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Response of Tuberose (*Polianthes tuberosa*) to Potassium and Planting Depth

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Abstract
A research work was carried to find out the effect of planting depths, potassium levels and their interaction during the year 2012. The corms of tuberose were planted at a depth of 5, 10, and 15 cm and were fertilized with four levels of potassium 0, 50, 100 and 150 Kg of K_2O per hectare using K_2SO_4 as a source of K_2O. Result of the study revealed that planting depth of 15 cm significantly increased length of spike (56.9 cm), number of florets spike^{-1} (54.84), and plant height (103.13) cm. Planting depth of 5cm cause decreased number of days to last floret opening (180.08). Potassium level of 150 kg of K_2O ha^{-1} length of spike (55.24 cm), number of florets spike^{-1} (49.2) and plant height (100.29 cm). Planting depth of 15 cm and fertilizer application of 150 kg of K_2O ha^{-1}proved to be superior regarding length of spike opening (64.4cm), number of florets spike^{-1} (62.2) and plant height (106.20 cm). Hence planting tuberose at a depth of 15cm and fertilizer application of 150 kg of K_2O ha^{-1} is recommended for commercial cultivation of tuberose.
Keywords: Tuberose; Potassium; Planting Depth; Number of Florets Spike^{-1}; Spike Length.

INTRODUCTION:

Tuberose has its place in Amaryllidiaceae family. Its origin is Mexico. The major use of tuberose is as cut flower. It is famous for its sweet fragrance. The extracts of tuberose is also used in making perfumes (Biswas *et al., 1983).* Their white colored floret has very potential demand in the markets. (Dahiya *et al., 2001*). Tuberose has two main problems regarding its vase life. One is sensitivity of ethylene and the other is vascular tissues blockage (Edrisi *2009*). Germicides such as citric acid, cobalt chloride etc. is recommended for enhancing post-harvest life of tuberose (Damunpula *et al., 2006*).

Reproduction through bulbs is the main source of asexual means of propagation (Mahanta *et al., 1999*). Suitable planting depth for bulbous plants is vital factor in achievement of best quality of flowers (Hagiladi *et al., 1992).* Proper planting depth for tuberose is consider between 3cm and 10cm but it depends on environmental conditions and type of (medium) soil (De Hertogh, *et al*., 1998*)*.

Potassium is very important for proper plant growth. It is connection with very vital physiological and bio-chemical processes (Chakmak, 2005). It is involved in regulation of stomata during transpiration and photosynthesis, enzymes activation and turgor pressure maintenance (Pettigrew, 2008).

Potassium is involved in limiting rotting of bulb underground. Potassium deficiency causes less number of buds, result in short stem of flowers and delaying flowering. Yellowing of older leaves and inter-venal yellowing occur as a result of potassium deficiency (Wilfert, 1980).

In bulbous plants planting depth has also a significant effect on flowering. For tuberose generally 4-7cm planting depth is recommended. Planting depth is dependent on bulb size. Bigger bulbs should be planted deeper in the soil. Similarly bulbs should be planted deeper in the sandy soil as compared to clay soil and a result of deeper planting sprouting is also delayed (Chandy. 1994).

Keeping in view the significance of Potassium and Planting depth, a research work to realize the influence of these factors on Tuberose was carried out in Horticulture Farm University of Agriculture, Peshawar during the year 2012.

MATERIALS AND METHOD:

Experimental material: The experiment response of tuberose (*Polianthes tuberosa* cv single) to Potassium and proper planting depth, was conducted in Horticulture Farm University of Agriculture, Peshawar during the year 2012.

The bulbs of tuberose were planted at different planting depths (5, 10 and 15 cm) in soil on 28th of February 2012. The field was fertilized with different level of Potassium (0, 50 100, and 150 kg of K_2O ha^{-1}). All the other cultural practices such as weeding, irrigation etc. were uniform throughout the experiment. The experiment was laid out as Randomized Complete Block Design (RCBD) with split plot arrangement. Potassium was kept in Main plot and planting depth was kept in Sub-Plot. There were 3 replications in the experiment. A total of 10 bulbs were planted in each treatment.

RESULT AND DISCUSSION

Days to Last Floret Opening

The application of Potassium significantly affected days to last floret opening. In the absence of potassium it took maximum number of days to open the last florets (209.89). On the other hand when 50 kg of K_2O/ha^{-1} was applied it took minimum number of 189.02 days to open last florets. These results are similar to the findings of Zubair 2006 and Wilfret 1980. According to them increase in potassium dose delay flowering in bulbous flowers. Bulbs planted at 15 cm planting depth took maximum number of days (211.70) to last floret opening and last floret opened earlier after 189.02 days when bulbs planted 5cm deep. Bulbs planted at shallow depth sprouts earlier and as a result their floret also open earlier. (De Hertogh, *et al*., 1998). Interaction between planting depth and potassium was also significant. Combination of 15cm planting depth and potassium level of 100 kg of K_2Oha^{-1} 216.53 days to last floret opening and minimum number of 166.67 days were taken by the combination of 5cm planting depth and 150 kg of K_2Oha^{-1}.

Spike Length at Last Floret Opening

The data regarding spike length at last floret opening (Table 2) shows the maximum length of spike 56.96 cm was obtained when the corms were planted at 15cm planting depth and on the other hand minimum length of 39.36cm was observed at the depth of 5cm planting depth. The deeper planted showed maximum length of spike because of maximum availability of water in the deeper zone of soil. As water act as a solvent for nutrients so a result maximum length is obtained (Gregory, 2006). Potassium also significantly improved the spike length at last floret opening stage. Maximum length of 55.24cm was obtained when Potassium was applied at the rate of 150 kg ha^{-1} K_2O, while on the other side minimum length of 44.88cm was achieved as a result of 50 kg ha^{-1} K_2O. Potassium is the main nutrient for plant growth, its deficiency cause many abnormalities in the plant including weak root system, stunted growth of stem and yellowing of leaves (Wilfert, 1980).Thus Potassium is the main reason for good quality growth. The two factors planting depth and potassium also significantly interacted with each other. Planting tuberose bulbs at 15cm and potassium application of 150 kg ha^{-1} K_2O gives the superior length of spike of 64.4cm.

