Original Research Article

Assessment of Growth and Yield in Onion: Comparative Study of Three Varieties and Muriate of Potash Fertilizer Application Techniques

Comment [IA1]: Delete. **Comparative Study of Onion Varieties and Application Techniquesof Muriate Potash Fertilizer.**

ABSTRACT

A comparative study on the growth and yield of onions was conducted at Sher-e-Bangla Agricultural University's Horticulture farm from October 2021 to March 2022 during the Rabi season. The experiment employed a Randomized Complete Block Design (RCBD) with two factors: onion varieties (V_1=BARI Piaz-1, V_2=BARIPiaz-4, V_3=BARI Piaz-6) and muriate of potash fertilizer application methods (M_1=Basal application (Full dose), M_2 = ½ basal application + ½ 25 DAT (Days aftertransplanting), M_3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT).The results showed significant impacts of both onion varieties and potash fertilizer application methods on growth and yield. Among the onion varieties, BARI Piaz-4 (V_2) exhibited the highest bulb weight per plant (66.52g), yield per plot (1.60 kg), and yield per hectare (17.74 t). Regarding potash fertilizer application, the ⅓ basal + ⅓ 25 DAT + ⅓ 50 DAT method (M3) resulted in the highest bulb weight per plant (59.97 g), bulb yield per plot (1.44 kg), and onion yield per hectare (15.99 t).The combination treatment of BARI Piaz-4 and the ⅓ basal + ⅓ 25 DAT + ⅓ 50 DAT potash fertilizer application (V_2M_3) produced the best results, with the highest bulb weight per plant (73.50 g), yield per plot (1.76 kg), and bulb yield per hectare (19.59 t). In conclusion, cultivating BARI Piaz-4 with a three-times split application of muriate of potash fertilizer (V_2M_3) can significantly enhance onion growth and yield, facilitating improved quality production.

Keywords: bunching onion, spacing, fertilizer, seed yield.

I. INTRODUCTION

One significant bulbous crop is the onion (*Allium cepa* L.). It belongs to the Alliaceae family. It is a member of the Allium genus. The Mediterranean region serves as the secondary origin region for large type onions, whereas Central Asia serves as the major origin region for spices. One of Bangladesh's most significant and well-liked spice crops is the onion. It is also regarded as a significant vegetable crop. It is ranked first in Bangladesh among all other things. Majorspices such as chili, onion, garlic, turmeric and ginger are regularly used indaily diet at large amount[1].onion is a basic ingredient in South Asian food andis used as a spice in almost all countries. It is a photo and thermo sensitive crop[2]. Onion stands first among the spice crops in Bangladeshboth in area (1.94 lakh ha) and production (25.17 lakh metric ton) [3]. The majoronion producing districts of Bangladesh in 2020-21 were Pabna, Faridpur, Rajbari, Rajshahi,Kushtia, Jhinaidaha, Manikganj, Magura, Meherpur and Khulna. Onion output in Bangladesh has gradually expanded over the past few years, but so has the country's reliance on imports. In contrast, rising demand has led to an almost two-and-a-half-fold increase in import volume during the past five years. Bangladesh imported 1.35 lakh MT of onions in 2008-09; this number grew to 6.64 lakh MT in 2021-22, a 4.92-fold increase. Only by boosting output and utilizing a variety of techniques and approaches would it be possible to satisfy the huge demand for onions. In different parts of this country, numerous varieties of onions, including Taherpuri, Faridpuri, BARI piaz-1, BARI piaz-2, BARI piaz-3, BARI piaz-4, BARI piaz-5, Pabna local, Shuk Sagar, Bahadur, Lalima, and Ranga, are produced either as a crop for spices or for food. Some of these varieties (e.g., Taherpuri and Faridpuri) have very good flavour,pungency, taste and storage quality besides their excellent size and shape [4]. Due to the spread of new technology over the past two decades, such as HYV seeds, fertilizer, irrigation, pesticides, power tillers, etc., onion production has increased by many times[5].There is a significant response of onion to both inorganic and organic fertilizer[6]. One of the crucial management elements that could have a significant impact on the output of onions is fertilizer control. Onion bulb formation, elongation, skin color development, and pungent flavor are all influenced by the nutrients nitrogen, potassium, and sulfur[7]. Best quality onion can be produced through application of well-balancedfertilizers. Potassium is essential for several processes in plant metabolism, including photosynthesis, the movement of photosynthates, the control of plant pores, the activation of plant catalysts, and pest and disease resistance. In addition to enhancing the onion's keeping quality, it also enhances the quality characteristics of various crops, including the onion, such as color, glossiness, and dry matter buildup[8]. Time of application of

