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EFFECT OF POTASSIUM APPLICATION RATES AND VARIETIES ON GROWTH AND SEED YIELD OF ONION

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ABSTRACT

Although, potassium is one of the essential macronutrients for plants; majority of our onion growers in Sindh province prefer to apply only nitrogen and phosphorus and avoid applying potassium fertilizers in their onion fields; which not only stunts crop growth, but it deteriorates the quality of onion seed; mainly used by farmers for cultivation of next season crop. In order to investigate the effect of potassium application rates on growth and seed quality; we conducted a field experiment during the winter season of 2017-18, applied potassium fertilizer (SoP) @ K₁: 0, K₂: 25, K₃: 50, K₄: 75, K₅: 100 and K₆: 125 kg K₂O ha⁻¹ to three most common local onion varieties, viz., Phulkara, Nasarpuri and Thano Bolakhan. The study was conducted at Horticultural Garden, Sindh Agriculture University Tandojam, Hyderabad. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three repeats. It was observed from the experiment that among the six potassium application rates included in the study; the potassium applied @ 100 kg K₂O ha⁻¹ (K₅) remained more positively effective for seed quality traits including days to 50% bolting, flowering and maturity, flower stalk height, number of seeds umbel⁻¹, seed index and per hectare seed yield. Averaging overall potassium application rate treatments we found that Phulkara variety took fewer days to 50% bolting, gave more seed yield (g umbel⁻¹) and displayed maximum seed index; whereas variety Nasarpuri took fewer days to both 50% flowering and 50% maturity, showed tallest flower stalk, gave more seeds umbel⁻¹ and produced higher per hectare seed yield as well.

Keywords: potassium rates, onion varieties, seed yield.

INTRODUCTION

Onion (*Allium cepa* L.) is counted as one of the most important vegetable cash crops of Pakistan. It is mostly consumed as a vegetable at green stage and is also cultivated for mature bulbs (Ambulker *et al.*, 1995). No doubt in Pakistan, Sindh province alone produces 666.8 thousand tons it is which seems to be double than that produced by Punjab province (303.2 thousand tons), most probably due to favourable climatic condition required by this crop (FBS, 2014-15). Production and marketing of quality seed of local varieties still remains serious issue in the province. The seed generally available in the market is usually of low quality with poor viability, less vigour and genetically impure. It has also been observed that some onion growers keep own seed for their next season crop; and only surplus seed is sold by them to

other farmers and market (Elhag and Hala, 2013). It has been observed by several workers that the storage capability of onion seed is very low as it loses its viability within a year of time (Shinde and Sontakke, 1993; Baghel *et al.*, 2017) therefore, it is essential to produce fresh onion seed each year by adopting proper production technology. Onion seed yield and quality is influenced by several factors including cultivars and nutrient management (Singh *et al.*, 1989; Geetha *et al.*, 1999; Nagaich *et al.*, 1999; Naidu *et al.*, 2000; Al-Moshileh, 2001;). Several nutrient management studies have been reported to understand the role of different plant nutrients in onion seed production (Agarwal *et al.*, 2010; Rafique *et al.*, 2011) majority of these reports are related to nitrogen and phosphorus application; whereas the information on potassium application is lacking. Being an essential element, potassium is necessary for photosynthesis activity of leaf to assist in food

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translocation; it enhances root growth, increases assimilation of food, helps in grain formation (Ali *et al.*, 2007) and increases bulb weight as well (Behairy *et al.*, 2015). The farmers in Sindh province are habitual to apply only nitrogen and phosphorus in their fields and avoid K application. This paper reports the results of field study we planned and conducted to investigate the influence of potassium application rates on some growth traits and onion seed production of local varieties under field condition.

MATERIALS AND METHODS

The experiment was conducted during the winter season of 2017-18, at Horticulture Garden, Sindh Agriculture University, Tandojam. Three onion varieties included in the study were: Phulkara, Nasarpuri and Thano Bolakhan. The seeds (bulbs) were obtained from the Onion Research Station, Husri Hyderabad Sindh. The experiment was planned with six potassium application rates (0, 25, 50, 75, 100 and 125 kg K₂O ha⁻¹), three repeats and factorial Randomized Complete Block Design. The average maximum and minimum temperatures, relative humidity and pan evaporation rates recorded during the course of study were: 33.21°C and 11.53°C, 47.33% and 4.93 mm, respectively. The experimental soil was Typic Camborthid, silty clay loam in texture and calcareous in nature. Before, sowing the soil was properly prepared by ploughing, clod crushing, levelling, etc. The experimental plot size was: 15 m² (3m x 5m), whereas the raised beds were of about 60 cm wide. Healthy and uniform sized bulbs were selected for plantation at 15 x 20 cm space. Regular hand weeding was done in each plot. First irrigation was given at the time of planting, followed by light irrigation given on the third day after bulb planting, then the other required irrigations were applied as per soil moisture condition. Averagely three acre inches each irrigation was applied. The entire quantity of di-ammonium phosphate (100 kg P₂O₅ ha⁻¹) and K as per treatments were applied to soil through sulphate of potash (SOP), along with urea (200 kg N ha⁻¹) in two splits one at bed preparation and other 45 days after planting of bulbs. Five plants from each treatment plots were selected randomly for recording observations on: flower stalk height (cm), days to: 50% bolting, 50% flowering and 50% maturity, number of seeds (umbel⁻¹), seed weight (g umbel⁻¹), seed index (g) and seed yield (kg ha⁻¹).

Statistical analysis

The crop data were processed for the analysis of variance (ANOVA) using a software Statistics 8.1 (Statistics, 2006). The least significant difference (LSD) test was applied to compare the treatment superiority for all the parameters at the 5% level of probability.

