https://doi.org/10.3126/adj.v17i1.67874

PLANT CHARACTERISTICS AND BULB YIELD OF ONION AS INFLUENCED BY FARM YARD MANURE AND POTASSIUM APPLICATION UNDER MAIZE-BASED CROPPING SYSTEM AT DAILEKH

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ABSTRACT

This study was conducted to investigate the effect of different levels of farm yard manure (FYM) (0, 10 and 20 t/ha) and potassium (K_2O) fertilization (0, 30, 60 and 90 kg/ha) on plant characteristics and bulb yield of onion cv. 'Red Creole' at Horticulture Research Station (HRS), Dailekh during two consecutive years (2019 and 2020). Experiments were laid out in factorial randomized complete block design with three replications. The combined analysis revealed that FYM significantly affected on plant height, number of leaves/plant, leaf length, bulb diameter, bulb weight and bulb yield. But the significant effect of K_2O was observed on plant height, number of leaves/plant, leaf length, bulb weight and bulb yield. The highest bulb yield (37.4 t/ha) was recorded at the treatment of 10 t/ha FYM, whereas K_2O fertilization at 90 kg/ha produced the highest (39.9 t/ha) bulb yield. The combined application of 10 t/ha FYM and 30 kg/ha K_2O produced the highest (41.7 t/ha) bulb yield and found the best treatment combination from the benefit cost ratio analysis. Therefore, the combination of 10 t/ha FYM with 30 kg/ha K_2O can be recommended to apply at the soils having medium organic matter and high K_2O content to get the highest bulb yield at maize-based cropping system of upland condition in Dailekh.

Keywords: Bulb yield, Combined analysis, Cropping system, Potassium, Upland

1. INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetables worldwide and used as flavorings or as vegetables in stews, and salads. Onion is the best sources of flavonoids in the human diet, which is related to reduce the risk of cancer, heart disease and diabetes (Gereufael et al., 2020). In Nepal, it ranks at the third position among the production of vegetables after tomato and cabbage (Acharya & Shrestha, 2018). According to the statistics of MoALD (2020), onion is cultivated in 20, 424 ha land with a total production of 2, 84,926 t with productivity of 13.9 t/ha. The productivity is quite low compared to India (16.18 t/ha). Despite the different factors affecting onion production, unbalanced fertilizer application and inappropriate fertilizer rate are the major reasons for low onion productivity in Nepal.

Organic manures are commonly used as an important component of nutrient supply system and to improve crop yield (Shah et al., 2019). FYM improves soil physical and chemical properties that are important for plant growth. Moreover, organic fertilizers have positive effect on root growth by improving the root rhizosphere conditions and also plant growth is encouraged by increasing the population of microorganisms (Shaheen et al., 2007). Organic

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fertilizers are easily available and can be applied to reduce the amount of chemical fertilizers. Organic manure is not just to reduce the chemical fertilizers, its necessary to have a balanced use of chemical and organic fertilizers so that adverse effect of chemical fertilizers can be minimized. FYM with balanced amount of chemical fertilizer helps in improving the fertility, productivity and physical properties of the soil (Abusaleha & Shanmugavelu, 1988). K_2O is the third essential primary plant nutrient which is required for the plants in large amount. It is required for photosynthesis, fruit formation, osmotic regulations, disease resistance, promotion of enzymes activity, translocation of assimilates and maintaining agronomic productivity and sustainability (Mengel, 1985). Continuous use of potassic fertilizers alone through inorganic sources affects soil productivity and, thus results in lower yield with poor quality of produce (Mamatha, 2006). The role of K_2O in the activation of many enzymes, storage qualities, increased bulb sizes and bulb yield has reported (Pachuri et al., 2005).

Most researches in onion crop in Nepal so far are focused on variety evaluation (Gautam et al., 2019; Luitel et al., 2021) and seed production techniques (Tiwari, 2014; Bhusal & Luitel, 2023). But the effect of FYM and K_2O fertilizers on bulb production particularly in maize-based cropping system at upland condition of mid-hill has not been studied yet. The effect of K_2O on bulb yield has been studied by previous researchers in different countries (Rani & Jha, 2018; Andishmand & Norri, 2021). The application of inorganic fertilizers without the use of organic manure has resulted micronutrient deficiencies, imbalance soil physical and chemical properties and unsustainable crop production (Yohannes et al., 2017). This research was carried out to ascertain the effect of FYM and inorganic K_2O on plant characteristics and bulb yield of onion cv. 'Red Creole' at upland condition of Dailekh.

