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Impact of Various Sources of Nutrients on Yield and Yield Attributes of Pearlmillet (*Pennisetum glaucum*L.)-Wheat (*Triticum aestivum* L.) Cropping System

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ABSTRACT

An investigation was undertaken to study the effect of inorganic fertilizers and organic materials (farmyard manure, wheat straw and green manure) on yield and yield attributes Pearlmillet (Pennisetum glaucum L.)-Wheat (Triticum aestivum L.) cropping system. The study was conducted at Agronomy Research Area, CCS HAU Hisar during 2009-10 in randomized block design with 12 treatments combination viz., T_1 - control (no fertilizer); T_2 -50% recommended NPK to pearlmillet and wheat; T_3 - 50% recommended NPK to pearlmillet and 100% recommended NPK to wheat; T_4 - 75% recommended NPK to pearlmillet and wheat; T_5 - 100% recommended NPK to pearlmillet and wheat; T_6 - 50% NPK + 50% N (farmyard manure) to pearlmillet and 100% recommended NPK to wheat; T_7 - 75% NPK + 25% N (farmyard manure) to pearlmillet and 75% recommended NPK to wheat; T_8 - 50% NPK + 50% N (wheat straw) to pearlmillet and 100% recommended NPK to wheat; T_9 - 75% NPK + 25% N (wheat straw) to pearlmillet and 75% recommended NPK to wheat; T_{10} - 50% NPK + 50% N (Sesbania spp.) to pearlmillet and 100% recommended NPK to wheat; T_{11} - 75% NPK + 25% N (Sesbania spp.) to pearlmillet and 75% recommended NPK to wheat and T_{12} - farmers' practice. The finding shows that the increase in nitrogen levels correspondingly increase the yield attributes and yield of pearlmillet-wheat cropping system. Treatment T_6 recorded maximum number of effective tillers/meter row length (32.32 and 103.5), length of earhead (21.97 and 12.48 cm), 1000-grain weight (9.17 and 45.02 g), grain yield (3644 and 5922 kg/ha) and biological yield (12669 and 12539 kg/ha) in pearlmillet-wheat cropping system, which was statistically at par with treatments T_5 and T_{11} in pearlmillet and T_5 and T_{10} in wheat in pearlmillet-wheat cropping system. The results suggest that integrated use of inorganic fertilizer in combination with organic materials (farmyard manure, wheat straw and green manure) facilitates higher crop productivity under pearlmillet-wheat cropping system.

Keywords: *Cropping System, FYM, Organic Sources, Pearlmillet-Wheat, Yield Attributes*

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INTRODUCTION

Many intensive cereal based cropping systems are under practice in the country according to agro-climatic regions. In Indo-Gangetic Plains of India, pearlmillet-wheat is the second most important cropping system after rice-wheat [8].The pearlmillet is also most widely cultivated cereal after rice and wheat. In addition to tolerating hot and dry climates, pearlmillet is able to produce reasonable yield on marginal soils of arid and semi-arid areas. However, presently, the trend of production of pearlmillet–wheat cropping system is constant or marginal decline in production due to continuous cropping of this highly nutrient exhaustive cropping system for the last three decades. Furthermore, intensive cropping, cultivation of high yielding varieties, crop residue burning and indiscriminate use of chemical fertilizers have resulted into depletion of nutrients, soil organic carbon and deterioration of soil physical conditions.

Fertilizer as the key component for crop production which can be effectively managed to get desired use efficiency under a given situation. Higher food production needs a balance amount of plant nutrients. In the last five decades, the food grain production increased from a low of 50.82 mt in 1950-51 to 252.22 mt in 2015-16 by five folds and consumption of fertilizer (N+P+K) has increased from 0.07 to 26.76 mt (in nutrient terms) over the same period. A consumption of 26.76 mt of nutrients comprises 17.37 mt of nitrogen, 6.98 mt of phosphorus and 2.4 mt of potash. Consumption of fertilizers (all nutrients) increased from 1.0 kg to 150.5 kg per hectare in 2014-15 [1].

At several locations, long-term studies were being carried out on different cropping systems indicated that if all the needed nutrients applied through chemical fertilizers that has a deleterious effect on soil health, leading to unsustainable yield [4, 17]. This further leads to aggravated micronutrient deficiency in soil system. Since, the nutrient turnover in soil-plant system is considerably higher under intensive cropping system. Therefore, neither the chemical fertilizers nor the organic/biological sources alone can achieve production sustainability. 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 the emergence of secondary and micronutrient deficiency and deterioration in the soil physical environment. Whereas, organic manure alone or in combination with inorganic fertilizers is known to have a favorable effect on the soil environment and correct marginal deficiencies of secondary and micro-nutrients and enhance efficiency of applied nutrients. Therefore, there is a need to the improved nutrient supply system for sustainable production of this very important cropping system of India.

