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Effect of Different Doses and Splits of Potassium on Growth and Yield of Onion

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ABSTRACT

An experiement entitled "Effect of different doses and splits of potassium on growth and yield of onion" was carried out at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2015-16. The experiment was laid out in Factorial Randomized Block Design with three replications and two factors i.e factor 'A' viz., K_1 - 40 kg, K_2 - 50 kg , K_3 - 60 kg and K_4 - 70 kg of K ha^{-1} and factor 'B' S_1, - 100 % at the time of transplanting , S_2 - 50 % at the time of transplanting + 50 % at 30 DAT and S_3 - 33.33 % at the time of transplanting + 33.33 % at 30 DAT + 33.33 % at 60 DAT with 12 treatment combination. K_3 was found significantly superior in respect of plant height (56.71cm), number of leaves per plant (10.22), leaf area (232.13 $cm^{2)}$ fresh and cured bulb weight (68.82 and 65.36 g), diameter of bulb (5.50 cm), marketable bulb yield per plot (6.68 Kg), total yield per plot (7.70 Kg). The split application method S_3 was found significantly superior in respect of plant height, number of leaves per plant, leaf area at 30, 60 and 90 DAT respectively, fresh and cured bulb weight, diameter of bulb, marketable bulb yield per plot, and total yield per plot. Combined effect of different levels of potassium and its split application was statistically significant with K_3S_3 and lowest bulb yield was obtained from K_1S_1.

Key words: *Potassium, Splits, Growth, Yield, Onion.*

INTRODUCTION

Onion is indispensable commodity of masses and used as salad and cooked in various ways in curies, fried, boiled, baked and used in soup making and pickles. Besides fresh consumption, onion provides very good raw material for processing industry as it is processed in the form of dehydrated powder, rings, shreds and onion in vinegar or brine. They are highly valued for their flavor and nutritional value in supplying minor constituents such as minerals and trace elements.

Potassium is unique element that plants can accumulate it in abundant amounts without any toxicity symptoms. This behavior is referred to as luxury consumption. Potassium plays a regulatory role in plant mechanism.

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Potassium is not a component of any organic compound in plants. It improves drought tolerance. Neutralizes organic anions and other compounds and maintains the pH of cytoplasm in the range of 7-8. Activates > 60 enzymes, including starch synthetase, potassium is responsible for the activation of nitrate reductase enzyme, enhance its quality, shelf life of fruit and vegetables, reduce lodging of crops, enhance winter hardiness and imparts disease resistance.

Potassium plays an important role in onion production. Generally a heavy dose of fertilizer is recommended for onion cultivation. Like other tuber and root crops onion is very responsive to potassium. Among the various nutrients required to produce high yield of onion, potassium is considered to be very important element due to its influence for translocation of photosynthates, storage quality, bulb size, bulb numbers and yield per plot. Potassium is one of the three major nutrients taken up by the plant in large quantities and the adequate level of potassium increases crop resistance to various diseases, stalk and stem breakage and at stress conditions. Methods of application of potassium fertilizers have great influence on their utilization by the crop. Time of application of potassium during the growing period of onion is important in bulb formation. Satter and Haque[2] reported that split application of nitrogen and potassium gave higher weight of winter onion bulb than single application of same dose.

As this crop is gaining the importance due to its high value consumptions and their pungency content, it is necessary to study the demand of potassium to produce good quality onion. Considering this view, the study was taken under on "Effect of different doses and splits of potassium on growth and yield of onion", during Rabi 2015-16 with following objectives.

MATERIALS AND METHODS

The research study entitled "Effect of different doses and splits of potassium on growth and yield of onion" was carried out at the Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, during the *rabi* season of 2015-16. The experiment consists with four levels of potassium and three split applications. The effect of these combinations on growth and yield of onion was recorded. Akola is situated at 307.415 meters above mean sea level and geographically situated at latitude of 220.421 and longitude of 770.021E.This place has moderate rainy season, mild winter, comparatively hot and dry summer. The meteorological data recorded at Meteorological Observatory, University Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the experimental period of 2015-16. The experiment was laid out in Factorial Randomized Block Design with three replications and two factors i.e factor 'A' viz., K_1 - 40 kg, K_2 - 50 kg , K_3 - 60 kg and K_4 - 70 kg of K ha^{-1} and factor 'B' S_1, - 100 % at the time of transplanting , S_2 - 50 % at the time of transplanting + 50 % at 30 DAT and S_3 - 33.33 % at the time of transplanting + 33.33 % at 30 DAT + 33.33 % at 60 DAT with 12 treatment combination.

