

Nitrogen substitution through organic sources in pearl millet-wheat cropping system

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Abstract : The yield performance of pearl millet-wheat crop sequence to nitrogen through inorganic and organic sources indicate that both the crops significantly responded to application of N through inorganic sources as compared to organic sources. The significantly higher grain yield of pearl millet (40.47 q ha⁻¹) and wheat (48.23 q ha⁻¹) was recorded with the application of recommended dose of NPK supplemented with 10 t FYM ha⁻¹. Nitrogen applied to pearl millet crop through organic sources did not show its residual response to wheat crop.

Key Words: Nitrogen, Organic sources.

Introduction

Pearl millet-wheat sequence is predominant in North Western Plain Zone and Central Zone of India. Even with the application of recommended dose of fertilizer, yield potential of this cropping system (cereal-cereal) has reached to a plateau because of soil health deteriorated (Roshan Lal and Hooda, 1993, Singh *et al.* 1999). In sustained crop production organic manuring plays an important role. Inorganic fertilizers on the other hand, will continue to be one of the main instruments for quickening the pace of agricultural production. The results of a large number of experiments on manures and fertilizers conducted in the country and abroad revealed that neither the chemical fertilizers alone nor the organic sources exclusively could achieve the production sustainability of soils as well as crops under highly intensive cropping system. Hence, it is essential to know the suitable combination of chemical fertilizer with organic manures for sustainability and yield stability.

Materials and Methods

An experiment was conducted during *kharif* and *rabi* season of 1996-97 of Post Graduate Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri. The soil of the experimental field had pH 8.2, organic carbon 0.59%, available N 125 kg ha⁻¹, available P₂O₅ 12.91 kg ha⁻¹, available K₂O 450 kg ha⁻¹ with silty clay texture and belong to Sawargaon series (Isohyperthermic family of Vertic Ustocrepts under Inceptisol). Treatments included were 12 consisted of N levels through fertilizers and organic sources *viz.* FYM and Vermicompost and combination of both (Table 1). The experiment

was laid out in randomized block design with four replications and carried out under irrigated conditions. Pearl millet (RHRBH-8609) in *kharif* and wheat (HD-2189) in *rabi* season were sown on 23rd July, 1996 and 28th November, 1996 respectively. The experimental purpose was to study the residual effect of organic material on wheat crop left over after *kharif* pearl millet. For wheat crop the treatments were superimposed by keeping the same treatment of pearl millet. The FYM (0.74% N) and vermicompost (1.08% N) as per treatment was applied 15 days before sowing of both the crops.

The recommended dose applied through chemical fertilizer for pearl millet and wheat was 60:30:0 and 120:60:60 kg NPK/ha respectively. Half dose of N and full dose of P₂O₅ and K₂O was applied at sowing and remaining half dose of N was top dressed at 30 days after sowing for both the crops. One protective irrigation was given to pearl millet crop during *Kharif* and six irrigations were applied to wheat crop during *rabi*. One weeding and hoeing was adopted. No incidence of pest and disease was observed in both the crops during study. The harvested plot size was 3.60 x 2.70 m.

Results and Discussion

Grain and Straw yield

Data presented in Table 2 indicate that application of 60 kg N through urea + 10 t FYM ha⁻¹ produced maximum grain (40.47 q ha⁻¹) and fodder yield (46.20 q ha⁻¹) of pearl millet and was significantly superior over rest of the treatments. Grain production with the application

Table 1. Treatment details

Treatment	Pearlmillet	Wheat
T ₁	60 kg N ha ⁻¹ through fertilizer	120 kg N ha ⁻¹ through fertilizer
T ₂	45 kg N ha ⁻¹ through fertilizer	90 kg N ha ⁻¹ through fertilizer
T ₃	30 kg N ha ⁻¹ through fertilizer	60 kg N ha ⁻¹ through fertilizer
T ₄	60 kg N ha ⁻¹ through FYM	120 kg N ha ⁻¹ through FYM
T ₅	45 kg N ha ⁻¹ through FYM	90 kg N ha ⁻¹ through FYM
T ₆	30 kg N ha ⁻¹ through FYM	60 kg N ha ⁻¹ through FYM
T ₇	60 kg N ha ⁻¹ through vermicompost	120 kg N ha ⁻¹ through vermicompost
T ₈	45 kg N ha ⁻¹ through vermicompost	90 kg N ha ⁻¹ through vermicompost
T ₉	30 kg N ha ⁻¹ through vermicompost	60 kg N ha ⁻¹ through vermicompost
T ₁₀	60 kg N + 10 t FYM ha ⁻¹	120 kg N ha ⁻¹ + 10 t FYM ha ⁻¹
T ₁₁	22.5 kg N through fertilizer + 22.5 kg N through FYM	45 kg N ha ⁻¹ through fertilizer + 45 kg N ha ⁻¹ through FYM
T ₁₂	22.5 kg N through fertilizer + 22.5 kg N through Vermicompost	45 kg N ha ⁻¹ through fertilizer + 45 kg N ha ⁻¹ through Vermicompost

Table 2. Effect of N application through inorganic and organic sources on yield and N uptake of pearl millet - wheat cropping system

