Forage Res., **45** (2) : pp. 133-136 (2019) **http://forageresearch.in**

PRODUCTIVITY OF PEARL MILLET – WHEAT CROPPING SYSTEM UNDER INTEGRATED NUTRIENT SUPPLY

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(Received: 2 August 2019; Accepted : 25 September 2019)

SUMMARY

A field experiment was conducted at Agronomy Research Area, CCS HAU Hisar to study the effect of integrated nutrient supply on productivity of pearl millet – wheat cropping system during 2015-16 and 2016-17 in randomized block design with treatments *viz*. RDF (Recommended dose of fertilizers) through inorganic source, RDF through inorganic source + *Azotobactor* + PSB, Recommended N through vermicompost, 75% recommended dose of nutrients through inorganic source + 25% N from vermicompost + *Azotobactor* + PSB, 50% recommended dose of nutrients through inorganic source + 50% N from vermicompost + *Azotobactor* + PSB, 25% recommended dose of nutrients through inorganic source + 75% N from vermicompost + *Azotobactor* + PSB both in pearlmillet and wheat crop. In pearlmillet as well as in wheat crop RDF + *Azotobactor* + PSB through inorganic source produced highest yield attributes and yield but it did not differ significantly from the treatment where RDF through inorganic source was applied. Application of 75% RDF through inorganic source + 25% N from vermicompost + *Azotobacto*r + PSB produced significantly higher yield over 50% recommended dose of nutrients through inorganic source + 50% N from vermicompost + *Azotobactor* + PSB and 25% recommended dose of nutrients through inorganic source + 75% N from vermicompost + *Azotobactor* + PSB in respective crops.

Key words : Pearlmillet, wheat, cropping system, PSB, *Azotobactor* and yield

Many intensive cereal based cropping systems are under practice in the country according to agro-climatic regions. In Indo-Gangetic Plains of India, pearl millet - wheat cropping system is second most prominent and popular double cropping system after rice-wheat of the country and spreads over arid eco-region comprising, western plains, Kachh and parts of Kathiawar Peninsula having desert and saline soils representing Gujarat, Rajasthan and Haryana; semi-arid eco-region comprising northern plains of Haryana, western Uttar Pradesh and central high lands of Rajasthan with alluvium derived soils. Pearl millet grain is more nutritious and the grain contains 11-19 % protein, 60- 78% carbohydrates and 3.0-4.6% fat and also has good amount of phosphorous and iron (Reddy *et al.,* 2016). This system is very exhaustive and a crop giving 2.9 tonnes of pearl millet and 4.2 tonnes /ha of wheat may remove 238, 54 and 131 kg nitrogen, phosphorus and potassium, respectively. Further, long term studies being carried out at several locations in India indicated that application of all the needy nutrients through chemical fertilizers have deleterious effect on soil health, leading to unsustainable yields (Swarup, 2002). Since, the nutrient turnover in soil-plant system is considerably high under intensive cropping system. So, neither the chemical fertilizers nor the organic/ biological sources alone can achieve production sustainability. Integrated use of chemical fertilizers with organic manures has been found to be quite promising in maintaining high productivity and providing greater stability to crop production (Patidar and Mali, 2004). FYM is used as a major source of organic manure in field crops. In view of poor efficiency of FYM, vermicompost has been advocated as a good source of organic manure along with inorganic source for field crops (Roy and Singh, 2006). Even with the so called balance use of NPK fertilizers in long term studies, higher yield levels could not be maintained for years because of emergence of secondary and micro-nutrient deficiency and deterioration in the soil physical environment. Whereas, organic manure alone or in combination with inorganic fertilizers is known to have favourable effect on soil environment, correct the marginal deficiency of secondary and micro-nutrients and enhance the efficiency of applied nutrients. For higher fertilizer

use efficiency and sustainability of cropping system, there is need to recommend and develop site specific nutrient Therefore, there is a need to improve nutrient supply system in terms of integrated nutrient management involving the use of chemical fertilizers in conjunction with organic manures and coupled with inputs through biological processes.

MATERIALS AND METHODS

A field experiment was carried out at Agronomy Research Farm, Chaudhary Charan Singh Haryana Agricultural University; Hisar located in Indo-Gangetic Plains of North-West India with latitude of 29^{0}10' North and longitude of 75^{0}46' East at 215.2 meters above mean sea level during 2015-16 and 2016-17 in randomized block design with treatments *viz*. RDF (Recommended dose of fertilizers) through inorganic source, RDF through inorganic source+*Azotobactor+PSB*, Recommended N through vermicompost, 75% recommended dose of nutrients through inorganic source+25% N from vermicompost+ *Azotobactor+PSB*, 50% recommended dose of nutrients through inorganic source+50% N from vermicompost+*Azotobactor+PSB*, 25% recommended dose of nutrients through inorganic source+75% N from vermicompost+*Azotobactor+PSB* in both pearlmillet and wheat crop. The soil was sandy loam in texture, having pH value of 7.8, low in available N (130 kg/ha), medium in P (18 kg/ha) and rich in K (240 kg/ha). Mean weekly values of important weather parameter during the crop season recorded at the Agro-meteorological observatory of CCS Haryana Agricultural University, Hisar are depicted in Figure 1(a to b) and 2(a to b). In pearlmillet, variety HHB-197 was used with 5 kg/ha seed keeping intra row spacing of 10 cm and inter row spacing 45 cm. In wheat, variety WH 1142 was sown with 100 kg/ha seed keeping inter row spacing of 20 cm. The weighed