2. MATERIALS AND METHODS

2.1 STUDY AREA AND EXPERIMENTAL MATERIALS

The experiments were carried out in 2019 and 2020 from November to the end of May at Horticulture Research Station (HRS), Dailekh (28˚50'49.8" N longitude and 81˚43'19.4" E latitude, at an elevation of 1, 255 m above sea level). According to the agro-climatic classification of Nepal, the climatic zone of the study area is generally sub-tropical with an extended dry period ranging from October to May (seven to eight months). A maximum effective rainy season ranges from 120 to 140 days with average rainfall of 470 mm. The area has average temperature of 15°C with a mean maximum temperature of 26.5°C in May and minimum temperature of 6.8°C in January (HRS, 2020). The soil texture of the study site is clay loam with pH 5.6–6.0 (HRS, 2020). The maize was preceding crop in the experimental site and trial was conducted in upland condition. The cropping pattern was maize-vegetables. 'Red Creole', a popular variety having the characteristic of long storability and strong pungent was used as an experimental material. For the experiments, the seeds produced at HRS, Dailekh were used.

2.2 EXPERIMENTAL DESIGN AND PLANT CULTIVATION

Experiment was designed in factorial randomized complete block with three replications, consisting of 12 treatments with three replications. Three levels of FYM (0, 10, and 20 t/ha) and

four levels of K_2O (0, 30, 60 and 90 kg/ha) were applied to the soil at different combinations. But recommended dose of nitrogen (N) and phosphorous (P_2O_5) i.e. 100 kg/ha and 80 kg/ha was consistently applied to all the treatments. The experimental plot was ploughed three times followed by levelling and marked out into blocks and plots. The spacing between the blocks and plots were 1.0 m and 0.5 m, respectively. Field experiments were laid out in factorial randomized complete block design with three replications. The inorganic fertilizers used were N in the form of Urea (46% N), P_2O_5 in the form of diammonium phosphate (DAP, 18% N, 46% P_2O_5), K_2O in form of muriate of potash (MoP, 60% K_2O). The well-rotted FYM was collected from the research station. The half amount of N, full doses of P_2O_5 and K_2O, and FYM were applied uniformly to all the plots before seedling transplanting. Remaining half amount of nitrogen was top-dressed equally at 40 and 60 days after transplanting. The plot size for each treatment was maintained at 2 m^2 with plant spacing of 20 cm × 20 cm and five rows were maintained at each plot. Ten seedlings (40 days-old) were were transplanted on December 15 in 2019 and 2020, and each treatment consisted of 50 seedlings. Soil samples were taken at 0-15 cm depth block wise before treatment application and analyzed for pH, organic matter (OM), N, P_2O_5 and K_2O at Regional Soil Testing Laboratory, Department of Agriculture, Khajura, Banke. Intercultural practices including irrigation, weeding and top-dressing were done as recommended by Chalise and Pun (2015).

2.3 DATA COLLECTION

Data on plant height, number of leaves/plant, leaf length, bulb diameter and individual bulb weight were collected from five randomly selected plants excluding the border plants. Plant height (cm) was measured using a meter scale from the ground level to the tip of the terminal leaves of five randomly selected plants at the maturity time and averaged. Number of leaves/plant was counted from five randomly selected plants at maturity and averaged. Leaf length (cm) was measured at physiological maturity stage from the sheath to tip of the leaf of five plants using a meter ruler and averaged it. Bulb diameter (mm) was measure at the widest portion of matured bulbs at harvest using digital Vernier caliper (150mm, Model: DC-515) and averaged. Individual bulb weight (g) was weighted on randomly selected five bulbs using digital balance (H-Honda™, India) and averaged it. Total bulb fresh weight (kg) was measured at all harvested bulbs in each plot that were measured in kg/plot and finally converted into bulb yield (t/ha).

