Forage Res., **43** (3) : pp. 208-212 (2017) **http://forageresearch.in**

INFLUENCE OF MANURE AND NITROGEN LEVELS ON NUTRIENT UPTAKE, SOIL FERTILITY AND ECONOMICS OF PEARLMILLET UNDER SEMIARID ENVIRONMENT

MANJEET* AND PARVEEN KUMAR

Department of Agronomy
CCS Haryana Agricultural University,
Hisar-125 004 (Haryana), India
**(e-mail : manjeetjakher619@gmail.com)*

(Received : 5 December 2017; Accepted : 25 December 2017)

SUMMARY

A field experiment was conducted at Agronomy Research Area, CCSHAU, Hisar during **kharif** 2016 with the objective to study the effect of manure and nitrogen level on nutrient uptake, soil fertility and economics of pearl millet hybrid HHB-223. The experiment was conducted in split plot design with three replications. In the main plot, there were manurial treatments viz., control, biomix, vermicompost @ 2.5 t/ha and vermicompost @ 2.5 t/ha+biomix and nitrogen levels viz., 70, 80, 90 and 100 per cent RDN were kept under sub-plot. Higher N, P, K content and uptake were with biomix+vermicompost @ 2.5 t/ha and 100 per cent RDN. Availability of nutrient (N, P and K) after harvest in soil increased with increasing level of nitrogen and was highest in biomix+vermicompost @ 2.5 t/ha treatment among manurial treatment. In manurial treatment higher gross return (Rs. 50252) and net returns (Rs. 17532) were recorded with biomix+vermicompost @ 2.5 t/ha. Gross return, net returns and B : C ratio of pearl millet increased with increasing level of nitrogen and highest values were recorded with 100 per cent RDN and were Rs. 48217, Rs. 21036 and 1.77, respectively, but almost comparable with 90 per cent RDN. Hence, to enhance yield and monetary returns, pearl millet seed should be treated with biomix and fertilized with 90 per cent RDN along with vermicompost application @ 2.5 t/ha.

Key words : Manure, nutrient uptake, soil fertility, economics, pearl millet

Pearl millet [*Pennisetum glaucum* (L.) R. Br. Emend. Stuntz], commonly known as ***bajra,*** is a dual purpose crop. Its grains are used for the human consumption and fodder as cattle feed. So, being an important dual purpose crop, it plays a dominant role in integrated agricultural and animal husbandry economy of the drier region of the country. Its tolerance to drought, high temperature, low soil fertility, rapid growth rate when conditions are favourable and ability to extract mineral nutrition and water even from the poorest soils make it impossible to beat the pearl millet in growing it in the world's hardest agricultural production environment. In India, it is the fifth most important cereal grain crop next to rice, wheat, maize and sorghum. India is the largest producer of pearl millet in the world occupying about 7.1 million hectare area with annual production of 9.1 million tonnes and with average productivity of 1272 kg/ha (Anonymous, 2015). In Haryana, area under this crop was 0.38 million hectare with total production of 0.67 million tonnes and productivity of 1749 kg/ha (Anonymous, 2015). Productivity of any crop depends on many production factors like application of major and micronutrients through organic, inorganic or biofertilizers, thinning, weeding, irrigation and every factor has significant role towards quality and nutrient aspects of the crop. Non-adoption of improved package of practices recommended for specific zone by the farmers is one of the major causes for low yield of pearl millet crop. Therefore, it is necessary to find out the contribution of individual or combination of production factors on the nutrient and quality aspects of pearl millet (Kumar *et al.*, 2015). To meet the ever growing food demand with limited resources, we need to increase the productivity by adopting better agronomic practices and efficient fertilization. Biofertilizers play an important role in increasing the availability of native and applied nutrient and productivity in sustainable manner (Rinku *et al.*, 2014). Moreover, nitrogenous fertilizers have played a key role in increasing food grains production in India and will continue to do so in future (Singh *et al.*, 2013). The unabated use of the high analysis chemical fertilizers coupled with the high yielding varieties has no doubt increased the food grain production mani fold but these intensive agricultural practices have led to a decline in the soil physical, chemical and biological properties. Current trends in agriculture are focused on reduction in the use of inorganic fertilizers compelling the search for alternatives (Hameeda *et al.*, 2006). The chemical fertilizers are quite expensive and the small and marginal farmers are unable to use these fertilizers in required quantity (Patil *et al.*, 2014). Now, it is the need of the hour to think about the alternative to chemical fertilizers that can be used by the farmers and the use of organic manure alone or in combination with the bio-fertilizers for minimizing the dependence on inorganic fertilizers can be an alternative. Since, pearl millet is an exhaustive crop and to sustain its productivity, use of organic source of nutrients in combination with inorganic fertilizers is necessary not only to maintain soil fertility but also to improve the efficacy of chemical fertilizers (Bagla *et al.*, 2008). The present investigation was, therefore, planned to study nutrient uptake, soil fertility and economics of pearl millet as influenced by manure and nitrogen levels under semi-arid environment.

