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Influence of Integrated Nutrient Management on Fodder Pearl Millet in Transitional Plain of *Luni* Basin

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Abstract

The field experiment was carried out in loamy sand soil at Agricultural Research Station, Keshwana (Jalore) during *Kharif* season 2018 with the specific objective to find out the influence of integrated nutrient management on fodder pearl millet. The experimental treatment consisted of seven treatments *viz.,* 100% of RDF, 5 t FYM+50% of RDF, 5 t FYM+75% of RDF, 5 t FYM+100% of RDF, 5 t FYM+50% of RDF+ Biofertilizer and 5 t FYM+75% of RDF+ Biofertilizer laid out in randomized block design and replicated thrice. Application of 5 t FYM+100% RDF substantially improved plant height (149 cm), number of tillers per plant (4.52), green fodder yield (14.47 t ha^{-1}) and dry fodder yield (2.38 t ha^{-1}) over control. Similarly, application of 5 t FYM+100% RDF markedly fetched higher gross return (₹ 28,940), net return (₹ 9,856) and B:C ratio (1.52) over control and other treatments tested under the study. Efficient integrated nutrient management strategies are the potential approaches for improving green and dry fodder yield of fodder pearl millet and fetching higher returns in the Transitional Plain of *Luni* Basin (IIB) of Rajasthan. We concluded that applying integrated nutrient management having combination of organic and inorganic sources of nutrients would be worthwhile to improve fodder yield and achieving greater economic returns in fodder pearl millet.

Keywords: Dry fodder, FYM, green fodder, INM, pearl millet, yield

1. Introduction

In present changing scenario of Indian agriculture, livestock play an important role in livelihood of farming community particularly in western arid areas of Rajasthan wherein large proportion of landless as well as small and marginal rural farmers are dependent on livestock species (Narain et al., 2016). Currently, animal sector of India faces net deficit of 61.1% green fodder and 21.9% dry fodder supply resulting livestock sector suffers continuously with malnutrition for the year round in general hence their production capacity is remained below suboptimum level. Pearl millet, an important fodder crop, mainly cultivated in African and Indian subcontinent and covers 50 per cent of the total world production of millets. India is the largest producer of pearl millet in the globe. It is well adapted to vagaries of drought, high temperature and low soil fertility. Pearl millet locally known as *bajra* is a main dual purpose crop, its grain used for human consumption while the fodder used for livestock feeding. It is an important component of agricultural and animal husbandry dominated rural economy of dryland areas of India. It is a fast growing short duration crop which has high biomass production potential and mainly grown in arid and semi arid regions where moisture is a limiting factor for crop growth. It is an ideal crop with high tillering ability, high dry matter production, high protein content (10-12%) with excellent growth habit, high palatability and better nutritive value (Shashikala et al., 2013; Bind et al., 2015). The green fodder of *bajra* is leafy, palatable and very nutritious feedstock for cattle ensuring good milk yield (Upadhyaya et al., 2018). Farmers' in North-Western Rajasthan reared livestock for their livelihood security and except rainy season, the shortage of green fodder is a most common problem for livestock feeding. Except pearl millet, no other fodder crop is grown in this area due to harsh climatic condition. Farmers in this area generally cultivating the fodder pearl millet under limited availability of rain water and the soils of North-western Rajasthan was developed under harsh arid tropical climate and are inherently poor in organic matter, fertility and water holding capacity. In present context of the changing scenario of agriculture, further expansion of area under fodder crops is not possible in the country due to lot of demand of food grain to meet the feeding for increasing human population (Dhedhi et al., 2016; Saad et al., 2016; 2016a). Hence, increasing the fodder yield of crop per unit area is possible

through introduction of high yielding fodder varieties and suitable location specific agronomic practices is the only way to enhance the fodder production under the existing situation. Nitrogen and phosphorus is one of the basic plant nutrients essential for profuse growth. It increases vegetative growth of plant and herbage quality which is highly desirable for the forage yield and dry matter accumulation. Integrated nutrient management involves efficient use of organic manures, bio-fertilizers and inorganic fertilizers which can substantially enhance crop production, and also minimize environmental pollution. Nutrient management coupled with organic manure (FYM) or other farm waste is the tool to enhance fodder yield and improve soil health. FYM being the source of all essential elements and it also improves soil organic matter and play important role in habitating beneficial bacteria thus makes nutrients available to crops. In the disadvantageous soils it was hypothesized that whether the combinations of the recommended dose of fertilizers with organic sources or solubilizer will improve fodder biomass or not? To answer the research question, the present study was carried out in the sandy loam soil of Rajasthan.

