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Effect of Graded Levels of Nitrogen and Potassium on Growth and Yield of Elephant Foot Yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson] Under Terai Region of West Bengal

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ABSTRACT: In the current status of research on this so far, a very meager number of findings on nutrient management with nitrogen and potassium fertilizer applications are available in the Terai region of West Bengal. Therefore, it has become very important to find out how appropriate fertility levels affect the growth and yield of elephant foot yam in this region. The present experiment was conducted at the Experimental Farm, Regional Research Sub-Station (TZ), Uttar Banga Krishi Viswavidyalaya, Kharibari, Darjeeling during 2019-20 and 2020-21 to study the effect of nitrogen and potassium on growth and yield of elephant foot yam var. Bidhan Kusum. The experiment was laid out in 5 x 3 factorial randomized block design (RBD) with three replications. Individually, nitrogen and potassium levels had a significant impact on practically all growth including plant height, canopy spread and leaflet number and yield indices. Among the treatments investigated, T_{11} (N @ 200 kg/ha and K_2O @ 100 kg/ha) produced the highest corm yield in terms of corm bulking rate (CBR), corm diameter, corm weight and corm yield during both trials. As a result, fertilizer doses of 200 kg/ha nitrogen and 100 kg/ha potassium may be recommended for higher yields of elephant foot yam under Terai agro-climatic conditions in West Bengal.

Keywords: Elephant foot yam, nitrogen, potassium, growth, yield.

INTRODUCTION

Under the family Araceae, elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is recognized as the "King of Tuber Crops". The crop is also known as "oal" or "oalkochu" in West Bengal, and various more names such as "suran" and “jimikand” are used throughout the country (Ravi *et al*., 2009; Kundu *et al*., 1998). It is the most well-known and widely farmed species of edible aroid. With a diploid chromosomal number of 2n = 28, it is thought to be endemic to tropical Asia, Southeast Asia, and Africa (Swarup, 2006). This crop is grown in India and many other countries, including the Philippines, Java, Indonesia, Malaysia, Bangladesh, China, and countries in south-eastern Asia (Sugiyama and Santosa 2008; Chandra, 1984). The Pacific Islands view it as a famine food. Due to its great production potential, higher biological efficiency, acceptable culinary features, medicinal utility, and therapeutic values, it is becoming more and more popular among farmers in our nation as a cash crop. It is also thought to have blood-purifying qualities. Elephant foot yam's position has been elevated from a small-scale subsistence crop to a large-scale commercial crop since it is widely used for culinary purposes, pickle production, and is an effective treatment for patients suffering from piles, asthma, dysentery, and stomach pain (Misra *et al.*, 2002). Elephant foot yam is one of the most nutritious tuber crops with 79% moisture and 100 g of tuber containing 1.2 g of protein, 0.1 g of fat, 18.4 g of carbohydrates, 0.8 g of minerals and fibers each, 50 mg of calcium, 34 mg of phosphorus, 0.6 mg of iron and 260 IU of vitamin A (Chattopadhyay *et al*., 2010; Ravi *et al*., 2009). The crop is also regarded as a highly lucrative crop since it can yield more dry matter per unit area than other vegetable crops. The crop has a production potential of 50–80 t/ha with a net economic return of over 1 lakh rupees per hectare. Since in other countries it is cultivated as an underutilized crop, this crop offers good export potential to our country (Srinivas and Ramanathan 2005; Misra *et al*., 2001; Misra and Shivalingaswamy 1999). Elephant foot yam thrives in hot (250-350°C) and humid environments. Fertile, sandy loam soils with evenly distributed rainfall of 1000-1500 mm and sufficient drainage systems are required for effective cultivation. Elephant foot yam is currently endangered in West Bengal's Terai Teesta Alluvial Zone, which includes the districts of Cooch Behar, Jalpaiguri, Darjeeling Plains, and Uttar Dinajpur. During the first advance estimates for 2021-22, the National Horticultural Board (NHB) reported that West Bengal ranks top, accounting for around 41.87% of Indian elephant foot yam production (NHB, 2021-22). As a result, this crop has a lot of room to grow in terms of both area and productivity in this part of West Bengal.

