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Effect of Different Potassium Rates on the Growth and Productivity of Onion

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Abstract:
The experiment was conducted during the year 2021 at the Horticultural Orchard, Sindh Agriculture University, TandoJam, to investigate the effect of potassium different rates on growth and productivity of onion, in a three replicated randomized complete block design using plot size 3m x 3.5m (10.5m²). The potassium rate includes T1=Control, T_2 = 20 kg (K) ha-1, T3= 40 kg (K) ha-1, T4 = 60 kg ha-1, T5 = 80 kg (K) ha-1 and T6 = 100 kg (K) ha-1. The present study results were statistically significant for growth and yield of onion. The potassium rates T6 = 100 kg (K) ha-1 produced highest growth and yield for all parameters including plant height (52.33 cm), stem girth (55.60 cm), number of leaves plant-1 (13.00), weight of leaves plant (66.90 g), bulb diameter (6.40 cm), single bulb weight (106.67 g), yield plot-1 (6.4 kg) and yield ha-1 (6095.2 kg) was recorded in T6 = 100 kg (K) ha-1. The average data was Plant height (48.83 cm), stem girth (53.32 cm), number of leaves plant-1 (10.00), weight of leaves plant-1 (63.90 g), bulb diameter (5.73 cm), single bulb weight (93.00 g), yield plot-1 (5.58 kg) and yield ha ha-1 (5314.3 kg) recorded in T5 = 80 kg (K) ha-1. Whereas the minimum data was Plant height (41.70 cm), stem girth (46.8 cm), number of leaves plant-1 (6.33), weight of leaves plant-1 (46.56 g), bulb diameter (3.33 cm), single bulb weight (49.33 g), yield plot-1 (2.96 kg) and yield ha-1 (2819.2 kg) recorded in T_1 = Control. It was concluded that T6 = 100 kg (K) ha-1 produced better results for all growth and yield parameters as compared to other potassium rates.

Keywords: Potassium, onion growth and productivity

INTRODUCTION

Onion (Allium cepa L), the most widely cultivated species of Amaryllidaceae, is important to many genus in the world. About 170 countries grow onions for domestic use or trade. In 2016, the global area was planted with an area of about 5 million hectares, which produced 93 million MT, with an average yield of 18 MT. Onion has diploid chromosome numbers 2n = 16. Onion is the most widely distributed herb plant in over 600 varieties worldwide. The onion has a low root system, long, linear and hollow pin, as it grows on the base structure (Ozkan et al., 2018).

Depending on the purpose and variety, onions can be made from seeds or bulbs. Onions are best planted in fertile soil, which is well dried. Without soil type, the maximum pH range is 6.0 to 6.8, although alkaline soils are also suitable. Onions are not dispersed in the ground below 6.0 because of the lack of trace element, or sometimes, because of the aluminum or manganese precipitate. Salt salts are better because they have less sulfur, while clay soils generally have higher sulfur content and produce a thicker bulb. Onions need significant levels of fertilizer in the soil (Aftab et

al., 2017). In Pakistan, there is no doubt that Sindh province alone produces 666.8 thousand tonnes, which seems to double as compared to 303.2 thousand tonnes produced by the province of Punjab, especially due to the climatic conditions required by this crop (FBS, 2015). Both organic and inorganic fertilizer enhancing have an important response. Larger doses are commonly recommended for onion cultivation (Nasreen and Hussein, 2007). In high nutrients, potassium plays an important role in plant metabolism such, regulation of plant photosynthetic substrates, activation of plant regeneration and resistance to insects and diseases. It is also considered a quality factor because it improves the quality of many crops, including onions. Improves potassium as well as collects color, gloss and dries substances, it also maintains the onion bulb quality (Aftab et al., 2017). The application of potassium also improves the life of onion cultivars and some potassium also plays an important role in the production and quality as well as onion life. Potassium is involved in many metabolic processes such as carbohydrate and sugar production and transport, protein synthesis, enhances stomach and disease resistance and activates several enzymes. (Pachauri et al., 2005).