2.4 STATISTICAL ANALYSIS

Data were subjected to analysis of variance (two-way ANOVA) using GenStat Release 10.3 DE Software (VSN International Ltd., UK) Discovery Edition. Pearson's correlation was estimated to see the association between different characters using SPSS 20.0 statistical analysis package (SPSS Inc., Chicago, IL, United States). Besides, cost of FYM, urea, DAP and MoP were taken from the market, and information on market price of onion bulbs was collected to calculate the benefit-cost ratio.

3. RESULTS AND DISCUSSION

3.1 PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

The physical and chemical analysis of experimental soil was analyzed after harvesting the maize crop. The results of soil analysis showed the acidic pH (5.6), medium OM (2.5%), medium total N (0.13%), high available P_2O_5 (88.8 kg/ha) and available high K_2O (315.0 kg/ha). The textural class of soil found to be clay loam. The total N of experimental soil was 0.13% which is considered as medium according to Tekalign et al. (1991). According to the rating of Bruce and Rayment (1982), pH is classified as acidic, neutral and alkaline. The optimum pH for onion production ranges from 6 to 8 (Nikus and Mulugeta, 2010). Olsen et al. (1954) stated that the availability of phosphorous >25.0, 18.0–25.0. 10.0–17.0, 5.0–9.0 and < 5.0 mg/kg are classified as very high, high, medium, low and very low, respectively. According to Maria and Yost (2006), organic carbon content of <1.5, 1.5–2.5 and >2.5% were grouped as low, medium and high, respectively. The available potassium <110.0 kg/ha, 110.0–280.0 kg/ha and >280.0 kg/ha is considered as low, medium and high, respectively.

3.2 EFFECT OF FYM AND K_2O ON PHENOLOGICAL CHARACTERS

Plant height

Plant height of onion was significantly ($P<0.05$) influenced as the main effect of FYM and K_2O fertilization (Table 1). The results showed that plants grown at 20 t/ha FYM produced the highest (62.8 cm) plant height, but the plants grown at 0 t/ha FYM and 10 t/ha FYM did not show statistically different plant heights. Plant height measured at 60 kg K_2O/ha produced higher (62.9 cm) than the rest of the treatments, although it was statistically similar with those treated with 30 t/ha and 60 K_2O kg/ha. Aftab et al. (2017) have stated the maximum plant height (48.16 cm) of onion at 120 kg K_2O/ha and minimum (33.9 cm) at control treatment. The interaction effect between FYM and K_2O on plant height was significant ($P<0.05$). But in a study by Andishmand and Norri (2021), they have reported the maximum plant height (50.5 cm) at the combination of 20 t/ha FYM + 150 kg/ha N+100 kg/ha P_2O_5+100 kg K_2O.

Leaf number

Main effect of FYM on number of leaves/plant was significant ($P<0.05$). However, the number of leaves/plant at FYM treatments were not statistically different. But effect of K_2O fertilization had highly significant ($P<0.01$) effect on number of leaves/plant. The highest (10.5/plant) leaf number was recorded at the plot treated with 60 kg/ha and rests of the treatment showed statistically similar number of leaves/plant (Table 1). But in a study by Aftab et al. (2017), they reported the highest number of leaves (7.5/plant) at 120 kg K_2O/ha. But interaction effect of FYM and K_2O on number of leaves/plant was non-significant ($P<0.05$). The highest number of leaves/plant (15.4) were recorded at the treatment of 150 kg N/ha and 45 t FYM/ha and the lowest was in control (Kokobe et al., 2013). But in our study, the levels of FYM did not show statistically different in number of leaves/plant. The increase number of leaves/plant in response to the increased application of K_2O fertilization might be due to role of K_2O in plant metabolic process including synthesis, transport and storage of photoassimilates that plays shoot growth in plants (Hawkesford, 2012).