MATERIAL AND METHODS

The current study was conducted in 2019-20 (Y_1) and 2020-21 (Y_2) at the Experimental Farm, Regional Research Sub-Station (TZ), Uttar Banga Krishi Viswavidyalaya, Kharibari, Darjeeling, West Bengal. During both growth seasons, the months of May through September received most rainfall. The 500g cut corms of elephant foot yam cv. Bidhan Kusum were planted at a spacing of 90 cm × 75 cm on the 1^{st} week of April before the onset of monsoon under rainfed condition. The experiment was laid out in RBD with three replications. The treatments consist of five (5) nitrogen levels (N_1: 50 kg/ha; N_2: 100 kg/ha; N_3: 150 kg/ha; N_4: 200 kg/ha and N_5: 250 kg/ha) and three (3) potassium levels (K_1: 50 kg/ha; K_2: 100 kg/ha and K_3: 150 kg/ha) with FYM (25t/ha) and phosphorus (60kg/ha). Full dose of P_2O_5 along with $1/4^{th}$ of N and K_2O was applied as basal dose at the time of planting and remaining $3/4^{th}$ of N and K_2O was applied in three split doses (35 DAP, 75 DAP and 105 DAP). Table 1 represents the treatment details.

Five randomly chosen plants from each replication were observed for various growth parameters, such as plant height (cm), pseudo stem diameter (cm), number of leaflets per plant, and canopy spread (cm), at five months after planting (MAP), and the yield traits, such as corm diameter (cm), corm weight (kg/plant), corm yield per plot (kg/13.5 sqm), and corm yield per hectare (t/ha), were observed at harvest. Three, five, and seven months (3 MAP, 5 MAP, and 7 MAP) after planting, the CBR (kg/ha/day) was measured. The results were then statistically analyzed. When ANOVA analysis showed significant differences, additional statistical analysis was done using the Duncan Multiple Range Test (DMRT). To investigate the economics, total cost was computed using current market rates for fertilizer, field preparation, seed sowing, labor charges, intercultural operations, and so forth, and then the B:C ratio was determined [B:C ratio= Gross return (Rs.)/Cost of cultivation (Rs.)].

RESULTS AND DISCUSSIONS

A. Effect of Fertilizers on Vegetative Growth

The data pertaining to the vegetative traits has been presented in Table 2, which amply illustrates the differences between all the investigated treatments. It has been noted that the rising level of both nitrogen and potassium fertilizers in both years had a considerable impact on nearly all growth indicators. But the interaction effect did not show any significant influence on the growth characters of elephant foot yam.

Maximum plant height (111.01, 114.73 and 112.87 cm), number of leaflets per plant (241.10, 236.05 and 148.73) and canopy spread (99.44, 104.18 and 101.81 cm) in Y_1, Y_2 and pooled analysis, respectively, was obtained from the treatmentN_5(N @ 250 kg/ha). Whereas, the treatment N_1 (N @ 50 kg/ha) was recorded with minimum values for all the growth traits studied. Along with the growing level of nitrogen fertilizer, a considerable gradual increase in the aforementioned growth features was also noted. This outcome may result from nitrogen's favorable impact on plant morphology. Nitrogen, according to Lombardo *et al*. (2020), "has positive effect on both the number of emerging leaves and the rate of leaf expansion, therefore, on the development of the plant's canopy," which unquestionably validates the findings of the present study. But when an excessive amount of fertilizer was applied, the pseudo-stem diameter began to decrease. The diameter of the pseudo-stem increased as the amount of nitrogen fertilizer was increased, reaching a maximum of 9.42 and 8.64 cm when 200 kilogram of nitrogen was treated per hectare (N_4), but it reduced to 6.63 and 5.36 cm when 250 kg of nitrogen was applied per hectare (N_5). This finding was consistent with the information gathered by Chattopadhyay *et al*. (2006). Highest level of potassium (K_3i.e., K_2O @ 150 kg/ha) also resulted in maximum plant height (86.49, 97.72 and 92.11cm), pseudo-stem diameter (6.99, 6.11 and 6.55 cm), number of leaflets per plant (197.78, 201.48 and 199.63) and canopy spread (85.28 cm, 88.74 cm and 87.01 cm)in Y_1, $Y_2$and pooled analysis, respectively. While the treatment with the lowest potassium level (K_1, or K_2O @ 50 kg/ha) was noted for the lowest values in all the growth features examined over the course of the year as well as in the combined study. This effect might be due to, application of potassium, results in less NH_4 being fixed, which promotes the use of nitrogen by growing plants. As a result, potassium is more readily available to plants due to its ability to exchange NH_4 ions. Because of this, high nitrogen application levels were accompanied by greater increases in vegetative growth. This observation was also in accordance with Chattopadhyay *et al*. (2006).