Potassium (K) helps in increasing the production of basal matter, being absorbed in large quantities, just beyond potassium (K). The beneficial effects of potassium can be found in a variety of agricultural products, such as color, acidity. Shipping resistance, handling and storage, nutritional value and industrial qualities (Kumar et al., 2001). Regarding working knowledge with K Pusa Madhvi, applying 40 kg/ha^{-1} of K2O reported an increase in onion yield and a decrease in diameter of the reaction at levels of 80 and 160 kg/ha^{-1} And the latest case of the bulb, using K2O at 60kg/ha^{-1}, nasik Red Cultivar, as well as an increase in diameter and fresh matter of the bulb, with the application of 60 kg/ha^{-1} of K2O. When studying five cultivars (k Lacara, Burgoyne, White Kriel, Swat and Texas Early Grano), it was found that onion bulb production increased by 200 kg ha^{-1} K2O, and the lowest yield of all crops showed a decrease in curry. General Chat Chat Lounge Fertility. Considering the importance of potassium (K), the present experiment was conducted to evaluate the effect of different rates of potassium-on-potassium growth and production (Akhtar et al. 2002).

MATERIALS AND METHODS

The experiment was conducted during the year 2020 at the Horticultural Orchard, Sindh Agriculture University. Tando Jam, to evaluate the effect of different potassium rates on the growth and productivity of onion. The experiment was conducted in Randomized complete block Design (RCBD). The study comprised of six different Potassium rates including T_1= Control where no potassium application was applied, T_2= 20 kg (K) ha^{-1} (40 g SOP plot^{-1}), T_3= 40 kg (K) ha^{-1} (80 g SOP plot^{-1}), T_4= 60 kg (K) ha^{-1} (120 g SOP plot^{-1}), T_5= 80 kg (K) ha^{-1} (160 g SOP plot^{-1}), T_6= 100 kg (K) ha^{-1} (200 g SOP plot^{-1}), each treatment was replicated three times.Uing plot size 3m x 3.5m (10.5m^2). A good seed bed was achieved by recommended practices for land preparation. The growth and yield response of onion was assessed by different potassium (K) application rates. The K was applied in the form of sulphate of potash (SOP).

Observation Recorded

1. Plant height (cm)
2. Stem girth (cm)
3. Number of leaves plant^{-1}
4. Weight of leaves plant $^{-1}$(g)
5. Bulb diameter (cm)

6. Single bulb weight (g)
7. Yield plot^{-1} (kg)
8. Yield ha^{-1} (kg)

Statistical Analysis

Data was statistically analysis to determine superiority of the treatment using ANOVA and least significant difference (LSD) tests. All statistical tests were performed using the computer software Statistic (Ver.8.1).

Procedure for Recoding Observation

Plant Height (cm):

Plant height was measured from the ground level up to the tip of the highest leaf using a standard ruler.

Number of Leaves Plant^{-1}:

Numbers of leaves plant-1 was calculated from randomly selected plants from each treatment.

Bulb Weight (g):

Weight of each bulb were collected and tagged at random and weighted to record the weight in (g).

Bulb Diameter (cm):

The diameter of all the bulbs in randomly selected plants was measured in centimeters with vernier caliper and average was worked out with the following

$$\text{Formula} = \text{Area} = 3.14 \times r^2$$

Average Yield Treatment^{-1}(kg):

Average yield was calculated as per plant weight of onion bulb taken from five plants per treatment then average was done

RESULTS

The experiment was conducted during the year 2020 at the Horticultural Orchard, Sindh Agriculture University, Tando Jam, in a three replicated randomized complete block design using plot size 3m x 3.5m (10.5m2). Observation was recorded for including plant height (cm), stem girth (cm), number of leaves plant^{-1}, weight of leaves plant^{-1} (g), bulb diameter (cm), single bulb weight (g), yield plot^{-1} (g), and yield ha^{-1}(kg)

Plant Height (cm)

The results in regard to plant height (cm) of onion under treatments of different Potassium (K) application rates are presented in table -1 The analysis variance suggested that plant height was significantly ($P<0.05$) affected by different potassium application rates.