Leaf length

Main effects and their interaction had significantly (P<0.05) affected the length of leaves (Table 2). The highest (51.7 cm) leaf length was measured at 20 t/ha FYM, but it showed statistically similar with the treatment of 10 t/ha FYM. Kokobe et al. (2013) indicated that the leaf length was increased by 28% with the application of FYM compared with the control. Our study showed that the application of 10 t and 20 t FYM/ha gave 4.15 % and 6.18% higher leaf length than that of control. Bagali et al. (2012) reported that the availability of higher quantities of nutrients, improvement of physical properties of soil and increased activity of microbes with higher levels of organic matters helps in increasing vegetative growth. In this study, FYM also improved the physical properties of the soil which might be increased the uptake of nutrients and that might be helped in increasing leaf growth of onions. Likewise, the leaf length measured at 30, 60 and 90 kg K_2O/ha treatments was not significantly different, but the lowest (47.9 cm) leaf length was measured at control treatment. FYM and K_2O interaction on leaf length was significantly (P<0.05) different (Table 1).

Table 1. Effect of FYM and K_2O on plant height, number of leaves/plant and leaf length of onion at HRS, Dailekh, 2019 and 2020

Treatments	Plant ht. (cm)		Mean	Leaf (no./ plant)		Mean	Leaf length (cm)		Mean
	2019	2020		2019	2020		2019	2020	
FYM, t/ha									
0	54.5	67.3	60.8	10.0	9.0	9.5	46.8	50.1	48.5
10	55.7	65.3	60.8	11.0	9.0	10.0	48.7	52.5	50.6
20	59.5	66.2	62.8	11.0	9.0	10.0	49.8	53.6	51.7
F-Test			*			*			*
LSD (0.05)			1.98			0.53			2.25
K_2O, kg/ha									
0	53.4	65.7	59.6	10.0	9.0	9.5	46.4	49.5	47.9
30	57.1	65.2	61.1	11.0	9.0	10.0	49.4	52.9	51.2
60	57.5	66.6	62.1	11.0	10.0	10.5	48.4	52.1	50.2
90	58.3	67.5	62.9	12.0	9.0	10.5	49.5	53.8	51.6
Mean	56.57	66.24	61.41	10.88	9.24	10.20	48.43	52.07	50.25
F-Test			*			**			*
LSD (0.05)			2.28			0.61			2.60
FYM × K_2O			*			NS			*
LSD (0.05)			3.96			1.05			4.50
CV (%)			5.6			9.1			7.7

Note: NS: Non-significant at p<0.05, *significant at p<0.05, **highly significant at p<0.01.

The interaction effect of FYM and K_2O on plant height and leaf length is given in Table 2. The highest plant height (63.7 cm) was measured at 10 t FYM/ha along with 90 kg K_2O/ha, but the value was not statistically different from rest of the treatments except 10 t FYM/ha and 0 kg K_2O/ha and control. Similarly, the combined application of 20 t FYM/ha along

with 90 kg K_2O resulted the highest leaf length (52.8 cm), but the value was not statistically different from the rest of the treatments except control. The lowest leaf length (41.8 cm) was measured at control.

Table 2. Interaction effect of FYM and K_2O on plant height and leaf length of onion at HRS, Dailekh

FYM, t/ha	Plant height (cm)				Leaf length (cm)			
	K_2O, kg/ha				K_2O, kg/ha			
	0	30	60	90	0	30	60	90
0	53.3	62.0	60.7	62.4	41.8	50.8	50.9	50.3
10	57.4	60.1	60.7	63.7	48.7	51.6	50.1	51.9
20	63.4	60.7	64.7	62.6	53.3	51.1	49.7	52.8
LSD (0.05)				3.97				4.50
CV (%)				5.6				7.7

4. EFFECT OF FYM AND K_2O ON BULB CHARACTERISTICS AND YIELD

4.1 BULB DIAMETER

FYM had highly significant ($P<0.01$) effect on bulb diameter and treatment treated with 20 t FYM/ha produced the highest (77.7 mm) bulb diameter. However, it was statistically similar with treatment treated with 10 t/ha FYM. Main effect of K_2O and their interaction effect on bulb diameter was non-significant ($P>0.05$) (Table 3). In contrast, Aftab et al. (2017) have reported the significant differences in bulb diameter in various K_2O fertilization.

