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Effect of different Fertility Levels on Yield, Nutrient Content and Uptake and Economics of Fodder Pearlmillet (*Pennisetum glaucum* L.) Cultivars under Arid Region

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ABSTRACT: Animal nutrition is main factor for livestock production. Due to the decrease in the availability of green fodder in the arid region, there is a continuous decrease in the livestock. Therefore, an experiment was conducted on fodder pearl millet crop during *kharif* season of 2018 at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner Rajasthan. The treatments consisted of four fertility levels [0, 40, 80 and 120 kg N ha^{-1}] and three varieties [Raj bajra -1, Raj- 171 and Local]. The experiment was laid out in factorial randomized block design with three replications. The productivity of crops was evaluated in terms of green and dry fodder yield and the nutrient content and uptake by crop at both cutting stages. Results revealed that total green fodder, dry matter yield and nutrient content and uptake by crop at both cutting stages were higher in variety Raj bajra -1 as compared to Raj 171 and Local variety. Among nutrient management, treatment 80 kg N + 40 kg P_2O_5 ha^{-1} recorded higher fodder production as well as and nutrient content and uptake by crop at both cutting stages as compare to control and 40 kg N + 20 kg P_2O_5 ha^{-1} and being statistically at par with 120 kg N + 60 kg P_2O_5 ha^{-1}. Therefore, concluded that the Raj bajra -1 with 80 kg N + 40 kg P_2O_5 ha^{-1} can produce more grains and will be economically effective.

Keywords: Dry fodder yield, green fodder yield, nutrient management, nutrient uptake.

INTRODUCTION

India is home for 535.8 million livestock population contributing to 187.7 million tonnes of milk production during 2018-19 (Basic Animal Husbandry Statistics 2019). India occupy the number one position in milk production in world but productivity of Indian cattle is low compared to the global average and even lower than the European countries (Rajendran and Mohanty, 2004; Hindoriya *et al.*, 2019). Shortage of green fodder is one of the main reasons behind low milk yield along with other factors like imbalanced nutrition, quality fodder. In India, due to increased human population pressure and limited land, it is not possible to increase the area under fodder crops further. The reason can be different; from improper and inadequate nutrition to breeding and lack of adaptability problem (Bhakar *et al.*, 2020). The only way to bridge the large gap between demand and supply of fodder for animals is through maximizing the fodder production per unit area and unit time. Another possibility is through improved utilization of existing farming systems, utilizing marginal, sub marginal dry lands and problematic soils for developing fodder resources.

Furthermore, the stover (karbi) is major source of fodder for animal particularly in winter season. Pearlmillet is a better alternative because it is a quick-growing and short-duration crop, grown for both fodder and grain purposes mostly under rainfed conditions because of its high tillering potential, high dry matter production and drought escaping mechanism (Rana and Bana, 2012). Nitrogen is an integral part of chlorophyll ($C_{35}H_{72}O_5N_4Mg$) and to improve the yield and quality of forage pearl millet. Judicious and appropriate use of fertilizer not only increases yield but also improves quality of forage especially protein contents (Kumawat *et al.*, 2017). However, soils in arid and semiarid regions are mainly poor in nitrogen and inherently low in organic carbon because of rapid oxidation rates of organic material due to high soil temperature. The cruel

climatic conditions and low soil fertility, effective nutrient management is of considerable importance to overcome the situations of partial yields in these areas (Meena and Jain, 2013).

MATERIALS AND METHODS

An experiment was conducted on fodder pearl millet during *kharif* season of 2018 at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan) which is situated at 28°01′N latitude and 73°22′E longitude at an altitude of 234.70 meters above mean sea level in arid western hyper arid zone of Rajasthan. According to the average meteorological data of 2018 (June to October), the maximum temperature ranged between 35.0°C and 40.9°C during the crop growing season in the 30th and 28th standard meteorological weeks, respectively. Similarly, the values of minimum temperature *i.e.*, 16.7°C and 29.9°C was recorded in the 43th and 28th standard meteorological weeks, respectively. Crop received 279.2 mm of rainfall with 13 rainy days in the growing season. Pan evaporation ranged from 1.1 to 9.4 mm day^{-1} during the crop growing period. The average relative humidity during experiment fluctuated in the range of 19.7 to 91.9 per cent. The bright sun shine hours during experiment fluctuated in the range of 4 to 9.7 hours.