Treatment	Yield of pearl millet		Yield of Wheat		Nitrogen uptake (kg ha ⁻¹)		Actual N balance after the Sequence (kg ha ⁻¹)	Net loss or gain in nitrogen (kg ha ⁻¹)
	Grain (q ha ⁻¹)	Fodder (q ha ⁻¹)	Grain (q ha ⁻¹)	Straw (q ha ⁻¹)	Pearl millet	Wheat		
T ₁	35.78	43.60	45.65	55.14	56.66	117.63	138	+8
T ₂	33.12	39.30	42.44	52.98	53.93	97.60	135	+27
T ₃	31.06	34.70	37.16	47.32	49.38	83.03	124	+41
T ₄	27.10	28.20	30.61	41.15	17.38	87.84	123	-97
T ₅	24.80	23.10	27.39	37.55	12.34	59.51	121	-67
T ₆	22.00	22.60	24.43	34.46	10.77	51.68	126	-26
T ₇	30.94	32.10	34.72	44.75	24.38	78.89	123	-79
T ₈	28.14	28.60	31.38	41.67	21.40	71.78	122	-45
T ₉	24.48	26.40	27.52	37.55	17.48	61.68	122	-14
T ₁₀	40.47	46.20	48.22	58.89	60.67	128.28	142	+26
T ₁₁	25.83	27.00	37.42	47.84	35.54	90.02	128	-6
T ₁₂	30.64	30.50	39.09	50.41	42.37	93.23	132	+7
S.Ed	0.86	01.60	1.47	2.00	-	4.75		
C.D.	3.34	06.20	4.24	5.76	-	13.67		

(P=0.05)

of 60 and 45 kg N ha⁻¹ through inorganic sources was not significant. The differences in fodder production with application of 60 kg N + 10 t FYM ha⁻¹ as 60 kg N applied through inorganic sources were not significant. Both grain and fodder production with the application of 60 kg N ha⁻¹ through vermicompost and 75 per cent of recommended N, half applied through urea and half through vermicompost did not differ significantly. Relatively higher response of direct application of fertilizer than organic sources were also observed by Singh *et al.* (1981), Khan *et al.* (1982) and Katyal *et al.* (1999).

Maximum and significantly more grain (48.23 q ha⁻¹) and straw (58.89 q ha⁻¹) yield of wheat was obtained with the application of 120 kg N through urea supplemented with 10 t FYM ha⁻¹ but it was on par with the application of 120 kg N ha⁻¹ through urea. Differences in grain and straw yield of wheat with the application of 75 per cent of recommended dose (90 kg N ha⁻¹) through fertilizer, 120 kg N ha⁻¹ through inorganic source and 90 kg N ha⁻¹ half through inorganic sources and half through vermicompost were not significant. Several research workers have also reported that application of 120 kg N ha⁻¹ or higher level produced significantly more grain and straw yield of wheat than that of reduced levels of N. They have also reported grain production on higher side with application of organic manures in conjunction with recommended dose of N through inorganic sources (Patel *et al.* 1992, Shinde 1992, Naphade *et al.* 1993, and Varma and Rajput 1999).

There was no residual effect of N to wheat when N applied through organic sources to preceding pearl millet. That might be due to wider C:N ratio due to pearl millet roots left over after harvest. Similar observations were also made by Gogoi and Sandhu (1984). In pearl millet - wheat crop sequence the significant response to grain production was upto 120 kg N ha⁻¹ while in fallow wheat the response was upto 80 kg N ha⁻¹. This indicated that pearl millet crop required more N and residue left in the soil was negligible which was not beneficial for succeeding crop. These results are in conformity with the results obtained by Raj *et al.* (1984).

Nitrogen uptake

Maximum total uptake of N in pearl millet crop was with the application of 60 kg N ha⁻¹ through fertilizer + 10 t FYM ha⁻¹ and this was followed by 60 kg N ha⁻¹ applied through chemical fertilizer. Lowest N uptake was noticed in N applied through organic sources. This might be due to slow release on N to pearl millet crop. Removal of N by wheat was significantly more with the application of 120 kg N ha⁻¹ through fertilizer + 10 t FYM ha⁻¹ than rest of the treatment. But the above treatment was on par with application of 120 kg N ha⁻¹ through fertilizer alone. Significantly lowest uptake was with application of 60 kg N ha⁻¹ through FYM. These results are in conformity with the results obtained by Singh and Agarwal (1983), Naphade *et al.* (1993). The uptake is generally a function of yield and it has positive correlation with the biomass production. Verma and Rajput (1999) also reported similar observations in pearl millet-wheat crop system.

Nitrogen balance

As regards to the residual N in the soil in pearl millet-wheat cropping system there was gain in available N when it was applied through inorganic sources. The graded levels of N applied through FYM lost more N than the same levels applied through vermicompost. The maximum gain in N was with recommended dose of N supplemented with 10 t FYM ha⁻¹ to both the crops.

For getting maximum yields from pearl millet -wheat crop sequence it is necessary to apply recommended dose of N through fertilizer (60:30:0, and 120:60:60 kg NPK ha⁻¹ respectively) in conjunction with 10 t FYM ha⁻¹ for both pearl millet and wheat crop.

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