Comment [IA2]: O (Capital)

potassium during the growingperiod of onion is important in bulb formation.[9] reported that split application ofpotassium gave higher weight of onion bulb than single application of same dose. Thus, to maintain development and quality, potassium must be applied to onions during crucial growth phases in the proper quantity. This study will assist farmers in growing high-quality onions, which will boost output and ensure the farmers' financial well-being. Thepurpose of this study is to identify suitable variety on growth and yield of onion. To observeactual application method of muriate of potash fertilizer on growth and yield of onion. It alsohelps to determine the combined effect of variety and fertilizer application method ofmuriate ofpotash fertilizer on growth and yield of onion.

II. MATERIAL AND METHODS

1. Description of the site

The study took place from October 2021 to March 2022 at the Horticulture Farm of the Sher-e-Bangla Agricultural University in Sher-e-Bangla Nagar, Dhaka. There was an elevation of 8.6 meters above sea level at the location, which was located at 23° 77′ N Latitude and 90° 35′ E Longitude. In this location, the three distinct seasons of winter (November to February), pre-monsoon or hot season (March to April), and monsoon season (May to October) were all encountered. Averaging 490 mm of precipitation annually, mostly during the monsoon season, the region experienced frigid winters and hot summers. 28°C and 19°C, respectively, were the mean annual maximum and lowest temperatures.

2. Soil sampling and analysis

Before the experiment, soil samples were collected from the experimental plot. The soil, classified as silty loam, belonged to AEZ No. 28 within the Modhupur Tract region. Soil samples were taken from a depth of 0-15 cm and had a pH of 7.1. These samples were analyzed for their physical and chemical properties at the Soil Resources Development Institute (SRDI), Soil Testing Laboratory in Kamarhati, Dhaka. The soil was air-dried, crushed, and subjected to comprehensive testing.

3. Statistical Analysis

The recorded data on different parameters were statistically analyzed using Statistic 10 software. The significance of the difference among the treatments means was estimated by the least significant difference test (LSD) at 5% level of probability.

4. Field preparation and Treatment allocation

The plot selected for the experiment was opened with a power tiller in the middle of October 2021 and left exposed to the sun for 10 days. To achieve good tilth, the land was harrowed, ploughed, and cross-ploughed several times, followed by laddering. The experiment was laid out in a Randomized Complete Block Design (RCBD) having double factor with three replications. The experiment comprised as two factors. Factor A: Varieties of onions-3 kinds e.i. V1=BARI Piaz-1, V2=BARIPiaz-4, V3=BARI Piaz-6 and Factor B: Application method of potash fertilizer- 3 typese.i. M1=Basal application (Full dose), M2 = ½ basal application + ½ 25 DAT (Days aftertransplanting), M3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT. Each block was divided into 09 plots where 09 treatments combination were distributed randomly and 27-unit plots altogether in the experiment. The size of each plot was 1 m × 0.9 m. The distance maintained between two blocks were 0.75 m and two plots were 0.50 m.

5. Planting Materials

The seeds of onion were collected from Bangladesh Agricultural Research Institute (BARI), Gazipur.

Comment [IA3]: A more detailed description should be provided, whether the seeds were directly transplanted to the soil or grown into seedling first before planting. The time of harvesting and measuring the growth characteristic should also be provided.

6. Manuring and Fertilization

Full amount of TSP and full amount of Gypsum were applied in the field as basal dose as pertreatment during final land preparation. While the rest of urea was given in 2 equal split doses at 20 and 45 days after transplanting. Muriate ofpotash was applied according to treatment requirement.