The organic sources of nutrients including farmyard manure (FYM), green manure, crop residue etc. have potential for increasing soil organic matter. It is being realized that when crops are grown in sequence, the fertilizer needs of the cropping sequence as a whole is important than that of the individual crop. The soil organic matter plays an important role in improving soil physical, chemical and biological properties and ultimately enhance soil productivity and crop yield [2, 11]. For achieving higher fertilizer use efficiency and sustainable production of cropping system, there is need to develop the site specific nutrient management strategies considering the cropping system as a whole rather than component crops in isolation [7, 15]. To attain this, we have to take into consideration the direct as well as residual effect of applied fertilizer to different crops in the system. Long-term experiments have shown that crop residues incorporation, FYMand green manures increased soil organic carbon and nutrient availability as compared to the chemical fertilizers [3, 9]. Integrated nutrient management (INM) is reported to be the best option to increase the yield of the crops and maintaining soil health. Integrated use of organic and inorganic fertilizers in various combinations or alone performed better with regards to seed yield, stover yield, and biological yield of sesame [14]. Likewise integration of 50 % RDF + Agro residue vermicompost (ARV) @ 5 t ha^{-1} gave better agronomical performance in terms of plant height, root length, dry weight, chlorophyll content, LAI, number of flowers/plant, fruits/plant, crop yield/plant, crude protein, dietary fiber, total carbohydrates and total sugar of tomato [5]. Highest number of pods per plant of Indian Bean was reported in INM treatment and similarly seed as well as stover yield were also influenced significantly due to INM treatment [16].

Therefore, the present investigation was carried out to study the effect of different organic materials including FYM, wheat straw and green manure along with inorganic fertilizers on yield attributes and yields of pearlmillet-wheat cropping system.

MATERIALS AND METHODS

The field experiment was carried out at Agronomy Research Area, CCS, Haryana Agricultural University, Hisar during 2009-10. The soil of experiment site was sandy loam in texture. The experiment was laid out in randomized block design with 12 treatments combinations replicated four times. The treatments were: T_1 - control (no fertilizer); T_2 -50% recommended (RD) NPK to pearlmillet and wheat; T_3 - 50% RD-NPK to pearlmillet and 100% RD-NPK to wheat; T_4 - 75% RD-NPK to pearlmillet and wheat; T_5 - 100% RD-NPK to pearlmillet and wheat; T_6 - 50% RD-NPK + 50% N (FYM) to pearlmillet and 100% RD-NPK to wheat; T_7 - 75% RD-NPK + 25% N (FYM) to pearlmillet and 75% RD-NPK to wheat; T_8 - 50% RD-NPK + 50% N (wheat straw) to pearlmillet and 100% RD-NPK to wheat; T_9 - 75% RD-

NPK + 25% N (wheat straw) to pearlmillet and 75% RD-NPK to wheat; T_{10} - 50% RD-NPK + 50% N (*Sesbania*spp.) to pearlmillet and 100% RD-NPK to wheat; T_{11} - 75% RD-NPK + 25% N (*Sesbania*spp.) to pearlmillet and 75% RD-NPK to wheat and T_{12} - farmers' practice.
The recommended levels of N and P were 125 and 62.5 kg/hafor pearlmillet and 150 and 60 kg/ha for wheat. The farmers' practice based on state average was 116 kg/haN for pearlmillet. In wheat the farmers' practice based on state average was 138.75 kg/hafor N and 54.75 kg/hafor P. 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 PBW 502 was sown with 100 kg/ha seed keeping inter row spacing of 20 cm. Pearlmillet was sown on June 21, 2009 and was harvested on September 6, 2009. Similarly, wheat was sown on November 2, 2009 and was harvested on April 11, 2010. The N content in different organic materials was determined and the amount of these materials required for substituting a specified amount of N as per the treatments was calculated. The organic sources of nutrients *viz.*, FYM, wheat straw and green manure were incorporated in soil 40, 43 and 36 days, respectively, before sowing pearlmillet crop. The recommended N and Pwere applied through urea and DAP, respectively. Recommended package of practices were followed in both the crops for other agronomic operations.
Effective tillers were considered those tillers, which produced ears completely, filled with grains out of total tillers recorded with in a running meter row length. Length (cm) of earhead was recorded from the base of the whorl to tip of ear of five randomly selected earheads. Thus, mean length of earhead was recorded. A random sample of grains was drawn from the produce of each plot and then converted to kg/ha. One thousand grains from each sample were counted by seed counter and their weight was recorded. Harvest index was calculated by dividing the economic yield to the biological yield and multiplied by 100. Data was analyses statistically with the help of procedure given by Panse and Sukhatme [12].