Number of Florets $Spike^{-1}$

Planting depth has a significant effect on number of florets per spike. Maximum number of florets i.e. 54.83 were produced when the bulbs were planted 15 cm deep in the soil. On the other hand potassium application of 150 kg ha^{-1} resulted in maximum number of florets per spike (49.2). The interaction of planting depths and potassium levels was also significant. Maximum number of florets per spike (62.2) was observed when the corms were planted 15 cm deep in the soil and treated with 150 kg K_2O ha^{-1}. While on the other hand minimum number of florets per spike (34.0) were obtained as result of interaction of 5cm planting depth and control level of potassium.Increasing potassium level increases the florets per spike. 150 kg K_2O ha^{-1} gave the maximum number of florets per spike (40.13). Potassium is involved in formation of chlorophyll as stated by Carroll and Edward, (2011) and Parmer (2007) quoted that increased number of florets per spike is the result of manufacturing of amino acids, chlorophyll synthesis and swift carbohydrates conversion, which outcome as better growth and maximum number of florets. These results are alike with Boshra (2012).

Plant Height

Plant height is significantly affected by planting depth. Maximum height of 103.13 cm is obtained when the corms were planted 15 cm deep in the soil while on the other hand 88.3 cm plant height was obtained when planting corms 5 cm deep in the soil. Deeper planting results in maximum length of spike. These results are confirmed by Choi *et al.* (1997) for freesia, and Mane *et al., (2007)* for tuberose.Maximum plant height 100.29 cm was obtained when corms were treated with 150 kg of K_2O ha^{-1}. Maximum plant height is the outcome of better food intake as result of strong root system caused by optimum potassium present in soil as quoted by Carroll and Edward, (2011). Interaction of planting depth and potassium also turns out to be significant. Treatment of 150 kg of K_2O ha^{-1} gives the maximum plant height of 106.2 cm when the bulbs were planted at 10 and 15 cm.

It is confirmed from the data above the planting Tuberose bulbs at a depth of 15cm results in the enhancing of Tuberose floral characteristics like spike length, number of florets per spike and final plant height. On the other hand Potassium also significantly increased number of florets per spike and Plant height. Thus it is recommended to plant tuberose bulbs at a depth of 15cm and Potassium (K_2O) application at the rate of 150 Kg of K_2O ha^{-1} for the agro-ecological conditions of Peshawar, Pakistan.

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Table-1.Days to Last Floret Opening of Tuberose as affected by various levels of potassium and different planting depths of tuberose:

	Planting Depths (cm)			
Potassium (Kg K_2O ha^{-1})	5	10	15	Means
Control	201.27	215.13	213.27	209.89a
50	179.80	185.27	202.00	189.02b
100	172.60	188.63	216.53	192.59b
150	166.67	201.33	215.00	194.33b
Means	180.08c	197.59b	211.70a	

LSD for Planting Depth at 5% level of significance: 9.13
LSD for Potassium Levels at 5% level of significance: 6.18
LSD for interaction at 5% level of significance: 16.12
Means followed by same letters are non-significantly different, whereas means followed by different letters are significantly different

Table-2.Spike length (cm) at first floret opening as affected by various levels of potassium and different planting depths of tuberose:

	Planting Depths (cm)			
Potassium (Kg K_2O ha^{-1})	5	10	15	Means
Control	28.26	41.73	41.13	37.04b
50	25.13	32.73	43.0	33.62c
100	28.93	30.8	45.2	34.97c
150	32.13	41.53	46.73	40.13a
Means	28.61c	36.7b	44.02a	

LSD for Planting Depth at 5% level of significance: 2.68
LSD for Potassium Levels at 5% level of significance: 1.91
LSD for Interaction at 5% level of significance: 4.78
Means followed by same letters are non-significantly different, whereas means followed by different letters are significantly different.

Table-3. Number of Florets Spike^{-1} of Tuberose as affected by various levels of potassium and different planting depths:

	Planting Depths (cm)			
Potassium (Kg K_2O ha^{-1})	5	10	15	Means
Control	34.0	49.4	58.2	47.2ab
50	35.86	48.26	47.26	43.800b
100	38.86	40.66	51.33	43.73b
150	34.06	51.33	62.2	49.200a
Means	35.7c	47.41b	54.83a	

LSD for Planting Depth at 5% level of significance: 3.47
LSD for Potassium Levels at 5% level of significance: 4.01
LSD for Interaction at 5% level of significance: 7.37
Means followed by same letters are non-significantly different, whereas means followed by different letters are significantly different.

Table-4. Plant Height (cm) as affected by various levels of potassium and different planting depths:

	Planting Depths (cm)			
Potassium (Kg K_2O ha^{-1})	5	10	15	Means
Control	186.47	102.47	104.67	97.87ab
50.	87.60	92.73	100.13	93.49c
100.	90.67	94.47	101.53	95.56bc
150.	818.47	106.20	106.20	100.29a
Means	88.30c	98.97b	103.13a	

LSD for Planting Depth at 5% level of significance: 1.78
LSD for Potassium Levels at 5% level of significance: 1.72
LSD for Interaction at 5% level of significance: 3.38

Means followed by same letters are non-significantly different, whereas means followed by different letters are significantly different.

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