RESPONSE OF PEARL MILLET TO NITROGEN MANAGEMENT IN RELATION TO QUALITY PRODUCE AND SOIL HEALTH

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ABSTRACT

A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during the year 2015 to study the response of pearl millet to nitrogen management in relation to quality produce and soil health. Results revealed that an application of 50% RDN through chemical fertilizers + 25% N through vermicompost + 25% N through neemcake to summer pearl millet crop resulted in significantly the higher yield of grain (2613 kg/ha) and straw (6769 kg/ha) followed by the treatments with application of 50% RDN through chemical fertilizers + 25% N through biocompost + 25% N through neem cake and 50% N through chemical fertilizers + 25% N through vermicompost + 25% N through castor cake as well as treatment of 50% RDN through chemical fertilizers + 25% N through biocompost + 25% N through castor cake. All the treatments with application of 50% RDN through chemical fertilizers + 25% RDN through biocompost / vermicompost + 25% RDN through neemcake/ castorcake gave higher net return with improvement in soil health as compared to 100% RDN through chemical fertilizer.

KEY WORDS: Economics, nitrogen management, nutrient status, nutrient uptake, quality, yield

INTRODUCTION

Pearl millet is the fourth most important cereal crops and widely grown in India because of its tolerance to drought, high temperatures and low soil fertility. Pearl millet grain is the staple diet and nutritious source of vitamins, minerals and protein, while pearl millet stover is a valuable livestock feed. India is the largest producer of pearl millet in the world occupying about 9.4 million hectare with annual production of 10.1 million tonnes with average productivity of 1069 kg/ha (Anonymous, 2014). In plant nutrition, organic matter of a soil is the key property that decides the availability status of essential nutrients. Integrated nutrient management system through efficient use of organic matter, besides improving soil health and conservation of moisture, can

substantially enhance crop production. The nutrient supply, the flows and the nutrient added should be managed properly to achieve as high yield as possible under the climatic circumstances while minimizing environmental pollution. The use of organic manure is the tool to improve physical, chemical and biological properties of the soil. Vermicompost, biocompost, castorcake and neemcake is being the source of all essential elements, improves soil organic matter and humus part of soil and also plays important role in habitation beneficial bacteria, thus, making the nutrients available to crops. Integrated plant nutrition involves judicious and integrated use of chemical fertilizers along with organic manure. Keeping this in view, present investigation was undertaken to find out the effect of integrated nitrogen management on nutrient uptake, quality, economics and soil fertility of pearl millet under summer conditions.

MATERIALS AND METHODS

A field experiment was conducted during *summer* season of 2015 at College Farm, N. M. College of Agriculture, Navsari agricultural University, Navsari, to study the effect of integrated nitrogen management on pearl millet (*Pennisetum glaucum* L.). Geographically, the Navsari is situated at 200 57' North Latitude and 720 54' East longitude with an elevation of 10 meter above the mean sea level and situated in the South Gujarat Agro-climate region. The climate of the region is warm humid with heavy monsoon. The soil of the experimental field was clayey in texture, low in organic carbon (0.37%) and showed medium rating for available nitrogen (276 kg/ha) and phosphorus (37 kg/ha) and high rating for available potassium (365 kg/ha). The soil was found slightly alkaline (pH 7.6) with normal electrical conductivity (0.58 dS/m). Nine treatment combinations comprising of chemical fertilizers and organic manures. *viz*., 100% recommended dose of nitrogen i.e. 120 kg N/ha (T_1), 75% RDN + 25% N from vermicompost (T_2), 75% RDN + 25% N from biocompost (T_3), 75% RDN + 25% N from castorcake (T_4), 75% RDN + 25% N from neemcake (T_5), 50% RDN + 25% N from vermicompost + 25% N from castorcake (T_6), 50% RDN + 25% N from vermicompost + 25% N from neemcake (T_7), 50% RDN + 25% N from biocompost + 25% N from castorcake (T_8) and 50% RDN + 25% N from biocompost + 25% N from neemcake (T_9) were evaluated in randomized block design with three replications. Recommended dose of phosphorus @60 kg P_2O_5/ha was appended through single supper phosphate and applied at the time of sowing. Organic manures were thoroughly incorporated in soil in furrow as per treatment and fertilizers were applied according to the treatments manually before sowing the seeds. The sources of nitrogen and phosphorus were urea and single super phosphate, respectively. All other cultural practices were performed uniformly for all treatments. Pearl millet variety (GBH 558) was sown on 11th February, 2015 using recommended seed rate of 3.5 kg/ha and keeping 45 cm distance between two rows at the depth of about 4-5 cm. Thinning were carried out after 15 days of sowing to maintain optimum plant population in the experimental plots. Weeding and plant protection measures were undertaken as per the need and the required plant population was maintained. The data related to each parameter of the experiment were statistically analyzed using MSTATC software. The net realization was

calculated by deducting the total cost of cultivation from the gross realization for each treatment. The benefit cost ratio (BCR) was calculated on the basis of the formula given below:

BCR = Net realization (₹ /ha) / Cost of cultivation (₹ /ha)

RESULTS AND DISCISSION

Grain and straw yield per hectare were significantly influenced by different treatments of nitrogen management. An application of 50% RDN through chemical fertilizers + 25% N through vermicompost + 25% N through neemcake (T_7) to *summer* pearl millet crop resulted in significantly the higher grain (2613 kg/ha) and straw yield (6769 kg/ha) followed by the treatments with application of 50% RDN through chemical fertilizers + 25% N through biocompost + 25% N through neemcake (T_9) and 50% N through chemical fertilizers + 25% N through vermicompost + 25% N through castorcake (T_6) as well as treatment of 50% RDN through chemical fertilizers + 25% N through biocompost + 25% N through castorcake (T_8) (Table 1). The percentage grain yield increased in the treatment T_7, T_6, T_9, T_8 and T_2 were to the tune of 27.0, 25.5, 20.6, 19.3 and 11.5 per cent, respectively, as compared to the treatment having 100% RDN through chemical fertilizer. The percentage straw yield increased in the treatment T_7, T_6, T_9, T_8 and T_2 were to the tune of 26.6, 25.2, 21.2, 20.1 and 10.5 per cent, respectively, as compared to the treatment having 100% RDN through chemical fertilizer (T_1). The highest grain and stover yield per hectare gained under these treatments might be due to chemical fertilizer in conjunction with organic manure might have provide favourable soil environment and nourishment for better plant growth resulted in maximum grain and stover yield. Yield of the crop is a function of several yield components which are dependent on complementary interaction between vegetative and reproductive growth of the crop. Positive responses in terms of yield attributes to integrated nitrogen management have also been reported by Narolia *et al*. (2009), Jakhar *et al.* (2011), Singh *et al.* (2013), Choudhary *et al.* (2014), Kumar *et al.* (2014) and Sinha (2015).

Protein content of pearl millet grain has been not exerting their significant effect by integrated nitrogen management practices. But, data of protein yield (kg/ha) from pearl millet in grain as influenced by treatments of integrated nitrogen management and were remained at par with each other and proved significantly superior over control. Application of 50 % RDN + 25% N from vermicompost + 25 % N from neemcake resulted in the highest grain protein yield (291.03 kg/ha), which was remained statistically at par with the treatment of 50 % RDN + 25% N from vermicompost + 25 % N from castorcake, 50 % RDN + 25% N from biocompost + 25 % N from neemcake and 50 % RDN + 25% N from biocompost + 25 % N from castorcake. Significantly the lower protein yield (220.11 kg/ha) was recorded under the treatment of 100 % RDN (Table 1). It may be because of increased N content in seed which might be the result of increased availability of nitrogen to plants. Another reason for higher nitrogen content might be due to increased activity of nitrate reductase enzyme. Higher nitrogen in seed is directly responsible for higher protein because it is a primary component of amino acids which constitute the basis of protein. The findings of present

investigation are in agreement with those of Meena and Gautam (2005).

An economic analysis of the data revealed that higher net realization of rupees 18774/ha and BCR of 0.71 were obtained with treatment of 50 % RDN + 25 % N from vermicompost + 25% N from neemcake (T_7) and followed by 50 % RDN + 25 % N from vermicompost + 25% N from castercake (T_6) and 50 % RDN + 25 % N from biocompost + 25% N from neemcake (T_9). The lower net realization of rupees 12868/ha and BCR of 0.53 were recorded under treatment of 75 % RDN + 25 % N from biocompost (T_3) (Table 1). The reason is self explanatory that grain and straw yields at par in these treatments as compared to rest of the treatments, but application of manures increased cost of inputs. These results are in close conformity with the findings of Kanzaria *et al.* (2010) and Saha *et al.* (2012).

Application of 50 % RDN + 25% N from vermicompost + 25 % N from neemcake reported significantly the maximum total nutrient uptake by plant (99.62, 16.37 and 75.23 kg/ha N, P and K, respectively) followed by the treatments of 50 % RDN + 25% N from vermicompost + 25 % N from castorcake, 50 % RDN + 25% N from biocompost + 25 % N from castorcake and 50 % RDN + 25% N from biocompost + 25 % N from neemcake. The treatment, 100% RDN recorded the minimum total nutrient uptake of N, P and K (71.38, 11.75 and 55.29 kg/ha, respectively) by plant (Table 2). This might be due to improved nutritional environment in the rhizosphere as well as its utilization in the plant system leading to enhanced translocation of nutrients towards reproductive structures viz., ear heads, seeds and other plant parts. These results gain support from Meena and Gautam (2005) and Narolia *et al.* (2009).