The experimental plot was prepared uniformly by following proper cultural practices and mixed with well decomposed cow dung and all the fertilizers following the recommendation. Except nitrogen and potassium all other fertilizers were applied to the soil during final land preparation. Urea was applied to the soil in two equal splits. The first split was applied during land preparation and second split after 30 DAT. The 55 days old seedlings with uniform growth were transplanted in the experimental plot on 20th January, 2016 by adopting spacing of 15×10 cm. intercultural operations were done whenever required like gap filling, weeding. First irrigation was given just after transplanting and subsequent irrigations were given at weekly intervals. The insect and

diseases were controlled with appropriate control measures. The plant height (cm), number of leaves per plant and leaf area of selected five plants in each plot was measured after 30, 60 and 90 days after transplanting (DAT). The height was taken from the neck of the bulb to the tip of the longest leaf and number of leaves per plant. The crops were harvested on maturity. Data of five selected plants were recorded from each plot and i.e. diameter of bulb (cm) .total yield of bulb per plot (kg) and marketable bulb yield per plot (kg). The data collected on various parameters of the study were statistically analyzed using OP STAT at 5 % level of significance.

RESULT AND DISCUSSION

Growth parameters

Plant height, number of leaves per plot and leaf area was significantly influenced by different levels of potassium (Table 1). At 60 (DAT), the tallest plant height, number of leaves per plant and leaf area was recorded from the plots, which received 60 kg ha^{-1} (K_3) potassium and the shortest plant recorded from 40 kg ha^{-1} (K_1). Similar effect was also recorded at 30, 60 and 90 DAT. The rate of 60 kg ha^{-1} potassium showed the best performance which might be due to the availability of optimum level of potassium than other levels.

The plant height, number of leaves and leaf area was also significantly influenced by the split application of potassium. At all DA, the tallest plant height, number of leaves per plant and leaf area was found in the plot receiving three splits of potassium (S_3) while the shortest plant height, number of leaves per plant and leaf area was noted from the plots receiving single application of potassium as basal application (S_1) at 60 DAT in every cases. These results revealed that the application of split doses of potassium gave higher plant height over basal application. These findings are in agreement with the results of Islam and Yadav et al.

The highest number of leaves per plant (11.3) , leaf area (243.81 cm^2) and lowest number of leaves , leaf area were recorded from the treatment combination of three splits with potassium 60 kg ha^{-1} (K_3S_3) and potassium 40 kg ha^{-1} with basal application (K_1S_1) respectively at 60 DAT (Table 3). This was observed at all the growth stages in this study.

Yield Parameters

Among the levels of potassium 60 kg ha^{-1} potassium (K_3) produced the highest fresh and cured bulb weight (68.82 and 65.21 g) which were at par with K_4, diameter of bulb (5.5 cm), total yield per plot (7.7 kg) and marketable yield per plot (6.68 kg) and lowest results were recorded from K_1 i.e. 40 kg ha^{-1}. The yield increased due to increasing levels of potassium except at 70 kg ha^{-1} of potassium indicated that the uptake of potassium at vegetative as well as bulb formation stage was much better than the other levels of potassium (Table 4). This results also was in agreement with the findings of Rahman *et al.* and Islam *et al.*

The weight of fresh and cured bulb, diameter of bulb, total yield per plot and marketable yield per plot were influenced by split application of potassium (Table 5). Three split of potassium application (S3) produced statistically higher yield parameters than basal and two split application of potassium. While basal application of potassium (S1) gave lowest results. This might be due to the loss of potassium through fixation at S_1 and S_2. Potassium may not be utilized effectively when2 split and basal dose applied.

The highest yield parameters like fresh and cured bulb weight (72.4 and 70. 81 g), diameter of bulb (5.69 cm) which was at par with (K_2S_3), total yield per plot (8.8 kg per plot) and marketable yield per plot (8 kg per plot) were produced from the treatment combination of three splits with 60 kg ha^{-1} (K_3S_3) and lowest was recorded from 40 kg ha^{-1} with basal application (Table 6).