2. Materials and Methods

The present study was carried out at Agricultural Research Station, Keshwana, Jalore during *Kharif* season 2018 to study the influence of integrated nutrient management on fodder pearl millet. Geographically, experimental site was located at 25.23° N Latitude; 72.30° E Longitude and 149.9 m above mean sea level) which falls under the zone Transitional Plain of *Luni* Basin (IIB) of Rajasthan. Characteristically, the zone covers an area of 7.70 mha, with average rainfall of 300–500 mm, with mean maximum temperature 38 °C and means minimum temperature 4.9 °C. The 'RCB-2' variety of pearl millet released for cultivation in entire *bajra* growing area of the country and has potential to produce green fodder yield 30-45 t ha^{-1} and also resistant to foliar diseases and insect pests was undertaken in the study. The main morphological characters of the variety 'RCB-2' are internodes completely covered in the leaf sheath, leaves are broad and shining at ear emergence stage. Looking towards the suitability of the variety in the region it was sown using *kera* method in the present experiment. The soils of the experimental field was loamy sand in texture, slightly alkaline in reaction, low in organic matter and available nitrogen and medium in available phosphorous, potassium and sulphur and low in DTPA extractable Zn and Fe (Table 1). The study was laid out in randomized block design consisted of seven treatments *viz.,* 100% of RDF, 5 t FYM+50% of RDF, 5 t FYM+75% of RDF, 5 t FYM+100% of RDF, 5 t FYM+50% of RDF+ Biofertilizer and 5 t FYM+75% of RDF+ Biofertilizer. The treatments were replicated thrice. The recommended dose of fertilizers (60 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1}) were applied under the respective treatment plots using urea and DAP, respectively. Biofertilizer as *Azotobacter* and PSB was used as seed inoculation. The seed were sown in line keeping 30 cm row to row distance at seed rate of 10 kg ha^{-1}. During scarcity of rainfall one life saving irrigation was applied. The green fodder yield was recorded after cutting while as dry fodder yield was recorded after sun dying the samples. The selling price of green fodder was sold at ₹ 2.0 kg^{-1}. The cross section data on output of pearl millet crop and input used per hectare were collected and used for further calculation of cost of cultivation, gross returns, net returns, and benefit cost ratio. The benefit cost ratio (B:C) was calculated dividing gross monetary returns by the total cost of cultivation.

Table 1: Physico-chemical characteristics of the experimental field (0-30 cm)

Soil parameters	Value
pH	8.02
EC (dS m^{-1})	0.45
Organic carbon (%)	0.23
Bulk density (Mg m^{-3})	1.55
Available N (kg ha^{-1})	166
Available P_2O_5 (kg ha^{-1})	18
Available K_2O (kg ha^{-1})	275
Available S (mg kg^{-1})	13.44
DTPA extractable Zn (mg kg^{-1})	0.17
DTPA extractable Fe (mg kg^{-1})	2.70
Soil texture	Loamy sand

3. Results and Discussion

3.1. Growth attributes

Marked improvement in growth attributes in terms of plant height and tillers per plant were recorded due to addition of Farm Yard manure (FYM) and biofertilizers in recommended dose of fertilizers (RDF) (Table 2). Application of 5 t FYM+100%

Table 2: Effect of integrated nutrient management on growth parameters, green and dry fodder yield of pearl millet

Treatments	Plant height (cm)	Tillers $plant^{-1}$ (No.)	Green fodder yield (t ha^{-1})	Dry fodder yield (t ha^{-1})
Control	115.3	3.49	5.80	1.00
100 % of RDF	129.0	3.90	10.97	1.60
5 t FYM +50 % of RDF	126.0	3.81	10.40	1.65
5 t FYM +75 % of RDF	132.0	3.98	13.80	2.18
5 t FYM +100 % of RDF	149.0	4.52	14.47	2.38
5 t FYM+50 % of RDF+ Biofertilizer	140.0	4.21	13.73	2.32
5 t FYM+75 % of RDF+ Biofertilizer	143.3	4.29	14.03	2.35
SEm±	3.8	0.14	1.05	0.14
CD (*p*=0.05)	11.7	0.45	3.26	0.45

of RDF recorded significantly taller plants (149 cm) over control (115.3 cm), 100% of RDF (129 cm), 5 t FYM+50% of RDF (126 cm), 5 t FYM+75% of RDF (132 cm). Similarly, application of 5 t FYM+100% RDF (4.52) also recorded marked improvement in number of tillers per plant over control (3.49), 100% RDF alone (3.9), 5 t FYM+50% of RDF (3.81), 5 t FYM+75% of RDF (3.98). Owing to addition or fulfilling sufficiently the demand of nutrient of crop leads to taller plant heights and greater tillers (Upadhyaya et al., 2018).

