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Potassium Influence on Flowering and Morphology of *Zinnia Elegans*

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ABSTRACT: Flowering and morphology of *Zinnia elegans* cv. Dreamland were evaluated against different levels of Potassium in an experiment conducted under soil and climatic conditions of Peshawar, Khyber Pakhtunkhwa, Pakistan. This experiment aimed to find out optimum level of potassium for enhanced production of zinnia flowers. Various potassium levels such as 0, 10, 20, 30g m^{-2} were applied to investigate their impact on zinnia flower production and morphology. Findings revealed that K when used @ 20g m^{-2} showed encouraging impact particularly on number of days to flowering, flowers number $plant^{-1}$, flower diameter (cm), flower fresh and dry weight (g), plant height (cm), number of primary and secondary shoots $plant^{-1}$, number of leaves $plant^{-1}$,leaf area (cm2) and number of roots as well as roots length (cm).

***Keywords*:** Dreamland, Flowering, Growth, Potassium, *Zinnia elegans*

INTRODUCTION

Pakistan and particularly Khyber Pakhtunkhwa, a North-West Province of Pakistan, formerly known as the North-West Frontier Province (NWFP), has small farming household, where floriculture seems to be the best option for maximum utilization of limited resources. Simultaneously, the province has favorable climate for growing such crops with additional advantage of cheap labor availability. The trend in floriculture popularity shows that the annual flowering plants are becoming increasingly popular in the province. The main reasons of its popularity might be the provision of colors they provide to the landscape and it's ever more use as cut flowers.

Generally, Floriculture crops give premium price round the year without waiting for a specific period of time as for other routine crops. Moreover, net profit against investment is much higher in these crops as compare to the other conventional crops. Additionally, floricultural products are in high demand at local and also a sumptuous amount of foreign exchange can be earned, if grown extensively. Among floriculture crops, annual flowering plants have a prominent role in the floriculture industry and zinnias are champions of the season (Cohoon 2000).

Zinnia (Zinnia elegans) is the most prominent summer flower of the family Asteraceae, usually grown in beds, borders, containers, cottage garden landscapes or as background plants. However, its use as cut flowers cannot be denied as it is one of the most valued annual love flowers. Additionally, it attracts butterflies, hummingbirds, and other wildlife to the garden (Johnson, 2007). Apart from its ornamental use, Yassin, 1993 reports that Zinnia may be used as a mix-crop in tomato against the nematodes.

Zinnia are produced throughout Pakistan; it is sown from December to the end of March in Karachi followed by March and April and then again in August and September plantation in Lahore, Rawalpindi and Islamabad (Nasir, 2004). In Peshawar normally sown in April and its flowers are available from till October.

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).

Among the important plant food ingredients, potassium as an essential element, a backbone to a plant's life which plays crucial vital roles in plant life. It increases root growth and improves drought resistance. Potassium in elemental form is generally required to energize more than 50 different enzymes (Atwell, 1999). It reduces lodging, controls plant turgidity, and maintains the selectivity and integrity of the cell membranes. Potassium helps translocation of sugars and starch, reduces water loss, wilting as well as reduces respiration, prevents energy losses, helps in protein synthesis and uplifts the protein content of plants (Alam and Naqvi 2003). The potassium deficiency in plant will produce stunted growth and this stress may limit flowering because the plant cells can't divide to allow the growth and reduce the quality of flower.

Keeping in view the importance of flowers, its uses, provision of colour in the garden, its longer stay in scorching summer, as a cut flower, the research studies was designed to see the impact of potassium on plant growth and flower production and to determined best potassium level under the agro-climatic conditions of Peshawar.

MATERIALS AND METHODS

The experiment was initiated at Ornamental Horticulture Nursery, Department of Horticulture, The University of Agriculture Peshawar during 2010. The experiment was laid out in Randomized Complete Block Design (RCBD) to test four level of Potassium such as 0, 10, 20, 30 g m-2. The experimental field was divided into 3-blocks with uniform conditions and each block was further divided into 20-sub plots having 2.1 x 0.9 m2 size.

