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Effect of nutrient management practices on productivity of perennial grasses under high moisture condition

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ABSTRACT

A field experiment was started from *Kharif* 2012 (establishment year) to 2015 at JNKVV, Jabalpur to evaluate the performance of lowland grasses regarding crop establishment, forage productivity and nutrient management. The treatments consisted of three types of grass, viz., para grass (*Brachiaria mutica*), humidicola grass (*Brachiaria humidicola*) and guinea grasses and four nutrient management practices, viz., M1- 100% NPK through inorganic fertilizers; M2- 50% NPK through inorganic fertilizers + FYM @ 5 t/ha; M3- FYM @ 5 t/ha and M4- Farmer practice (without nutrient) laid out in split plot design and replicated three times. The study on the effect of nutrient management on the productivity of perennial grasses under high moisture conditions revealed that the grass *Brachiaria mutica* grown with M1- 100% NPK (inorganic fertilizer) gave the highest green and dry fodder yield and net monetary returns *fb* by M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha.

1. INTRODUCTION

Livestock is the backbone of Indian agriculture and accounts for around 4.4 percent of the country's gross domestic product. Furthermore, it accounts for 28.6% of overall agricultural gross domestic output [1]. In India, over 20.5 million people rely on animal husbandry for their livelihood. For many small-scale farmers in the nation, animal rearing provides a source of off-farm income. India is home to approximately 15 percent of the world's livestock population; it has 56.7 percent of the world's buffalo population and 12.5 percent of its cattle population. The total cattle population in the country is 536 million [2]. However, the nation has a more significant gap in milk productivity (987 kg lactation^{-1} animal^{-1}) compared to the world (2038 kg lactation^{-1} animal^{-1}) and Europe (6941 kg lactation^{-1} animal^{-1}) [3]. The ever-increasing world population and low livestock productivity have added to the pressure to meet the daily demand for livestock products. Milk and meat demand are expected to reach 400 and 14 million tonnes by 2050, up from 198.4 million tonnes and 8.14 million tonnes, respectively, in the current scenario [4].

Grasses are essential in providing hay and pasture-based forage for livestock. Grass and grass-legume mixtures providing hay and pasture-based forage for livestock in India. With proper species selection and good irrigation, fertility, and harvest or grazing management, yields of 8 tons acre^{-1} or more have been achieved. Management is the key to successful forage production. Supplying the correct amount of nutrients is one crucial management factor. Grass grown for hay removes large quantities of nitrogen, phosphorus and other nutrients from the soil. Grass grown for pasture removes lower quantities of nutrients since as much as 85 to 90% of the nutrients consumed in the forage are re-deposited on the pasture in manure and urine. Due to the recycling effect of grazing animals, the nutrient requirements of pasture differ from the requirements of fields harvested for hay. Plants require higher amounts of the critical nutrients nitrogen (N), phosphorus (P), and potassium (K) for healthy growth. Many nutritional deficits have occurred from agricultural intensification and the growth of high-yielding cultivars, much beyond the NPK scenario. This is one of the emerging constraints to achieving higher production [5]. Farmyard manure (FYM) is an organic fertilizer that improves the chemical properties of the soil, specifically nitrogen (N), phosphorous (P), and potassium (K), allowing for increased growth and sustainable production [6]. It is also recognized that FYM helps to minimize soil pH to some degree by generating organic acids while decomposing them, which may also be the reason for greater nutrient availability and mobility, mainly of micronutrients. This may also have contributed to additional nutrient uptake by plants [7]. This indicates the potential use of farmyard manure to maintain soil fertility.

2. MATERIALS AND METHODS

A field experiment was started from *Kharif* 2012 (establishment year) to 2015 at JNKVV, Jabalpur to evaluate the performance of lowland grasses in relation to crop establishment, forage productivity and nutrient management. The treatments consisted of three types of grass viz., para grass (*Brachiaria mutica*), humidicola grass (*Brachiaria humidicola*) and guinea grasses at Jabalpur and four nutrient management practices (M1- 100% NPK through inorganic fertilizers; M2- 50% NPK through inorganic fertilizers + FYM @ 5 t/ha; M3- FYM @ 5 t/ha and M4- farmer practice (without nutrient) laid out in a split-plot design and replicated three times. During the experiment, four cuttings each year were taken at 12-15 cm from ground level at a regular interval of 90 days. The weight of fresh fodder from each plot was recorded immediately after cutting and expressed in tones ha^{-1}. Dry matter was recorded by randomly selecting five plants from each plot and drying them @ 80 °C for 24 hours or until a constant weight was achieved. The sample obtained from the first cut in each year was analysed for crude protein and crude fiber, which were used to calculate the yield of crude protein and fiber of the fodder. The green fodder of the system was harvested. It is expressed in tonnes ha^{-1}. Based on green fodder yield per plot, green fodder yield ha^{-1} was calculated. The dry matter yield was obtained by drying (at 65 °C) the known quantity of green fodder from each plot to a constant weight. The crude protein yield was computed by multiplying the crude protein content by the dry matter yield. The soil samples were air dried and sieved on a 2 mm mesh for chemical analysis (SOC and available N). Organic carbon was determined by rapid titration [8] and soil available N by the alkaline permanganate method [9].