Table 1. The following doses manure and fertilizers were applied in the experimental plots

Fertilizer	Dose /ha
Cowdung	10 ton
Urea	240 Kg

Muriate of Potash (MP)	150 Kg
Triple super phosphate	220 Kg
Gypsum	150 kg

III. RESULT AND DISCUSSIONS

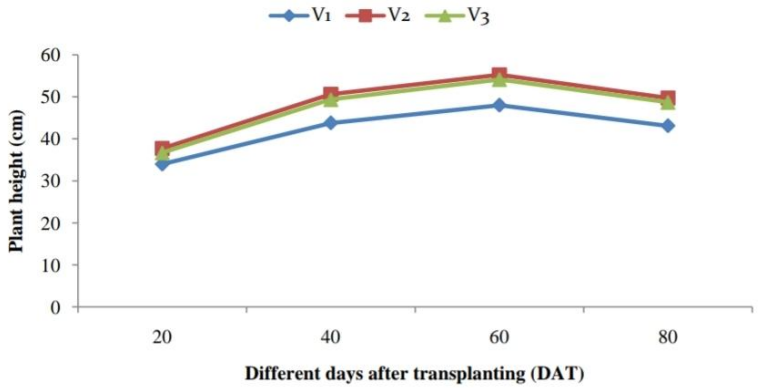
1. Effect of variety

Significant differences were observed in the different parameters of plant due to different variety. The maximum plant height (55.29 cm) was measured at 60 DAT from V_2 (BARI Piaz-4) treatment (Fig.1). The highest number of leaves (6.02) per plant at 60 DAT was recorded from V_2 treatment (Fig.3). The treatment V_2 recorded the maximum neck diameter (1.16 cm),bulb length (5.13 cm),bulb diameter of onion (5.43cm), dry matter content of bulb (13.72%), fresh weight of leaves (25.34 g),polar diameter (1.49 cm),bulb weight per plant (66.52 g)(Table 2).The height brix percentage was measured from V_2(9.44%). The data revealed that highest yield per plot (1.60 kg), yield (17.74t) per hectorwas obtained from V_2 treatment (Table 2).

Comment [IA4]: Method for measuring plant height for onion should be provided in material and method

Comment [IA5]: hectar

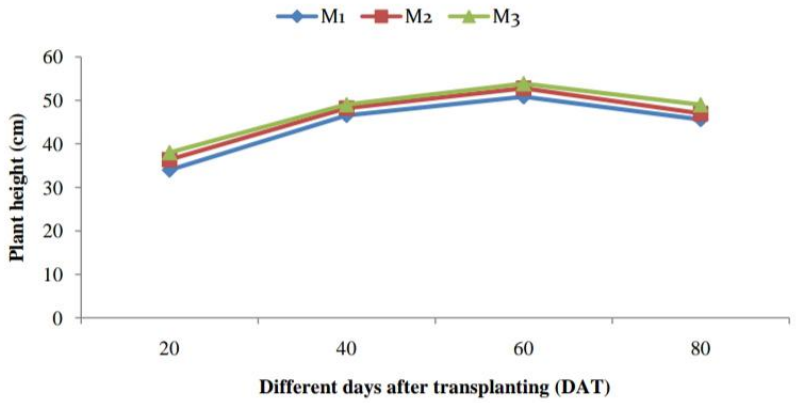
The variation of plant height is probably due to the geneticmake-up of the varieties.[10] reported that in onion varieties height of aplant is determined by genetical character and under a given set of environment different varieties will acquire their height according to their genetical makeup.[11] found a significant difference in the number of leaves per plant among onion varieties. [12] reported that neck diameter of onion varied among different onion varieties and the highest neck thickness of the bulb (0.47 cm), was found in variety Agrifound Dark Red onion variety. The bulb length result obtained from the present study was similar with the findings [13] .The results on bulb diameter corroborate the findings [14] .They stated that bulb development and individual bulb weight were differed significantly by the onion varieties. Genetic factors influence growth and bulb development. [15].



Note: Here, V1=BARI Piaz-1, V2=BARI Piaz-4 and V3=BARI Piaz-6

Comment [IA6]: This note should be added after the title of the figure as the part of the title.

Figure 1. Effect of variety on plant height at different days after transplanting of onion



Note: Here, M1=Basal application (Full dose), M2=½ basal application + ½ 25 DAT (Days after transplanting), M3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT.