RESULTS AND DISCUSSION

Effect of different sources of nutrients on pearlmillet

The results of the experiment revealed that yield attributes and yield of pearlmillet was significantly influenced by different sources of nutrients (Table 1). Treatment T_6 recorded the maximum number of effective tillers/meter row length (32.32), length of earhead (21.97), 1000-grain weight (9.17 g), grain yield (3644 kg/ha) and biological yield (12669 kg/ha), which is significantly higher than treatments T_1, T_2, T_3, T_4, T_8, T_9 and T_{12} but statistically at par with T_5 and T_{11}. Treatment T_6 recorded 61, 19, 4 and 11% higher effective tillers over treatments T_1, T_8, T_{10} and T_{12} respectively. Length of earhead was recorded highest in treatment T_6 and was at par with integrated nutrient management treatments T_{10} and T_{11}. Treatment T_6 recorded 33, 27, 24 and 15% longest earhead over inorganic treatments T_1, T_2, T_3 and T_4 respectively. 1000-grain weight in treatment T_6 was 42 and 21% higher over treatments T_1 (control)and T_{12} (farmers' practice), respectively. Chopra *et al.*[5] also reported higher yield attributed in integrated nutrient managed treatment in tomato [5]. Corroborative findings have also been reported by Tripathi*et al.* [18] and Dahiya*et al.* [6]. Higher yield attributes in treatment T_6 may be due to regular and readily availability of nutrients. Due to which vegetative growth of the plant was better as compared to other treatments. Treatment T_6 recorded 258 and 22% higher grain yield of pearlmillet over treatment T_1 and T_{12}.More grain yield in treatment T_6 than other treatments might be due to higher yield attributing characters. The maximum harvest index was recorded in treatment T_2, which is significantly higher than the rest of the treatments. The higher grain yield of pearlmillet obtained with treatment where 100% RD-NPK and 50% RD-NPK + 50% N through FYM in pearlmillet could be ascribed to their favourable effects on yield componential characters (Table 1). Biological yield was also recorded highest in treatment T_6 and corroborative findings have also been reported by Dahiya*et al.* [6]. These parameters also increased with increasing doses of inorganic fertilizers. This might be due to easy availability of plant nutrients and higher photosynthetic activities as compared to under dose fertilized treatments. Replacement of 50% N through FYM also results into higher grain and biological yield of pearlmillet. This increase in biological yield probably came through favourable influences on vegetative growth of the plant. The results are in conformity with Kumar *et al.* [8], who reported that in total production of the pearlmillet-wheat cropping system only FYMcould replace 50 percent nitrogen need of pearlmillet without much adverse effect on its production.

Table 1: Effect of different treatments on yield attributes, yield and harvest index of pearlmillet

Treatments	Effective tillers/meter row length	Length of earhead (cm)	1000-grain weight (g)	Grain yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T_1	20.08	16.57	6.44	1018	3880	26.24
T_2	24.50	17.25	7.02	2348	6985	33.61
T_3	25.50	17.77	7.16	2506	9021	27.78
T_4	28.80	19.14	7.42	2967	10369	28.61
T_5	31.25	20.78	9.02	3472	12010	28.91
T_6	32.32	21.97	9.17	3644	12669	28.76
T_7	31.00	20.12	8.06	3356	11628	28.86
T_8	27.04	18.12	7.20	2884	9954	28.97
T_9	29.50	20.02	7.78	3028	10536	28.73
T_{10}	31.23	20.74	8.76	3364	11299	29.77
T_{11}	31.50	21.24	9.11	3482	12084	28.81
T_{12}	29.02	19.96	7.60	2993	10589	28.26
SEm±	**0.51**	**0.41**	**0.22**	**70.12**	**242.68**	**0.71**
CD (P=0.05)	**1.46**	**1.21**	**0.64**	**208.54**	**721.98**	**2.04**

Table 2: Effect of different treatments on yield attributes, yield and harvest index of wheat