3. RESULTS AND DISCUSSION

3.1 Effect on green and dry fodder yield

Data presented in Table 1 indicated that para grass recorded significantly higher green and dry fodder yields than *Brachiaria humidicola* and guinea grasses, respectively. It is because *Brachiaria mutica* growth is good in high moisture conditions. Further, basal application of M1- 100% NPK (inorganic fertilizer) recorded significantly higher fodder yields in comparison to M3- FYM @ 10 t/ha and no fertilizer (15.82). However, it was found statistically at par with the application of M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha. The higher fodder yield in these treatments may be attributed to a higher number of tillers in the corresponding treatment. This increase in yield might be due to the additional amount of nutrients supplied by FYM and the beneficial effects of organic matter addition, which were derived in connection with the physical and chemical properties of the soil. Application of organic manure in conjunction with lower doses of N, P and K resulted in high growth and yield in fodder. [10, 11] reported the similar results.

3.2 Effect on crud protein yield

Different grasses significantly influenced the crude-protein yield (Table 1). Significantly higher crude protein yield (1.15 t/ha) was found with *Brachiaria mutica* compared to *Brachiaria humidicola* and guinea grasses. Application both treatments of M1- 100% NPK (inorganic fertilizer) and M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha were found at par by giving 1.15 t/ha and 1.13 t/ha, which was higher compared with M3- FYM @ 10 t/ha and no fertilizer. This increase could be ascribed to increased dry matter yield. The results align with the findings of [12], [13].

3.3 Effect on economics

The economic analysis of the treatments was worked out based on input-output analysis. The cost of cultivation incurred on treatments was added to the common cost of treatments and arrived at the total cost of cultivation. The data on the economic analysis presented in Table 1 shows that the highest gross monetary and net returns were recorded with *Brachiaria mutica* (41450.80 Rs. ha^{-1} and 24671.32 Rs. ha^{-1}), and the lowest were with the guinea grass. Among nutrient management treatments, the highest gross return (41450.80 Rs. ha^{-1} and 24671.32 Rs. ha^{-1}) was recorded with the application of M1- 100% NPK (inorganic fertilizer) *fb* by M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha over M3- FYM @ 10 t/ha and no fertilizer [14].

3.4 Effect on soil properties

The data in Table 2 indicated that available soil nutrients are similar to the initial status with advancement in crop growth stages under all treatments. The decline in nitrogen content with increasing growth could be attributed to higher nitrogen requirements for crops with age [15]. Significantly higher nitrogen content was recorded in *Brachiaria mutica* with nutrient M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha *fb* M1- 100% NPK (inorganic fertilizer) and M3- FYM @ 10 t/ha. The lowest value of NPK was found in control treatments. The increase in available nitrogen with poultry manure and bio fertilizer application might be attributed to the direct addition of nitrogen to the available soil nitrogen pool through manures [16]. A better response to adding organic manure to improve soil fertility can be attributed to its slow decomposition, which produces humic and amino acids, increasing nutrient availability. [17] also reported that applying FYM improves the soil's nutrient status.

Table 1. Effect of nutrient management practices on yield and economics

Treatment	Green fodder yield (q/ha)	Dry matter yield (q/ha)	Crude protein yield (q/ha)	Gross returns of the system (Rs/ha/yr)	Net returns of the system (Rs/ha/yr)	Benefit: Cost ratio
Grasses						
G1- Para grass	408.81	93.81	4.68	41450.80	24671.32	1.47
G2- Humidicola grass	361.25	60.94	3.15	16678.33	8147.16	0.48

G3- Guinea grass	104.90	28.27	1.39	5052.53	-8476.99	-0.50
CD at 5%	12.86	4.83	0.44	389.88	675.78	
Nutrient management						
M1- 100% NPK (inorganic fertilizer)	415.98	41.93	3.17	38826.67	22914.67	1.36
M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha	326.84	40.28	3.11	28911.10	14987.10	0.89
M3- FYM @ 10 t/ha	204.22	37.07	2.06	20653.33	8886.67	0.52
M4- Farmer practice (no nutrient)	166.21	31.40	1.92	16851.10	5648.88	0.33
CD at 5%	15.20	2.46	0.21	497.56	566.34	-