Comment [IA7]: This note should be added after the title of the figure.

Figure 2. Effect of application methods of potash fertilizer on plant height at different days after transplanting of onion

2. Effect of potash fertilizer application method

The data revealed that the different application method of potash fertilizer affected the growth and yield of onion. The maximum plant height (53.86 cm) at 60 DAT (Fig. 2) and number of leaves (7.40) at 60 DAT (Fig.4) was measured from M_3 treatment. The treatment M_3 recorded the maximum neck diameter (1.16 cm)(Table 3).Thetreatment M3 recorded thebulb length (4.81cm), bulb diameter (5.31 cm), dry matter content of leaves (12.98 %) (Table 3). The maximum polar diameter (1.53 cm), fresh weight of leaves(22.50 g) was obtained from M_3 treatment (Table 3).The height brix percentage (7.78) from M_2 treatment(Table 3).The data revealed that highest bulb weight (59.97 gm) per plant, yield (1.44 kg) per plot, yield (15.99 t) per hectare was obtained from M_3 Treatment (Table 3).

Optimal and regular supply of potassium fertilizer at different growth stages of crop throughsplittingapplication resulted in better utilization of potash by the plants which improved thegrowth and yieldattributes of onion. The findings were similar to[16] Who discovered that split application of potash in crop significantly influenced plant growth characteristics. [17] reported that application of potash fertilizer influenced leafnumber of onion plant. The result obtainedfrom the present study was similar with the findings of[18] recorded bulblength of onion after harvesting indicated that, the bulb length of onion was positively influencedby split application of potassium. The result was similar with the findings of [19] who founded significantlyhigher polar and equatorial diameter of bulb. These findings agree with the results of [20] .M2 treatment gave the height brix percentage of onion. The result wassimilar with the findings of [21]. [22] reported that three split of potashfertilizer significantly influenced onion yield per plot comparable to control treatment. Thefindings were similar to those of [23] who studied the response of summer onionsto potash and its application methods and reported that the highest bulb yield.

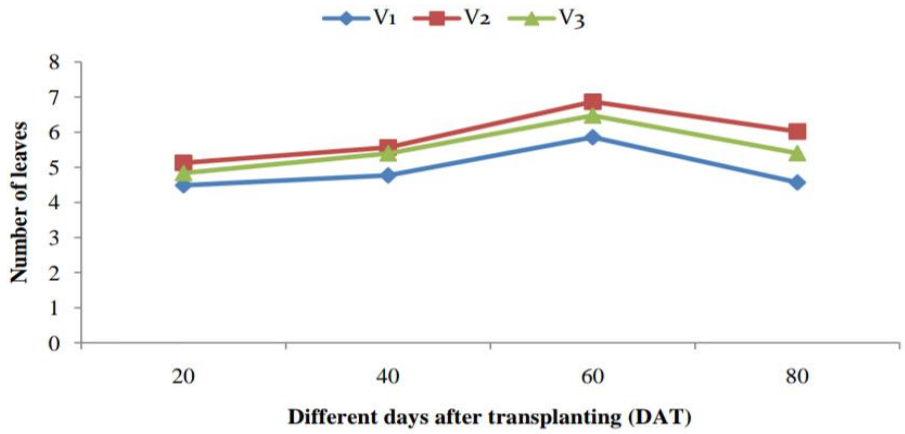
Comment [IA8]: Please also add the possible mechanism in plants that make the split application to increase growth. Consider the possible toxicity which inhibited growth.

.

3. Combined effect of variety and application method of potash fertilizer

Combined effect of variety and application method of potash fertilizer was found to be statistically significant. The maximum plant height (57.13 cm) at 60 DAT was obtained from V_2M_3 treatment combination and number of leaves per plant (7.73) at 60 DAT from V_2M_3 treatment combination (Table 4). The treatment V_2M_3 recorded the maximum neck diameter (1.23cm), (Table 5). The maximum bulb length (5.44 cm), bulb diameter (5.73 cm), bulb weight per plant (73.50 g),polar diameter (1.60cm),dry matter content of bulb (14.83%),fresh weight of leaves(26.50g) was obtained