Table 1: Effect of different levels of potassium on growth parameters of onion at various days after transplanting

Treatment	30 DAT			60 DAT			90 DAT		
	Pant height (cm)	Number of leaves per plant	Leaf area (cm^2)	Pant height (cm)	Number of leaves per plant	Leaf area (cm^2)	Pant height (cm)	Number of leaves per plant	Leaf area (cm^2)
K_1	36.67	5.83	73.55	56.71	9.51	222.53	52.01	8.41	152.44
K_2	37.58	5.97	75.88	57.69	9.76	229.02	53.59	8.57	157.17
K_3	38.11	6.1	77.37	58.56	10.22	232.14	54.76	8.93	158.86
K_4	36.96	5.86	74.06	57.29	9.23	225.356	52.3	8.53	153.26
F test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.182	0.032	0.294	0.19	0.03	0.338	0.261	0.072	0.864
CD at 5%	0.536	0.093	0.868	0.562	0.089	0.999	0.77	0.214	2.55

K_1 = 40 kg ha^{-1}, K_2 = 50 kg ha^{-1}, K_3 = 60 kg ha^{-1} and K_4 = 70 kg ha^{-1}

Table 2: Effect of split application of potassium on growth parameters of onion at various days after transplanting

Treatment	30 DAT			60 DAT			90 DAT		
	Pant height (cm)	Number of leaves per plant	Leaf area (cm^2)	Pant height (cm)	Number of leaves per plant	Leaf area (cm^2)	Pant height (cm)	Number of leaves per plant	Leaf area (cm^2)
$S_{1/}$	36.14	5.67	71.93	54.46	9.41	217.51	49.75	8.21	145.7
S_2	37.52	5.87	74.8	58.13	9.4	227.04	53.86	8.55	156.71
S_3	38.32	6.27	78.91	60.09	10.23	237.22	55.88	9.05	163.88
F test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.157	0.027	0.255	0.165	0.026	0.293	0.226	0.063	0.748
CD at 5%	0.464	0.081	0.752	0.486	0.077	0.865	0.667	0.185	2.209

S_1 = Basal application, S_2 = Two splits and S_3 = Three splits

Table 3: Interaction effect of different levels of potassium and its split application on growth parameters of onion

Treatment combinations	30 DAT		60 DAT		90 DAT	
	Number of leaves per plant	Leaf area (cm^2)	Number of leaves per plant	Leaf area (cm^2)	Number of leaves per plant	Leaf area (cm^2)
K_1S_1	5.60	70.50	9.20	214.27	7.94	142.78
K_1S_2	5.70	73.50	9.60	221.51	8.60	153.25
K_1S_3	6.20	76.65	9.74	231.80	8.70	161.28
K_2S_1	5.70	71.94	9.50	216.55	8.30	147.06
K_2S_2	5.90	75.70	9.69	230.18	8.50	160.50
K_2S_3	6.30	80.00	10.10	240.34	8.90	163.96
K_3S_1	5.80	73.50	9.65	220.81	8.40	149.18
K_3S_2	6.10	76.50	9.70	231.79	8.60	160.31
K_3S_3	6.40	82.11	11.30	243.81	9.80	167.10
K_4S_1	5.60	71.78	9.30	218.42	8.20	143.79
K_4S_2	5.80	73.50	8.60	224.70	8.50	152.80
K_4S_3	6.20	76.90	9.80	237.95	8.80	163.19
F test	NS	Sig	Sig	Sig	Sig	NS
SE (m) ±	0.055	0.51	0.052	0.586	0.126	1.496
CD at 5%	-	1.504	0.153	1.73	0.371	-

Table 4: Effect of different levels of potassium on yield parameters of onion at days after harvesting

Treatment	Yield Parameters				
	Fresh bulb weight (g)	Cured bulb weight (g)	Diameter of bulb (cm)	Total yield per plot (kg)	Marketable yield per plot (kg)
K_1	62.37	60.45	5.39	7.03	5.89
K_2	67.03	65.36	5.45	7.37	6.4
K_3	68.82	65.21	5.5	7.7	6.68
K_4	68.81	63.22	5.45	7.1	6.04
F test	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.488	0.295	0.006	0.085	0.057
CD at 5%	1.439	0.87	0.019	0.250	0.167

Table 5: Effect of split application of potassium on yield parameters of onion at days after harvesting

Treatment	Yield Parameters				
	Fresh bulb weight (g)	Cured bulb weight (g)	Diameter of bulb (cm)	Total yield per plot (kg)	Marketable yield per plot (kg)
S_1	63.06	58.21	5.28	6.75	5.73
S_2	66.11	64.07	5.45	7.12	6.05
S_3	70.6	68.98	5.62	8.02	6.97
F test	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.422	0.255	0.005	0.073	0.049
CD at 5%	1.247	0.753	0.016	0.217	0.145

