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Nitrogen Uptake by Hybrid Basmati Rice and its Nitrogen Use Efficiency (NUE) under Different Organic Sources of Nitrogen

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Abstract

A field experiment to study the nitrogen uptake by hybrid basmati rice (PRH-10) and its nitrogen use efficiency (NUE) under different organic sources of N was conducted during rainy season of 2007. Among the 12 treatments maximum N-uptake by grains were recorded in green manure at 30 t/ha + FYM at 10 t/ha (69.0 kg/ha). Similar trend was recorded with straw yield. The agronomic nitrogen use efficiency was highest with FYM at 10 t/ha (18.0 kg grain/kg N) followed by green manure at 30 t/ha (12.0 kg grain/kg N).
Key words : Hybrid basmati rice, Nitrogen uptake, Nitrogen use efficiency, Organic source.

Aromatic rice being indigenous wealth of nation, earns a good foreign exchange especially from Arabian countries. India has a large number of indigenous aromatic rice varieties. Several high yielding varieties has also been developed in connection to development of hybrid rice varieties the research and development of hybrid aromatic rice started at Indian Agricultural Research Institute (IARI), New Delhi during 90's. Pusa Rice Hybrid 10 (PRH-10) is the first super fine grained aromatic hybrid rice released from IARI, New Delhi with 40% yield advantages over Pusa Basmati-1 (140 days). A good yield also depreciates nutrients from soil, hence for maintaining soil health incorporating organic sources of nutrients is very essential. Organic agriculture may be a way to use available natural resources for the health of soil and benefit of man kind. Organic foods are in demand and becoming popular as organically products have been found safer than chemically grown ones. Therefore, growing of highly priced crop like aromatic rice through organic sources of nutrients is need of future. Keeping these points in mind the research was carried out to study the nitrogen uptake by hybrid basmati rice and to assess the nitrogen use efficiency (NUE) under different organic sources of N.

Methods

A field experiment on aromatic hybrid rice variety (PRH-10) was conducted during rainy reason of 2007 at Crop research center, G. B. Pant University of Agriculture and Technology, Pantnagar on Aquic Hapludoll and silt loam soil rich in organic carbon (1.06%), medium in available phosphorus (16 kg/ha) and potassium 220 kg/ha) contents with pH 7.9.

A total of 12 treatments : One control, one recommended inorganic sources of NPK (100 : 60 : 40 :: N: P_2O_5 : K_2O kg/ha) and ten consisting of different organic sources viz. green manure 30 t/ha, green manure 30 t + wheat straw 5 t/ha, green manure 30 t + FYM 10 t/ha, neemax 5 t/ha, green manure 20 t/ha, green manure 30 t + FYM 5t/ha, green manure 20 t + FYM 5 t/ha, green manure 20 t + FYM 10 t/ha, 50% recommended NPK and FYM 10 t/ha were replicated four times in randomized block design. Sesbania aculeata as green manure crop was grown during summer month and incorporated based on treatment before transplanting of rice crop. All recommended agronomic package of practices were done equally for all the treatments. Initial soil analysis and after harvest of crop plant analysis were done using standard procedures. The growth and yield attributes of hybrid rice recorded and analysed. Nitrogen use efficiency, nitrogen recovery (%) was worked out by formula given by Yoshu da (1).

Results and Discussion

Grain Yield

Green manure at 30 t/ha + FYM at 5 t/ha gave the highest grain yield (4.4 t/ha) which was found to be

Table 1. Effect of different organic sources of nutrients on grain yield, straw yield, total dry matter yield, nitrogen uptake by grain, straw and agronomic NUE of hybrid rice.

Treatments (t/ha)	Grain yield (t/ha)	Straw yield (t/ha)	Total dry matter yield (t/ha)	N uptake (kg/ha) Grain	Straw	Total	Agronomic NUE (kg grain/kg N applied)
T_1 Control	2.9	3.5	6.4	37.0	12.3	49.3	0.0
T_2 Recommended NPK (100 : 60 : 40)	3.9	4.2	8.1	60.8	22.5	83.3	10.0
T_3 GM 30	4.1	4.5	8.6	62.7	24.9	87.6	12.0
T_4 GM 30t + wheat straw 5	4.1	4.4	8.5	56.0	22.6	78.6	10.0
T 5 GM 30t + FYM 10	4.3	4.4	8.7	69.0	25.3	94.3	9.3
T 6 Neemax 5	3.2	3.4	6.6	45.1	16.1	61.2	3.0
T 7 GM 20	3.7	3.8	7.5	55.8	20.0	75.8	10.0
T 8 GM 30 t + FYM 5	4.4	4.6	9.0	65.8	22.9	88.7	12.0
T 9 GM 20 t + FYM 5	4.0	4.1	8.1	52.9	18.7	71.6	10.5
T10 GM 20 t + FYM 10	4.2	4.4	8.6	56.9	22.4	79.3	10.0
T11 50% recommended NPK	3.5	3.6	7.1	52.2	16.6	68.8	12.0
T12 FYM 10	3.8	3.9	7.7	44.7	15.3	60.0	18.0
SE ±	0.2	0.2	0.3	3.3	2.2	5.1	-
CD (P = 0.05)	0.6	0.6	1.0	9.2	6.1	14.1	-

