppm significantly prolonged the opening period of flower buds. The flowers harvested from plots treated with maximum amount of P and K fertilizer doses and pulsed with $AgNO_3$ @400 ppm for 24 h took more time for full opening. A similar finding was reported by Paull and Gode (1982), that the pretreatment of Antirrhinum flower cv. Ozakired stem with 1-10 ppm silver nitrate increased vase life by 40-60%. The extension of postharvest life of zinnia cut flowers is due to the application of P and K fertilizers, because the P fertilizer provides energy to the cells in the form of Adenosine Tri Phosphate (ATP). Similarly, K fertilizer has an important role in regulation of the osmotic potential of the plant cells. It helps in activation of many enzymes involved in respiration and photosynthesis. K also improves the strength of cell wall, hence strengthening the tissues (Taiz & Zeiger, 1991).

Table I. Effect of fertilizers and pulsing on opening period of flower of Zinnia elegans cv. Blue Point

Treat-ments	*P_2O_5+K_2O (g/m^2)*	*P_2O_5+K_2O (kg/ha)*	*Original order*	*Treatments*	*Ranked order*
T1*C1	0 + 0	0 + 0	2.10 e	T_1C_1	2.10 e
T1*C2	0 + 0	0 + 0	2.72 d	$T_3 C_2$	2.2 e
$T_2 C_1$	10 +10	37 +37	2.35 d e	$T_3 C_1$	2.28 e
$T_2 C_2$	10 +10	37 +37	2.78 d	$T_2 C_1$	2.35 de
$T_3 C_1$	10 + 20	37 + 74	2.28 e	$T_4 C_2$	2.46 de
$T_3 C_2$	10 + 20	37 + 74	2.20 e	$T_5 C_2$	2.65 d
$T_4 C_1$	10 + 30	37 + 111	3.0 d	T_1C_2	2.72 d
$T_4 C_2$	10 + 30	37 + 111	2.46 d e	$T_2 C_2$	2.78 d
$T_5 C_1$	20 + 10	74 + 37	2.88 cd	$T_6 C_2$	2.85 cd
$T_5 C_2$	20 + 10	74 + 37	2.65 d	$T_5 C_1$	2.88 cd
$T_6 C_1$	20 + 20	74 + 74	3.25 bcd	$T_7 C_2$	2.90 cd
$T_6 C_2$	20 + 20	74 + 74	2.85 cd	$T_4 C_1$	3.0 d
$T_7 C_1$	20 + 30	74 + 111	3.90 b	$T_6 C_1$	3.25 bcd
$T_7 C_2$	20 + 30	74 + 111	2.90 cd	$T_8 C_2$	3.25 bc
$T_8 C_1$	30 + 10	111 + 37	3.78 b	$T_9 C_2$	3.68 bc
$T_8 C_2$	30 + 10	111 + 37	3.25 bc	$T_8 C_1$	3.78 b
$T_9 C_1$	30 + 20	111 + 74	4.10 b	$T_7 C_1$	3.90 b
$T_9 C_2$	30 + 20	111 + 74	3.68 bc	$T_9 C_1$	4.1 b
$T_{10} C_1$	30 + 30	111 + 111	4.75 a	$T_{10} C_1$	4.75 a
$T_{10} C_2$	30 + 30	111 + 111	4.95 a	$T_{10} C_2$	4.95 a

*C_1 Pulsing with distilled water
*C_2 Pulsing with $AgNO_3$ (Means not sharing a letter differ significantly at $P \leq 0.05$)

Size of flower (cm). The maximum size of flower (7.06 cm) was recorded with 30 + 30 g P+K m^{-2} + $AgNO_3$ @ 400 ppm treatment(Table II) The results were statistically significantly different from all the treatments except 30 + 20 g P+K m^{-2} application + $AgNO_3$ @ 400 ppm treatment 20+20 g P+K m^{-2} application + $AgNO_3$ @ 400 ppm treatment, 20+30 g P+K m^{-2} application + $AgNO_3$ @ 400 ppm treatment, which produced flowers measuring 6.63, 6.46 and 6.43 cm in size, respectively. Similarly, the highest rate of pre-harvest fertilization along with $AgNO_3$ @ 400 ppm pulsing for 24 h, further increased the cut flowers size. While, minimum flower size (5.10 cm) was observed in control treatment where no pre harvest fertilizer was applied and pulsing with distilled water.

