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Comparison of Organic and Inorganic Sources of N for Wheat and Rice Production

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Abstract: This article reports comparitive performance of different organic and inorganic sources of N for wheat and rice rotation.The fertilizer proved to be the best source of N for the first crop i.e., wheat while it had a very poor residual effect on the following rice crop. In contrast the organic sources did not proved good for wheat crop but their residual effect on the coming rice crop was better than that of the fertilizer treatment. Among the organic sources, the farm yard manure proved to be the best of all followed by green manure. It may be concluded from these results that nutrients in the organic residues and manures take time to become available for the plants and therefore these must be added to soil well in time before the crop sowing .

Key words: Organic residues, inorganic sources, grain yield, paddy yield, crude protein, wheat and rice production

Introduction

The Integrated Plant Nutrition Management means the maintenance and possibly increase of soil fertility for sustaining increased crop productivity through optimizing all possible sources, organic and inorganic, of plant nutrients required for crop growth and quality in an integrated manner appropriate to each cropping system and farming situation in its ecological, social and economic possibilities (Roy and Braun, 1985). The approach is not new, however, there is a need to develope it in a technically feasible, socially acceptable and economically viable system. Nitrogen is the most important plant nutrient. It is generally limiting in cultivated lands and has to be supplemented through chemical fertilizers for successful crop production. Environmental and economic issues associated with its intensive use as a fertilizer have generated an interest in exploitation of its alternate sources. These alternate sources include biological systems and farm generated products (Yamagata and Ae, 1996).The organic farm products maintain long term productivity and sustainability of soils in addition to their role as a nutrient source. These products also improve the soil humus contents, cation exchange capacity, aeration, water holding capacity and water infiltration rate (Bhagat and Verma, 1991). The ultimate benefit of any crop residue addition to soil would depend on the ability of the organic matter to create a favorable environment in the soil to supply the essential plant nutrients and thus reducing the addition of inorganic fertilizers. A great potential exists for increasing crop production by an integrated use of organic and mineral sources of nutrients .The present study was planned to compare the potential and residual effect of various organic and inorganic sources of Nitrogen.

Materials and Methods

A pot experiment was conducted using wheat-rice crop rotation system. Soil was collected from the Experimental Area, Biochemistry Section, AARI, Faisalabad. This soil was air dried, sieved and filled in glazed earthen pots @ 12 kg per pot. Six treatments viz.; Control, Fertilizer N @ 60 mg kg^{-1} soil in the form of Urea, Wheat Straw @ 1 %, Rice Straw @ 1 %, Green Manure (Dhancha) @ 1 % and Farm Yard Manure (FYM) @ 1 % were applied. The experiment was laid out in Randomized Complete Block Design (RCBD) and each treatment was replicated four times. The N concentration of Wheat Straw, Rice Straw , Green Manure (Dhancha) and Farm Yard Manure (FYM) was 0.56, 0.45, 3.33 and 1.13 % respectively. Plant materials were chopped into small pieces and mixed in the soil of their respective pots manually 14 days before sowing. Fertilizer treatment was applied according to recommended method in two doses, first before sowing and second with first irrigation. Control treatment was kept as blank. All the pots were kept under well moistened conditions for two weeks. When soil came to a suitable sowing condition 8 wheat seeds per pot were sown. After germination at two leaves stage these were thinned out to 4 plants per pot. The plants were irrigated as and when required. After harvesting at maturity data regarding grain yield, straw yield and number of tillers were recorded and grains were analyzed for crude protein. In coming kharif season rice was planted in the same pots to see the residual effects of the applied treatments. For this purpose eight nursery plants of rice were transplanted in each pot in a way that there were two plants in one hill. No new addition of any treatment material was made for this rice crop. After harvesting at maturity data regarding paddy yield, straw yield and number of tillers were recorded and grains were analyzed for crude protein. The data was subjected to statistical analysis as given by Steel and Torrie (1980) using Duncan's New Multiple Range (DMR) Test to compute the significance of treatment means.

Results and Discussion

Grain/Paddy Yield: It is obvious from results shown in the Table 1 that there were significant differences in yield responses of wheat as well as rice obtained through the use of various organic and inorganic N sources.

Table 1: Effect of different N sources on Grain/Paddy Yield of Wheat and Rice (g pot^{-1}).

Treatments	Wheat	Rice
Control	11.94D	19.50D
Fert. N @ 60 mg kg^{-1} soil	17.19 A (44)	23.80 C (22)
Wheat straw @ 1%	13.14 CD (10)	26.45 B (36)
Rice straw @ 1%	14.35 BC (20)	25.30 B (29)
Green Manure @1%	16.80 AB (41)	28.30 A (45)
Farm Yard Manure @1%	15.34 B (28)	29.50 A (51)

Figures in parentheses show percent increase over control.
Treatment means bearing different letters differ significantly at P= 0.05 according to DMR Test.