The plant height of onion was significantly maximum (52.33 cm) when the plant was treated with T_6 =100 kg (K) ha, followed by plant height of 48.83 cm in plants treated with T_5 = 80 kg (K) ha". The onion plant height reduced considerably to 47.43, 46.73 and 45.13 cm, when plant was treated with T_4 = 60 kg (K) ha", T_3 = 40 kg (K) ha and T_2 = 20 kg (K) ha", respectively. However, the onion plant height was minimum (41.70 cm) under T_1 = Control where no potassium application was

applied. The LSD test demonstrated that the differences in plant height (cm) treated by potassium application rates were significant (P<0.05).

Stem Girth (cm)

The results in regard to stem girth (cm) of onion under treatments of different Potassium K) application rates are presented in Table-1 The analysis variance suggested that stem girth was significantly (P < 0.05) affected by different potassium application rates The stem girth of onion was significantly maximum 55.60 (cm) when the plant was treated with T_6 = 100 kg (K) ha^{-1} followed by stem girth of 53.32 cm in plants treated with T_5 = 80kg (K) ha^{-1} The onion stem girth reduced considerably to 51.67, 51.33 and 49.33 cm, when plant was treated with T_4 = 60 kg (K) ha^{-1} T_3 = 40 kg (K) ha^{-1} and T_2 = 20 kg (K) ha^{-1} respectively However the onion stem girth was minimum (46.8 cm) under T_1=Control where no potassium application was applied The LSD test demonstrated that the differences in stem girth (cm) treated by potassium application rates were significant (P < 0.05).

Number of Leaves Plant^{-1}

The results in regard to number of leaves plant of onion under treatments of different Potassium (K) application rates are presented in Table1. The number of leaves plant of onion was significantly maximum (13.00) under T_6= 100 kg (K) ha^{-1} followed by number of leaves plant of 10.00 in plants treated with T_5=80 kg (K) ha^{-1} and T_4 = 60 kg (K) ha^{-1} weight reduced considerably to 9.00 and 8.00 when plant was treated with T_3 = 40 kg (K) ha^{-1} and T_2 = 20 kg (K) ha^{-1} respectively However, the onion number of leaves plant was minimum (6.33) under T_1 = Control where no potassium application was applied The LSD test demonstrated that the differences in number of leaves plant treated by potassium application rates were significant (P<0.05)

Table 1. plant height (cm), stem girth (cm) and number of leaves plant^{-1} of onion treated by potassium different rates.

Treatments	Plant height (cm)	Stem girth (cm)	Number of leaves plant^{-1}
T_1 = Control	40.70 e	46.8 f	6.33 e
T_2 = 20kg (k) ha^{-1}	45.13 d	49.33 e	8.00 d
T_3 = 40 kg (k) ha^{-1}	46.73 c	50.5 d	8.66 c
T_4 = 60 kg (k) ha^{-1}	47.43 c	51.67 c	10.00 b
T_5 = 80 kg (k) ha^{-1}	48.83 b	53.32 b	10.33 b
T_6 = 100 kg (k) ha^{-1}	52.33 a	55.60 a	12.88 a
F - Value	107	406	247
P - Value	0.0000	0.0000	0.0000
LSD 0.05	1.0641	0.4712	0.4416
CV%	1.27	0.52	2.64
S.E $\pm$	0.4884	0.2162	0.2027

Weight of Leaves Plant (g)

The results in regard to weight of leaves plant^{-1} (g) of onion under treatments of different Potassium (K) application rates are showed in figure -1. The weight of leaves plant^{-1} of onion was significantly maximum (66.90 g) when the plant was treated with T_6 = 100 kg (K) ha^{-1} followed by weight of leaves plant^{-1} of 63.90 g in plants treated with T_5 = 80 kg (K) ha^{-1}. The onion weight of leaves plant^{-1} reduced considerably to 59.51, 53.32 and 51.34 g, when plant was treated with T_4= 60 kg (K) ha, T_3= 40 kg (K) ha^{-1} and T_2= 20 kg (K) ha^{-1}, respectively. However, the onion weight of leaves plant^{-1} was minimum (46.56 g) under T_1= Control where no potassium application was

applied. The LSD test demonstrated that the differences in weight of leaves plant (g) treated by potassium application rates were significant (P<0.05).

