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Effect of integrated use of fertilizer nitrogen, compost and green manure on yield and uptake of rice

Vishal Bhuria, Kamla Kanwar and Manjinder Kaur Bedi
CSK Himachal Pradesh Krishi Vishvavidyalaya
Hill Agricultural Research and Extension Centre, Dhaulakuan, Sirmour-173 001, India.

Abstract

A pot experiment was carried out to evaluate the effect of integrated use of fertilizer nitrogen, compost and green manure on yield and uptake of rice. Higher N percentage was recorded in green manures as compared to compost and followed the trend: Moong >Dhaincha>Sunnhemp>Compost. Rice yield was higher in treatments having combination of green manures + 75%N compared to green manures + compost. Highest total N – uptake by rice crop was observed in case of dhaincha + 75%N (1.72%) while highest phosphorus uptake was recorded in case of moong + 75%N (0.28%). Green manure moong + 75%N added highest amount of nitrogen followed by sunnhemp +75%N and dhaincha + 75%N, respectively. When green manures were incorporated along with compost, dhaincha recorded maximum N addition (1.32 g/pot), followed by moong and sunnhemp. Physiological efficiency was highest in treatment involving compost alone (38.9) which was followed by sunnhemp / moong + compost and dhaincha + compost.

Key words: Moong, dhaincha and sunnhemp green manures, compost, physiological efficiency.

Introduction

Increasing concern for ecological sustainability and escalating prices of nitrogenous fertilizers has renewed interest in the use of green manures, crop residues and other organic manures, which may be supplement or substitute for chemical fertilizers. The value of organic manures is determined by their content of nutrients available for plant growth. Yadvinder Singh *et al.* (1988) showed FYM is relatively low in N content and releases N more slowly than green manures. Johnston (1986) suggested that higher yields could be obtained by using a combination of organic manures and mineral fertilizers than the mineral fertilizers alone. It is a fact that neither chemical nor organic or biological sources alone can achieve production sustainability. Hence, green manure, which is a cheap monetary input and helps in increasing yield and improving soil health, can be a good alternative to save fertilizer N. In this regard, greenhouse study was undertaken to evaluate the effect of integrated use of fertilizer nitrogen, compost and green manure on yield and uptake of rice.

Material and Methods

Greenhouse study was carried out to evaluate the effect of integrated use of organic manure, green manure and fertilizer N on the yield and N uptake of rice. A bulk soil sample was collected from the research farm of CSKHPKV, HAREC Dhaulakuan (Sirmour), Himachal Pradesh in this study. It is located at 30 ^{0} S latitude and 70°E longitude at an altitude of 468 m above sea level and falls in sub-montane low hills subtropical zone of Himachal Pradesh. The soil is sandy loam in texture having pH 6.2, low in potassium (205 kg/ha), medium in nitrogen (380 kg/ha) and high in phosphorus (29 kg/ha). Soil was air dried and sieved (4 mm) before imposing the experimental treatments. Six kilogram soils were taken in 8 kg capacity earthen pots.

Compost used in this study was prepared in 1cubic meter pit in which rice straw and cow dung was used in the ratio 1:1 and rock phosphate was added @ 1% (w/w). It was ready within 4 months and applied to pots @ 10t/ha before transplanting of rice. The moisture was maintained to about 50% by adding water as and when required. The treatments were as follows: T_1 – Control (Soil + P K),T_2 – Dhaincha + 75 % N, T_3 – Sun hemp + 75 % N, T_4 – Moong + 75 % N, T_5 – Compost, T_6 – Dhaincha + Compost, T_7 – Sun hemp + Compost, T_8 – Moong + Compost and T_9 – 100% NPK alone. The experiment was replicated thrice in a randomized block design.

Biomass production of green manure crop

Ten seeds of each green manure crop (dhaincha, sun hemp and summer moong) were sown in each pot. N–dose in the form of urea for green manures was 20kg/ha. Basal dose of P_2O_5 and K_2O for rice crop was 60 & 40 kg ha^{-1} applied through single super phosphate and muriate of potash before sowing of green manure crop. The green manure crops were raised for 52 days and harvested on 53 rd day. The biomass was collected,

chopped into 4-6 cm size and incorporated in the same pot. Twenty seven days old rice seedlings (6 seedlings per pot) of var. PR116 were transplanted immediately after incorporating green manure. The recommended doses of N, P&K for rice (variety PR116) were 90-60-40. Nitrogen was applied in three splits as per treatments i.e. one third at transplanting of rice seedlings and remaining N was top dressed in two equal splits each at tillering and panicle initiation stages of crop.

Plant samples taken at harvest were analyzed for total nitrogen (Conventional Kjeldahl's method), phosphorus (Vanado molybedo phosphoric acid yellow colour method) and potassium (Perchloric acid digestion method) by Jackson (1967).

Results and Discussion

A perusal of the data in table 1 revealed that carbon content of dhaincha was maximum (51.53 %), followed by moong (49.33 %), sunnhemp (48.88 %) and least in compost (22%) respectively. On the other hand, moong recorded the narrowest C: N ratio (19.9:1) followed by dhaincha (21.53:1), sunnhemp (22.81:1) and compost (46.24:1). was shown by green manure crops showed higher N percentage as compared to compost and followed the trend: Moong >Dhaincha>Sunnhemp>Compost. Duhan *et al.* (2004) also reported higher N concentration in moong which is followed by sunnhemp and dhaincha. Phosphorus content of moong was 24 and 31% higher and K content 18 and 9% higher over sunnhemp and dhaincha. In accordance to this, Patnayak *et al.* (2001) reported higher K in dhaincha compared to sunnhemp.