The highest grain yield of wheat (17.19 g pot^{-1}) was obtained with the application of N as Urea @120 kg ha^{-1} (60 mg kg^{-1}). It differed significantly from the yield responses obtained by the application of organic sources except green manuring with dhancha. Grain yield in case of green manuring was 16.80 g pot^{-1} and it was statistically at par with that obtained by the application of rice straw and farm yard manure. Wheat straw performed the poorest of all organic and inorganic

applications. It improved the grain yield of wheat only by 10 % and was statistically at par with the controlled treatment that was kept as blank. The residual effects of applied treatments were studied on the following rice crop. The direct application of N as Urea to the first wheat crop increased its yield by 44 %, wheat straw by 10%, rice straw by 20 %, green manure by 41 % and farm yard manure by 28 %, while the increase in paddy yield due to the residual effects of N applied to preceding wheat crop through different sources were 22 % by Urea, 36 % by wheat straw, 30 % by rice straw, 45 % by green manure and 51 % by farm yard manure. This data show that the residual effect of inorganic source of N on paddy yield was the least of all the treatment sources of N. Green manure and farm yard manure proved to be the best source of residual N among all the treatments. It is also clear from the yield response that the organic sources of N did not give the comparable yield to fertilizer N in the case of first crop while it proved much better in the following crop. The reason of the low yield of wheat with organic N source might be due to incomplete decomposition of organic N compounds during the winter season of wheat while the higher yield of rice with organic sources might be due to comparatively more availability of N to the plants as a result of further decomposition of organic sources with the passage of time. Similar results of increased grain yield of wheat and rice crops by the application of wheat and rice straw has also been reported earlier by Srivastava *et al.* (1988). Bhagat and Verma (1991) has also reported increased grain yield of wheat due to rice straw application. Similarly Duraisamy *et al.* (1986) found that application of *Sesbania aculeta* as a green manure increased straw and paddy yield of rice. Similar residual effect of organic sources of nutrients has been reported earlier by Ibrahim *et al.* (1994) for the wheat crop.

Table 2: Effect of different N sources on Straw Yield of wheat and rice (g pot^{-1}).

Treatments	Wheat	Rice
Control	19.15 D	40.60 F
Fert. N @ 60 mg kg^{-1} soil	32.75 A	48.60 E
Wheat straw @ 1%	21.40 C	53.90 C
Rice straw @ 1%	22.65 C	51.60 D
Green Manure @1%	26.75 B	57.61 B
Farm Yard Manure @1%	23.15 C	60.10 A

Treatment means bearing different letters differ significantly at P= 0.05 according to DMR Test.

Table 3: Effect of different N sources on No. of Tillers of wheat and rice per pot.

Treatments	Wheat	Rice
Control	8.25 D	22.50 F
Fert. N @ 60 mg kg^{-1} soil	15.50 A	29.50 E
Wheat straw @ 1%	10.50 C	35.75 C
Rice straw @ 1%	11.00 C	34.75 D
Green Manure @1%	13.50 B	48.25 B
Farm Yard Manure @1%	13.00 B	54.50 A

Treatment means bearing different letters differ significantly at P= 0.05 according to DMR Test.

Straw Yield and Number of Tillers: The effect of direct applied as well as residual N from different organic and inorganic sources on wheat and rice straw yield (Table 2) and number of tillers (Table 3) was almost similar as was obtained in the case of grain yield of wheat and rice.

Application of N in the form of Urea produced the maximum straw yield and number of tillers of wheat while farm yard manure proved to be the best for rice as it provided the maximum residual effect for it and was followed by green manure while both wheat and rice straw performed very poor. Earlier Alam *et al.* (1997) has also reported significant improvement in yield contributing components of wheat including the straw yield and number of tillers due to the application of crop residues.

Crude Protein: Results showed that as the quantity of available N increased from either source (organic or inorganic), the protein contents also increased (see Table 4).

Table 4: Effect of different N sources on Crude Protein of wheat and rice grains. (g pot^{-1}).

Treatments	Wheat	Rice
Control	10.21 D	10.09 D
Fert. N @ 60 mg kg^{-1} soil	14.19 A	12.00 C
Wheat straw @ 1%	12.21 C	12.60 B
Rice straw @ 1%	12.50 C	12.40 BC
Green Manure @1%	13.55 AB	13.30 A
Farm Yard Manure @1%	13.46 B	13.60 A

Treatment means bearing different letters differ significantly at P= 0.05 according to DMR Test.

Highest quantity of crude protein in the case of first crop i.e., the wheat crop was found in the treatment where N was applied as Urea while the same treatment gave the lowest protein contents of all the treatments except control where no N was added. The maximum crude protein in case of rice crop was found in paddy grown with farm yard manure and minimum with control. Similar findings have been reported earlier by Ibrahim *et al.* (1994).

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