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Effect of different organic sources on productivity and quality of pearlmillet (*Pennisetum glaucum*) and their residual effect on wheat (*Triticum aetivum*)

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ABSTRACT

A field experiment was conducted during 2004-05 and 2005-06 at Indian Agricultural Research Institute, New Delhi to study the effect of different organic sources of nutrients on productivity and quality of pearlmillet (*Pennisetum glaucum* L. R. Br. Emend Stuntz) and to study the residual effect of various treatments on succeeding crop of wheat (*Triticum aetivum* L.). The experiment comprised eight treatments viz. control, Biofertilizer (*Azospirillum* + PSB), FYM (10 t/ha) + biofertilizer (*Azospirillum* + PSB), Vermicompost (10 t/ha) + biofertilizer (*Azospirillum* + PSB), Sesbania leaf manuring + biofertilizer (*Azospirillum* + PSB), FYM (10 t/ha) + legume intercropping, Vermicompost (10 t/ha) + legume intercropping and Sesbania leaf manuring + legume intercropping. Different organic sources showed considerable increase in growth components, yield and quality of pearlmillet. Vermicompost (10 t/ha) + biofertilizer produced the highest pearlmillet grain yield, that is 2.18 and 2.04 t/ha during 2004 and 2005 respectively; and had maximum residual effect on wheat yield.

Key words : Biofertilizer, FYM, intercropping, organic sources, pearlmillet, sesbania leaf manuring, vermicompost, wheat.

Pearlmillet [*Pennisetum glaucum* (L.) R. Br. Emend Stuntz] is most preferred crop of dryland and rainfed area owing to its drought escaping mechanism coupled with comparatively higher production ability under low soil fertility, soil moisture deficit and intense heat. Pearlmillet-wheat is an important cropping system in north-western dry tract of India and it plays significant role in food and nutritional security of the country. To sustain long term productivity of this cropping system without any environmental threat, use of organic sources of nutrients is important (Choudhary, 2005). Kumar and Gautam (2004) reported increase in grain yield and dry matter of pearlmillet due to application of organics. Low cost nutrient sources involving organic manures and biofertilizers can be affordable by resource poor farmers of rainfed areas and hence, can become a better substitute for expensive and unsustainable inorganic fertilizers. The application of organic sources of nutrients not only supplies all essential nutrients but also facilitates the growth and development of beneficial microbes, assists better uptake of nutrients by crop plants and counteracts the harmful effect of agrochemicals. Moreover, use of organics also helps in improving water holding capacity of soil, allows better root growth and leaves residual effect on soil fertility for long period, thus organics are important tool of sustainable farming. Since information on nutrient management in pearlmillet-wheat system through organic sources is meagre, the present investigation is carried out to know the effect of different organic sources of nutrients on growth, yield and quality of rainfed crop of pearlmillet and to study the residual effect of various organics on succeeding wheat.

MATERIALS AND METHODS

A field experiment was conducted during 2004-05 and 2005-06 at the Agronomy Farm, Indian Agricultural Research Institute, New Delhi to study the response of pearlmillet to different organic sources of nutrients and to study the their residual effect on succeeding wheat.

The soil was sandy clay loam in texture having 58.2% sand, 14.2% silt, 27.7% clay with field capacity of 19.12% and permanent wilting point of 6.52%,. The available N, P, and organic carbon content in the soil were 254 kg/ha, 9.89 kg/ha, and 0.33% respectively. The soil was nearly neutral in reaction having pH 7.2.

The experiment comprised of eight treatments viz. control, biofertilizer (azospirillum + PSB), farm yard manure (FYM) @ 10 t/ha + biofertilizer (azospirillum + PSB), vermicompost (VC) @ 10 t/ha + biofertilizer (azospirillum + PSB), Sesbania leaf manuring (SLM) + biofertilizer (azospirillum + PSB), FYM @ 10 t/ha + legume intercropping (LIC), vermicompost @ 10 t/ha + legume intercropping and Sesbania leaf manuring + legume intercropping; which were tested under Randomized Block Design in three replications with plot size 5m X 3m. The pearlmillet variety 'Pusa Composite 383' was sown with using a seed rate of 4 kg/ha with the above sited treatments under rainfed condition; whereas, succeeding wheat (variety 'HD- 2687') was grown on residual fertility under limited irrigation conditions.

Vermicompost (containing 1.2% N) was applied to pearlmillet as broadcast as per treatment and incorporated manually. Green leaves of Sesbania (containing 0.4% N on green weight basis), after cutting into small pieces buried into the soil at last ploughing. Cowpea was grown as legume intercrop in pearlmillet as paired row arrangement of 30/70 cm. The pearlmillet crop was sown after a pre sowing irrigation in the year 2004 which was followed by one life saving irrigation at flowering stage due to late onset of monsoon and long dry spell in between the season, whereas, in 2005 no irrigation was applied to the pearlmillet. Two irrigations, first at crown root initiation and second at flowering stage, were applied to wheat during both the years of study.