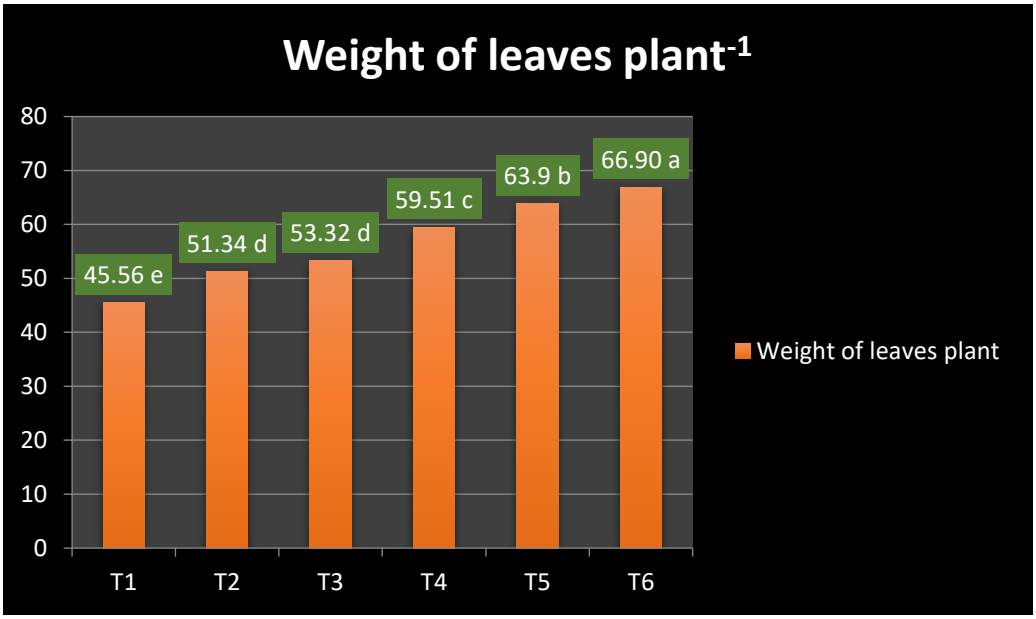

Figure 1. Weight of leaves plant^{-1} of onion treated by potassium different rates

Bulb Diameter (cm)

The results in regard to bulb diameter (cm) of onion under treatments of different Potassium (K) application rates are showed in Figure 2. The bulb diameter of onion was significantly maximum (6.40 cm) when the plant was treated with T_6 = 100 kg (K) ha^{-1} followed by bulb diameter of 5.73 cm in plants treated with T_5 = 80 kg (K) ha^{-1}. The onion bulb diameter reduced considerably to 5.33, 4.56 and 4.20 cm when plant was treated with T_4= 60 kg (K) ha^{-1}, 3 = 40kg (K) ha^{-1} T_2 = 20 kg (K) ha^{-1}, respectively However, the onion bulb diameter was minimum (3.33 cm) under T_1= Control where no potassium application was applied The LSD test demonstrated that the differences in bulb diameter (cm) treated by potassium application rates were significant (P < 0.05).