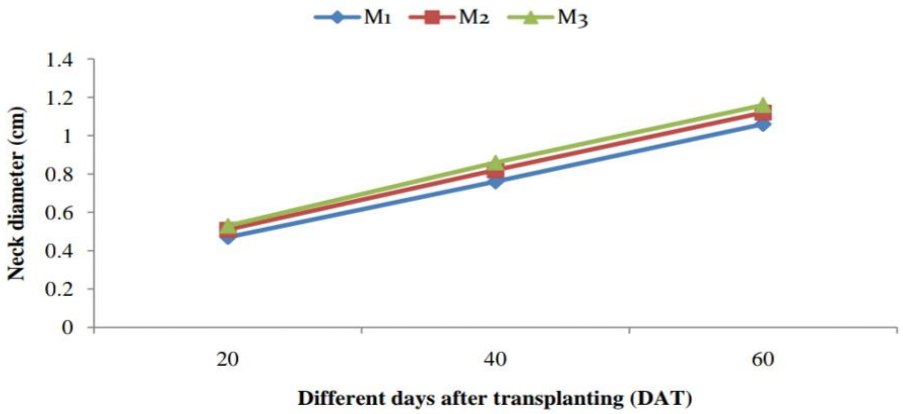
from V_2M_3 treatment (Table 5). The data revealed that highest yield per plot(1.76 kg), yield (19.59 t) per hectarewas obtained from V_2M_3 treatment and maximum brix percentage (10.17) was found from V_2M_2 treatment (Table 5)



Note: Here, V1=BARI Piaz-1, V2=BARI Piaz-4 and V3=BARI Piaz-6

Figure3. Effect of variety on number of leaves at different days after transplanting ofonion

Comment [IA9]: This note should be added to the title.



Note: Here, M1=Basal application (Full dose), M2=½ basal application + ½ 25 DAT (Days aftertransplanting), M3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT.

Figure 4. Effect of application methods of potash fertilizer on number ofleaves onion at different days after transplantation of onion

- **Table 2. Effect of variety onBulb length (cm), Bulb diameter (cm),Neck diameter (cm),Bulb weight per plant (g), Polar diameter(cm), Dry matter content of bulb (%),Fresh weight of leaves, Brix percentage, Yield per plot (kg), Yield per hector(ton) ofonion**

Treatment	Neck diameter (cm)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight per plant (g)	Polar diameter(cm)	Dry matter content of bulb (%)	Fresh weight of leaves	Brix percentage	Yield per plot (kg)	Yield per hector(ton)
V_1	1.06 c	3.80 c	4.66 c	38.87 c	1.38	10.20 c	16.59 c	6.83 b	0.93 c	10.36 c
V_2	1.16 a	5.13 a	5.43a	66.52 a	1.49	13.72a	25.34 a	9.44a	1.6 a	17.74 a
V_3	1.12 b	4.70 b	5.12b	57.76 b	1.45	12.30 b	21.50 b	4.94c	1.39 b	15.4 b
LSD (0.05)	0.0343	0.3168	0.1434	1.6751	0.3202^{ns}	0.2571	0.5622	0.5557	0.0141	0.4467
CV%	5.87	4.21	4.89	6.23	7.25	5.48	6.85	4.95	5.11	5.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

Note: Here, V1=BARI Piaz-1, V2=BARI Piaz-4 and V3=BARI Piaz-6

- **Table 3. Effect of application methods of potash fertilizeronNeck diameter (cm),Bulb length (cm), Bulb diameter (cm, Bulb weight per plant (g), Polar diameter(cm), Dry matter content of bulb (%),Fresh weight of leaves, Brix percentage, Yield per plot (kg), Yield per hector(ton) of onion**

Treatment	Neck diameter (cm)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight per plant (g)	Polar diameter(cm)	Dry matter content of bulb (%)	Fresh weight of leaves(g)	Brix percentage	Yield per plot (kg)	Yield per hector(ton)
M_1	1.06 c	4.31 b	4.84 c	48.81 c	1.36	11.20 c	20.07c	7.06 b	1.17 c	13.02 c
M_2	1.12 b	4.51 ab	5.08 b	54.36 b	1.43	12.06 b	20.87 b	7.78 a	1.3b	14.49 b
M_3	1.16 a	4.81 a	5.31 a	59.97 a	1.53	12.98 a	22.50 a	6.38 c	1.44 a	15.99 a
LSD (0.05)	0.0343	0.3168	0.1434	1.6751	0.3202^{ns}	0.2571	0.5622	0.5557	0.0141	0.4467
CV%	5.87	4.21	4.89	6.23	7.25	5.48	6.85	4.95	5.11	5.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

Here, M1=Basal application (Full dose), M2=½ basal application + ½ 25 DAT (Days aftertransplanting), M3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT.