B. Effect of fertilizers on corm bulking rate (CBR)

The data pertaining to the CBR has been demonstrated in Table 3, which amply illustrates the differences between all the treatments studied. In Y_1, $Y_2$and pooled analysis, nitrogen considerably affected the CBR at all phases of growth(3 MAP, 5 MAP and 7 MAP). At 3 MAP, 5 MAP, and 7 MAP, respectively, the treatment N_4 (N @ 200 kg/ha) was reported for a maximum CBR (pooled) of 12.01, 24.93 and 17.62 kg/ha/day. In contrast, N_1 (N @ 50 kg/ha) showed minimum CBR (pooled) values of 9.01, 17.03 and 13.63 kg/ha/day (3 MAP, 5 MAP, and 7 MAP, respectively). In $Y_2$and the pooled analysis, potassium significantly affected the CBR at 3 MAP, whereas in $Y_1$the effect was non-significant. However, potassium significantly impacted the CBR at 5 MAP and 7 MAP in Y_1, Y_2 and in pooled analysis. K_2 (K_2O @ 100 kg/ha) had the highest CBR (pooled) of 11.19, 21.91 and 16.60 kg/ha/day; K_3(K_2O @ 150 kg/ha) came in second with 10.62, 21.60 and 16.36 kg/ha/day at 3 MAP, 5 MAP, and 7 MAP, respectively. Whereas, K_1 (K_2O @ 50 kg/ha) had a minimum CBR (pooled) of 10.15, 20.64 and 14.88 kg/ha/dayat all phases of growth(3 MAP, 5 MAP and 7 MAP, respectively).The interaction effect significantly impacted the CBR at 3 MAP in the pooled analysis but not in the individual analyses for Y_1 and Y_2. At 7 MAP, the effect was also non-significant for both the individual years and the pooled analyses. However, the CBR at 5 MAP in Y_1, Y_2 and in pooled study were both significantly altered by potassium. T_{11} (N @ 200 kg/ha + K_2O @ 100 kg/ha) exhibited the greatest CBR (pooled) among the treatment combinations, measuring 12.86, 25.30 and 18.91 kg/ha/day, whereas, T_1 (N at 50 kg/ha + K_2O @ 50 kg/ha) had a minimum CBR (pooled) of 8.53, 15.88 and 12.12 kg/ha/dayat all stages of growth (3 MAP, 5 MAP, and 7 MAP, respectively).Additionally, it was observed that the CBR increased consistently throughout the first three months of planting but increased more quickly and significantly between the third and fifth months of planting before declining once more at 7 MAP (Fig. 1). This might be because during these months, when rainfall was at its highest, plants absorbed more nitrogen and potassium from split dosages of fertilizer. By increasing the amount of radiation intercepted, increased leaf growth promotes greater photosynthetic efficiency, which in turn has a clear impact on corm bulking and, of course, tuber output (Lombardo *et al*., 2020; Sahoo *et al*., 2014). Similar observation was reported in elephant foot yam by Sahoo *et al*. (2014); Mukhopadhyay and Sen (1986), in yam by Nwinyi (1984) and in taro by Ramaswamy *et al*. (1982).

C. Effect of fertilizers on yield and yield related traits

The data presented in Table 4clearly reflects the significant individual as well as interaction effect of nitrogen and potassium fertilizers on all the yield and yield related traits *viz*. corm diameter (cm), corm weight (kg/plant), corm yield per plot (kg/13.5 sqm) and corm yield per hectare (t/ha) of elephant foot yam cormsin both the years.