The soil of the experimental site was sandy loam in nature, having pH 8.13, electrical conductivity 0.20 dS/m, organic carbon 0.18 per cent and available N, P and K were 120, 16.20 and 175.70 kg ha^{-1}, respectively. The experiment was laid out in randomized block design (Factorial) with three replications. The treatments consisted of four fertility levels (N + P_2O_5 Kg ha^{-1}) *viz.* 0, 40 + 20, 80 + 40 and 120 + 60 and three varieties *viz.* Raj bajra-1, Raj-171 and Local variety. Sowing of fodder pear millet varieties were done manually with Kera method on 28 June 2018 with the onset of monsoon rain at row spacing of 30 cm using seed rate of 10 kg ha^{-1}. The nitrogen and phosphorus were applied as per treatments through urea and DAP. Full dose of phosphorus and half dose of nitrogen were applied at the time of sowing by drilling and remaining nitrogen was applied in two split doses at 30 DAS and after 1st cutting through broadcasting.

All recommended agronomic practices were followed during the cultivation of crops. To remove border effect, two rows on both sides were discarded and the net plot area was harvested separately from each plot to record the final green fodder yield. Fresh weight of the fodder was recorded per plot from the harvested plants. The harvested green forage yield was weighed in kg $plot^{-1}$ and then converted into q ha^{-1}. For green fodder, crop was harvested at 55 and 95 DAS. The harvested plant samples of seed and straw were oven dried (70°C) and ground in a Wiley mill to pass through two mm sieve. The sieved samples were used for determining nitrogen (Jackson 1967), phosphorus (Olsen and Sommers 1982), potassium (Richards, 1954), by using appropriate instrument. Nitrogen was estimated by colorimetric method, Phosphorus content in seed and straw were determined by "Vanadomolybdo phosphate" Yellow colour method and Potassium content in seed and straw determined by extract of tri-acid digested material by using flame photometer and expressed as per cent Potassium content on dry weight basis (Bhargava and Raghupathi 1993). Economics was computed using existing prices of inputs and outputs. Benefit: cost ratio was calculated by dividing net returns by cost of cultivation. Data were processed in Microsoft excel 2010 and analyzed by using SPSS 19.0 Version. The least significant difference test was used to compare among different treatments at 5% level of significance (P< 0.05).

RESULTS AND DISCUSSION

A. Yield and yield attributes

Results depicted that nitrogen and phosphorus levels along with different varieties in fodder pearl millet influenced the green fodder, dry fodder yield and green fodder productivity. Raj bajra -1 recorded the highest green fodder (224.62, 164.92 q ha^{-1}), dry fodder yield (55.27, 48.68 q ha^{-1}) and green fodder productivity (4.10q ha^{-1} day^{-1}) at 1st cutting and 2nd cutting respectively, as compared to Raj- 171 and Local variety (Fig. 1 and 2).

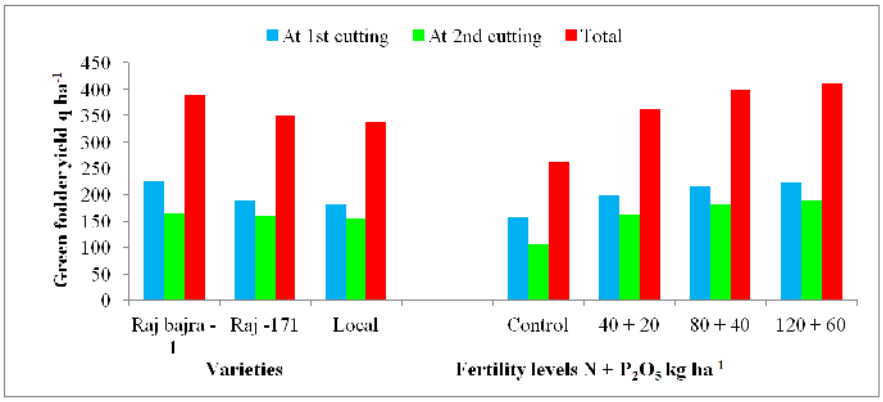

Fig. 1. Effect of different fertility levels on green fodder yield of fodder pearl millet.