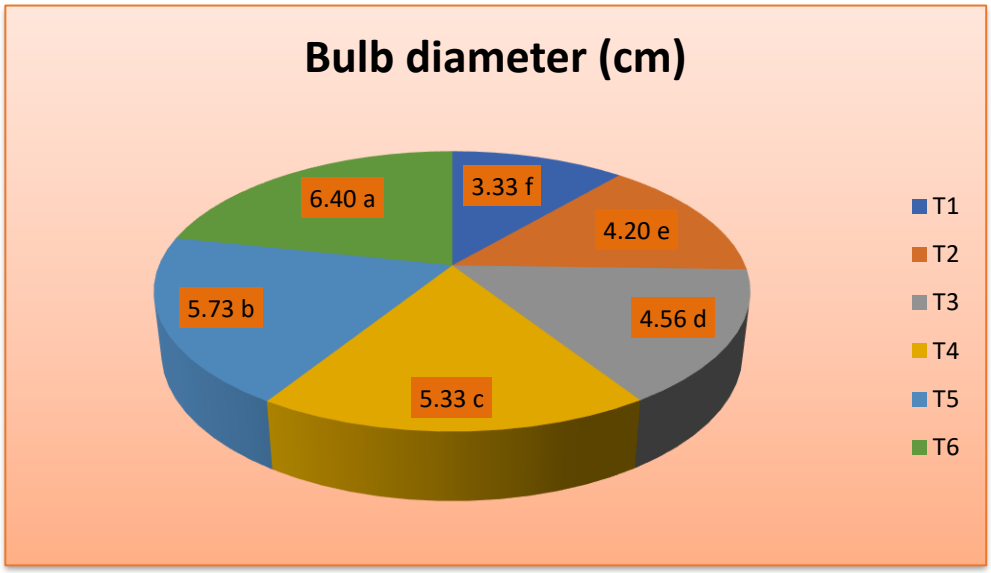

Figure 2. Bulb diameter (cm) of onion treated by potassium different rates

Single Bulb Weight (g)

The results in regard to single bulb weight (g) of onion under treatments of different Potassium (K) application rates are presented in Table -2. The single bulb weight of onion was significantly maximum (106.67 g) when the plant was treated with T_6 =100 kg (K) ha^{-1}, followed by single bulb weight of 93.00 g in plants treated with T_5 =80 kg (K) ha^{-1}. The onion single bulb weight reduced considerably to 83.00, 72.33 and 57.67 g, when plant was treated with T_4 = 60 kg (K) ha^{-1} T_3 = 40 kg (K) ha^{-1} and T_2 = 20 kg (K) ha^{-1}, respectively. However, the onion single bulb weight was minimum (49.33 g) under T_1 = Control where no potassium application was applied. The LSD test demonstrated that the differences in single bulb weight (g) treated by potassium application rates were significant (P<0.05).

Yield Plot^{-1} (kg)

The results in regard to yield plot-1 (kg) of onion under treatments of different Potassium (K) application rates are presented in Table-2. The yield plot of onion was significantly maximum (6.4 kg) when the plant was treated with T_6 = 100 kg (K) ha^{-1}, followed by yield $plot^{-1}$ of 5.58 kg in plants treated with T_5 = 80 kg (K) ha^{-1}. The onion yield $plot^{-1}$ reduced considerably to 4.98, 4.34 and 3.46 kg, when plant was treated with T_4 = 60 kg (K) ha^{-1}, T_3 = 40 kg (K) ha^{-1} and T_2 = 20 kg (K) ha^{-1}, respectively. However, the onion yield $plot^{-1}$ was minimum (2.96 kg) under T_1 =Control where no potassium application was applied. The LSD test demonstrated that the differences in yield plot (kg) treated by potassium application rates were significant (P<0.05).

Yield Ha^{-1} (kg)

The results in regard to yield ha^{-1} (kg) of onion under treatments of different Potassium (K) application rates are presented in Table -2. The yield ha of onion was significantly maximum (6095.2 kg) when the plant was treated with T_6 = 100 kg (K) ha^{-1}, followed by yield ha^{-1} of 5314.3 kg in plants treated with T_5 = 80 kg (K) ha^{-1}. The onion yield ha^{-1} reduced considerably to 4721.2, 4133.3 and 3295.2 kg, when plant was treated with T_4 = 60 kg (K) ha^{-1}, T_3 = 40 kg (K) ha^{-1} and T_2 = 20 kg (K) ha^{-1}, respectively. However, the onion yield ha^{-1} was minimum (2819.2 kg) under T_1 = Control where no potassium application was applied. The LSD test demonstrated that the differences in yield ha" (kg) treated by potassium application rates were significant (P<0.05).

