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Yield and Nitrogen Nutrition under Integrated Use of Summer Groundnut Residue and N in Transplanted Rice at Tarai Region

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Abstract

A field investigation was carried out during *kharif* season of 1997-08 to evaluate the effect of summer groundnut residue incorporation *in situ* alone or along with urea nitrogen on soil fertility and nitrogen nutrition to rice crop. Significantly higher level of soil available nitrogen was recorded with groundnut residue incorporation + 120 kg N per hectare which was at par with groundnut residue incorporation + 80 kg N in split, N 160. The total soil nitrogen data at rice harvesting showed positive input of groundnut residue incorporation plus chemical nitrogen treatments compared to chemical nitrogen alone at lower rates and indicates saving of around 40 kg chemical N/ha in rice crop due to preceding summer ground nut.
Key words : Rice, Summer groundnut residue, Nitrogen, Yield.

Legumes have been known for their soil ameliorative effects since time immemorial. By including legumes in cropping system, the heavy N needs of modern intensive cereal based systems such as rice-rice, rice-wheat and maize-wheat can be at least partly met, and the physical and chemical characteristics of the soil are generally improved. The ability of leguminous plants to biologically fixed atmospheric nitrogen (N) provides a relatively low cost method for building soil N pools. Rice after early summer grain legumes yielded higher than rice after fallow or fodder maize (1). High yield responses in rice and wheat legumes are often attributed to nitrogen contributed by legume crops. However, very little work has been done on the contribution of summer groundnut towards nitrogen nutrition of crop in sequence. The present investigation was therefore planned to study the behavior of mineralizable N and mineral N in rice soil and yield of rice due to incorporation of summer groundnut residue alone or in combination with urea nitrogen.

Methods

The experiment was conducted at Crop Research Center, G. B. Pant University of Agriculture and Technology, Pantnagar (29^0N, 79.3^0E and 243.8 m above mean sea level) during *kharif* of 1997-08. The experimental soil was salty clay loam of 7.4 pH and containing organic carbon 1.15%, total N 0.84%, available P 64.0 kg/ha and 275.0 kg/ha of available K.

The experiment was laid out in randomized block design with three replications on rice variety Pant Dhan-4. The treatments were control (N_0), 40 kg N/ha in split (N_{40}), 80 kg N/ha in split (N_{80}), 120 kg N/ha in split (N_{120}), 160 kg N/ha in split (N_{160}), groundnut residue removal (GRR), groundnut residue incorporation (GRI), groundnut residue incorporation + 40 kg N in split (GRI_{40}), groundnut residue incorporation + 80 kg N in split (GRI_{80}), groundnut residue incorporation + 120 kg N in split (GRI_{120}). Before the rice cultivation, the summer groundnut (Var Kausal) was grown based on the treatments and after harvesting of summer groundnut, the residue was incorporated in soil as pretreatment under puddle condition before two days of rice transplanting. Rice was sown in second week of June and seedlings were transplanted during third week of July. Half dose of N based on treatment and full dose of P and K at 40 kg P_2O_5/ha and 40 kg K_2O/ha was applied as basal to the rice crop. Remaining half quantity of N through urea based on treatment was applied by the top dressing in two equal splits at active tillering and panicle initiation.

Results and Discussion

Effect on Soil Fertility

A significant response of summer groundnut

Table 1. Soil available N, ammonical N and total soil N as influenced by different treatments applied to rice.

Treatments	Soil available N (kg/ha)	Ammonical N (mg/kg soil)	Total soil N (kg/ha)
Control	269	16.6	1980
40 kg N	280	18.4	1996
80 kg N	300	20.5	2020
120 kg N	323	21.7	2035
160 kg N	330	22.6	2047
Grounnd residues removal	276	18.3	2005
Groundnut residues incorporation	319	20.9	2028
Groundnut residues incorporation + 40 kg N in split	326	22.3	2044
Groundnut residues incorporation + 80 kg N in split	334	24.1	2049
Groundnut residues incorporation + 120 kg N in split	341	24.7	2053
CD P = (0.05)	11.17	2.16	9.53

residue incorporation was observed on soil available nitrogen (Table 1). The maximum available N content in soil was recorded in groundnut residue incorporation + 80 kg N in split (334 kg/ha), (N 339 kg/ha) was significantly higher to rest of the treatments. Minimum soil available nitrogen content was recorded under control. Beneficial effect of legume residue incorporation and nitrogen levels with respect to soil available N was also reported by Mahapatra and Sharma (2).