MATERIALS AND METHODS

A field experiment was conducted during **kharif** season of 2016 at Agronomy Research Area, Chaudhary Charan Singh Haryana Agricultural University, Hisar to study nutrient uptake, economics and soil fertility of pearl millet as influenced by manure and nitrogen levels under semi-arid environment. The soil was sandy loam in texture, slightly alkaline in reaction (pH 7.9), low in organic carbon (0.43) and nitrogen (133 kg/ha), medium in available phosphorus (18.3 kg/ha) and potassium (263 kg/ha). The experiment was laid out in split plot design with three replications. In the main plot manurial treatment viz., control, biomix, vermicompost @ 2.5 t/ha and vermicompost @ 2.5 t/ha+biomix and in sub-plot nitrogen levels viz., 70, 80, 90 and 100 per cent RDN were kept. The pearl millet hybrid HHB 223 was sown at a spacing of 45 cm at about 2.0 cm depth by seed drill using 5 kg seed/ha. The weighed quantity of vermicompost was applied two weeks before sowing as per treatment. The seed pertaining to inoculated plots was treated with biomix culture, as per treatment. Full dose of phosphorus and half of nitrogen, as per treatments, were applied at the time of sowing and remaining half of the nitrogen was top-dressed in two splits, one after thinning and gap filling, and another at the time of earhead formation stage. During experimentation period, a total rainfall of 340 mm was received during the crop season bifurcated as 244.8, 80.4 and 2.8 mm during July, August and September months, respectively. Nitrogen content was determined by Nessler's Reagent Method as described by Jackson (1973). Phosphorus content was determined by Vane domolybdo Phosphoric Acid Yellow Colour Method (Olsen *et al.*, 1954). Potassium content was determined by Flame Photometric Method (Richards, 1954). The total nitrogen uptake at harvest was calculated as under :