Seeds of zinnia were sown in 10 inches earthen pots and transplanted to experimental field when developed 2-3 true leaves. Field was ploughed thoroughly and well decomposed Farm Yard Manure (FYM) was supplied @ of 20 tons ha-1. A calculated amount of nitrogen (10 g m-2) and phosphorus (20 g m-2) was applied at time of field preparation, while remaining nitrogen (10 g m-2) was applied before flower bud formation in form of urea and single super phosphate. (It seems that nitrogen was also 20 gm- confirm it) Potassium was applied at time of field preparation at rate of 10, 20 and 30 g m-2 and 0 g m-2 (control) in form of potassium sulphate.(u need to more concentrate on pot)

Table 1. Physico-chemical characteristics of experimental field

Characteristics	Units
Textural Class	Silt loam
CaCO3	21 %
Organic Matter	0.14 %
Electric Conductivity	0.43 dSm-1
pH	8.02
Nitrogen	0.24 %
Potassium	24 mg kg-1
Phosphorous	12.84 mg kg-1

Data taken included days to flowering, number of flowers plant-1, flower diameter (cm), fresh and dry flower weight (g), plant height (cm), number of primary and secondary shoots plant^{-1}, number of leaves plant^{-1},leaf area (cm^2), number of roots plant^{-1} and root length (cm). The data was analyzed through a statistical package named Statistix 8.1 and were subjected to analysis of variance techniques and means were compared using least significant test

RESULTS AND DISCUSSION

Days to flowering

The statistical analysis of the data showed that potassium has non-significant effect over days taken to flowering of zinnia (Table 2). More days to flowering (52.27days) were recorded in control plots, while fewer days to flowering (49.27days) were observed in plots received 20g K m^{-2}. Potassium is required to increases carbon exchange and enhances carbohydrate movement (Collins and Duke, 1981) and stimulates early growth (Rehm and Schmitt, 1997) and decreases the translocation of photosynthats into storage organs (Larik, 1999) and

consequently these photosynthats may be used in the early initiation of flowers. Protacio (2000) also noted that potassium have a more direct role in floral initiation such as in mangoes. So if optimum dose (20 g m^{-2}) of potassium is applied to zinnia, plant will response more quickly to initiate and develop flowers as compare to the deficient one.

Number of flowers plant^{-1}

More number of flowers plant^{-1} (28.47) was counted in plots applied with 20g K m^{-2} while less (20.33) in plots received 10g K m^{-2} (Table 2). Similar results also reported by Javid, (2005) that highest number of flowers plant^{-1} was obtained when the plots received 20g K m^{-2}. Potassium plays a significant role in the transport of water and nutrients in plant xylem. When the potassium supply is increase, the transportation of nitrates, phosphates also increase (Bajwa and Rehman, 2005). Low potassium level decreased number of flowers produced and higher potassium levels offset damaging effects of high nitrogen levels (Joiner and Gruis, 1961). The result also in line with Pal and Ghosh (2010) who find out that yield of flowers in African marigold (*Tagetes erecta* Linn.) cv. Siracole increased with increased potassium fertilization from 0 to 200 Kg ha^{-1}.

Flower diameter

Maximum flower diameter (10.13 cm) was noticed in plots received 20g K m^{-2} while minimum flower diameter (7.35 cm) in control (Table 2). In pansy (*Viola ×wittrockiana*) it was that more potassium was absorbed after the flowers were opened (Hamlin and Mills, 2001) because potassium ions stimulate petal cell expansion (Wong, 1989). Zinnia flowers showed maximum flower diameter at 20 g potassium application.

Fresh and dry flower weight

Maximum fresh and dry flower weight (12.90g and 2.13g respectively) was recorded in the plots applied 20g K m^{-2} and minimum fresh and dry flower weight (7.63g and 0.71g respectively) was noticed in control plots (Table 2). Potassium helps in water economy, energy metabolism and enzymes activity (Mengel and Kirby, 1980), which have positive effect on flower weight. Potassium deficiency reduced dry matter accumulation (Duli Zhao, 2001). The experimental result showed that balance dose (20 g k m^{-2}) of potassium with other nutrients (Like N and P) increase fresh and dry flower weight of zinnia because luxury consumption of K does not increase yield if the accompanying N and P are not sufficient (Bajwa and Rehman, 2005).