Table 6: Interaction effect of different levels of potassium and its split application on yield parameters of onion

Treatment combinations	Yield Parameters				
	Fresh bulb weight (g)	Cured bulb weight (g)	Diameter of bulb (cm)	Total yield per plot (kg)	Marketable yield per plot (kg)
K_1S_1	56.38	53.96	5.24	6.50	5.57
K_1S_2	63.49	61.03	5.40	6.90	5.90
K_1S_3	67.29	66.36	5.54	7.70	6.20
K_2S_1	62.96	60.56	5.26	6.80	5.80
K_2S_2	67.40	66.51	5.43	7.20	6.10
K_2S_3	70.73	69.02	5.65	8.10	7.30
K_3S_1	67.1	59.95	5.29	7.00	5.83
K_3S_2	66.96	64.87	5.53	7.30	6.20
K_3S_3	72.40	70.81	5.69	8.80	8.00
K_4S_1	65.79	58.37	5.33	6.70	5.72
K_4S_2	66.57	61.56	5.43	7.10	6.00
K_4S_3	71.98	69.73	5.59	7.50	6.40
F test	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.488	0.51	0.011	0.147	0.098
CD at 5%	2.493	1.507	0.032	0.434	0.289

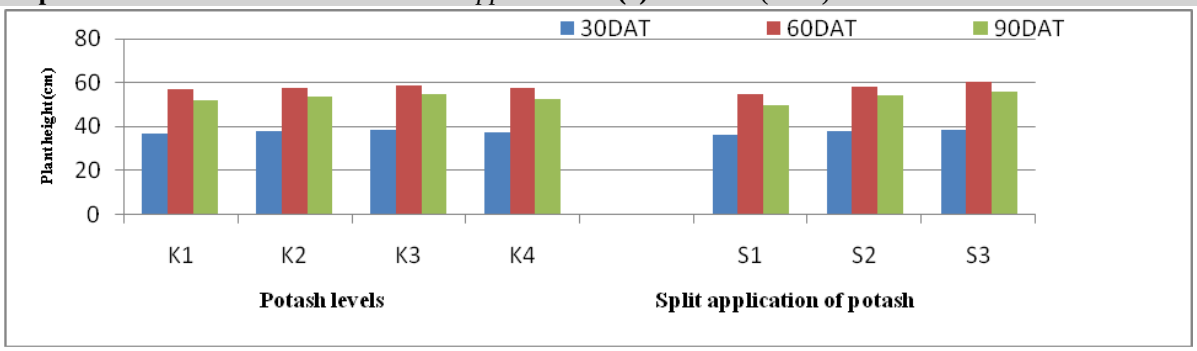

Fig. 1: Effect of different levels of potassium and its split application on plant height

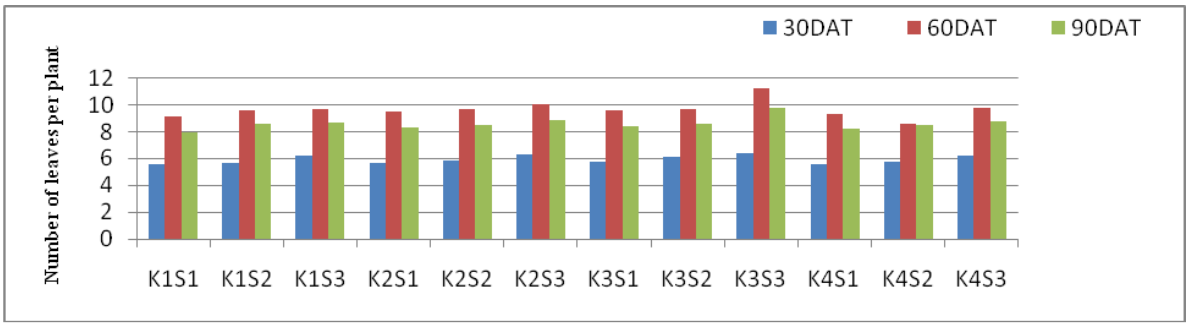

Fig. 2: Interaction effect of different levels of potassium and its split application on number of leaves per plant