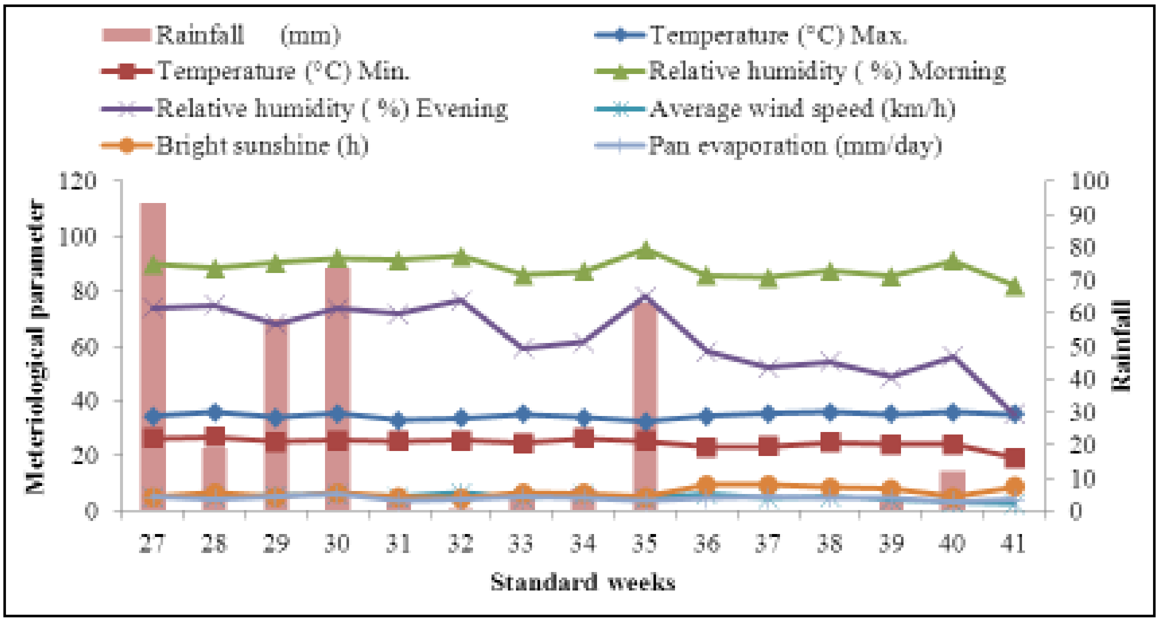

Fig. 1. Weekly meteorological data recorded during crop season.

$$\text{Nutrient uptake by grain or stover (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{grain or stover yield (kg/ha)}}{100}$$

The experimental data were statistically analyzed by Fisher's 'Analysis of Variance' technique (Fisher, 1950). The expenditure incurred on individual treatment was worked out from the detailed assessment of the fixed and variable costs involved such as land preparation, seed, plant protection, chemicals and labour engaged in different operations. Gross income for all treatments was calculated separately taking into consideration the prevailing sale prices of grain and stover yield of individual crop. Thereafter, net returns were calculated after subtracting expenditure incurred on the individual treatment from the gross expenditure of the same treatment. Available N in soil was determined according to alkaline permanganate method by Subbiah and Asija (1956). Available P in soil was determined by Olsen's method (Jackson, 1973). Available K in soil was extracted by neutral normal ammonium acetate and estimated by flame photometer (Piper, 1966).

RESULTS AND DISCUSSION

Neither the manure nor the nitrogen levels brought any significant variation in phosphorus and potassium content in grain and stover except K content in grain (Table 1). However, nitrogen content in grain and stover was affected significantly by manure and nitrogen levels. The increase in nitrogen content in grain and stover might be due to more availability of nitrogen and solubilization of fixed phosphorus under inoculation treatment (Satyajeet *et al*., 2007; Nisha *et al*., 2007). Uptake of N, P and K was affected significantly with different manurial and nitrogen treatments except P uptake in grain under manurial treatment. Significantly highest values of N, P and K uptake were recorded with the application of biomix+vermicompost @ 2.5 t/ha over other manurial treatments. Similarly, with the application of 100 per cent RDN resulted in higher N uptake over rest of the nitrogen levels. However, 100 per cent RDN resulted in higher P and K uptake over 70 and 80 per cent RDN but at par with 90 per cent (Table 2). The higher nitrogen uptake under higher levels of nitrogen was due to increased concentration of nitrogen in grain and stover and more dry matter production (grain and stover) of pearl millet. Similar findings were also reported by Satyajeet *et al*. (2007) and Singh *et al*. (2014). In general, soil fertility in respect of N, P_2O_5 and K_2O decreased as compared to their availability at the time of sowing (Table 3). Application of vermicompost @ 2.5 t/ha and biomix+vermicompost @ 2.5 t/ha improved the soil nutrient status in respect of available N, P and K after harvesting of crop. In case of manure application, highest gross returns, net returns and benefit : cost ratio were found with biomix+vermicompost @ 2.5 t/ha the respective values were Rs. 50252/ha, Rs. 17532/ha and 1.53, respectively. The inoculation of seed with biomix, vermicompost @ 2.5 t/ha and biomix+vermicompost @ 2.5 t/ha increased the net returns by Rs. 4167, 559 and 4975/ha, respectively, as compared to control. With