4.2 AVERAGE BULB WEIGHT

Individual bulb weight had highly significantly ($P<0.01$) affected by FYM treatments (Table 3). The individual bulb weight was highest (181.1 g) at 20 t/ha FYM treated plot, whereas the lowest (155.0 g) bulb weight was obtained from nil application of FYM. Abbey and Kanton (2004) have reported that number of leaves/plant and leaf length increase in response to FYM application which results in an increase in assimilate production and allocation to the bulb. In this study, the increase in leaf length might also be contributed to enhance the onion bulb weight. Application of K_2O fertilization did not produce significantly different bulb weight. However, FYM and K_2O interaction on individual bulb weight was non-significant ($P<0.05$) (Table 3).

4.3 BULB WEIGHT

Main effect of FYM and K_2O on bulb weight was highly significant (Table 3). The highest bulb weight (7.5 kg/plot) was recorded at 10 t/ha FYM, but it showed statistically similar with treatment treated with 20 t/ha FYM (7.4 t/ha). Likewise, bulb weight produced the highest (7.9 kg/plot) at the treatment treated with 90 kg/ha K_2O but it was statistically similar with the treatment treated with 60 kg/ha K_2O (7.4 kg/plot). The lowest (6.1 kg/plot) was produced at control plot. Interaction effect between FYM and K_2O was significant ($P<0.05$) on bulb weight (Table 3).

4.4 BULB YIELD

Bulb yield of onion was significantly ($p<0.01$) affected by FYM and K_2O fertilization (Table 3). Bulb yield was the highest (37.4 t/ha) at the treatment of 10 t/ha FYM which is statistically similar with bulb yield obtained at treatment of 20 t/ha FYM. However, the lowest bulb yield (31.6 t/ha) was obtained from nil application of FYM. Jawadagi et al. (2014) have reported the highest bulb yield at FYM applied plots. The addition of FYM into the soil facilitates to breakdown the complex nitrogenous compounds and makes steady N supply throughout the growth period of the crop. This process might be attributed to more availability and uptake of nutrients by the crop and increases the crop yield. Bagali et al. (2012) have reported the similar results of organic manures application in onion. Further, increased bulb yield in onion using the combined application of organic manure and chemical fertilizer has reported by Rawal (2014). Gereufael et al. (2020) reported the highest bulb yield (35.9 t/ha) in the combined application of 103.5 kg/ha N + 30 t/ha FYM/ha. Onion fertilized with 90 kg/ha K_2O produced the highest (39.9 t/ha) and the lowest bulb yield (30.3 t/ha) was produced at nil K_2O treated plants.

Table 3. Effect of FYM and K_2O on bulb traits, bulb weight and bulb yield of onion at HRS, Dailekh, 2019 and 2020

Treatments	Bulb diam. (mm)		Mean	Ind. Bulb wt. (g)		Mean	Bulb wt. (kg/ plot)		Mean	Total bulb yield (t/ha)		Mean
	2019	2020		2019	2020		2019	2020		2019	2020	
FYM, t/ha												
0	76.5	69.1	72.8	133.6	176.5	155.0	6.4	6.3	6.3	31.7	31.4	31.6
10	76.7	73.6	75.2	154.3	176.4	165.3	7.5	7.5	7.5	37.3	37.4	37.4
20	77.6	77.7	77.7	178.2	184.0	181.1	6.5	8.3	7.4	32.7	41.4	37.1
F-Test			**			**			**			**
LSD (0.05)			2.36			13.71			0.56			2.80
K_2O, kg/ha												
0	76.4	72.6	74.5	148.5	168.2	158.3	5.7	6.5	6.1	28.5	32.2	30.3
30	76.2	77.0	76.6	168.0	174.2	170.6	6.9	7.2	7.1	34.8	36.2	35.5
60	79.0	73.2	76.1	154.1	191.8	172.9	6.7	7.6	7.4	33.7	37.8	35.7
90	76.2	71.0	73.6	151.9	181.8	166.8	7.8	8.2	7.9	38.7	41.0	39.9
Mean	76.93	73.45	75.19	155.4	179.0	167.2	6.78	7.36	7.07	33.93	36.80	35.36
F-Test			NS			NS			**			**
LSD (0.05)			2.73			15.83			0.64			3.23
FYM×K2O			NS			NS			*			*
LSD (0.05)			4.73			27.42			1.12			5.68
CV (%)			5.4			14.1			11.0			13.6

Note: NS: Non-significant at $p<0.05$, *significant at $p<0.05$, **highly significant at $p<0.01$.