Table 2. Effect of nutrient management practices on soil properties

Treatment	pH	EC dS/mhos	OC (%)	Available (Kg/ha)		
				N	P	K
G1M1	7.46	0.45	0.62	239.8	16.79	340.2
G1M2	7.46	0.45	0.63	232.6	16.70	359.0
G1M3	7.45	0.45	0.65	242.2	16.85	360.5
G1M4	7.45	0.44	0.60	235.6	16.68	356.9
G2M1	7.45	0.43	0.61	233.4	16.80	359.3
G2M2	7.46	0.46	0.62	236.5	16.82	361.2
G2M3	7.47	0.46	0.62	235.8	16.80	357.3
G2M4	7.46	0.45	0.61	233.6	16.82	350.8
G3M1	7.46	0.45	0.62	235.7	16.82	362.2
G3M2	7.47	0.44	0.64	234.8	16.80	360.4
G3M3	7.46	0.45	0.64	235.1	16.81	360.2
G3M4	7.46	0.45	0.60	231.2	16.80	358.4
Initial status	7.46	0.45	0.62	236.8	16.79	360.2

4. CONCLUSION

It can be concluded that the grass *Brachiaria mutica* grown with M1- 100% NPK (inorganic fertilizer) gave the highest green and dry fodder yield and net monetary returns *fb* M2- 50% NPK through inorganic fertilizer + FYM @ 5 t/ha.

5. REFERENCES

[1] BAHS. 2019. Basic animal husbandry statistics. Government of India, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture AHS Series: 56.

[2] Anonymous. 20th Livestock census [Internet]. 2019. Available from: https://pib.gov.in/Press Release Page. aspx?PRID=1588304 [Accessed: 21 February 2020]

[3] Hindoriya, P.S., Meena, R.K., Kumar, Rakesh, Singh, Magan, Ram, Hardev, Meena, V.K., Ginwal, D., Dutta, S. 2019. Prouctivity and profitability of cereal –legume vis-a-vis their effect on soil nutrient status in Indo-Gangetic Plains. Legume Reserach –An Internation Journal 42(6): 812-817.

[4] Anonymous. 2018. National Accounts Statistics 2018. Central Statistical Organization, GOI. http://mospi.nic.in/ publication/ national-accounts-statistics-2018.

[5] Sharma, A, Singh, H. and Manwal, R.K. 2007. Effect of integrated nutrient management on productivity of wheat under limited and adequate irrigation supplies. Indian Journal of Agronomy 52(2): 120-123.

[6] Eghball, B., Ginting, D., and Gilley, J.E. 2004. Residual effects of manure and compost applications on corn production and soil properties. Agronomy Journal 96(2): 442-447.

[7] Singh, R.C., Kumar, S., Kadian, V.S. and Singh, S.N. 2005. Effect of FYM and fertilizer along and their combination on yield of pearlmillet. Haryana Agricultural University Journal of Research 35: 109-112.

[8] Walkley, A. and Black, I.A. 1934. An Examination of the Degtjareff Method for Determining Soil Organic Matter and a Proposed Modification of the Chromic Acid Titration Method. Soil Science 37: 29-38.

[9] Subbiah, B.V. and Asija, G.L. 1956. A Rapid Procedure for the Estimation of Available Nitrogen in Soils. Current Science 25: 259-260.

[10] Gobius, N.R., Phaikaew, C., Pholsen, P., Rodchompoo, O., Susena, W. 2001. Seed yield and its components of Brachiaria decumbens cv. Basilisk, Digitaria milanjiana cv. Jarra and Andropogon gayanus cv. Kent in north-east. Tropical Grassland 35: 26-33.

[11] Karen, Koenig, Shabtai, Bittman, Carson, Li, Derek, Hunt and Karen, Beauchemin. 2020. Effects of nutrient management and cropping strategies in a dual-crop forage production system of silage corn and perennial grass on nutritional quality and predicted milk production of dairy cattle. Journal of Animal Science 98(4): 433–434.

[12] Sadhu, A.C., Patel, J.R., Patel, P.C. and Patel, B.G. 1990. Cutting and nitrogen management studies in different genotypes of oats. Forage Research 16(2): 107-112.

[13] Kumar and Sharma, B.L. 2002. Effect of FYM, nitrogen and Azospirilium, inoculation on yield of fodder sorghum. Forage Research 28(3): 165-168.

[14] Khada, B.S., Kanak, J.K., Jadav, Lata, Kumar, R. and Rai, A.K. 2013. Evaluation of BN hybrid in Panchmahal district of Central Gujrat, Indian Journal of Agricultural Sciences 83(9): 977-980.

[15] Chand, S., Somani, L.L. and Bhandari, S.C. 2010. Effect of fertilizer, FYM and biofertilizer on the population of Azotobacter as phosphate solubilising bacteria (PSB) in the soil. Journal of the Indian Society of Soil Science 585(4): 460-463.

[16] Singh, Om, Chaturvedi, V.B.C, Verma, M.R. and Singh, H.C. 2018. Effect of Integrated Nutrient Management on Hybrid Napier Production under Irrigated Conditions. Int..J.Curr. Microbiol. App. Sci 7(4): 2731-2737.

[17] Ramamurthy, V. 2002. Response of Napier bajra hybrids to integrated nitrogen management. Indian Journal of Agronomy 47: 455-459.