TABLE 1

N, P and K content in grain and stover of pearl millet as influenced by manures and nitrogen levels

Treatment	N content (%)		P content (%)		K content (%)	
	Grain	Stover	Grain	Stover	Grain	Stover
Manure						
Control	1.62	0.64	0.20	0.22	0.49	1.34
Biomix	1.68	0.69	0.21	0.24	0.50	1.40
Vermicompost @ 2.5 t/ha	1.68	0.71	0.21	0.24	0.51	1.40
Biomix+vermicompost @ 2.5 t/ha	1.79	0.81	0.22	0.25	0.53	1.51
C. D. (P=0.05)	0.10	0.10	NS	NS	0.03	NS
Nitrogen levels						
70% RDN	1.53	0.58	0.19	0.22	0.49	1.34
80% RDN	1.66	0.67	0.20	0.23	0.50	1.38
90% RDN	1.77	0.76	0.21	0.24	0.52	1.46
100% RDN	1.81	0.84	0.21	0.24	0.53	1.48
C. D. (P=0.05)	0.08	0.07	NS	NS	NS	NS

NS–Not Significant.

TABLE 2
N, P and K uptake by pearl millet as influenced by biofertilizers, vermicompost and nitrogen levels

Treatment	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	Grain	Stover	Grain	Stover	Grain	Stover
Manure						
Control	37.4	36.2	4.7	12.4	11.4	75.9
Biomix	43.2	43.7	5.3	15.1	12.8	87.7
Vermicompost @ 2.5 t/ha	45.7	48.5	5.6	15.9	13.9	95.2
Biomix+vermicompost @ 2.5 t/ha	54.4	58.2	6.2	17.7	16.2	108.1
C. D. (P=0.05)	3.3	8.2	NS	1.8	1.2	12.7
Nitrogen level						
70% RDN	36.6	34.6	4.5	13.0	11.7	79.1
80% RDN	43.6	43.9	5.4	15.1	13.2	89.7
90% RDN	49.6	52.0	6.0	16.6	14.5	96.1
100% RDN	52.6	58.1	6.2	16.9	15.3	102.5
C. D. (P=0.05)	2.6	4.2	0.8	1.9	1.1	12.4

TABLE 3
Effect of biofertilizers, vermicompost and nitrogen levels on soil fertility after experimentation

Treatment	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Manure			
Control	117.3	15.1	243.0
Biomix	119.4	17.4	249.2
Vermicompost @ 2.5 t/ha	124.7	17.4	251.3
Biomix+vermicompost @ 2.5 t/ha	126.1	17.9	252.5
C. D. (P=0.05)	2.8	0.47	2.7
Nitrogen level			
70% RDN	117.6	16.6	245.9
80% RDN	121.4	16.8	248.7
90% RDN	123.8	17.2	249.5
100% RDN	124.7	17.2	251.7
C. D. (P=0.05)	2.1	0.43	3.6
Nutrient available before sowing	133	18.3	263

TABLE 4
Economics of pearl millet as influenced by different nutrient management practices

Treatment	Grain Yield (Mg/ha)	Straw Yield (Mg/ha)	Gross returns (Rs./ha)	Cost of cultivation (Rs/ha)	Net returns (Rs./ha)	B : C ratio
Manure						
Control	2.3	5.6	38577	26020	12557	1.48
Biomix	2.6	6.3	42944	26220	16724	1.63
Vermicompost @ 2.5 t ha-1	2.7	6.7	45636	32520	13116	1.40
Biomix+vermicompost @ 2.5 t/ha	3.0	7.1	50252	32720	17532	1.53
C. D. (P=0.05)	0.1	0.4	-	-	-	-
Nitrogen level						
70 % RDN	2.4	5.9	40030	26621	13409	1.50
80 % RDN	2.6	6.5	44072	26812	17260	1.64
90 % RDN	2.8	6.8	46743	26991	19752	1.73
100 % RDN	2.9	6.9	48217	27181	21036	1.77
C. D. (P=0.05)	0.1	0.2	-	-	-	-

different nitrogen levels, the highest gross returns, net returns and benefit : cost ratio were found with the treatment 100 per cent RDN closely followed by 90 per cent RDN (Singh *et al.*, 2013; Kumar *et al*, 2015) This was because that there was not any significant difference between the grain and stover yield of pearl millet at 100 and 90 per cent RDN (Table 4).