Corm diameter (35.58 cm), corm weight (5.63 kg/plant), corm yield per plot (84.94 kg/13.5 sqm), and corm yield per hectare (53.59 t/ha) were all at their highest values (pooled) for the treatment N_4 (N @ 200 kg/ha). Whereas, from N_1 (N @ 50 kg/ha), the minimum values (pooled) of corm diameter (20.10 cm), weight (3.43 kg/plant), yield per plot (55.90 kg/13.5 sqm), and yield per hectare (35.27 t/ha) were measured. It was also observed that the corm yield per hectare (pooled) in N_4 (N @ 200 kg/ha) above N_1 (N @ 50 kg/ha) was likewise much significantly higher, at 51.94%.The treatment K_2 (K_2O @ 100 kg/ha) had maximum values (pooled) in all the yield and yield related traits *viz.*, corm diameter (31.07 cm), corm weight (5.13 kg/plant), corm yield per plot (80.36 kg/13.5 sqm), and corm yield per hectare (50.71 t/ha). Whereas, minimum values (pooled) of corm diameter (25.57 cm), corm weight (4.20 kg/plant), corm yield per plot (66.23 kg/13.5 sqm), and corm yield per hectare (41.79 t/ha) were recorded from K_1 (K_2O @ 50 kg/ha). A significant increase of 22.2% was also observed in corm yield per hectare (pooled) in K_2 (K_2O @ 100 kg/ha) over K_1 (K_2O @ 50 kg/ha).The interaction effect caused a significant difference in corm diameter between treatment combinations; it peaked in T_{11} (37.04, 40.37, and 38.71 cm during Y_1, $Y_2$and pooled, respectively). The largest corm weight (pooled) (6.29 kg/plant) was also achieved by plants receiving treatment T_{11} (N @ 200 kg/ha + K_2O @ 100 kg/ha), followed by T_{14} (N @ 250 kg/ha + K_2O @ 100 kg/ha), or 5.61 kg/plant. The treatment T_{11} (N @ 200 kg/ha + K_2O @ 100 kg/ha) had the highest corm yield per hectare (52.67, 61.50 and 57.08 t/ha in Y_1, Y_2 and pooled, respectively), with an average yield that was 91.03% higher (pooled) than the treatment with the lowest fertilizer dose (T_1 or N @ 50 kg/ha + K_2O @ 50 kg/ha). It's possible that the availability of nitrogen fertilizers to the plant, which assures improved photosynthetic efficiency and ultimately leads to a higher tuber production, is the cause of the increase in corm yield with the increased levels of nitrogen and potassium. However, excessive nitrogen fertilizer application may promote excessive vegetative growth, which can limit the formation of tubers. This resulted in lower corm yields for the plants under the treatments T_{13}, T_{14}, and T_{15} than they did for the treatment T_{11}, which had a nitrogen level of 250 kg/ha and a potassium level of 150 kg/ha. Patel *et al*. (2022); Pushpalatha *et al*. (2017) noted a comparable finding in sweet potato (*Ipomoea batatas* L.) tubers.

Economics: The whole expense was determined using market rates for fertilizer, field preparation, seed planting, labor costs, cross-cultural procedures, etc. The findings shown in Table 5 clearly show that T_{11}(N @ 200 kg/ha + K_2O @ 100 kg/ha) (3.05), which is 89.44% higher than the treatment using the lowest fertilizer dose, T_1, (N @ 50 kg/ha + K_2O @ 50 kg/ha), recorded the largest benefit-to-cost ratio (1.61). This variation in the B:C ratio was mostly brought on by the variation in yield. The T_{11}(N @ 200 kg/ha + K_2O @ 100 kg/ha) has the highest corm yield, which when computed yields the highest gross return and, as a result, the highest B:C ratio. Choudhary *et al*. (2012) conducted a related investigation, and they made comparable findings.

Table 1: Treatment details.