The interaction effect of FYM and K_2O on bulb weight and yield was significant ($P<0.05$) (Table 4). The maximum (8.5 kg/plot) bulb weight was recorded at 10 t FYM in combination with 90 kg K_2O, but it was statistically similar with 0 t FYM + 90 kg K_2O/ha, 10 t FYM + 30 kg K_2O/ha, 20 t FYM + 60 kg K_2O and 20 t FYM + 90 kg K_2O/ha. With regard to bulb yield,

the combination of 10 t/ha FYM at each 30 kg and 90 kg K_2O/ha produced 41.7 t/ha and 42.2 t/ha, respectively. Furthermore, plots treated with 20 t/ha FYM in combination with 90 kg/ha K_2O yielded 39.9 t/ha. Yohannes et al. (2013) mentioned that the combined application of 150 kg/ha N and 45 t/ha FYM produced the highest bulb yield (36.85 t/ha). But in this study, we found that FYM at 10 t/ha in combination with 30 kg K_2O also resulted similar yield to that of 10 t FYM/ha + 90 kg K_2O/ha and 20 t FYM + 90 kg K_2O/ha applied.

Table 4. Interaction effect of FYM and K_2O on bulb weight and bulb yield of onion at HRS, Dailekh

FYM, t/ha	Bulb weight (kg/plot)				Bulb yield (t/ha)			
	K_2O, kg/ha				K_2O, kg/ha			
	0	30	60	90	0	30	60	90
0	4.9	6.2	6.7	7.5	24.7	30.9	33.3	37.5
10	6.2	8.3	6.9	8.5	30.8	41.7	34.9	42.2
20	7.1	6.8	7.8	8.0	35.6	33.9	38.9	39.9
LSD (0.05)				1.12				5.60
CV (%)				11.1				13.6

4.5 CORRELATION AMONG THE MEASURED TRAITS

The Pearson's correlation coefficients of plant and bulb traits in onion are presented in Table 5. Plant height was positively and significantly correlated with leaf length (r = 0.65**), bulb diameter (r = 0.33**), individual bulb weight (r = 0.41**), bulb weight (r = 0.31**) and bulb yield (r = 0.32**). Number of leaves/plant showed significant and positive association with individual bulb weight (r = 0.40**), bulb weight (r = 0.47**) and bulb yield (r = 0.46**). Bulb diameter was positively and significantly correlated with individual bulb weight (r = 0.89**), bulb weight (r = 0.49**) and bulb yield (r = 0.52**). A strong positive and highly significant correlation was found between bulb weight and bulb yield (Table 4). The significant and positive correlation between average bulb weight and bulb yield was reported by Gereufael et al. (2020).

Table 5. Pearson's correlation coefficients of plant and bulb traits in onion at HRS, Dailekh, 2019-2020

Variables	PHT	LN	LL	BD	IBWT	BWT	BY
PHT	1.0	−0.19	0.65**	0.33**	0.41**	0.31**	0.32**
LN		1.0	−0.12	−0.14	0.40**	0.47**	0.46**
LL			1.0	0.26*	0.31*	0.32*	0.31*
BD				1.0	0.89**	0.49*	0.52**
IBWT					1.0	0.38*	0.42**
BWT						1.0	0.98**
BY							1.0

Note: *significant at $p<0.05$; **highly significant at $p<0.01$. PHT: Plant height (cm), LN: Leaf (no./plant), LL: Leaf length (cm), BD: Bulb diameter (mm), IBWT: Individual bulb weight (g), BWT: Bulb weight, BY: Bulb yield (t/ha).

4.6 ECONOMIC ANALYSIS

The economic analysis on use of FYM in onion production is given in Table 6. Marginal rate of return was 22.2 which is high, was obtained from the plots with 10 t/ha FYM applied.

Table 6. Economics of FYM use in onion at HRS, Dailekh, 2019-2020

FYM (t/ ha)	Value of added nutrient cost (Rs.)	Bulb yield (t/ha)	Yield increment (t/ha)	Value added onion cost (Rs.)	Marginal rate of return (MRR)
0	0	31.6	0	0	0
10	10,000	37.4	5.8	2,32,000.0	22.2
20	20,000	37.1	5.5	2,20,000.0	10.0

The economics of different levels of K_2O fertilization onion is estimated and presented in Table 7. The marginal rate of return was higher (74.6) in 30 kg K_2O/ha than rests of the treatments.