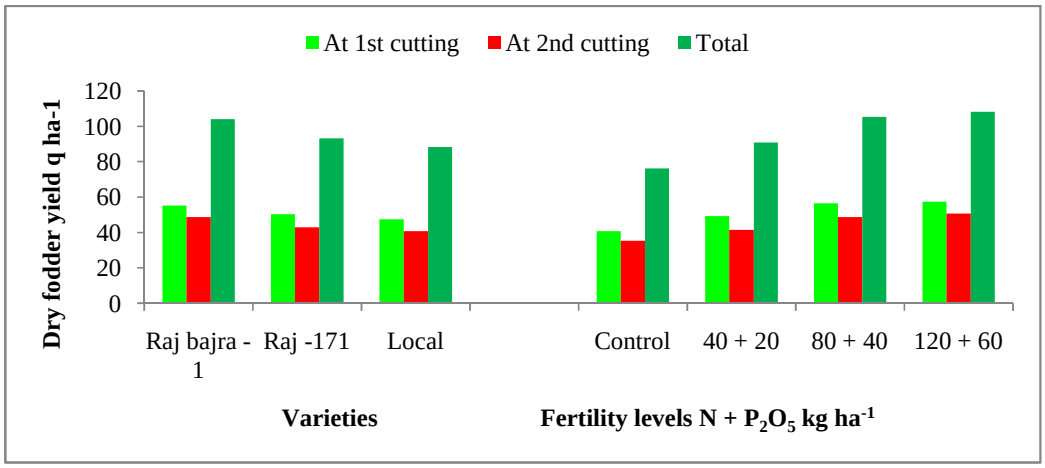

Fig. 2. Effect of different fertility levels on dry fodder yield of fodder pearl millet.

Table 1: Effect of different fertility levels on yield and green fodder productivity of fodder pearl millet.

Treatment	GFY (q/ha)			DFY (q/ha)			GF Productivity (q day^{-1}ha^{-1})
Varieties	**1st cutting**	**2nd cutting**	**Total**	**1st cutting**	**2nd cutting**	**Total**	
Raj bajra 1	224.62	164.92	389.54	55.27	48.68	103.95	4.10
Raj171	189.37	159.31	348.68	50.32	42.79	93.11	3.67
Local	182.87	159.31	348.68	47.50	40.72	88.21	3.67
S.Em±	2.05	1.57	3.16	0.58	0.53	0.84	0.03
CD at 5%	6.02	4.59	9.27	1.71	1.55	2.47	0.10
Fertility levels (N + P_2O_5 Kg ha^{-1})							
Control	157.13	105.50	262.63	40.84	35.38	76.22	2.76
40 + 20	199.87	162.43	362.30	49.35	41.44	90.79	3.81
80 + 40	216.72	182.30	399.01	56.47	48.80	105.27	4.20
120 + 60	222.09	188.33	410.43	57.45	50.62	108.07	4.32
S.Em±	2.74	2.09	4.22	0.78	0.70	1.12	0.04
CD at 5%	8.02	6.12	12.37	2.28	2.07	3.29	0.13

This might be due to the supremacy of the genotype to produce more values of growth characteristics like plant height, leaf area index, leaf: shoot ratio and number of tillers meter^{-1} row length. Similar results were also reported by Midha *et al.* (2015). In case of different fertility levels significant increase in green fodder, dry fodder yield and green fodder productivity was obtained when the crop was fertilized with 80 kg N + 40 kg P_2O_5 ha^{-1} compared with control, 40 kg N + 20 kg P_2O_5 ha^{-1} but at par with 120 kg N + 60 kg P_2O_5 ha^{-1}. Hence the productivity increased with increasing levels of nutrient application. Parallel results were also obtained by Singh *et al.* (2012); Bhakar *et al.* (2021).

Table 2: Effect of different fertility levels on nutrient content of fodder pearl millet.

Treatment	Nutrient content (per cent)					
	Nitrogen		Phosphorus		Potassium	
	1st cutting	2nd cutting	1st cutting	2nd cutting	1st cutting	2nd cutting
Varieties						
Raj bajra 1	1.83	1.44	0.403	0.323	1.72	1.29
Raj 171	1.82	1.43	0.399	0.320	1.73	1.27
Local	1.82	1.42	0.398	0.319	1.72	1.27
S.Em±	0.01	0.01	0.002	0.002	0.02	0.01
CD at 5%	NS	NS	NS	NS	NS	NS
Fertility levels (N + P_2O_5 Kg ha^{-1})						
Control	1.66	1.32	0.370	0.285	1.56	1.06
40 + 20	1.83	1.41	0.391	0.316	1.70	1.20
80 + 40	1.90	1.49	0.415	0.337	1.82	1.41
120 + 60	1.91	1.50	0.423	0.344	1.83	1.43
S.Em±	0.01	0.01	0.003	0.003	0.02	0.02
CD at 5%	0.02	0.03	0.009	0.009	0.06	0.05

B. Nutrient content and uptake

Results manifested that nitrogen, phosphorus and potassium content of fodder pearl millet were not influenced significantly due to different varieties. Variety Raj bajra -1 recorded higher nitrogen uptake (171.75 kg ha^{-1}), phosphorus uptake (38.29 kg ha^{-1}) and potassium uptake (159.50 kg ha^{-1}) as compare to Raj 171 and Local variety, respectively. Similar results were also reported by Meena and Jain (2013); Midha *et al.* (2015); Kumawat *et al*. (2017). Results revealed that application of 80 kg N + 40 kg P_2O_5 ha^{-1} recorded higher nitrogen content (1.90 and 1.49 per cent), phosphorus content (0.415 and 0.337 per cent) and potassium content (1.82 and 1.41 per cent) and higher nitrogen uptake (182.17 kg ha^{-1}), phosphorus uptake (39.98 kg ha^{-1}) and potassium uptake (171.34 kg ha^{-1}) at 1st cutting and 2nd cutting over control and 40 kg N + 20 kg P_2O_5 ha^{-1} being statistically at par with 120 kg N + 60 kg P_2O_5 ha^{-1}. Comparable results were also reported by Godara *et al.* (2012); Pareek *et al*. (2015).