However, the treatment 5 t FYM+100% of RDF remained on par with 5 t FYM+50% RDF+Biofertilizer and 5 t FYM+75% RDF+Biofertilizer. This indicated that the nutrient supplying capacity of the biofertilizers was not to the extent being added by 50% RDF and 75% RDF. These results are in close conformity with that of Das et al. (2010) and Moharana et al. (2012).

3.2. Green fodder yield

Increasing levels of RDF in addition to 5 t FYM enhanced markedly the green fodder yield of pearl millet (Table 2). Application of 5 t FYM+100% of RDF observed substantially higher green fodder yield (14.47 t ha^{-1}) over control (5.84 t ha^{-1}), 100% of RDF (10.97 t ha^{-1}), 5 t FYM+50% of RDF (10.40 t ha^{-1}), 5 t FYM+75% of RDF (13.80 t ha^{-1}). In per cent terms, the increase due to application of 5 t FYM+100 % of RDF was to the tune of 149.5, 31.9, 39.1 and 4.8 over control, 100% of RDF, 5 t FYM+50% of RDF, 5 t FYM+75% of RDF, respectively. In general, the low productivity in control plot might be ascribed poor nutrition and inappropriate supplementation of nutrient demand (Chaudhary et al., 2016; Saad et al., 2016). Further, enhancement in green fodder productivity due to supplementation of nutrients through FYM and biofertilizer could be due to its beneficial role in improving soil physical, chemical and biological properties (Moharana et al., 2012).

3.3. Dry fodder yield

All the treatments under experimentation substantially improved dry fodder yield over control (Table 3). Substantially higher dry fodder yield was recorded with the application of 5 t FYM+100% of RDF (2.38 t ha^{-1}) followed by 5 t FYM+75% of RDF+ Biofertilizer (2.35 t ha^{-1}). Application of 5 t FYM+100% of RDF treatment fetched 2.28, 2.59, 9.17, 44.24, 48.75 and 138.0 per cent higher dry fodder yield over 5 t FYM+75% of RDF+Biofertilizer, 5 t FYM+75% of RDF, 5 t FYM+50% of RDF +Biofertilizer, 100% of RDF, 5 t FYM +50% of RDF and control, respectively. The treatment 5 t FYM+75% of RDF+ Biofertilizer, 5 t FYM+50 % of RDF+ Biofertilizer, 5 t FYM+75% of RDF, 5 t FYM +50% of RDF and 100% of RDF significantly gave higher dry fodder yield by 135.0, 132.0, 118, 65.0 and 60.0%, respectively, over control. The beneficial effect of INM treatments on dry fodder yield of pearl millet might be due to its contribution in supplying additional plant nutrients and its capacity to improving solubility of native soil nutrients. The significant increase in dry fodder yields due to the influence of INM were largely a function of improved growth and the consequent improvement in yield attributes. Further, manure increased the efficiency of added chemical fertilizer in soil and rate of humification. Humic acid in FYM might have enhanced the availability of native nutrients in soil as a result of improved growth, yield attributes and yield of the crop significantly (Bhatnagar et al., 1998; Akponikpe et al., 2008; Das et al., 2010).

Table 3: Economics of integrated nutrient management in fodder pearl millet

Treatments	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
Control	11,600	-2,152	0.84
100 % of RDF	21,940	6,876	1.46
5 t FYM+50% of RDF	20,800	2,392	1.13
5 t FYM+75% of RDF	27,600	8,825	1.47
5 t FYM+100% of RDF	28,940	9,856	1.52
5 t FYM+50% of RDF+ Biofertilizer	27,460	9,032	1.49
5 t FYM+75% of RDF+ Biofertilizer	28,060	9,304	1.50

3.4. Economics

Economics, an important parameter to accept or reject a technology was estimated under the experimentation. The economics of the treatments were calculated using the prevailing market prices of the inputs and outputs during the particular year (Table 3). All the nutrient management treatments tested under study gave significantly higher net returns and B:C ratio in comparison to control. Application of 5 t FYM +100 % of RDF to pearl millet fetched significantly higher gross return (₹ 28,940), net return (₹ 9,856) and B: C ratio (1.52) over rest of the treatments including control. This was attributed to the fact that higher green and dry fodder yields were obtained under this treatment. It is obvious that realization of higher net returns and benefit: cost ratio was the result of higher productivity. These results corroborate the findings of Sharma et al. (2009) and Choudhary and Prabhu (2014).

4. Conclusion

Based on the experimentation conducted, it is may be concluded that application of 5 t FYM+100% of RDF to pearl millet substantially enhanced green fodder yield (14.47 t ha^{-1}) and dry fodder yield (2.38 t ha^{-1}) and found most remunerative in Transitional Plain of *Luni* Basin. Further, it fetched significantly higher gross return (₹ 28,940), net return (₹ 9,856) and B: C ratio (1.52) over rest of the treatments.

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