The ammoniacal nitrogen of soil after rice harvest in groundnut residue incorporation + 120 kg nitrogen in split and groundnut residue incorporation + 80 kg nitrogen in split (Table 1), being at par, was significantly higher as compared to remaining all availability of NH_4^+-N in the soil possibly led to increased crop absorption which ultimately was reflected in the grain and straw yields.

The total soil nitrogen at rice harvest was significantly higher with groundnut residue incorporation + 120 kg N in split than all other treatments but it was at par with groundnut residue incorporation + 80 kg N in split and 160 kg N/ha through urea (Table 1). The extent of increase was associated with the amount of nitrogen added through above ground and root residue of groundnut. Biswas et al. (3) also reported that total soil nitrogen retained higher in the soil when leguminous crop is grown in rotation.

Effect of Nitrogen Content and Uptake in Rice

Nitrogen concentration in rice grain recorded after ground nut residue incorporation + 120 kg N in split was significantly higher over all other treatments

Table 2. Grain yield (q/ha), straw yield (q/ha), N-content, N uptake by rice crop as influenced by different treatments.

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Nitrogen content (%)		Nitrogen uptake (kg/ha)	
			Grain	Straw	Grain	Straw
Control (N_0)	22.1	37.2	1.01	0.42	22.5	15.6
40 kg N (N_{40})	27.8	43.6	1.17	0.48	32.7	21.1
80 kg N (N_{80})	40.3	54.0	1.20	0.50	48.3	27.4
120 kg N (N_{120})	50.3	61.0	1.22	0.56	61.1	34.8
160 kg (N_{160})	57.2	61.2	1.32	0.58	74.0	35.5
Ground residues removal (GRR)	28.6	46.0	1.23	0.47	35.1	21.4
Groundnut residues incorporation (GRI)	38.5	52.8	1.26	0.51	48.5	27.1
Groundnut residues incorporation + 40 kg N in split (GRI_{40})	49.2	60.9	1.27	0.53	62.2	31.9
Groundnut residues incorporation + 80 kg N in split (GRI_{80})	56.2	61.3	1.30	0.54	73.3	33.1
Groundnut residues incorporation + 120 kg N in split (GRI_{120})	59.1	60.7	1.39	0.57	78.7	34.6
CD P = (0.05)	2.001	4.173	0.097	0.024	4.976	2.813

and was at par with groundnut residue incorporation + 80 kg N in split and N 160. Each successive level of N applied to rice caused significant increase in nitrogen content in grain and straw (Table 2).

Higher nitrogen uptake by rice grain was recorded with groundnut residue incorporation + 120 kg N in split which was at par with groundnut residue incorporation + 80 kg N in split and (Table 2). This increase might be due to increased supply of nitrogen and growth, and increased yield. Khanda and Dixit (4) also reported increased nitrogen uptake by rice crops a result of summer legumes with or without residue incorporation and by nitrogen application to the rice crop.

Yield

Sumar groundnut residue incorporation increases the grain yield of rice over control and residue removal treatments. Groundnut residue incorporation + 120 kg N in split produced the maximum grain yield (59.1 q/ha) of rice than rest of the treatments except N_{160} (57.2 kg/ha) (Table 2). The minimum grain yield was recorded in control. The grain yield obtained in groundnut residue incorporation + 120 kg N in split was 167.43% higher over the control of 17.49% higher over N_{120}.

Significant positive correlations were observed between grain yield with available soil N (r = 0.973, 0.960, 0.954 at 20, 40 and 60 DAT, respectively), soil ammonium – N (r = 0.976), panicle number (r = 0.984), 1000-grain weight (r =0.993) and total nitrogen uptake (r = 0.997). Similarly total nitrogen uptake also showed significant positive correlations with available soil N (r = 0.974, 0.959 and 0.975 at 20, 40 and 60 DAT), soil ammonium-N (r = 0.975) and panicle number (r = 0.983).

So, it can be concluded that there is saving of around 40 kg chemical N/ha in rice crop due to preceding summer ground nut residue incorporation plus chemical nitrogen treatments compared to the application of chemical nitrogen alone. The soil physical properties and nutrient status can be improved with the incorporation of groundnut residue into the soil.

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