Treatments	Effective tillers/ meter row length	Length of earhead (cm)	1000-grain weight (g)	Grains/ spike	Grain yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T_1	48.25	7.62	37.18	26.00	1106	2353	47.00
T_2	77.78	8.85	39.15	35.10	3812	8082	47.17
T_3	100.01	11.42	42.18	40.08	5418	11634	46.57
T_4	87.00	9.45	39.70	36.20	4716	10003	47.15
T_5	101.78	11.78	43.64	43.04	5738	12190	47.07
T_6	103.50	12.48	45.02	44.78	5922	12539	47.23
T_7	95.06	10.95	41.50	39.00	4933	10461	47.16
T_8	101.38	11.47	42.75	42.50	5564	11824	47.06
T_9	93.97	9.55	40.07	37.40	4772	10090	47.29
T_{10}	102.18	11.90	44.12	43.70	5767	12233	47.14
T_{11}	94.42	10.25	40.78	38.20	4784	10193	46.93
T_{12}	98.64	11.15	42.00	39.70	5256	11411	46.06
SEm±	**0.74**	**0.33**	**0.96**	**1.28**	**73.12**	**123.31**	**1.18**
CD (P=0.05)	**2.16**	**0.96**	**2.78**	**3.70**	**217.42**	**362.41**	**N.S.**

Effect of different sources of nutrients on wheat

The results of the study evident that treatment T_6 recorded highest number of effective tillers (103.50), which is at par with T_5, T_8 and T_{10} but significantly higher than the rest of the other treatments (Table 2). Similarly treatment T_6produced significantly longest spike (12.48 cm) over all other treatments except treatment T_{10} (11.90 cm) and T_5 (11.78 cm). Treatment T_6 produced boldest grain. Treatment T_6 recorded the maximum number of grains per spike (44.78) which was significantly superior over rest of the other treatments but atstatistically par with treatments T_5 (43.04), T_8 (42.50) and T_{10} (43.70). Higher yield attributes in treatment T_6 may be due to regular and readily availability of nutrients in this treatment, due to which vegetative growth of the plant was better as compared to other treatments.

Corroborative findings have also been reported by Tripathi*et al.*[18] and Dahiya*et al.*[6]. Highest grain yield (5922 kg/ha) and biological yield (12539 kg/ha) was recorded in treatment T_6 which is significantly higher than treatments T_1, T_2, T_3, T_4, T_7 T_8, T_9, T_{11} and T_{12} but statistically at par with T_5 (5738 and 12190 kg/ha) and T_{10} (5767 and 12233 kg/ha). Treatment T_6 was recorded 436 and 13% higher grain yield over control and farmers' practice respectively, indicating that 50% N can be supplemented through FYM in pearlmillet-wheat cropping system. The highest grain yield in treatment T_6 is being supported by different yield contributing characters. The availability of NPK increased by addition of FYM and thus the total uptake was increased. Increases in total uptake by addition of organic sources with inorganic sources have been reported by Reddy and Reddy [13] and Maitra*et al.*[10]. The higher grain yield and biological yield of wheat obtained with treatment T_6 could be ascribed to their favourable effects on yield componential characters (Table 2). These two parameters also increased by application of higher doses of inorganic fertilizers. This might be due to easy availability of plant nutrients and higher photosynthetic activities as compared to under dose-fertilized treatments. Replacement of 50% N through FYM also results into higher grain and biological yield of wheat. This increase in biological yield probably came through favourable influences on vegetative growth of the plant. The results are in conformity with Kumar *et al.* [8], who reported that in total production of the system only FYMcould replace 50 percent nitrogen need of pearlmillet without much adverse effect on its production. Grain and biological yield were recorded better in treatments where N was supplied through FYM and green manure, as to that of wheat straw. This may be due to higher C : N in wheat straw at initial growth period of the crop. Harvest index was not affected by different treatments.

CONCLUSION

Treatment T_6 [50% NPK + 50% N (FYM) to pearlmillet and 100% RD-NPK to wheat] produced the maximum number of effective tillers/meter row length, length of earhead, 1000-grain weight, grain yield and biological yield in pearlmillet-wheat cropping system, which is significantly higher than treatments T_1, T_2, T_3, T_4, T_7, T_9 and T_{12} but statistically at par with T_5 and T_{11} in pearlmillet and T_5 and T_{10} in wheat in pearlmillet-wheat cropping system. The results suggest that the integrated use of inorganic fertilizer in combination with organic materials (FYM, wheat straw and green manure) facilitates higher crop productivity under pearlmillet-wheat cropping system.