Results and Discussion

Pearlmillet

Growth parameters

Number of tillers/ meter row length, dry matter accumulation and days to 50% flowering increased markedly due to different organic sources of nutrients (Table 1). Use of FYM + biofertilizer, vermicompost + biofertilizer, FYM + legume intercropping and Sesbania leaf manuring + legume intercropping influenced all the growth parameters significantly over control. However, maximum number of tillers/ meter row length, dry matter accumulation and days to 50% flowering, were observed with vermicompost + biofertilizer. Superiority of vermicompost + biofertilizer treatment is contributed by vermicompost application enriching the supply of all the essential macro and micronutrients higher than other organic sources and secondly, the use of vermicompost had incorporated some earthworms in the field which could have worked in the soil and helped in improving the physical conditions of the soil thus increasing aeration for root development and more availability of nutrients, as also reported by Robinson et al. (1992). The vermicompost enhanced soil physical, chemical and biological properties and thus overall vegetative growth of the crop. This enhanced growth of pearlmillet was also attributed by the increased availability of nitrogen and phosphorus to the pearlmillet plant due to the use of Azospirillum and PSB, where Azospirillum bacteria fixes atmospheric nitrogen and PSB increases solubility of native phosphorus of the soil in the rhizosphere of pearlmillet (Mekki et al. 1999). In addition of increased nutrient availability, Azospirillum and PSB also affected the plant growth through the production of growth hormones like IAA, GA and Cytokinin (Sattar and Gaur, 1987).

Yield

Remarkable improvement in number of earheads/ meter row length and earhead length was observed due to different organic sources of nutrients (Table 2). Maximum number of earheads and earhead length were recorded with vermicompost + biofertilizer. It was at par with all other sources except sesbania leaf manuring + legume intercropping. Being a genetic character, 1000-grain weight was not affected significantly by different organic sources of nutrients (Table 2). The superiority these organics might be due to increased

Table 1. Effect of different organic sources of nutrients on no. of tillers per meter row length, dry matter accumulation and days to 50% flowering of pearlmillet

Treatments	No. of tillers/ m row length		Dry matter accumulation (g/plant)		Days to 50% flowering	
	2004	2005	2004	2005	2004	2005
Control	21.3	17.3	38.42	39.79	42.0	43.0
Biofertilizers	28.3	23.3	54.21	54.11	45.6	44.6
FYM + Biofertilizer	28.3	24.6	58.00	58.63	48.0	48.0
VC + Biofertilizer	28.6	25.0	65.66	64.09	50.0	50.0
SLM + Biofertilizer	28.0	24.0	56.09	55.50	43.3	44.6
FYM + legume intercropping	29.0	23.6	56.70	56.36	46.0	45.0
VC + legume intercropping	29.6	24.3	55.08	56.62	46.6	46.3
SLM + legume intercropping	27.3	22.0	40.33	41.98	43.3	42.6
SEm	0.47	1.01	3.97	3.93	1.40	1.43
C.D. (P=0.05)	1.43	3.07	12.04	11.93	4.27	4.35

Table 2. Effect of different organic sources of nutrients on yield attributing characters, pearlmillet equivalent yield and net returns

Treatments	Earheads/m row length		Earhead length (cm)		1000-grain weight (g)		Grain yield (t/ha)		Stover yield (t/ha)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Control	17.0	16.3	23.6	23.3	6.20	6.26	1.40	1.37	5.33	4.87
Biofertilizers	23.0	22.3	27.0	26.5	6.22	6.33	1.66	1.65	6.55	6.13
FYM + Biofertilizers	23.3	23.0	31.0	29.4	6.40	6.43	2.04	1.94	6.88	6.50
VC + Biofertilizers	23.9	23.7	31.2	30.4	6.40	6.46	2.18	2.04	7.10	6.72
SLM + Biofertilizers	22.4	22.0	28.0	27.6	6.38	6.34	1.82	1.76	6.21	5.75
FYM + LIC	22.9	23.3	28.9	28.5	6.38	6.36	1.86	1.85	6.66	6.20
VC + LIC	22.8	23.3	29.5	29.0	6.36	6.40	1.93	1.89	6.66	6.15
SLM + LIC	21.7	20.7	26.0	25.6	6.30	6.27	1.55	1.56	6.55	6.03
SEm	0.87	0.85	1.17	1.16	0.56	0.59	0.059	0.116	0.212	0.216
C.D. (P=0.05)	2.63	2.58	3.62	3.50	NS	NS	0.179	0.351	0.643	0.656

photosynthetic activity resulted in higher accumulation of photosynthates. Further, these have translocated to sink due to better development of source-sink channel. Grain and stover yield of pearlmillet increased markedly due to different organic sources of nutrient, Chaudhary and Gautam (2007) also found the similar results. Maximum grain and stover yield, however, was recorded with vermicompost + biofertilizer. The yield of any species is the cumulative function of yield attributes; the effect of any treatment on these parameters ultimately affects the biological and economical yield of crop.