significantly higher than control (2.9 t/ha), neemax at 5 t/ha (3.2 t/ha), 50% recommended NPK (3.5 t/ha) and green manure at 20 t/ha (3.7 t/ha) but statistically at par with the treatments FYM 10 t/ha (3.8 t/ha), recommended NPK 100 : 60 : 40 (3.9 t/ha), GM 20 t/ha + FYM 5 t/ha) (4.0 t/ha), GM 30 t/ha (4.1 t/ha), GM 30 t/ha + wheat straw 5 t/ha (4.1 t/ha), GM 20 t + FYM 10 t/ha (4.2 t/ha) and GM 30 t+ FYM 10 t/ha (4.3 t/ha). Yield increased under FYM applied treatments might be associated with the better root development and root length density that increased the capacity of rice plant to extract nutrient from the deeper soil layer (2) (Table 1).

Straw Yield

The data recorded for straw yield showed similar trend as the grain yield. The highest straw yield was recorded in the treatment with 30 t GM + 5 t FYM/ha (4.6 t/ha) which being statistically at par with recommended NPK (3.9 t/ha), GM 30 t/ha (4.1 t/ha), GM 30 t + wheat straw 5 t/ha (4.1 t/ha), GM 30 t + FYM 10 t/ha (4.3 t/ha), GM 20 t + FYM 5 t/ha (4.0 t/ha), and GM 20 t +FYM 10 t/ha (4.2 t/ha) was significantly superior over the treatments control (2.9 t/ha), Neemax 5 t/ha (3.2 t/ha), 50% recommended NPK (3.5 t/ha) and FYM 10 t/ha) (3.8 t/ha).

Nitrogen Uptake (kg/ha)

Grain. The different sources of nutrients had significant effect on nitrogen uptake by grains of hybrid rice. Maximum N uptake by grains were recorded in the treatment with green manure at 30 t/ha + FYM at 10 t/ha (69.0 kg/ha), which being significantly superior than all other treatments was statistically at par with green manure at 30 t/ha + FYM at 5 t/ha (65.8 kg/ ha), green manure at 30 t/ha (62.7 kg/ha) and recommended NPK (60.8 kg/ha). All the fertility treatment had increased the N uptake significantly over control except neemax at 5 t/ha and FYM at 10 t/ha.

Straw. The highest N-uptake (25.3 kg/ha) in straw was recorded in green manure at 30 t/ha + FYM at 10 t/ha which being statistically at par to all other sources of nutrients except control, Neemax 5 t/ha, green manure 20 t/ha + FYM 5 t/ha, 50% recommended NPK and FYM 10 t/ha (Table 1).

Total N Uptake by Hybrid Rice

The various sources of nutrients differed significantly with respect to total N uptake by rice crop. Highest total N uptake was recorded in green manure at 30 t/ha + FYM 10 t/ha (94.3 kg/ha) which was significantly higher than all other treatments except green manure at 30 t/ha (87.6 kg/ha), the recommended NPK (83.3 kg/ha) and green manure at 30 t/ha + FYM 5 t/ha (88.7 kg/ha).

Nitrogen uptake is determined by total dry mat-

ter yield and concentration of nutrients in the plants. Higher N-uptake might be associated with the conversion of organically bound N to inorganic form by the micro organism (3).

Agronomic Nitrogen Use Efficiency (NUE)

The agronomic nitrogen use efficiency varied from 3.0 kg grain/kg N applied with neemax at 5 t/ha to the highest 18.0 with FYM at 10 t/ha. The highest value of agronomic nitrogen use efficiency was exhibited by FYM at 10 t/ha (18.0 kg grain/kg N applied) followed by green manure at 30 t/ha and 50% recommended NPK (12.0 kg grain/kg N applied).

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