Treatments	Treatment combinations
T_1	N@50kg/ha+K_2O@50kg/ha
T_2	N@50kg/ha+K_2O@100kg/ha
T_3	N@50kg/ha+K_2O@150kg/ha
T_4	N@100kg/ha+K_2O@50kg/ha
T_5	N@100kg/ha+K_2O@100kg/ha
T_6	N@100kg/ha+K_2O@150kg/ha
T_7	N@150kg/ha+K_2O@50kg/ha
T_8	N@150kg/ha+K_2O@100kg/ha
T_9	N@150kg/ha+K_2O@150kg/ha
T_{10}	N@200kg/ha+K_2O@50kg/ha
T_{11}	N@200kg/ha+K_2O@100kg/ha
T_{12}	N@200kg/ha+K_2O@150kg/ha
T_{13}	N@250kg/ha+K_2O@50kg/ha
T_{14}	N@250kg/ha+K_2O@100kg/ha
T_{15}	N@250kg/ha+K_2O@150kg/ha

Table 2. Effect of graded levels of nitrogen and potassium fertilizer on vegetative growth of elephant foot yam cv. Bidhan Kusum.

Treatment details	Plant height (cm)			Pseudo stem diameter (cm)			number of leaflets			canopy spread (cm)		
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
Levels of nitrogen (N)												
50kg/ha	60.68^{e}	70.73^{e}	65.71^{e}	4.91^{e}	5.06^{c}	4.98^{e}	143.24^{e}	154.23^{e}	148.73^{e}	66.67^{e}	60.62^{e}	63.65^{e}
100kg/ha	71.24^{d}	85.35^{d}	78.30^{d}	5.25^{d}	5.21^{c}	5.23^{d}	167.15^{d}	175.98^{d}	171.57^{d}	73.62^{d}	81.33^{d}	77.48^{d}
150kg/ha	84.65^{c}	97.12^{c}	90.88^{c}	7.63^{b}	6.03^{b}	6.83^{b}	188.80^{c}	198.88^{c}	193.84^{c}	80.27^{c}	91.06^{c}	85.66^{c}
200kg/ha	94.48^{b}	104.18^{b}	99.33^{b}	9.42^{a}	8.64^{a}	9.03^{a}	209.05^{b}	217.60^{b}	213.33^{b}	87.35^{b}	97.91b	92.63^{b}
250kg/ha	111.01^{a}	114.73^{a}	112.87^{a}	6.63^{c}	5.36^{c}	5.99^{c}	241.10^{a}	236.05^{a}	238.58^{a}	99.44^{a}	104.18^{a}	101.81^{a}
SEm(±)	1.04	1.58	0.98	0.06	0.15	0.12	2.44	3.88	2.27	1.22	1.09	1.14
CD at 5%	3.03	4.60	2.79	0.19	0.43	0.34	7.10	11.31	6.43	3.55	3.18	3.24
Levels of Potassium (K)												
50kg/ha	81.89^{b}	91.06^{b}	86.47^{c}	6.47^{c}	5.95^{a}	6.21^{b}	181.54^{c}	190.24^{b}	185.89^{c}	78.51^{b}	84.91^{b}	81.71^{c}
100kg/ha	84.86^{a}	94.49^{ab}	89.67^{b}	6.83^{b}	6.13^{a}	6.48^{a}	190.29^{b}	197.93^{ab}	194.11^{b}	80.62^{b}	87.41^{a}	84.01^{b}
150kg/ha	86.49^{a}	97.72^{a}	92.11^{a}	6.99^{a}	6.11^{a}	6.55^{a}	197.78^{a}	201.48^{a}	199.63^{a}	85.28^{a}	88.74^{a}	87.01^{a}
SEm(±)	0.80	1.22	0.76	0.05	0.11	0.09	1.89	3.01	1.76	0.94	0.84	0.89
CD at 5%	2.35	3.56	2.16	0.15	NS	0.26	5.05	8.76	4.98	2.75	2.46	2.51

Y_1- 2019-20
Y_2- 2020-21
NS- non-significant

Table 3: Effect of nitrogen and potassium levels on CBR at 3, 5 and 7 MAP of elephant foot yam cv. Bidhan Kusum.

