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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON PRODUCTIVITY, QUALITY, PROFITABILITY AND SOIL STATUS OF SUMMER FODDER PEARL MILLET (*PENNISETUM GLAUCUM* L.)

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SUMMARY

The experiment was carried out at the Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) during the summer seasons of 2020 to 2022. The treatment consists of three levels of organics (Control, FYM 5.0 t/ha and Bio compost 5.0 t/ha) and three levels of nitrogen *viz*., 75 kg N/ha, 100 kg N/ha and 125 kg N/ha in Randomized Block Design with factorial concept. The common application of Biofertilizers, *Azotobacter* + PSB used as seed treatment @10 ml/kg seed each. The result of three year experimentation revealed that application of Bio compost 5.0 t/ha produced higher plant height, leaf: stem ratio, crude protein content, green fodder yield, dry fodder yield and maximum profit as compared to FYM. The content of N was found significant with application of Bio compost where as P_2O_5 and K_2O found non significant. Nutrient uptake also significantly influenced and higher with use of the Bio compost 5.0 t/ha. The major nutrients (N, P_2O_5 and K_2O) in soil stated the positive effect by application of Bio compost 5.0 t/ha. In case of nitrogen levels, application of 125 kg/ha produced higher plant height, number of leaves per plant, leaf: stem ratio, crude protein, green fodder and dry fodder yield and ultimately maximum net return. The uptake of N, P_2O_5 and K_2O were also higher under this treatment. The interaction was also found significant with respect to quality parameters crude fiber and leaf stem ratio. The lower CF observed under N_3O_1 and N_3O_2. In case of L:S ratio the higher L:S ratio observed under N_3O_2 and N_2O_2.

Key words: Bio compost, crude fibre, Leaf : Stem ratio, fodder pearl millet

India has the largest livestock population in the world, which is about 18 per cent of the world's livestock population with only 2 per cent of the world's geographical area. Availability of nutritious feed and fodder are major bottleneck for enhancing livestock products. The cultivation of fodder crops has gained importance in recent years due to rapid diminution of grassland and pasture areas. Pearl millet commonly known as Bajra is one of the important food as well as fodder crop. It is widely grown in India because of its tolerance to drought, high temperatures and low soil fertility. Among the various agronomic practices for increasing productivity of crop, nutrient management plays an important role. For higher fodder yield, vegetative growth of this crop is very important which is largely dependent upon the potential of the genotype, nutrient supply system, capacity of the soil to supply the nutrients to the plants and capacity of the plants to take and use the nutrients in unit time (Sheoran *et al.*, 2016). The application of organic manure *viz*., FYM and Bio compost may serve as source of macro and micro nutrients and complexion agent. On an average, well decomposed farmyard manure contains 0.5 per cent N, 0.2 per cent P_2O_5 and 0.5 per cent K_2O. Bio compost means a product obtained by the controlled decomposition of sugarcane industry wastes and finally used as organic manure. It is well decomposed manures having lower C: N ratio. The intensive use of inorganic fertilizers in agricultural fields has resulted in environmental pollution. To produce high-quality fodder crops without damaging the environment, it is necessary to adopt Integrated Nutrient Management (INM). INM involves the use of a combination of organic, inorganic and biological components to enhance soil fertility and provide essential nutrients to plants. Nitrogen plays important role as it is vital constituent of protein, nucleic acid, enzyme, co-enzyme, chlorophyll and cell wall. So, judicious use

of organic and inorganic fertilizer can play the most important role in maximization of production and maintain the soil fertility.

MATERIALS AND METHODS

A field experiment was carried out during the summer seasons of the year 2020 to 2022 at Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat). The place is located 12 km away in East from great historical place "Dandi" on the Arabian Sea. The experimental site was characterized by flat topography with medium to poor drainage and good water holding capacity. Representative soil samples were collected from 0-30 cm depth covering the entire area of experimental site before sowing and finally composite sample was prepared and then analyzed for various physico-chemical properties of the soil.