Table 7. Economics of K_2O use in onion at HRS, Dailekh, 2019-2020

K_2O (t/ha)	Value of added nutrient cost (Rs.)	Bulb yield (t/ha)	Yield increment (t/ha)	Value added onion cost (Rs.)	Marginal rate of return (MRR)
0	0	30.3	0	0	0
30	2,750	35.5	5.2	2,08.000	74.6
60	5,500	35.7	5.4	2,16,000	38.3
90	11,000	39.9	9.6	3,84,000	33.9

Benefit cost analysis of different levels of FYM and K_2O in onion is given in Table 8. In this study, benefit cost ratio showed the highest (53.0) at the treatment combination of 0 t/ha FYM + 100 kg N/ha + 80 kg P_2O_5/ha + 30 kg K_2O/ha and the lowest (30.2) was in 20 t/ha FYM + 100 kg N/ha + 80 kg P_2O_5/ha + 90 kg K_2O.

Table 8. Effect of different FYM and K_2O combination on its economic benefit and production cost/ha (all other factors remain constant) at HRS, Dailekh, 2019-2020

FYM:N:P_2O_5:K_2O, kg/ ha	Bulb yield (t/ha)	Fertilizer cost (Rs.)	Total income, (Rs.)	Net benefit, (Rs.)	Benefit cost ratio
0+100+80+0	24.7	20,130	9,88,000	9,67,870	48.1
0+100+80+30	30.9	22,880	12,36,000	12,13,120	53.0
0+100+80+60	33.3	25,630	13,32,000	13,06,370	50.9
0+100+80+90	37.5	31,130	15,00,000	14,68,870	47.1
10+100+80+0	30.8	30,130	12,32,000	12,01,870	39.8
10+100+80+30	41.7	32,880	16,68,000	16,35,120	49.7
10+100+80+60	34.9	35,630	13,96,000	13,60,370	38.2
10+100+80+90	42.2	41,130	16,88,000	16,46,870	40.0
20+100+80+0	35.6	40,130	14,24,000	13,83,870	34.5
20+100+80+30	33.9	42,880	13,56,000	13,13,120	30.6
20+100+80+60	38.9	45,630	15,56,000	15,10,370	33.1
20+100+80+90	39.9	51,130	15,96,000	15,44,870	30.2

5. CONCLUSION

We studied the effect of FYM and K_2O fertilization on plant characteristics and bulb yield of onion in two years (2019 and 2020) at Dailekh. The main effects of FYM and K_2O on plant height, number of leaves/plant, leaf length, bulb weight and bulb yield were found significantly different. The combination of 10 t/ha FYM with each 30 kg and 90 kg K_2O produced 41.7 t/ha and 42.2 t/ha, respectively. But marginal rate of return was higher in 10 t/ha FYM and 30 kg/ha K_2O used. The bulb yield at 10 t/ha FYM along with 30 kg/ha K_2O had significantly higher than nil FYM and 30 kg/ha K_2O applied. Considering the cropping pattern, existing soil properties, available resources and yield, present study is recommended 10 t/ha FYM along with 30 kg/ha K_2O for sustainable onion production. This recommended fertilizer would be appropriate for onion cultivation having similar soil properties of maize-based cropping system under upland condition of Dailekh. Since the experimental plot consisted of high K_2O status, further study is needed to narrow down ranges of K_2O (less than 30 kg K_2O/ha) in order to determine its effect on growth and bulb traits. In addition, the effects of FYM and K_2O fertilization on bulb yield, nutrient uptake, soil physical and chemical properties, bulb quality and storability need to be further investigated at maize-based cropping system in mid-hills of Nepal for for corroborating these results.

DECLARATION

The authors declare no conflict of interest.

ACKNOWLEDGMENT

This work was carried out from the financial support of 'The Feed the Future (FTF)', Nepal Seed and Fertilizer Project (NSAF), International Maize and Wheat Improvement Center (CIMMYT), USAID, Nepal.

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