Results of post experimentation analysis showed that improvement in soil organic carbon available N, P_2O_5 and K_2O were increased in all the treatments except the treatment 100% RDN as compared to initial value (Table 2). Application of 50 % RDN + 25% N from vermicompost + 25 % N from neemcake recorded significantly higher value of available nitrogen of soil as compared to all other treatments of integrated nitrogen managements expect with treatment 100% RDN. Significantly lower available nitrogen (254.9 kg/ha) recorded under the treatment 100 % RDN. Soil organic carbon, available P_2O_5 and K_2O in soil did not differ significantly by different nitrogen management treatments in pearl millet. Numerically higher organic carbon (0.46%), phosphorus (41.3 kg/ha) and potassium (371.3 kg/ha) observed with treatment 50 % RDN + 25% N from vermicompost + 25 % N from neemcake and lower value of organic carbon (0.35%), phosphorus (37.3 kg/ha) and potassium (357.9 kg/ha) with 100 % RDN. It could be understood in the light of differential solubility and rate of decomposition of fertilizers and manures. Significantly build-up of available N status under this integration of fertilizer and organic manures could be due to organic matter added with addition of vermicompost, biocompost, castor cake and neem cake which remained longer period in the soil as residual nutrient and in presence of organic matter. Besides, CO_2 and organic acid released during the process of decomposition which increase the availability of nitrogen from native as well as applied organic sources. The findings of present investigation are in

agreement with those of Golada *et al.* (2012).

CONCLUSION

Based on the results of the field experimentation, it seems quite logical to conclude that higher production and net profit from summer pearl millet (GHB 558) can be secured by application of 50% RDN through chemical fertilizers + 25% N through vermicompost/biocompost + 25% N through neemcake/castorecake with maintaining the soil health.

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Table 1: Effect of nitrogen management on yield, quality and economics of pearl millet.

Treatments	Yield (kg/ha)		Protein (%)	Protein Yield (kg/ha)	Cost of Cultivation (x10^3 ₹ /ha)	Net Returns (x10^3 ₹ /ha)	B:C Ratio
	Grain	Straw					
100% recommended dose of nitrogen	2057	5347	10.68	220.11	19.866	15.507	0.781
75% RDN + 25% N from VC	2294	5908	10.89	248.81	24.657	14.682	0.595
75% RDN + 25% N from BC	2160	5607	10.64	229.21	24.271	12.867	0.530
75% RDN + 25% N from CC	2126	5500	10.72	228.56	22.441	14.067	0.627
75% RDN + 25% N from NC	2131	5515	10.76	228.60	21.325	15.273	0.716
50% RDN + 25% N from VC + 25% N from CC	2582	6693	11.03	285.30	27.233	17.133	0.629
50% RDN + 25% N from VC + 25% N from NC	2613	6769	11.13	291.03	26.117	18.773	0.719
50% RDN + 25% N from BC + 25% N from CC	2455	6420	10.86	266.79	26.847	15.452	0.576
50% RDN + 25% N from BC + 25% N from NC	2482	6482	11.01	273.34	25.731	17.012	0.661
SEm ±	112	315	0.32	12.97			
CD (P=0.05)	336	945	NS	38.90			

RDF=120:60:0 NPK/ha

Table 2: Effect of nitrogen management on total nutrient uptake by pearl millet and soil nutrient status.

Treatments	Total Nutrient Uptake (kg/ha)			Soil Organic Carbon (%)	Nutrient Status of Soil (kg/ha)		
	N	P	K		Available N	Available P_2O_5	Available K_2O
100% recommended dose of nitrogen	71.38	11.75	55.29	0.34	254.9	37.3	357.9
75% RDN + 25% N from VC	83.85	13.86	63.85	0.39	280.2	40.5	368.3
75% RDN + 25% N from BC	76.58	12.72	58.76	0.37	278.6	40.5	369.2
75% RDN + 25% N from CC	75.92	12.52	58.00	0.38	277.9	40.0	368.9
75% RDN + 25% N from NC	76.12	12.51	58.40	0.39	280.4	40.8	369.9
50% RDN + 25% N from VC + 25% N from CC	97.55	15.99	73.92	0.45	284.5	40.6	370.4
50% RDN + 25% N from VC + 25% N from NC	99.62	16.37	75.23	0.46	288.6	41.3	371.3
50% RDN + 25% N from BC + 25% N from CC	90.31	14.85	68.95	0.42	282.9	41.0	370.4
50% RDN + 25% N from BC + 25% N from NC	91.98	15.28	70.38	0.43	286.7	41.3	370.7
SEm ±	4.74	0.78	3.96	0.02	6.11	1.31	14.47
CD (P=0.05)	NS	19.41	19.23	NS	18.31	NS	NS
			Initial value	0.37	276	37	365

RDF=120:60:0NPK

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