Table 2. Influence of Potassium levels on days to flowering, number of flowers plant^{-1}, flower diameter (cm), fresh and dry flower weight (g) and plant height (cm) of Zinnia

Treatments K (g $m^{-2)}$	Days to flowering	No. of flowers plant^{-1}	Flower diameter (cm)	Fresh flower weight (g)	Dry flower weight (g)	Plant height (cm)
0	52.27	21.60 ab	7.35 c	7.63 c	0.71 c	29.87 c
10	49.73	20.33 b	8.76 b	9.27 b	1.66 b	35.93 ab
20	49.27	28.47 a	10.13 a	12.90 a	2.13 a	41.17 a
30	51.27	20.80 ab	8.73 b	8.20 bc	1.63 b	33.40 bc
LSD(P≤0.05)	NS	7.7964	0.2664	1.1871	0.1585	5.7355

Plant height

The statistical analysis showed that maximum plant height (41.17cm) was recorded in the plots received 20g K m^{-2} while minimum (29.87cm) was recorded in control plot (Table 2). Potassium increases carbon exchange and enhances carbohydrate movement (Collins and Duke, 1981), also enhances meristematic activity (Verma and Verma, 2007) and consequently stimulates vegetative growth and plant height.

Number of primary and secondary shoots plant^{-1}

The highest number of primary and secondary shoots plant^{-1} (12.23 and 28.47 respectively) was recorded in the plots received 20g K m^{-2} and lowest number of primary and secondary shoots plant^{-1} (6.6 and 14.87 respectively) in control plots (Table 3). The plants deficient in potassium, the rate of photosynthesis and the rate of ATP production are reduced, and all of the processes dependent on ATP are slowed down (Armstrong, 1998) and reduced activity of the cambium (Wakhloo, 1975). The balance level of K (20g m^{-2}) has positive effect on the plant growth and development, and it improved plant vigor, vegetative growth and increased number of branches per plant.

Number of leaves plant^{-1}

The analysis of data showed that more number of leaves plant^{-1} (369.10) was recorded in the plots applied 20g K m^{-2} and few number of leaves plant^{-1} (228.67) in control plots (Table 3). Potassium enhances meristematic activity (Verma and Verma, 2007) resultantly increases chances of more leaves production. The trend indicates that balance dose of nutrients increase plant growth and vigor, thus encourage more leaves production plant^{-1}.

Leaf area

Maximum leaf area (16.57cm^2) was recorded in plots received 20g K m^{-2} and minimum leaf area (10.69m^2) was recorded in control plots (Table 3). Potassium deficiency dramatically reduces leaf area and also affects assimilate partitioning among plant tissues (Zhao, 2001). Potassium increases the translocation and synthesis of carbohydrate. Optimum dose of potassium with other nutrients (N and P) will promote more leaf area to provide photosynthesis activity for vigorous and healthy plant growth.

Number of roots plant^{-1}

High number of root plant^{-1} (69.43) was recorded in the plots received 20g K m^{-2} and less number of root plant^{-1} (36.67) in control plots (Table 3). These findings are in line with those reported by Shafi, (2001) whose find out that increase of potassium with nitrogen and phosphorous from a critical level adversely affected number of roots per plant. Zinnia plant responded to developed maximum number of roots plant^{-1} at 20 g K m^{-2}.

Root length

The experimental results showed that maximum root length (21.73cm) was obtained from the plots applied 20g of K m^{-2} and minimum root length (13.27cm) was noticed at 30 g K m^{-2} level (Table 3). Potassium is a key nutrient in the development of new root growth (McAfee, 2008). Roots of K deficient plants are poorly developed (Bajwa and Rehman, 2005) and decreases root elongation (Alam and Naqvi, 2003). Optimum level of potassium helps in maximum root length (khan, 2007). Zinnia plant produced maximum roots at 20 g K m-2.

Table 3. Influence of Potassium levels on number of primary and secondary shoots plant^{-1}, number of leaves plant^{-1}, Leaf area (cm2), number of roots plant-1and Root length (cm)) of Zinnia

Treatments K (g m-2)	No. of primary shoots plant^{-1}	No. of secondary shoots plant-1	No. of leaves plant^{-1}	Leaf area (cm2)	No. of roots plant^{-1}	Root length (cm)
0	6.60 c	14.87 b	228.67 b	10.69 b	36.67 b	13.33 c
10	7.87 bc	17.73 b	276.67 b	13.3 ab	43.33 b	18.17 b
20	12.23 a	24.77 a	369.10 a	16.57 a	69.43 a	21.73 a
30	8.67 b	18.67 b	281.47 b	14.97 a	45.70 b	13.27 c
LSD(P≤0.05)	1.6289	5.5484	76.225	3.4084	13.661	1.8223

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