Size of the flower is dependent upon the reserves of nutrients in its parts (pedicel, leaves, calyx, corolla etc.) (Taiz & Zeiger, 1991) and the nature of food provided them externally, as incase of 30 + 30 g P + K m^{-2} + $AgNO_3$ @ 400 ppm treatment, The rate of both the major nutrients were high enough to help an increase in the flower size after its removal from mother plant.

Table II. Effect of fertilizers and pulsing on size of cut flowers (cm) of Zinnia elegans cv. Blue Point

Treat-ments	*P_2O_5+K_2O (g/m^2)*	*P_2O_5+K_2O (kg/ha^1)*	*Original order*	*Treatments*	*Ranked order*
T1*C1	0 + 0	0 + 0	5.10 cd	T_1C_1	5.10 cd
T1*C2	0 + 0	0 + 0	5.35 c	$T_3 C_1$	5.25 c
$T_2 C_1$	10 +10	37 +37	5.48 c	T_1C_2	5.35 c
$T_2 C_2$	10 +10	37 +37	5.93 bc	$T_2 C_1$	5.48 c
$T_3 C_1$	10 + 20	37 + 74	5.25 c	$T_4 C_1$	5.70 c
$T_3 C_2$	10 + 20	37 + 74	5.91 bc	$T_5 C_1$	5.70 c
$T_4 C_1$	10 + 30	37 + 111	5.70 c	$T_3 C_2$	5.91 bc
$T_4 C_2$	10 + 30	37 + 111	6.16 bc	$T_2 C_2$	5.93 bc
$T_5 C_1$	20 + 10	74 + 37	5.70 c	$T_{10} C_1$	5.96 b
$T_5 C_2$	20 + 10	74 + 37	6.31 b	$T_8 C_1$	5.90 bc
$T_6 C_1$	20 + 20	74 + 74	6.00 b	$T_6 C_1$	6.00 b
$T_6 C_2$	20 + 20	74 + 74	6.46 ab	$T_8 C_2$	6.06 bc
$T_7 C_1$	20 + 30	74 + 111	6.10 b	$T_7 C_1$	6.10 b
$T_7 C_2$	20 + 30	74 + 111	6.43 ab	$T_4 C_2$	6.16 bc
$T_8 C_1$	30 + 10	111 + 37	5.90 bc	$T_9 C_1$	6.26 b
$T_8 C_2$	30 + 10	111 + 37	6.06 bc	$T_5 C_2$	6.31 b
$T_9 C_1$	30 + 20	111 + 74	6.26 b	$T_7 C_2$	6.43 ab
$T_9 C_2$	30 + 20	111 + 74	6.63 ab	$T_6 C_2$	6.46 ab
$T_{10} C_1$	30 + 30	111 + 111	5.96 b	$T_9 C_2$	6.63 ab
$T_{10} C_2$	30 + 30	111 + 111	7.06 a	$T_{10} C_2$	7.06 a

(Means not sharing a letter differ significantly at $P \leq 0.05$)

The results also revealed a positive effect of $AgNO_3$ @ 400 ppm on increase in flower diameter. Silver nitrate ($AgNO_3$) has been found to remove the bacterial plugging and infection form xylem vessels of cut flowers. It promotes the water movement in the vessels on one hand and inhibits ethylene production on the other hand hence improving the quality and size of cut flowers (Druege, 2001).

Table III. Effect of fertilizers and pulsing on Longevity (days) of *Zinnia elegans* cv. Blue Point cut flowers