REFERENCES

Anonymous. 2015 : Accessed from agricoop.nic.in, Department of Agriculture, Co-operation and Farmer Welfare.

Bagla, G., I., Singh, S. K. Yadav, and P. Kumar. 2008 : Effect of organic and inorganic sources of nutrient supply on growth and yield parameters of pearl millet. *Natnl. J. Pl. Improv.*, **10** : 37-39.

Fisher, R. A. 1950 : *Statistical Methods for Agricultural Research* Workers, 2nd edn. Oliver and Boyand. London.

Hameeda, B., O. P. Rupela, G. Reddy, and K. Satyavani. 2006 : Application of plant growth promoting bacteria associated with composts and macrofauna for growth promotion of pearl millet (*Pennisetum glaucum* L.). *Biol. Fertil. Soils,* **43** : 221-227.

Jackson, M. L. 1973 : *Soil Chemical Analysis.* Parentica Hall of India Pvt. Ltd., New Delhi.

Jadhav, R. P., H. R. Khafi, and A. D. Raj. 2011 : Effect of nitrogen and vermicompost on protein content and nutrients uptake in pearl millet (*Pennisetum glaucum* L.). *Agric. Sci. Digest,* **31** : 319-321.

Kumar, A., A. Kumar, L. K. Midha, and B. S. Duhan. 2015 : Effect of different production factors on productivity, NPK uptake and quality of pearl millet [*Pennisetum glaucum* (L.) R. BR.]. *Forage Res.*, **41** : 46-49.

Nisha, R., A. Kaushik, and C. P. Kaushik. 2007 : Effect of indigeneous cynobacterial application on structural stability and productivity of an organically poor semi-arid soil. *Geoderma*, 138 : 1/2, 49-56. **38** ref.

Olsen, S. R., C. V. Cole, F. S. Watanable, and C. A. Dean. 1954 : Estimation of available phosphorus in soil extraction with sodium bicarbonate. *Circ. V. S. Department of Agric*. **939**. Washington, D. C.

Patil, A. S., H. K. Patel, and N. P. Chauhan, 2014 : Yield, quality and monetary returns of summer pearl millet (*Pennisetum glaucum* L.) as influenced by integrated nitrogen management and sowing methods. *Crop Res.,* **47** : 24-28.

Piper, C. S. 1966 : *Soil and Plant Analysis.* Hans Publishers, Bombay.

Richards, L. A. 1954 : Diagnosis and improvement of saline and alkali soils. USDA Hand Book No. **60**. Washington, D. C.

Rinku, P. S. Shekhawat, N. Kumawat, P. S. Rathore, P. K. Yadav, and Hari, Om. 2014 : Effect of nitrogen levels and biofertilizers on growth and yield of pearl millet (*Pennisetum glaucum* L.) under north-western Rajasthan. *Ann. Agric. Res. New Series,* **35** : 311-314.

Satyajeet, R. K. Nanwal, V. K. Yadav, and K. Pawan. 2007 : Effect of integrated nutrient management on productivity and quality of pearl millet. *Ann. of Bio.*, **23** : 37-40.

Singh, Niranjan, S. K. Sharma, Rohtas Kumar, Rajpaul and Satyender Singh. 2014 : Effect of sodicity and nitrogen levels on dry matter yield, protein and nutrient uptake in pearl millet. *Forage Res.,* **40** : 28-35.

Singh, R., T. Ram, G. L. Choudhary, and A. K. Gupta. 2013 : Effect of integrated nitrogen management on nutrient uptake, quality, economics and soil fertility of pearl millet under rainfed conditions. *Elix. Agric.,* **54** : 12373-12375.

Subbiah, B. V., and G. L. Asija. 1956 : A rapid procedure for the estimation of available nitrogen in soil. *Curr. Sci.,* **25** : 259-260.