Table 4. Combined effect of variety and application methods of potash fertilizeron plant height and number of leaves at different days after transplanting of onion

Treatment	Plant height (cm) at				Number of leaves at			
	20 DAT	40 DAT	60 DAT	80 DAT	20 DAT	40 DAT	60 DAT	80 DAT
V_1M_1	32.69 f	42.87 e	47.13 g	41.07 h	3.69 e	4.37 g	5.02 g	4.09 g
V_1M_2	33.73 e	44.13 d	48.33 f	42.67 g	4.60 cd	4.89 ef	5.53 fg	4.55 fg
V_1F_3	35.60 d	44.43 d	48.67 f	45.65 f	4.93 bc	5.05 de	7.03 bc	5.07 def
V_2M_1	35.27 d	48.47c	54.17 d	48.47 d	4.67cd	5.07 de	6.33 de	5.41 cd
V_2M_2	38.43 b	50.64 b	54.59 cd	49.54 bc	4.87 bc	5.38 cd	6.53 cd	5.81 bc
V_2M_3	39.53 a	52.87 a	57.13 a	51.27 a	5.85 a	6.25 a	7.73 a	6.84 a
V_3M_1	34.07 e	48.42 c	51.24 e	47.32 e	4.21 de	4.50 fg	5.78 ef	4.76 ef
V_3M_2	37.07 c	49.84 b	55.47 bc	48.73 cd	4.87 bc	5.78 bc	6.23 de	5.22 cde
V_3M_3	39.00 ab	49.87 b	55.77 b	50.14 b	5.43 ab	5.93 ab	7.43 ab	6.27 ab
LSD (0.05)	0.8972	0.8894	1.1824	0.9968	0.6009	0.4173	0.6356	0.6133
CV%	4.25	5.68	7.23	4.02	5.58	6.32	4.85	6.25

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s)differ significantly at 5% level ofsignificance. Here, V1=BARI Piaz-1, V2=BARI Piaz-4, V3=BARI Piaz-6, M1=Basal application (Full dose), M2=½ basal application + ½ 25 DAT (Days aftertransplanting), M3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT.

Table 5. Combined effect of variety and application methods of potash fertilizer onNeck diameter (cm) Bulb length (cm), Bulb diameter (cm, Bulb weight per plant (g), Polar diameter(cm), Dry matter content of bulb (%),Fresh weight of leaves, Brix percentage, Yield per plot (kg), Yield per hector(ton) of onion