Table 3: Effect of fertility levels on nutrient uptake in fodder pearl millet.

Treatments	Nutrient uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium
Cultivars			
Raj bajra 1	171.75	38.29	159.50
Raj 171	153.81	34.03	142.16
Local variety	147.96	32.26	134.86
S.Em±	1.38	0.36	1.78
CD at 5%	4.04	1.04	5.23
Fertility levels (N + P_2O_5 Kg ha^{-1})			
Control	114.55	25.28	99.41
40 + 20	148.32	32.51	134.17
80 + 40	182.32	39.98	171.34
120 + 60	186.17	41.67	177.12
S.Em±	1.84	0.60	2.38
CD at 5%	5.39	1.77	6.97

C. Economics

The highest gross returns (51974 ₹ ha^{-1}) and highest net returns (30,753 ₹ ha^{-1}) were recorded with variety Raj bajra -1 over Raj 171 and Local (Fig. 3). Similar results were also reported by Sheoran *et al*. (2016); Kumawat *et al*. (2017).

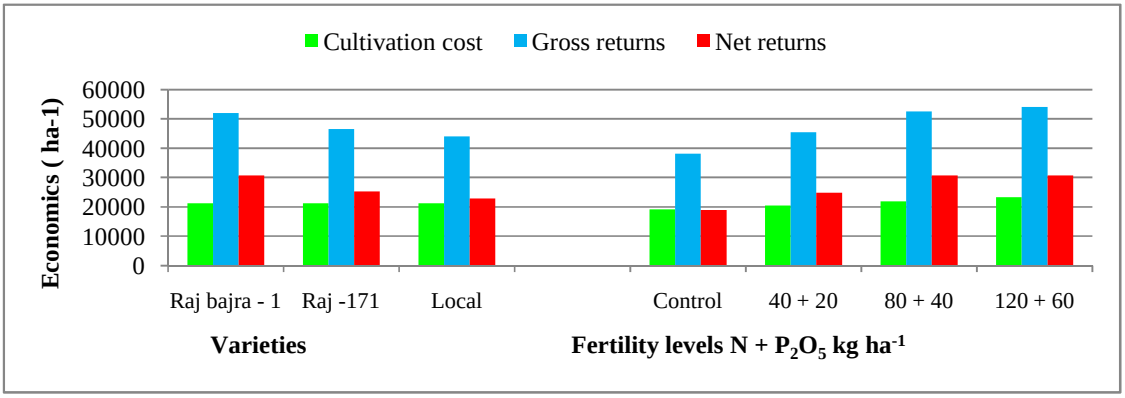

Fig. 3. Effect of different fertility levels on economics of fodder pearl millet.

Table 4: Effect of different fertility levels on economics of fodder pearl millet.

Treatment	Economics (` ha^{-1})		
	Cultivation cost	Gross returns	Net returns
Varieties			
Raj bajra 1	21218	51974	30753
Raj 171	21218	46553	25332
Local variety	21218	44107	22886
S.Em±	-	421	420
CD at 5%	-	1234	1233
Fertility levels (N + P_2O_5 Kg ha^{-1})			
Control	19145	38111	18966
40 + 20	20528	45397	24868
80 + 40	21912	52635	30722
120 + 60	23289	54036	30740
S.Em±	-	561	561
CD at 5%	-	1645	1645

Results revealed that application of 80 kg N + 40 kg P_2O_5 ha^{-1} gave higher gross returns (52,635 ₹ ha^{-1}) and highest net returns (30,722 ₹ ha^{-1}), which were higher over control and 40 kg N + 20 kg P_2O_5 ha^{-1} being statistically at par with 120 kg N + 60 kg P_2O_5 ha^{-1}. Similar results were also reported by Choudhary and Prabhu (2014); Khinchi *et al*. (2017).

CONCLUSION

When 80 kg N and 40 kg P_2O_5 were applied per hectare, Raj bajra - 1 gave significantly higher green, dry fodder yield and green fodder productivity, with higher content and uptake of N, P, K by fodder.

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Conflict of Interest. None.

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