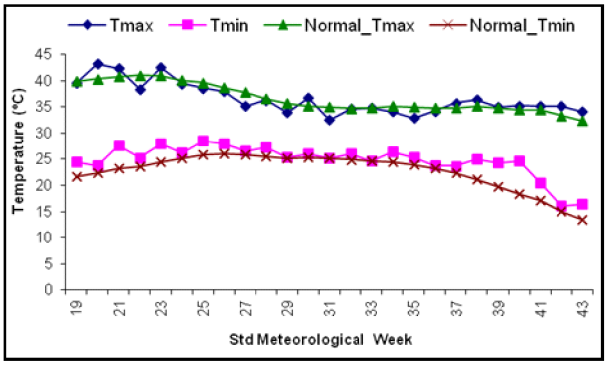

Fig. 1(a). Maximum and Minimum Temperature along with Normal during kharif 2016.

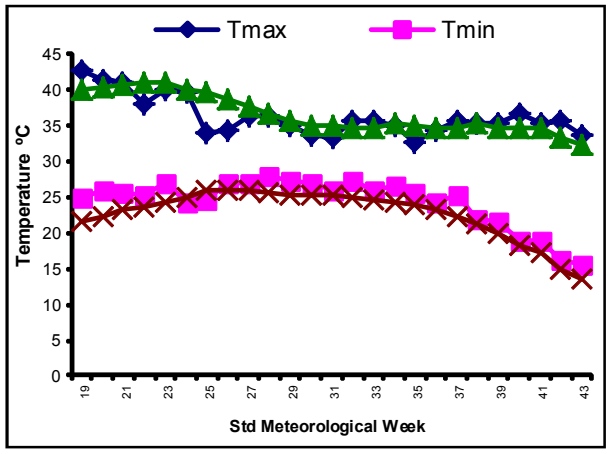

Fig. 1(b). Maximum and Minimum Temperature along with Normal during kharif 2017.

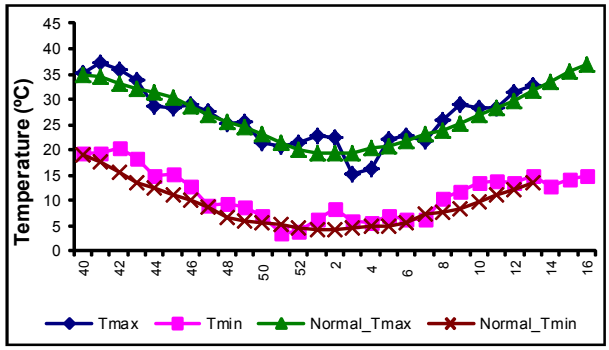

Fig. 2(a). Weekly maximum and minimum temperature during rabi 2015-16.

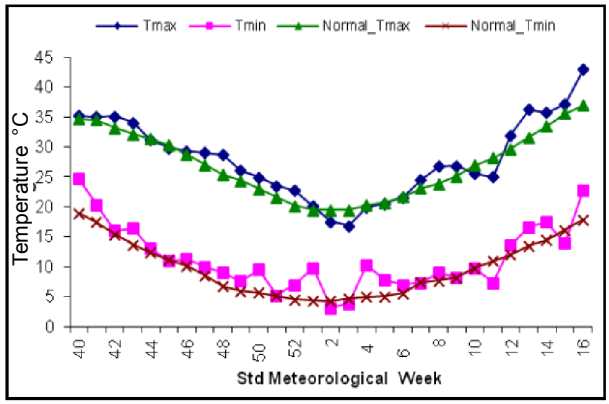

Fig. 2(b). Maximum and Minimum Temperature along with Normal during rabi 2016-17.

quantity of vermicompost was applied two weeks before sowing as per treatment. The seed pertaining to inoculated plots was treated with *Azotobactor* and *PSB* 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 as per recommendation in both the crops. The recommended N and P were applied through urea and SSP, respectively. Recommended

package of practices was followed in both the crops for other agronomic operations. Data on number of effective tillers, number of grains/earhead, 1000 grain weight, grain yield and straw yield were recorded by using standard procedure at harvest in both the crop. To determine grain yield, ear heads/ spike from the net plot were harvested and sun dried. Threshing was done by plot thresher. The separated grains were cleaned, dried in sun to bring down the moisture content at storage level. To determine stover yield, stalks were cut at ground level and weighed after sun drying.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads

Pearl millet

Data on yield attributing characters *viz*., effective tiller per plant, earhead length, earhead girth and yield were recorded at harvest and summarized in Table 1. The differences in these yield attributing characters due to various treatments were quite visible at harvest. Highest number of effective tillers per plant was recorded under RDF through inorganic source+*Azotobactor+PSB* which did not differ significantly from the treatment where RDF through inorganic source was applied. The results further revealed that different treatments did not differ significantly in respect of earhead length and girth during both the years of study. In the treatment where RDF (40 kg N+20 kg P_2O_5/ha)+*Azotobactor*+PSB through inorganic source was used, produced highest yield attributes and yield (20.58 q/ha) but it did not differ significantly from the treatment where RDF through inorganic source was applied. Application of 75% RDF through inorganic source+25% N from vermicompost+*Azotobacto*r+PSB produced significantly higher yield over 50% recommended dose of nutrients through inorganic source+50% N from vermicompost+ *Azotobactor*+PSB and 25% recommended dose of nutrients through inorganic source+75% N from vermicompost+*Azotobactor*+PSB. The increase in yield attributes may be due to the fact that INM application of fertilizer makes more availability of nutrients which is providing higher availability of nutrient to the plant, while application of biofertilizers led to higher availability of N and P as well as promoted the root growth, which promoted yield attributes characters. The results were in agreement with the findings of Khandelwal *et al*. (2017) and Manjeet and Kumar (2017).

Wheat

Data on yield attributing characters *viz*., spike/ m^2, grains per spike and 1000- grain weight and yield were recorded at harvest and summarized in Table 2. Significantly higher numbers of spike per sq. meter, grains per spike and grain yield were recorded under the treatment RDF through inorganic source + Azotobactor + PSB which did not differ significantly from the treatment where RDF through inorganic source was applied. The results further revealed that different treatments did not differ significantly in respect of 1000- grain weight during both the years of study. This is might be due to combined use of chemical fertilizers and biofertilizers in balanced proportion which played a very vital role in

TABLE 1
Effects of integrated nutrient management on yield attributes and yield of pearl millet in pearl millet - wheat cropping system

Treatment	Effective tiller/ plant		Earhead length (cm)		Ear head girth (cm)		Grain Yield (q/ha)	
	2016	2017	2016	2017	2016	2017	2016	2017
RDF (40 kg N+20 kg P_2O_5/ha) through inorganic source	3.00	3.35	20.25	20.45	8.50	8.75	19.24	19.90
RDF through inorganic source+Azotobactor+PSB	3.25	3.50	20.25	20.80	8.75	9.05	20.58	21.85
Recommended N through vermicompost	2.25	2.45	19.50	19.45	8.75	8.18	12.34	13.15
75% recommended dose of nutrients through inorganic source+25% N from vermicompost+Azotobactor+PSB	2.00	2.73	19.75	20.30	8.50	8.98	17.45	17.85
50% recommended dose of nutrients through inorganic source+50% N from vermicompost+Azotobactor+PSB	2.75	2.77	20.25	19.90	8.25	8.90	14.28	14.72
25% recommended dose of nutrients through inorganic source+75% N from vermicompost+Azotobactor+PSB	2.50	2.52	20.25	19.75	8.08	8.25	13.38	13.90
CD at 5%	0.93	0.93	NS	NS	NS	NS	2.94	3.04

TABLE 2
Effects of integrated nutrient management on yield attributes and yield of wheat in pearl millet - wheat cropping system

Treatment	Spike/ m^2		Grains/ spike		Test weight (g)		Grain Yield (q/ha)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
RDF (90 kg N+60 kg P_2O_5+40 kg K_2O/ha) through inorganic source	297	300	48	49	38	39.0	4125	4611
RDF through inorganic source+Azotobactor+PSB	302	305	51	50	39	38.5	4320	4813
Recommended N through vermicompost	221	225	36	38	35	37.0	2014	2875
75% recommended dose of nutrients through inorganic source+25% N from vermicompost+Azotobactor+PSB	262	267	40	42	37	38.0	3865	4342
50% recommended dose of nutrients through inorganic source+50% N from vermicompost+Azotobactor+PSB	252	258	38	43	36	39.0	3435	3889
25% recommended dose of nutrients through inorganic source+75% N from vermicompost+Azotobactor+PSB	240	245	39	38	35	37.0	2350	3132
CD at 5%	8.5	7.5	3.9	4.3	NS	NS	270	292

decomposition and easy release of different nutrients and their uptake by the crop which led to higher dry matter accumulation and its translocation in different plant parts, which in turn resulted into higher yield parameters and yield. Moreover, application of fertilizers could be ascribed to vital role of nitrogen (enhances growth processes being an integral part of chlorophyll, proteins and nucleic acid) and phosphorous (improves metabolic and physiological processes, improving both vegetative and reproductive growth) which subsequently led to build up of all the components of plant biomass. Lack of N and chlorophyll means the crop will not utilize sunlight as an energy source to carry on essential function such as nutrient uptake. It is a component of vitamins and energy systems in plants. Nitrogen is an essential component of amino acids, which form plant proteins. Besides these, it is also a constituent of certain organic compounds of physiological importance. The results are in line with the finding of Chaudhary *et al* (2017).

CONCLUSION

Application of RDF through inorganic source + *Azotobactor* + PSB produced highest yield attributes and yield in pearl millet as well as in wheat crop.

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