	Neck diameter (cm	Bulb length (cm)	Bulb diameter (cm)	Bulb weight per plant (g)	Polardiameter (cm)	Dry matter content of bulb (%)	Fresh weight of leaves	Brixpercentage	Yield per plot (kg)	Yield per hector(ton)
V_1M_1	1.01 f	3.47 e	4.39 g	33.30 h	1.31	9.30 h	15.33 f	6.83 cd	0.80 g	8.88 h
V_1M_2	1.08 de	3.78 de	4.74 f	39.67 g	1.36	10.27 g	16.10 f	7.50 c	0.95 f	10.58 g
V_1M_3	1.09 cde	4.15 cd	4.87 ef	43 .63 f	1.49	11.05 f	18.33 e	6.16 de	1.05 f	11.63 f
V_2M_1	1.12 cd	4.87 b	5.16 bcd	60.46 cd	1.43	12.80 cd	24.37 b	9.50 ab	1.45 cd	16.12 cd
V_2M_2	1.15 bc	5.08 ab	5.40 b	65.60 b	1.45	13.53 b	25.17 b	10.17 a	1.57 b	17.49 b
V_2M_3	1.23 a	5.44 a	5.73 a	73.50 a	1.60	14.83 a	26.50 a	8.67 b	1.76 a	19.59 a
V_3M_1	1.05 ef	4.59 bc	4.95 def	52.67 e	1.35	11.50 e	20.50 d	4.833 fg	1.26 e	14.04 e
V_3M_2	1.14 bc	4.67 bc	5.10 cde	57.83 d	1.48	12.37 d	21.33 d	5.67 ef	1.39 d	15.42 d
V_3M_3	1.18 ab	4.84 b	5.33 bc	62.80 bc	1.51	13.05 c	22.67 c	4.33 g	1.51 bc	16.75 bc
LSD (0.05)	0.0594	0.5486	0.2483	2.9014	0.4506^{ns}	0.4452	0.9737	0.9625	0.11	0.7736
CV%	5.87	4.21	4.56	8.25	7.25	5.48	6.85	4.95	5.11	5.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 5% level of significance. Here, V1=BARI Piaz-1, V2=BARI Piaz-4, V3=BARI Piaz-6, M1=Basal application (Full dose), M2=½ basal application + ½ 25 DAT (Days after transplanting), M3 = ⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT.

IV. CONCLUSION

On the basis of present study, it is concluded that the V_2variety gave highest plant height at 60 DAT of onion. V_2(BARI Piaz-4) gave highest number of leaves, plant neck diameter, bulb length ,bulb diameter ,polar diameter ,brix percentage, yield per plot ,yield per hector of onion. Among different application method of potash fertilizer height bulb length, bulb diameter, bulb weight per plant ,fresh weight of leaves ,dry matter content of onion ,yield per plot ,yield per hector were found in the M_3treatment (⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT Combination of V2M3 treatment gave the height growth and yield per hector (19.59 t) comparable to the other treatment combination. However, from the present study it may be concluded that, the most suitable combination for a higher yield of onion was V_2 (BARI Piaz -4) with M_3(⅓ basal application + ⅓ 25 DAT + ⅓ 50 DAT)

Comment [IA10]: ...was found..

Comment [IA11]: ...is...

REFERENCE

Comment [IA12]: references

1. Rana, M., Islam, S. and Kamruzzaman, M. (2021). Growth and instability in area, productionand productivity of major spices in Bangladesh. *J. Agric. Food Res*. **6**: 4-7.

2. BARC (Bangladesh Agricultural Research Council) (2021). Availability and price volatility ofrice, potato and onion in Bangladesh: an inter-institutional study in 2020. Published by:Agricultural Economics and Rural Sociology Division Bangladesh Agricultural ResearchCouncil (BARC). pp. 82-102.

3. BBS (Bangladesh Bureau of Statistics). (2022). Summary crop statistics area, yield rates andproductions of minor crops in 2020-21 and 2021-22. Bureau of Statistics, Statistics andInformatics Division, Ministry of Planning, Government of the Peoples Republic ofBangladesh, Dhaka. pp. 1-3.

4. Biswas, S.C. (2021). Development of a new improved onion variety through selection. BRACAgricultural Research and Development Centre, BRRI, Joydebpur, Gazipur, Bangladesh.pp. 1-4.

5. Saddam, M.R.H. (2018). Profitability of onion cultivation in selected areas of Pabna district inBangladesh. MS thesis, department of development and poverty studies. pp. 1-66.

6. Gererufael, L.A., Abraham, N.T. and Reda, T.B. (2020). Growth and yield of onion (*Alliumcepa* L.) as affected by farmyard manure and nitrogen fertilizer application in TahtayKoraro District, Northwestern Zone of Tigray, Ethiopia. Vegetos. **33**: 617-627.

7. El-Morsy, A.E., El-Kassas, A.A.I. and El-Tantawy, E.M. (2016). Onion plant growth andyield as affected by nitrogen, potassium and sulphur combinations under El-Arish regionconditions. *Sinai J. App. Sci*. **5**(3): 345-362.

8. Balvir, K., Sraw, P.K., Kaur, A. and Singh, K. (2017). Effect of potash and sulphur on yieldand quality parameters under different planting methods in onion. *J. App. Nat. Sci*. **9**(4):2434-2437.