Table 2. Single bulb weight (g), yield $plot^{-1}$ (kg) and yield ha^{-1} (kg) of onion treated by potassium different rates.

Treatments	Single bulb weight (g)	Yield $plot^{-1}$ (kg)	Yield ha^{-1} (kg)
T_1 = Control	49.33 f	2.96 f	2819.2 f
T_2 = 20kg (k) ha^{-1}	57.67 e	3.46 e	3295.2 e
T_3 = 40 kg (k) ha^{-1}	72.33 d	4.34 d	4133.3 d
T_4 = 60 kg (k) ha^{-1}	83.00 c	4.98 c	4721.2 c
T_5 = 80 kg (k) ha^{-1}	93.00 b	5.58 b	5314.3 b
T_6 = 100 kg (k) ha^{-1}	103.33 a	6.4 a	6095.2 a
F - Value	174	174	168
P-Value	0.0000	0.0000	0.0000
LSD 0.05	5.0492	302.95	293.22
CV%	3.69	3.69	3.75
S.E $\pm$	2.3174	139.04	134.58

DISCUSSION

Among the major nutrients, potassium plays a vital role in plant metabolism such as photosynthesis, translocation of photosynthetic substrates regulation of plant pores, activation of plant catalysts and resistance against pests and diseases. It is also considered as a quality element as it improves quality parameters of many crops including onion. Potassium improves color, glossiness and dry matter accumulation besides improving, it also keeping bulb quality of onion (Aftab et al. 2017). Potassium application also improved the post-harvest life of onion and some other Potassium also plays important role in production and quality as well as shelf- life of onion. Potassium is helpful in many metabolic processes namely, production and transport of carbohydrates and sugars, protein synthesis, imparting resistance to pests and diseases and activation of many enzymes (Pachauri et al., 2005). Potassium (K) contributes markedly to improving the production of onion, being absorbed in large amounts, exceeded only by potassium (K). The beneficial effect of potassium can be found in different traits of agricultural products, such as color, acidity, resistance to shipping, handling and storage, nutritional value and industrial qualities (Kumar et al., 2001).

The present study results finding statistically significant for different potassium different rates. The data was recorded for plant height (cm), stem girth (cm), number of leaves plant^{-1}, weight of leaves plant (g), bulb diameter (cm), single bulb weight (g), yield plot^{-1} (kg) and yield ha^{-1} (kg). Among the different potassium rates T -100 kg (K) ha^{-1} had better results for all parameters. The present study finding results were resemble with (Aftab et al., 2017). They reported that potassium application of 120 kg/ha^{-1} is recommended as the most suitable dose for obtaining maximum yield of onion.

The present study findings that the plant height (cm) was statistically significant treated with potassium rates. The highest plant height was observed where T_6 = 100 kg (K) ha^{-1} was applied. Awatef et al. (2015) studied the potassium levels 100 kg (K) ha produced highest plant height.

Furthermore, present study results the bulb weight and bulb diameter were also recorded highest under T_6 = 100 kg (K) ha^{-1}. Aftab et al. (2017) indicated that maximum average bulb weight (78.44 g) and maximum bulb diameter (5.20 cm) maximum was noted in plots applied with potassium at the rate of 120 kg/ha^{-1}, Islam et al. (2008) also reported that potassium had significant effect on bulb diameter and bulb weight and also size.