The soil of the experimental field was clayey in texture and showed medium in available nitrogen (227.50 kg/ha), moderately high phosphorus (46.90 kg/ha) and very high potassium (330.40 kg/ha), slightly alkaline in reaction with normal electrical conductivity. After the harvest of the previous crop, the experimental field was cultivated with tractor- drawn cultivator in cross wise direction. The treatment consists of three levels of organics (Control, FYM 5.0 t/ha and Bio compost 5.0 t/ha) and three levels of nitrogen *viz*., 75 kg N/ha, 100 kg N/ha and 125 kg N/ha. The design of experiment was Randomized Block Design with factorial concept. The common application of Biofertilizers, *Azotobacter* + PSB used as seed treatment @10 ml/kg seed each. The organic manures were given as a basal and nitrogen was given in two equal splits at basal and 30 DAS. The first irrigation was given immediately after sowing for proper germination. The subsequent irrigations were given as per the requirement of the crop. In order to maintain a uniform plant population, gap filling and thinning operations were carried out in all the plots at 10 days after sowing. Hand weeding operations was carried out manually, depending on field conditions after sowing during the crop season. The periodical plant height was measured from ground level to the tip of the main shoot of the previously selected five plants from each net plot. The crops were harvested after 50% flowering. Previously tagged plants were harvested for recording necessary biometric observations. The crop from the ring area of each plot was harvested first and collected. The crop in the net plot area was harvested close to ground level separately and bundles were tied and weighed as a green fodder yield. The gross realization was worked out on the basis of green fodder yield per hectare of each treatment and prevailing market prices. The cost of cultivation was worked out considering operations right from preparation of land to the harvesting of the crop and the cost of all inputs involved.

RESULTS AND DISCUSSION

Effect of organics

The results of the tree years experimentation, revealed that organics treatment O_2 Bio compost 5.0 t/ha recorded significantly higher plant height in pooled result, but this treatment was statistically at par with treatment O_1 (FYM 5.0 t/ha). In case of number of leaves per plant, there were no significant differences among all the treatments. The pooled results indicated the highest green and dry fodder yields of fodder pearl millet with treatment O_2 (Bio compost 5.0 t/ha). Crude protein content affected significantly by various organic treatments in pooled result, significantly higher CP noted by application of Bio compost 5.0 t/ha and this treatment was statistically at par with used of FYM 5.0 t/ha. Crude fibre content and L: S ratio influenced significantly by organics treatments. Significantly higher L: S ratio observed under treatment Bio compost 5.0 t/ha during pooled results. In case of crude fibre, the reverse trend seen and the lowest crude fibre content noted in Bio compost 5.0 t/ha which gained similarity with FYM 5.0 t/ha (Table 1). The result revealed that P_2O_5 and K_2O content by fodder pearl millet not influenced significantly by organic treatments. However in case of N content showed significantly higher in Bio compost 5.0 t/ha and which was at par with application of FYM 5.0 t/ha. Significantly higher uptake of N, P_2O_5 and K_2O observed under the application of Bio compost 5.0 t/ha (Table 2). The results of available N influenced significantly by different organics. Significantly higher available N recorded by Bio compost 5.0 t/ha. Available P_2O_5 and K_2O were not affected significantly by various treatments of organics (Table 3). The maximum gross return (Rs. 111255/ha), net return (Rs. 83652/ha) and B: C ratio (3.02) recorded by application of O_2 (Bio compost 5.0 t/ha) followed by O_1 (FYM 5.0 t/ha) (Table 4). This was due to favorable effects of bio compost on growth consequently more nutrients uptake by the crop. The above results were in

TABLE 1
Effect of INM on growth, yield and quality of fodder pearl millet (Pooled over three years)