REFERENCES

1. Anonymous. http://eands.dacnet.nic.in/PDF/Glance-2016.pdf (2016).
2. Antil, R.S., Narwal, R.P., Singh, B. and Singh, J.P. Long-term effects of FYM and N on soil health and crop productivity under pearlmillet-wheat cropping system. *Indian Journal of Fertilizers***7**: 14-32 (2011).
3. Babhulkar, P.S., Wandle, R.M., Badole, W.P. and Balpande, S.S. Residual effect long term application of FYM and fertilizers on soil properties and yield of soyabean. *Journal of Indian Society of Soil Science***48**: 89-92 (2000).
4. Behra, U.K., Sharma, A.R. and Pandey, H.N. Sustaining productivity of wheat-soybean cropping system through integrated nutrient management practices on the vertisols of central India. *Plant and Soil* **297**(1/2): 185-199 (2007).
5. Chopra, A.K., Payum, T., Srivastava, S. and Kumar, V. Effects of integrated nutrient management on agronomical attributes of tomato (*Lycopersiconesculentum* L.) under field conditions. *Archives of Agriculture and Environmental Science***2**(2): 86-91 (2017).
6. Dahiya, D.S., Dahiya, S.S., Lathwal, O.P., Sharma, R. and Sheoran, R.S. Integrated nutrient management in wheat under rice-wheat cropping system. *Haryana Journal of Agronomy* **24**(1/2): 51-54 (2008).
7. Khurana, H.S., Singh, Y. Site specific nutrient management performance in a rice-wheat cropping system. *Better Crops with Plant Food.* **92**(4): 26-28 (2008).
8. Kumar, P., Nanwal, R.K. and Yadav, S.K. Integrated nutrient management in pearlmillet (*Pennisetumglaucum*)-wheat (*Triticumaestivum*) cropping system. *Indian Journal of Agricultural Science***75**(10): 640-43 (2005).
9. Lado, M., Paz, A. and Ben-Hur, M. Organic matter and aggregate-size interaction in saturated hydraulic conductivity. *Soil Science Society of American Journal***68**: 234-242 (2004).
10. Maitra, D.N., Sarkar, S.K., Saha, S., Tripathi, M.K., Majumdar, B. and Saha, A.R. Effect of phosphorus and farm yard manure applied to sunnhemp (*Crotalaria juncea*) on yield and nutrient

uptake of sunnhemp-wheat (*Triticumaestivum*) cropping system and fertility status in a TypicUstocrept of Uttar Pradesh. *Indian Journal of Agricultural Sciences* **78**(1): 70-74 (2008).

11. Moharana, P.C., Sharma, B.M. and Biswas, D.R. Changes in the soil properties and availability of micronutrients after six-year application of organic and chemical fertilizers using STCR-based targeted yield equations under pearlmillet-wheat cropping system. *Journal of Plant Nutrition***40**(2): 165–76 (2017).
12. Panse, V.G. and Sukhatme, P.V. *Statistical Methods for Agricultural Research Workers*. IVth edition, ICAR, New Delhi (1985).
13. Reddy, R.U. and Reddy, M.S. Uptake of nutrients by tomato and onion as influenced by integrated nutrient management in tomato-onion cropping system. *Crop Research* (Hisar) **36**(1-3): 174-78 (2008).
14. Sahu, G., Chatterjee, N. and Ghosh, G.K. Effect of Integrated Nutrient Management in Yield, Growth Attributes and Microbial Population of Sesame (*Sesamumindicum*). *International Journal of Current Microbiology and Applied Sciences***6**(7): 462-468 (2017).
15. Singh, R., Singh, B. and Patidar, M. Effect of preceding crops and nutrient management on productivity of wheat (*Triticumaestivum*)-based cropping system in arid region. *Indian Journal of Agronomy* **53**(4): 267-72 (2008).
16. Sodavadiya, H.B., Naik, V.R. and Chaudhari, S.D. Effect of Land Configuration, Irrigation and INM on Growth, Yield and Water Use Efficiency of Indian Bean (var. GNIB-21). *International Journal of Current Microbiology and Applied Sciences* **6**(7): 2624-2630 (2017).
17. Swarup, A. Lessons from long term fertilizer experiments in improving fertilizer use efficiency and crop yield. *Fertilizers News***47**(2): 59-66, 71-73 (2002).
18. Tripathi, H.P., Mauriya, A.K. and Kumar, A. Effect of integrated nutrient management on rice-wheat cropping system in eastern plain zone of Uttar Pradesh. *Journal of Farming System and Development* **13**(2): 198-203 (2007).