9. Deepa, A.H., Wagh, A.P., Nagre, P.K. and Kale, V.S. (2018). Effect of different doses andsplits of potassium on quality of onion. *Int. J. Pure App. Biosci*. **5**(6): 908-912.

10. Kitila, C., Abraham, A. and Shuma, S. (2022). Growth and bulb yield of some onion (alliumcepa L.) varieties as influenced by NPS fertilizer at Dambi Dollo University research site,Western Ethiopia. Cogent Food Amp. *Agric*. **8**(1): 1-11.

11. Tadesse, A. and Bekele, Y. (2022). Evaluation of improved onion (Allium Cepa L.) varietiesfor growth and bulb yield under irrigated condition in lowland area of south omo zone,Southern Ethiopia. *Adv. Crop Sci. Tech*. **10**(5): 510.

12. Dubey, S., Verma, S., Chandrakar, K. and Keshari, R. (2019). Suitability of kharif onionvarieties in mahasamund district of Chhattisgarh. *J. Krishi Vigyan*. **7**(2): 243-247.

13. Ahmed, S., Rahim, M., Moniruzzaman, M., Khatun, M., Jahan, F. and Akter, R. (2021).Effect of bulb sizes on the seed yield of two onion (*Allium Cepa* L.) varieties. *SAARC J.Agric*.**18**(2): 51–65.

14. Demisie, R. and Tolessa, K. (2018). Growth and bulb yield of onion (*Allium cepa* L.) inresponse to plant density and variety in Jimma, South Western Ethiopia. *Adv. Crop Sci.Tech*. **6**: 1-6.

15. Gosai, J.A., Rathawa, S.N., Dhakad, R.J., Jatav, A. and Verma, L.R. (2018). Evaluation ofdifferent varieties of onion (*Allium cepa* L.) under North Gujrat condition. *Int J. Curr.Microbiol. App. Sci*. **7**: 3775-3780.

16. Nand, M.M., Singh, S.P., Kishor, K., Kumar, A., Alam, M.M. and Kumar, V. (2020).Impact of split application of potassium on inbred and hybrid rice yield and its attributesin calcareous soil. *Int. J. Curr. Microbiol. App. Sci.***9**(3): 3279-3286.

17. Naher, M.S., Brahma, S., Islam, M.A., Sarkar, M.B., Hasan, M.M. and Fahim, A.H.F (2017).Productivity of summer onion to different sources and levels of potash. *Bangladesh Agron. J.***20**(1), 37-43.

18. Deepa, A.H., Wagh, A.P., Nagre, P.K. and Kale, V.S. (2018). Effect of different doses andsplits of potassium on quality of onion. *Int. J. Pure App. Biosci.***5**(6): 908-912.

19. Kumara, B.R., Mansur, C.P. Girish, C., Wani, S.P., Allolli, T.B., Jagadeesh, S.L., Mesta,R.K., Satish, D., Shankar, M. and Sanjeevraddi, G.R. (2018). Effectof potassium levels, sources and time of application on yield of onion (*Allium cepa* L.). *Int. J.Pure App. Biosci*. **6**(2): 540-549.

20. Geries, L.S.M., Marey, R.A. and Morsy, M.G. (2011). Growth, yield and storability of onionas influenced by potassium fertilizer application time and urea as foliar spray. *J. PlantProd. Mansoura Univ.***2**(8): 1073 – 1090

21. Ahmad, N., Sarfraz, M., Farooq, U., Arfan-ul-Haq, M., Mushtaq, M.Z. and Ali, M.A.(2015). Effect of potassium and its time of application on yield and quality of tomato. *Int.J. Sci. Res. Pub.***5**(9): 1-4.

22. Holer, D.A. (2017). Effect of different doses and splits of potassium on growth, yield, qualityand storage of onion. Ms thesis. Department of horticulture. Dr. Panjabrao DeshmukhKrishi Vidyapeeth Krishinagar Po, Akola, India. pp. 115-120.

23. Islam, M.A., Shamsuddoha, A.T.M., Bhuiyan, M.S.I. and Hasanuzzaman, M. (2008).Response of summer onion to potash and its application methods. *American-Eurasian J.Agron*. **1**(1): 10-15.