RESULTS AND DISCUSSION

Effect of potassium application rates on onion crop

The results related to potassium application rates on onion crop are given in the Table 1. It is evident from the data that there was significant effect of potassium application rates on almost all the recorded physiological and yield traits. Generally, increasing potassium application rate from 0 to 100 kg ha⁻¹ showed reduction in days to 50% flowering, 50% bolting and 50% maturity and increase in flower stalk height, number of seeds (umbel⁻¹), seed weight (umbel⁻¹) and seed yield (kg ha⁻¹). Over application of potassium (125 kg ha⁻¹) to onion crop rather showed negative impact on almost all the recorded traits including seed yield. This suggests that proper rate of potassium application is up to 100 kg ha⁻¹; hence farmers should not go beyond 100 kg ha⁻¹ rate. There are several other evidences (Ali *et al.*, 2007; Tiwari, 2012) which indicate that potassium application turns the crop towards maturity; instead of vegetative growth, the plants in potassium rich soils start flowering earlier and mature faster than in potassium deficient soils. In addition to that plants produce healthy, vigorous and bolder seeds with potassium. The study suggests that farmers should not avoid applying potassium in onion crop in Sindh province, particularly when quality seed is required for future onion crop production.

Effect of varieties on growth and seed yield of onion crop

Three onion (Phulkara, Nasarpuri and Thano Bula Khan) varieties were selected for this study (Table 2). All these three varieties are most common varieties of this region and are cultivated on large scale. Averaged over all potassium application rates we found large differences among the varieties for the traits under study. The variety Phulkara was found to took fewer days to 50% bolting, gave more seed yield (g umbel⁻¹) and displayed maximum seed index as well; whereas variety Nasarpuri took fewer days to both 50% flowering and 50% maturity, it showed tallest flower stalk, gave more seeds umbel⁻¹ and produced higher per hectare seed yield as well.

Table 1. Effect of potassium application rates on growth and seed yield of onion

Potassium application rates (kg K ₂ O ha ⁻¹)	Days to 50% bolting	Days to 50% flowering	Days to 50% maturity	Flower stalk height (cm)	Number of seeds (umbel ⁻¹)	Seed weight (g umbel ⁻¹)	Seed Index (g)	Seed yield (kg ha ⁻¹)
0 Control	26.77	53.55	124.22	63.66	789.89	2.24	3.37	69.83
25	26.33	52.88	124.33	72.00	812.33	2.26	3.73	74.54
50	25.66	51.77	123.89	80.88	835.22	2.71	3.79	77.47
75	24.77	50.77	123.78	84.55	861.11	2.86	4.02	78.64
100	24.00	49.66	122.78	88.77	899.44	2.83	4.10	81.70
125	24.00	49.77	124.00	87.00	878.33	2.89	4.00	77.84
SE±	0.3021	0.3779	0.4908	0.7568	6.9709	0.0746	0.0621	1.0062
LSD 0.05	0.6139	0.7680	0.9974	1.5380	14.167	0.1516	0.1262	2.0449
CV%	2.54	1.56	0.84	2.02	1.75	5.89	3.43	2.78

Each value is a mean of three replicates; SE= Standard error; LSD= Least significant difference; CV= Coefficient of variance; Values followed by same letters do not differ significantly at 0.05 probability level

Table 2. Effect of onion varieties on growth and seed yield of onion

Varieties	Days to 50% bolting	Days to 50% flowering	Days to 50% maturity	Flower stalk height (cm)	Number of seeds (umbel ⁻¹)	Seed weight (g umbel ⁻¹)	Seed Index (g)	Seed yield (kg ha ⁻¹)
Phulkara	24.44	51.66	125.33	79.50	822.89	2.70	3.86	74.04
Nasarpuri	25.88	49.11	121.11	81.50	905.39	2.67	3.85	83.20
Thano Bolakhan	25.44	53.44	125.00	77.44	809.89	2.67	3.79	72.77
SE±	0.2136	0.2672	0.3470	0.5351	4.9292	0.0527	0.0439	0.7115
LSD 0.05	0.4341	0.5431	0.7053	1.0875	10.017	0.1072	0.0892	1.4459
CV%	2.54	1.56	0.84	2.02	1.75	5.89	3.43	2.78

Each value is a mean of three replicates; SE= Standard error; LSD= Least significant difference; CV= Coefficient of variance; Values followed by same letters do not differ significantly at 0.05 probability level

The difference among varieties observed in some traits could be the genotypic variation; this suggests that such genotypic difference can be exploited in the future studies. The response of varieties also varied with potassium application rates. Variety Phulkara, followed by Nasarpuri were found to be more responsive to various potassium application rates. Similar response of Phulkara variety to potassium application has also been observed by other workers, including Akhtar *et al.* (2002); Desuki *et al.* (2006) and Tiwari (2012).

The above findings can be supported by several other studies including Hossain *et al.* (2017); Manna *et al.* (2017) who found that the number of seeds umbel⁻¹ can be increased by applying potassium up to a certain level. Similar trend of increase in seed index (g), seed yield, etc. in response to applied potassium to onion crop through soil has also been observed by Mohanty and Das, (2001); Sing and Verma, (2001); Bybordi and Malakouti, (2003); Sharma *et al.* (2003) who particularly observed that onion plant growth i.e. flower stalk height (cm), number of seed umbel⁻¹, seed index (g) and seed yield can be raised with potassium.

CONCLUSION

It can be concluded from the study that potassium is much more essential for onion crop; it may be applied to onion crop @ 100 kg K₂O ha⁻¹; especially for achieving good growth and higher onion seed yield. Further the variety Nasarpuri was found to be more responsive to potassium application in this study; hence potassium may be applied to this variety for obtaining more onion seed yield.

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