Treatment	Plant height at harvest (cm)	No. of leaves/ plant at harvest	L:S ratio	Crude protein content (%)	Crude fibre content (%)	Green fodder yield (q/ha)	Dry fodder yield (q/ha)
Organics							
O_0: Control	155.68	10.63	0.71	7.09	34.86	290.92	118.95
O_1: FYM 5.0 t/ha	174.96	10.82	0.83	7.20	29.35	349.35	143.02
O_2: Bio compost 5.0 t/ha	180.80	10.93	0.90	7.33	28.87	370.85	152.26
S. Em±	3.77	0.23	0.01	0.06	0.51	6.59	2.72
C. D. (P=0.05)	10.71	NS	0.04	0.16	1.45	18.71	7.72
Nitrogen levels							
N_1: 75 kg/ha	157.29	10.36	0.67	7.06	33.13	280.12	114.43
N_2: 100 kg/ha	172.87	10.78	0.83	7.24	31.02	352.22	141.85
N_3: 125 kg/ha	181.28	11.23	0.94	7.32	28.93	378.79	157.95
S. Em±	3.77	0.23	0.01	0.06	0.51	6.59	2.72
C. D. (P=0.05)	10.71	0.64	0.04	0.16	1.45	18.71	7.72
Interaction (OXN)							
S. Em±	6.16	0.39	0.02	0.09	0.84	11.07	4.54
C. D. (P=0.05)	NS	NS	0.06	NS	2.37	NS	NS
Sig. Interactions with Y	-	-	-	-	-	-	-
C.V. (%)	11.56	11.32	9.51	4.25	8.50	10.10	10.09

TABLE 1.1
Interaction effect of Organics and Nitrogen levels on CF and L:S ratio of fodder pearl millet (Pooled over three years)

Treatment	CF (%)			L:S ratio		
	N_1: 75 kg/ha	N_2: 100 kg/ha	N_3: 125 kg/ha	N_1: 75 kg/ha	N_2: 100 kg/ha	N_3: 125 kg/ha
O_0: Control	38.63	32.67	33.29	0.65	0.64	0.85
O_1: FYM 5.0 t/ha	31.43	29.88	26.72	0.66	0.89	0.95
O_2: Bio compost 5.0 t/ha	29.33	30.50	26.78	0.71	0.97	1.03
S. Em±		0.84			0.02	
C. D. (P=0.05)		2.37			0.06	

TABLE 2
Effect of INM on N, P_2O_5, and K_2O content and uptake after harvest of fodder pearl millet (Pooled over three years)

Treatment	N content (%)	P_2O_5 content (%)	K_2O content (%)	N uptake (kg/ha)	P_2O_5 uptake (kg/ha)	K_2O uptake (kg/ha)
Organics						
O_0: Control	1.134	0.243	1.190	67.47	14.42	71.11
O_1: FYM 5.0 t/ha	1.151	0.247	1.195	82.40	17.72	85.79
O_2: Bio compost 5.0 t/ha	1.173	0.248	1.210	89.22	18.87	92.61
S. Em±	0.009	0.002	0.011	1.55	040	1.96
C. D. (P=0.05)	0.025	NS	NS	4.40	1.12	5.55
Nitrogen levels						
N_1: 75 kg/ha	1.129	0.243	1.182	64.44	13.84	68.16
N_2: 100 kg/ha	1.158	0.246	1.198	82.12	17.45	85.06
N_3: 125 kg/ha	1.172	0.249	1.214	92.53	19.71	96.30
S. Em±	0.009	0.002	0.011	1.55	0.40	1.96
C. D. (P=0.05)	0.025	NS	NS	4.40	1.12	5.55
Interaction (OXN)						
S. Em±	0.01	0.003	0.018	2.62	0.66	3.27
C. D. (P=0.05)	NS	NS	NS	NS	NS	NS
Sig. Interactions with Y		-			-	
C.V. (%)	4.25	4.63	4.79	10.11	11.78	12.31

TABLE 3
Effect of INM on soil available N, P_2O_5 K after harvest of fodder pearl millet (Pooled over three years)

Treatment	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Organics			
O_0: Control	221.79	49.00	331.48
O_1: FYM 5.0 t/ha	233.25	49.49	332.46
O_2: Bio compost 5.0 t/ha	240.46	50.57	333.98
S. Em±	2.44	0.53	4.98
C. D. (P=0.05)	6.93	NS	NS
Nitrogen levels			
N_1: 75 kg/ha	223.79	48.77	331.04
N_2: 100 kg/ha	230.94	49.71	332.53
N_3: 125 kg/ha	240.76	50.58	334.35
S. Em±	2.44	0.53	4.98
C. D. (P=0.05)	6.93	NS	NS
Interaction (O×N)			
S. Em±	4.10	0.89	4.98
C. D. (P=0.05)	NS	NS	NS
Sig. Interactions with Y	-	-	-
C.V. (%)	5.69	5.80	4.86
Initial status	227.50	46.90	330.40

conformity with the findings of Thumar *et al* (2016) and shah *et al* (2022).