The bulb yield parameters had also significant results treated with potassium T_6 = 100 kg (K) ha^{-1}. The present study results similar with (Siddiquee et al. (2008). They observed that It was observed that the application of K @ 100 kg ha^{-1} significantly increased the yield of onion. Aftab et al. (2017) reported that potassium application of 120 kg/ha^{-1} is recommended as the most suitable dose for obtaining maximum yield of onion. Furthermore, scientists reported that split application of 120 kg/ha^{-1} potassium may be considered to be optimum for getting higher yield of onion.

SUMMARY

The experiment was conducted during the year 2020 at the Horticultural Orchard, Sindh Agriculture University. Tando Jam, to evaluate the effect of different potassium rates on the growth and productivity of onion. The experiment was conducted in Randomized complete block Design (RCBD). The study comprised of six different Potassium rates including T_1= Control where no potassium application was applied, T_2= 20 kg (K) ha^{-1} (40 g SOP plot^{-1}), T_3= 40 kg (K) ha^{-1} (80 g SOP plot^{-1}), T_4= 60 kg (K) ha^{-1} (120 g SOP plot^{-1}), T_5= 80 kg (K) ha^{-1} (160 g SOP plot^{-1}), T_6= 100 kg

(K) ha^{-1} (200 g SOP $plot^{-1}$), each treatment was replicated three times. Observation was recorded for including plant height (cm), stem girth (cm), number of leaves $plant^{-1}$, weight of leaves $plant^{-1}$ (g), bulb diameter (cm), single bulb weight (g), yield $plot^{-1}$ (kg) and yield ha^{-1} (kg).

Plant height (41.70 cm), stem girth (46.8 cm), number of leaves $plant^{-1}$ (6.33), weight of leaves $plant^{-1}$(46.56 g), bulb diameter (3.33 cm), single bulb weight (49.33 g), yield $plot^{-1}$ (2.96 kg) and yield ha^{-1} (2819.2 kg) was recorded in T_1 = Control.

Plant height (45.13 cm), stem girth (49.33 cm), number of leaves $plant^{-1}$ (8.00), weight of leaves $plant^{-1}$ (51.34 g), bulb diameter (4.20 cm), single bulb weight (57.67 g), yield $plot^{-1}$ (3.46 kg) and yield ha^{-1} (3295,2 kg) was recorded in T_2 = 20 kg (K) ha^{-1}.

Plant height (46.73 cm), stem girth (51.33 cm), number of leaves $plant^{-1}$ (9.00), weight of leaves $plant^{-1}$ (53.32 g), bulb diameter (4.86 cm), single bulb weight (72.33 g). yield $plot^{-1}$ (4.34 kg) and yield ha^{-1} (4133.3 kg) was recorded in T_3 = 40 kg (K) ha^{-1}.

Plant height (47.43cm), stem girth (51.67 cm), number of leaves $plant^{-1}$ (10.00), weight of leaves $plant^{-1}$ (59.51 g), bulb diameter (5.33 cm), single bulb weight. (83.00 g), yield $plot^{-1}$ (4.98 kg) and yield ha^{-1} (4721.2 kg) was recorded in T_4 = 60 kg (K) ha^{-1}.

Plant height (48.83 cm), stem girth (53.32 cm), number of leaves $plant^{-1}$ (10.00), weight of leaves $plant^{-1}$ (63.90 g), bulb diameter (5.73 cm), single bulb weight (93.00 g), yield $plot^{-1}$ (5.58 kg) and yield ha^{-1} (5314.3 kg) was recorded in T_5 = 80 kg (K) ha^{-1}.

Plant height (52 33 cm), stem girth (55.60 cm), number of leaves $plant^{-1}$ (13.00), weight of leaves $plant^{-1}$ (66.90 g), bulb diameter (6.40 cm), single bulb weight (106.67 g), yield $plot^{-1}$ (6.4 kg) and yield ha" (6095.2 kg) was recorded in T_6 = 100 kg (K) ha^{-1}

CONCLUSION

The present study results findings that T_6 = 100 kg (K) ha^{-1} produced highest growth and yield of onion as compare to other potassium rates.

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