Treatm-ents	*$N+P_2O_5+K_2O$ (g/m^2)*	*$P_2O_5+K_2O$ ($kg\ ha^{-1}$)*	*Original order*	*Treatments*	*Ranked order*
T1*C1	0 + 0	0 + 0	3.63 d	T_1C_1	3.63 d
T1*C2	0 + 0	0 + 0	3.93 cd	$T_2 C_1$	3.68 d
$T_2 C_1$	10 +10	37 +37	3.68 d	$T_3 C_1$	3.91 cd
$T_2 C_2$	10 +10	37 +37	4.10 cd	T_1C_2	3.93 cd
$T_3 C_1$	10 + 20	37 + 74	3.91 cd	$T_2 C_2$	4.10 cd
$T_3 C_2$	10 + 20	37 + 74	4.16 cd	$T_3 C_2$	4.16 cd
$T_4 C_1$	10 + 30	37 + 111	4.28 c	$T_4 C_1$	4.28 c
$T_4 C_2$	10 + 30	37 + 111	4.45 c	$T_5 C_1$	4.43 c
$T_5 C_1$	20 + 10	74 + 37	4.43 c	$T_4 C_2$	4.45 c
$T_5 C_2$	20 + 10	74 + 37	4.96 c	$T_7 C_1$	4.83 c
$T_6 C_1$	20 + 20	74 + 74	4.98 c	$T_5 C_2$	4.96 c
$T_6 C_2$	20 + 20	74 + 74	5.30 bc	$T_6 C_1$	4.98 c
$T_7 C_1$	20 + 30	74 + 111	4.83 c	$T_8 C_1$	5.23 bc
$T_7 C_2$	20 + 30	74 + 111	5.28 bc	$T_7 C_2$	5.28 bc
$T_8 C_1$	30 + 10	111 + 37	5.23 bc	$T_6 C_2$	5.30 bc
$T_8 C_2$	30 + 10	111 + 37	6.26 b	$T_9 C_1$	5.63 bc
$T_9 C_1$	30 + 20	111 + 74	5.63 bc	$T_{10} C_1$	5.96 bc
$T_9 C_2$	30 + 20	111 + 74	6.10 b	$T_9 C_2$	6.10 b
$T_{10} C_1$	30 + 30	111 + 111	5.96 bc	$T_8 C_2$	6.26 b
$T_{10} C_2$	30 + 30	111 + 111	7.76 a	$T_{10} C_2$	7.76 a

*C_1 Control (Distilled Water)
*C_2 Pulsing with $AgNO_3$ (Means not sharing a letter differ significantly at $P \leq 0.05$

Longevity of flower. Data revealed that maximum longevity (7.76 days) was observed with 30 + 30 g P + K m^{-2}+Distilled water treatment, having significant difference from all other treatments Table III. It was followed by the application of 30 + 10 g P + K m^{-2} + $AgNo_3$ 400 ppm treatment, with vase life of 6.26 days and 30+20 g P+K m^{-2} + $AgNO_3$ @ 400 ppm remaining marketable for 6.10 days. Minimum longevity of flower (3.63 days) was recorded with no application of fertilizers and pulsing with distilled water.

There was a positive interaction between pre-harvest fertilizer application and pulsing with $AgNO_3$ @ 400 ppm on post harvest life of *Zinnia elegans* blooms. The pre-harvest fertilization of P and K significantly increased the longevity of cut flowers. As P and K are the most important nutrients as far as the strength and development of cells and tissues is concerned (Reiley & Shry, 2002).

When $AgNO_3$ was used in addition to pre-harvest, higher rates of P and K it further prolonged the vase life of Zinnia cut flowers. $AgNO_3$ is reported to inhibit the action of ethylene, a hormone which accelerates the process of respiration and hence senescence (Reid 1992; King, 2003). It might be due to the effect of $AgNO_3$ that the vase life of Zinnia flowers was further prolonged.

CONCLUSIONS

On the basis of above mentioned results, it is concluded that the pre-harvest fertilization of P_2O_5 and K_2O @ 30 + 30 g m^{-2} (111 + 111 Kg ha^{-1}), accompanied by postharvest pulsing of flower stalks with $AgNO_3$ @ 400 ppm for 24 h are suitable treatments to enhance the postharvest life and quality of Zinnia cv. Blue Point flowers. Further, it is suggested that either the pulsing time or $AgNO_3$ concentration may be increased to evaluate its effect in the extension of postharvest life of Zinnia cut flowers.

REFERENCES

Druege, U., 2001. Postharvest responses of different ornamental products to pre harvest nitrogen supply: Role of carbohydrates, Photosynthesis and plant hormones. *Acta Hort*., (ISHS) 543: 97–105

King, R., 2003. *Bio-pesticide and Pollution Prevention*. A publication of Office of Pesticide Programs, Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington DC. P.21

Paull, R. and T. Gode, 1982. Pulse treatment with Silver Nitrate extends vase life of Antirrhinums. *J. Amer. Soc. Hort. Sci.*, 107: 842–4

Reid, M.S., 1992. *Ethylene in post-harvest technology. In:* A.A. Kader (ed.), *Post-harvest Technology of Horticultural Crops*, p. 107. Division of Agricultural and Natural Resources, University of California, USA

Reiley, H.E. and C.L. Shry, 2002. Plant Science. *In:* Delmer (ed.), *Introductory Horticulture*, pp: 41–3. Columbia Circle, Albany, NY

Taiz, L. and E. Zeiger, 1991. *Mineral Nutrition. In: Plant Physiology*, p. 114. The Benjamin Cummings Publishing Co. Inc., 390–Bridge Parkway, Redwood City, California 94065

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