Quality

The variation in N content in grain was found significant due to application of different organic sources of nutrients, except biofertilizer and Sesbania leaf manuring + legume intercropping treatment (Table 3). Accordingly, the variation in protein content in pearlmillet grain was found significant due to different organic sources of nutrients except biofertilizer

Table 3. Effect of different organic sources of nutrients on nitrogen and protein content in pearlmillet grain

Treatments	Nitrogen contents (%)		Protein content (%)	
	2004	2005	2004	2005
Control	1.58	1.61	9.88	10.05
Biofertilizers	1.69	1.70	10.56	10.60
FYM +Biofertilizer	1.86	1.85	11.62	11.55
Vermicompost + Biofertilizer	1.92	1.92	12.00	11.89
SLM + Biofertilizer	1.81	1.78	11.31	11.12
FYM + legume intercropping	1.82	1.80	11.37	11.24
Vermicompost + legume intercropping	1.84	1.82	11.50	11.36
SLM + legume intercropping	1.69	1.68	10.56	10.49
SEm	0.04	0.04	0.25	0.24
C.D. (P=0.05)	0.13	0.12	0.78	0.74

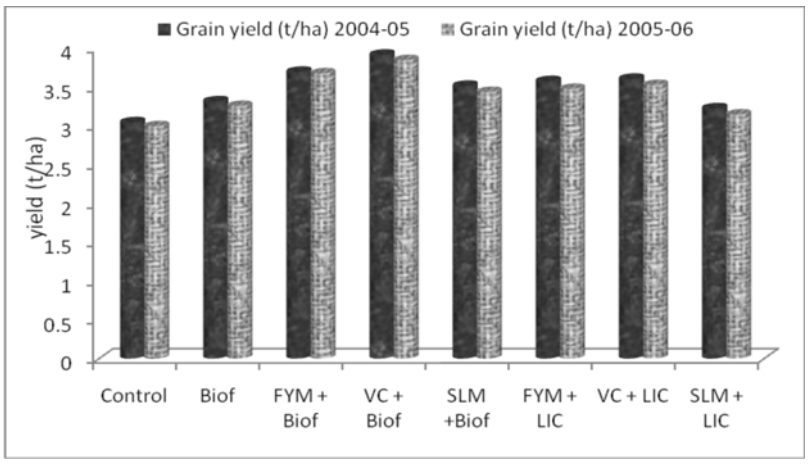

Fig. 1. Wheat yield as influenced by different organic sources of nutrients applied to preceding crop of pearlmillet

and Sesbania leaf manuring + legume intercropping. The highest protein content in grain was observed with vermicompost + biofertilizer. It was found at par with FYM + biofertilizer, vermicompost + legume intercropping and FYM + legume intercropping.

N is the structural component of protein and thus has a positive correlation with N content in grain. The higher N content in the grain as a result of vermicompost application could be due to its higher N content (1.2 %), and mineralization effect upon native N. The results of present study are in line with the findings of Singh and Yadav (2006-2007). Higher N and protein content in pearlmillet grain with biofertilizer application might be due to more uptake of nutrients through effective root system and increased concentration of nutrients in soil solution. Quality improvement through the use of organic sources might be due to better microbial activity and fixation of atmospheric N. The microbes secrete many growth promoting substances which accelerates the physiological processes like synthesis of carbohydrates and proteins. This result corroborates with the findings of Mekki *et al.* (1999).

Residual effect on wheat

The grain yield of wheat was greatly influenced by treatments applied to preceding crop of pearlmillet. The results are in closer conformity with Choudhary (2005) and

Choudhary and Gautam (2007). The highest grain yield was observed with vermicompost + biofertilizer and it was closely followed by FYM + legume intercropping, FYM + legume intercropping and sesbania leaf manuring + biofertilizer (Fig. 1). In general, organic manure, besides causing overall improvement in the soil health, increased the activity and number of soil microorganism by feeding them. They transform non-available plant nutrients into available form (Yawalkar *et al.* 1992).

It can be concluded that different organic sources of nutrients had remarkable effect on growth, yield and quality of pearlmillet. Application of vermicompost + biofertilizer recorded highest growth and yield, and better quality of pearlmillet. Various organic sources of nutrients applied to pearlmillet had significant residual effect on productivity of succeeding wheat. The maximum wheat yield was recorded with vermicompost (10 t/ha) + biofertilizers, applied to preceding pearlmillet crop.

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