	CBR at 3 MAP (kg/ha/day)			CBR at 5 MAP (kg/ha/day)			CBR at 7 MAP (kg/ha/day)		
Treatments	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
Nitrogen (N)									
N_1	8.84^{c}	9.18^{b}	9.01^{c}	17.03^{e}	17.04^{d}	17.03^{d}	13.53^{c}	13.72^{d}	13.63^{c}
N_2	9.52^{c}	10.01^{b}	9.76^{c}	19.74^{d}	21.32^{c}	20.53^{c}	15.50^{b}	15.95^{bc}	15.73^{b}
N_3	10.51^{ab}	11.52^{a}	11.01^{b}	22.16^{b}	22.67^{b}	22.42^{b}	15.32^{b}	15.39^{c}	15.35^{b}
N_4	11.49^{a}	12.53^{a}	12.01^{a}	23.89^{a}	25.96^{a}	24.93^{a}	17.41^{a}	17.83^{a}	17.62^{a}
N_5	11.04^{a}	11.92^{a}	11.48^{ab}	21.06^{c}	22.95^{b}	22.01^{b}	17.30^{a}	17.54^{ab}	17.42^{a}
SEm(±)	0.41	0.37	0.28	0.27	0.19	0.21	0.45	0.55	0.32
CD at 5%	1.20	1.09	0.79	0.80	0.56	0.54	1.33	1.62	0.92
Potassium (K)									
K_1	9.84^{a}	10.47^{b}	10.15^{b}	20.06^{b}	21.23^{b}	20.64^{b}	14.74^{b}	15.03^{b}	14.88^{b}
K_2	10.75^{a}	11.64^{a}	11.19^{a}	21.23^{a}	22.58^{a}	21.91^{a}	16.52^{a}	16.68^{a}	16.60^{a}
K_3	10.25^{a}	10.99^{ab}	10.62^{b}	21.04^{a}	22.15^{a}	21.60^{a}	16.18^{a}	16.55^{a}	16.36^{a}
SEm(±)	0.32	0.29	0.21	0.21	0.15	0.16	0.35	0.43	0.25
CD at 5%	NS	0.85	0.61	0.62	0.44	0.23	1.03	1.25	0.71
Interaction (N × K)									
T_1	8.42	8.64	8.53	15.38	16.38	15.88	12.06	12.18	12.12
T_2	9.12	9.24	9.18	17.10	17.80	17.45	14.08	14.24	14.16
T_3	8.98	9.66	9.32	18.61	16.94	17.77	14.46	14.76	14.61
T_4	9.16	9.42	9.29	19.16	19.32	19.24	14.74	14.98	14.86
T_5	9.86	10.68	10.27	20.06	22.18	21.12	15.48	16.22	15.85
T_6	9.56	9.94	9.75	20.02	22.46	21.24	16.30	16.66	16.48
T_7	9.92	10.76	10.34	21.38	22.37	21.87	15.06	14.70	14.88
T_8	11.14	12.28	11.71	23.02	23.04	23.03	15.52	15.32	15.42
T_9	10.48	11.54	11.01	22.10	22.60	22.35	15.38	16.16	15.77
T_{10}	10.82	12.02	11.42	24.20	25.99	25.09	15.70	16.58	16.14
T_{11}	12.36	13.37	12.86	24.24	26.36	25.30	18.82	19.00	18.91
T_{12}	11.30	12.22	11.76	23.24	25.54	24.39	17.72	17.92	17.82
T_{13}	10.88	11.52	11.20	20.18	22.10	21.14	16.14	16.74	16.44
T_{14}	11.28	12.64	11.96	21.76	23.52	22.64	18.74	18.62	18.68
T_{15}	10.96	11.62	11.29	21.25	23.24	22.25	17.04	17.26	17.15
SEm(±)	0.71	0.65	0.48	0.48	0.33	0.36	0.79	0.96	0.56
CD at 5%	NS	NS	1.37	1.39	0.98	1.02	NS	NS	NS

Y_1- 2019-20
Y_2- 2020-21
NS: Non-significant

Table 4: Effect of graded levels of nitrogen and potassium fertilizer on yield attributes of elephant foot yam cv. Bidhan Kusum.