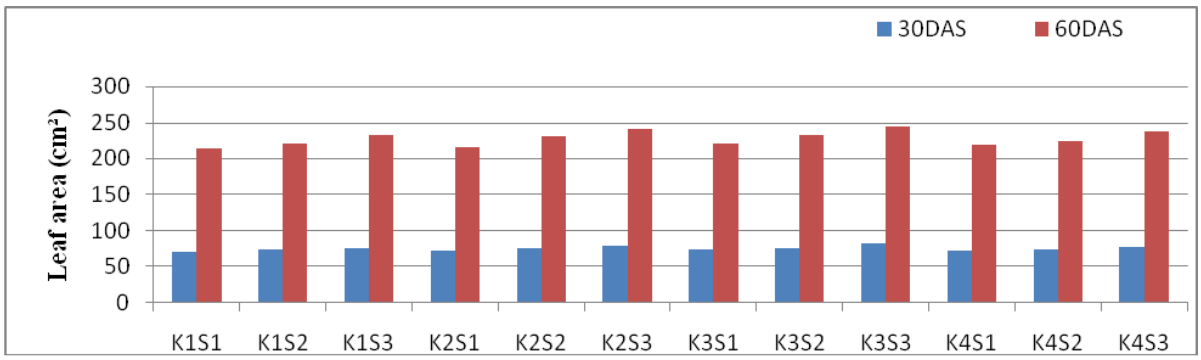

Fig. 3: Interaction effect of different levels of potassium and its split application on Leaf area

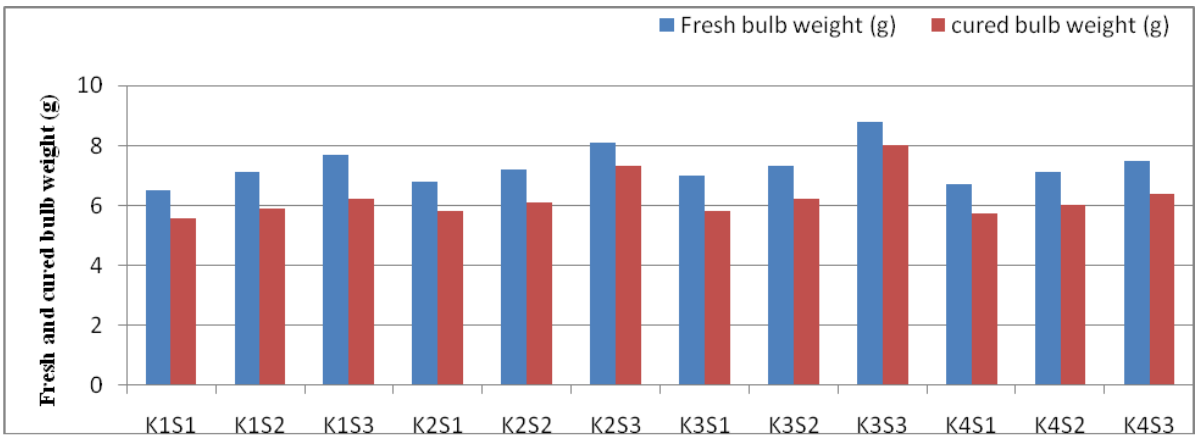

Fig. 4: Interaction effect of different levels of potassium and its split application on fresh and cured bulb weight

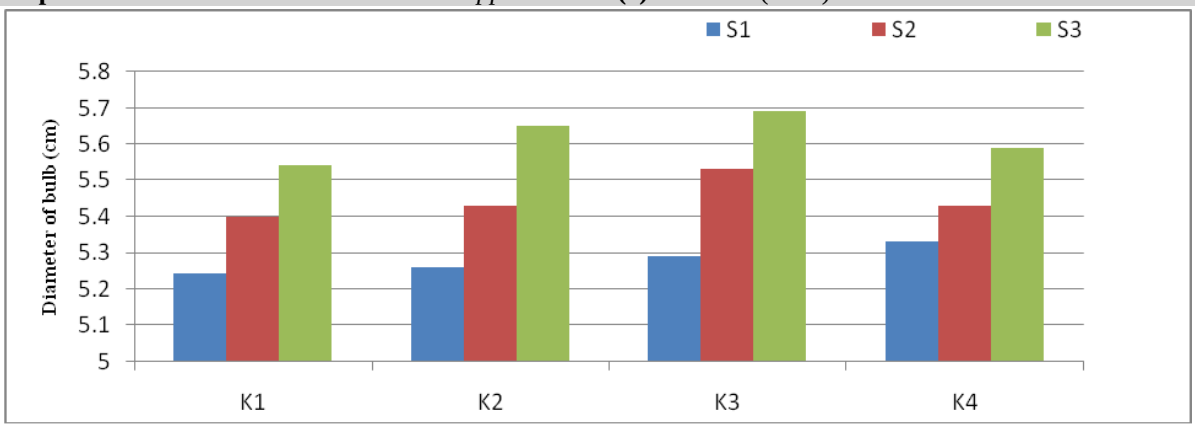

Fig. 5: Interaction effect of different levels of potassium and its split application on diameter of bulb