Effect of nitrogen levels

Nitrogen level influenced significantly on plant height. Significantly higher plant height and numbers of leaves per plant were recorded with treatment N_3 (125 kg N/ha) in pooled analysis, but it was statistically at par with lower level N_2 (100 kg/ha). Significantly higher green and dry fodder yield obtained with higher nitrogen level N_3 (125 kg N/ha) during pooled result. Application of 125 kg N/ha recorded significantly higher L: S ratio and lower crude fibre content. The crude protein content noted significantly higher in treatment N_3 (125 kg N/ha), although this treatment was statistically at par with treatment N_2 (100 kg N/ ha) (Table 1).

The data present in Table 2 indicated that N content significantly higher with use of 125 kg N/ha and which was at par with 100 kg N/ha. With respect to uptake of nutrients, application of 125 kg N/ha (N_3) recorded significantly higher N, P_2O_5 and K_2O uptake over the lower levels. The results of available N were found significantly superior in N_3. Available P_2O_5 and K_2O were not affected significantly by various levels of nitrogen (Table 3). Application of nitrogen 125 kg N/ha recorded the maximum gross return (Rs. 113636/ ha), net return (Rs. 83074/ha) and B: C ratio (2.77) over lower levels (Table 4). The improvement in yield was mainly due to continuous and sufficient availability of nitrogen during different growth and development period of the plant. Similar results observed by Khadadiya *et al* (2020.) and Anchra *et al*.(2022).

TABLE 4
Effect of Integrated nutrient management on economics of fodder pearl millet (Pooled over three years)

Treatment	Gross returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Organics				
O_0: Control	87277	25169	62108	2.46
O_1: FYM 5.0 t/ha	104806	36837	67970	1.84
O_2: Bio compost 5.0 t/ha	111255	27604	83652	3.02
Nitrogen levels				
N_1: 75 kg/ha	84095	29055	54981	1.96
N_2: 100 kg/ha	105667	29991	75675	2.59
N_3: 125 kg/ha	113636	30563	83074	2.77

Price: Green fodder: Rs. 3.00/kg, FYM Rs. 2.0/kg, Bio compost: Rs. 0.65/kg, N: Rs. 5.91/kg and P: Rs. 10.80/kg.

Interaction effects

The data regarding interactions are presented in Table-1.1. Interaction effect of organics and nitrogen levels was found significant in case of CF and L:S ratio during pooled analysis. Treatment combination O_1N_3 (FYM 5.0 t/ha + 125 kg N/ha) recorded significantly lower CF content and which was at par with O_2 N_3 (Bio compost 5.0 t/ha + 125kg N/ha). In case of L:S ratio significantly higher L:S ratio observed with O_2N_3(Bio compost 5.0 t/ha + 125 kg N/ha) and which was at par with O_2N_2 (Bio compost 5.0 t/ha + 100kg N/ha). The probable reason might be balanced fertilization increased photosynthetic efficiency and enhanced the yield of the crop. These results are in close conformity with Kadam (2019) and Bijarnia *et al* (2020).

CONCLUSION

Based on three-year experimentation, it can be concluded that application of Bio compost 5.0 t/ha as basal and 125.0 kg N/ha (62.5 kg N/ha as basal and 62.5 kg N/ha at 30 DAS) with seed treatment of biofertilizers (*Azotobacter* + PSB @ 10 ml/ kg seed each) resulted in higher green and dry fodder yields of summer fodder pearl millet with maximum net returns and better quality.

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