Treatments	corm diameter (cm)			corm weight (kg/plant)			corm yield per plot (kg/13.5 sqm)			corm yield per hectare (t/ha)		
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
Nitrogen (N)												
N_1	19.56^{e}	20.64^{c}	20.10^{d}	3.54^{d}	3.33^{e}	3.43^{e}	57.90^{e}	53.90^{e}	55.90^{e}	36.53^{e}	34.01^{e}	35.27^{e}
N_2	24.35^{d}	27.87^{b}	26.11^{c}	4.12^{c}	4.54^{d}	4.33^{d}	67.33^{d}	67.34^{d}	67.33^{d}	42.49^{d}	42.49^{d}	42.49^{d}
N_3	26.34^{c}	28.41^{b}	27.37^{c}	4.47^{b}	5.05^{c}	4.76^{c}	72.17^{c}	80.60^{c}	76.39^{c}	45.54^{c}	50.86^{c}	48.20^{c}
N_4	35.01^{a}	26.14^{a}	35.58^{a}	4.93^{a}	6.33^{a}	5.63^{a}	79.43^{a}	90.44^{a}	84.94^{a}	50.12^{a}	57.07^{a}	53.59^{a}
N_5	33.62^{b}	34.68^{a}	34.15^{b}	4.58^{b}	5.91^{b}	5.25^{b}	77.41^{b}	85.91^{b}	81.66^{b}	48.84^{b}	54.21^{b}	51.52^{b}
SEm(±)	0.31	0.84	0.56	0.05	0.12	0.12	0.42	1.14	1.39	0.26	0.72	0.87
CD at 5%	0.90	2.44	1.60	0.15	0.35	0.34	1.22	3.32	3.92	0.77	2.09	2.48
Potassium (K)												
K_1	25.71^{b}	25.42^{c}	25.57^{c}	4.09^{c}	4.32^{c}	4.20^{c}	67.61^{c}	64.85^{c}	66.23^{c}	42.66^{c}	40.92^{c}	41.79^{c}
K_2	28.94^{a}	33.20^{a}	31.07^{a}	4.60^{a}	5.65^{a}	5.13^{a}	73.77^{a}	86.96^{a}	80.36^{a}	46.55^{a}	54.87^{a}	50.71^{a}
K_3	28.67^{a}	30.02^{b}	29.35^{b}	4.30^{b}	5.13^{b}	4.72^{b}	71.16^{b}	75.10^{b}	73.13^{b}	44.90^{b}	47.39^{b}	46.15^{b}
SEm(±)	0.24	0.65	0.44	0.04	0.09	0.09	0.32	1.14	1.07	0.20	0.72	0.68
CD at 5%	0.70	1.89	1.24	0.12	0.27	0.26	0.94	3.32	3.04	0.60	2.09	1.92
Interaction (N × K)												
T_1	17.55	19.25	18.40	3.22	2.49	2.85	52.80	41.91	47.35	33.32	26.44	29.88
T_2	20.76	22.09	21.43	3.84	3.80	3.82	63.41	66.59	65.00	40.01	42.02	41.01
T_3	20.37	20.61	20.49	3.57	3.71	3.64	57.50	53.19	55.34	36.28	33.56	34.92
T_4	22.21	27.44	24.83	3.86	3.57	3.71	64.70	53.99	59.34	40.83	34.70	37.45
T_5	25.63	29.92	27.78	4.45	5.26	4.85	69.33	81.34	75.33	43.75	51.32	47.53
T_6	25.21	26.26	25.74	4.06	4.81	4.43	67.97	66.69	67.33	42.89	42.08	42.48
T_7	24.67	23.47	24.07	4.52	4.34	4.43	70.31	64.63	67.47	44.37	40.78	42.57
T_8	27.09	32.51	29.80	4.55	5.59	5.07	74.44	95.23	84.83	46.97	60.09	53.53
T_9	27.26	29.27	28.27	4.33	5.23	4.78	71.76	81.94	76.85	45.28	51.70	48.95
T_{10}	31.34	29.44	30.39	4.40	6.22	5.31	73.42	86.54	79.98	46.33	54.60	50.46
T_{11}	37.04	40.37	38.71	5.14	7.16	6.29	83.47	97.46	90.47	52.67	61.50	57.08
T_{12}	36.68	38.63	37.66	4.99	5.62	5.31	81.41	87.32	84.37	51.37	55.10	53.23
T_{13}	32.82	27.52	30.17	4.44	4.98	4.71	76.83	77.19	77.01	48.48	48.70	48.59
T_{14}	34.20	41.15	37.68	4.75	6.47	5.61	78.22	94.16	86.19	49.36	59.41	54.38
T_{15}	33.85	35.39	34.62	4.57	6.29	5.43	77.18	86.39	81.78	48.70	54.51	51.60
SEm(±)	0.31	1.45	0.98	0.09	0.20	0.20	0.72	1.97	2.40	0.46	1.24	1.51
CD at 5%	1.57	4.23	2.78	0.27	0.61	NS	2.12	5.76	NS	1.34	3.63	NS

Y_1- 2019-20
Y_2- 2020-21
NS: Non-significant

Table 5: Economics for cultivation of elephant foot yam cv. Bidhan Kusum.