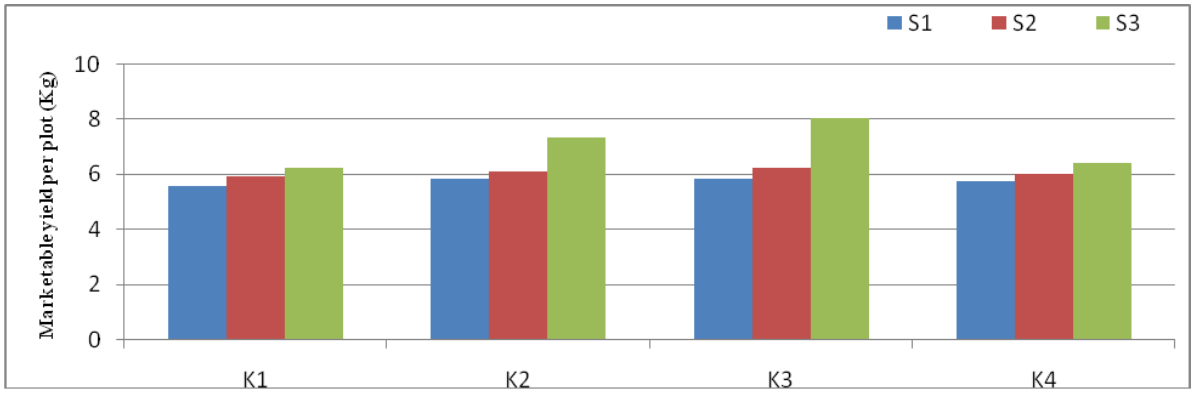

Fig. 6: Interaction effect of different levels of potassium and its split application on marketable yield per plot

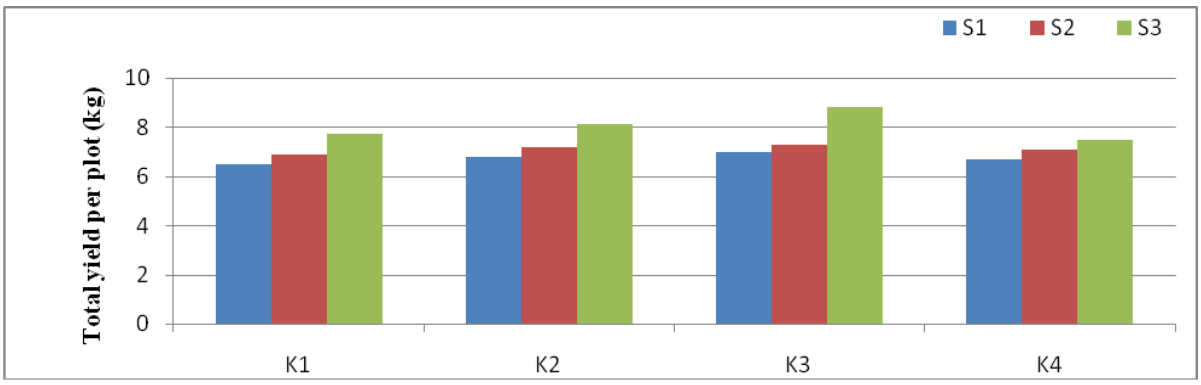

Fig. 7: Interaction effect of different levels of potassium and its split application on total yield per plot

CONCLUSION

As regards to potassium levels, the treatment K_3 was found to be record significantly maximum plant height, number of leaves per plant, leaf area, weight of fresh and cured bulb , diameter of bulb, marketable yield per plot and total yield per plot.

The split application of potassium treatment S_3 i.e. three split application of potassium recorded significantly maximum plant height, number of leaves per plant, leaf area, weight of fresh and cured bulb, diameter of bulb, marketable yield per plot and total yield per plot.

The treatment combination K_3S_3 i.e. 60 Kg of potassium in three split application recorded significantly maximum plant height, number of leaves per plant, leaf area, weight of fresh

and cured bulb, diameter of bulb, marketable yield per plot and total yield per plot.

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