Treatments	Cost of cultivation (Rs.)	Gross return(Rs.)	Net return (Rs.)	B:C Ratio
T_1	556489	896400	339911	**1.61**
T_2	560664	1230300	669636	**2.19**
T_3	564839	1047600	482761	**1.85**
T_4	557053	1123500	566447	**2.02**
T_5	561228	1425900	864672	**2.54**
T_6	565403	1274400	708997	**2.25**
T_7	557618	1277100	719482	**2.29**
T_8	561793	1605900	1044107	**2.86**
T_9	565968	1468500	902532	**2.59**
T_{10}	558182	1513800	955618	**2.71**
T_{11}	562357	1712400	1150043	**3.05**
T_{12}	566532	1596900	1030368	**2.82**
T_{13}	558746	1457700	898954	**2.61**
T_{14}	562921	1631400	1068479	**2.90**
T_{15}	567096	1548000	980904	**2.73**

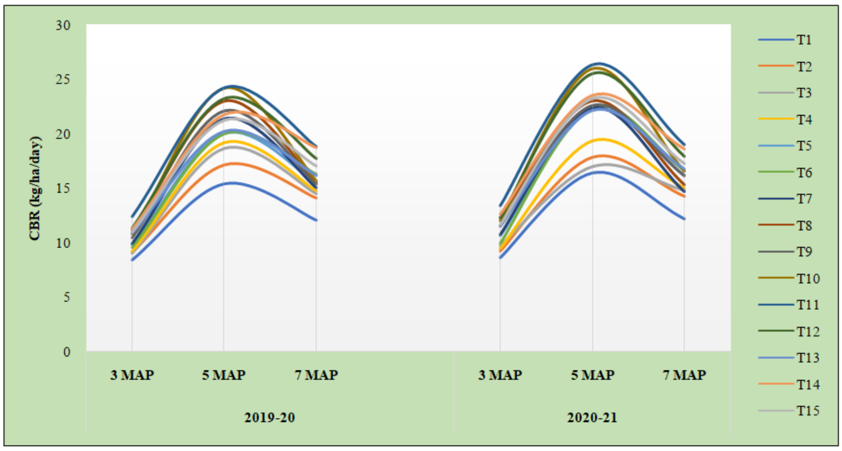

Fig. 1. Graphical representation of CBR effected by nitrogenand potassium at 3, 5 and 7 months after planting.

CONCLUSIONS

The aforementioned experiment with the elephant foot yam var. Bidhan Kusum showed that increasing levels of nitrogen and potassium fertilizer significantly affected almost all of the plant's growth characteristics, but that applying too much nitrogen and potassium fertilizer might reduce the corm yield. The information presented in the aforementioned figures made it abundantly evident that T_{11} (N @ 200 kg/ha +K_2O@ 100 kg/ha) offered the highest yields and economic returns. Therefore, for increased yields of elephant foot yam under Terai agro-climatic conditions in West Bengal, fertilizer doses including 200 kg/ha of nitrogen and 100 kg/ha of potassium may be advised.

FUTURE SCOPE

Farmers in West Bengal were not aware of the significance of varying nutrient doses for increased corm production because there has only been a limited amount of research on nutrient management for elephant foot yam. To reach the crop's 50-80t/ha potential output, there should be more care and attention given. According to Ravindran and Sreedharan (2001), nitrogen management has a major impact on crop competition, which raises the potential for overall production. Therefore, it is necessary to standardize the study's findings in order to raise farmer understanding of the ideal nitrogen and potassium fertilizer doses for better elephant foot yam development and output in the Terai region.

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