Yield

The data given in the table 2 indicated significant increase in grain yield of paddy with different treatments over control. Significantly highest grain yield was recorded in case of dhaincha +75%N followed by moong+75%N and sunnhemp + 75%N both being statistically at par with each other and superior to 100%NPK treatment. Incorporation of green manures along with compost resulted in significantly higher grain yield in comparison to incorporation of compost alone. Dhaincha + 75%N resulted in 9.4 and 12.5 % higher grain yield over moong + 75%N and sunnhemp + 75%N respectively. Rice yield was higher in treatment having combination of green manures + 75%N compared to green manures + compost. This might be due to lesser availability of nutrients owing to slow decomposition of compost having higher C: N ratio as compared to green manures which undergo fast decomposition because of low C: N ratio.

The effect of different green manures on straw yield of rice followed the same trend as in case of grain yield (Table 2). Dhaincha + compost and moong + compost were found to be at par but superior to sunnhemp + compost. Similar to grain yield, significantly highest straw yield was recorded in pots receiving dhaincha + 75%N.

Total nutrient uptake (NPK)

The values of N-uptake were higher with different treatments as compared to control (Table 2). When green manures were applied along with 75%N, highest N-uptake was recorded with dhaincha + 75%N followed by moong + 75%N and sunnhemp + 75%N. There was 18.62, 27.32 and 28.36% increase in total N- uptake due to dhaincha + 75%N over sunnhemp + 75%N, moong + 75%N and 100%NPK treatments, respectively. When compost was incorporated along with green manures, there was 48.23% increase due to dhaincha, followed by moong (38.64%) and sunnhemp (28.20%) over compost alone in increasing total N- uptake by paddy crop. Highest total N – uptake by rice crop was recorded in case of dhaincha + 75%N (1.72%).

Table 1. Composition of different green manures and compost

Green manures	Organic carbon (%)	C:N ratio	Nutrient concentration (%)		
			N	P	K
Dhaincha	51.53	21.53	2.8	0.26	2.19
Sunnhemp	48.88	22.81	2.5	0.29	1.96
Moong	49.33	19.90	2.9	0.38	2.40
Compost	22.00	34.02	0.75	0.17	0.33

Table 2. Effect of manures and fertilizers on grain and straw yield (g/ pot) and nutrient uptake by rice crop

Treatments	Grain yield	Straw yield	Nutrient uptake (g/pot)		
			Nitrogen	Phosphorus	Potassium
Control	35	49.0	0.74	0.14	1.47
Dhaincha + 75%N	64	121.0	1.72	0.29	3.70
Sunnhemp + 75%N	56	95.2	1.33	0.24	2.89
Moong + 75%N	58	104.4	1.45	0.29	3.23
Compost	42	63.0	0.92	0.18	1.8
Dhaincha + compost	52	88.9	1.26	0.24	2.69
Sunnhemp + compost	48	77.9	1.09	0.22	2.34
Moong + compost	50	85.0	1.17	0.23	2.57
100%NPK	54	103.0	1.34	0.25	3.09
C. (P=0.05)	2.7	4.52	0.06	0.02	0.15

Total phosphorus uptake showed significant increase due to different treatments as compared to control (Table 2). Among the green manures incorporated along with 75%N, dhaincha and moong were found statistically at par with each other and significantly superior to sunnhemp in increasing total phosphorus uptake by rice crop. When green manures were applied along with compost, dhaincha showed increasing tendancy in P uptake by rice crop over moong and sunnhemp but were at par with 100%NPK.

Total potassium uptake was found to increase significantly with different treatments as compared to control (Table2).Total potassium uptake followed the trend: dhaincha + 75%N > moong + 75%N > 100%NPK > sunhemp + 75%N > dhaincha + compost > moong + compost > sunhemp + compost > compost > control. Dhaincha + 75%N recorded the highest total potassium uptake by rice plant which was significantly superior to 100%NPK. Further, total K uptake in moong + 75%N treatment was found to be at par with 100%NPK.

Nutrient recovery

Data listed in table 3 show that the highest amount of nitrogen was added in treatment involving green manure moong + 75%N followed by sunnhemp +75%N and dhaincha + 75%N, respectively. When green manures were incorporated along with compost, dhaincha recorded maximum N addition (1.32 g/pot), followed by moong and sunnhemp. Application of green manures improved the N uptake by rice crop being highest with dhaincha + 75%N followed by moong and sunnhemp along with 75%N. Raju and Reddy (2000) also reported increase in N uptake by rice with the use of *Sesbania* green leaves. Percent N recovery followed the same trend as that of N addition being highest in dhaincha + 75 %N followed by moong and sunnhemp along with 75%N. Moris *et al.* (1986) reported 33% apparent N recovery from fertilizer N along with green manures application. Further, in both N uptake as well as N recovery, incorporation of green manures along with compost followed the trend as dhaincha>moong>sunnhemp.

Physiological efficiency

A look at the data of physiological efficiency (Table 3), revealed higher physiological efficiency in green manures along with compost as compared to green manures + 75 %N, which can be explained by the fact that N assimilated by rice was more efficiently translated into grain yield. Yadvinder *et al.* (1994) agreed with the above statement and reported better synchronization between N release from the combined application of green manures and FYM and N assimilation behavior of rice. Highest physiological efficiency was recorded in treatment involving compost alone (38.9) due to small increase in total Nuptake which was followed by sunnhemp / moong + compost and dhaincha + compost. It is in accordance to Yadvinder *et al.* (1994) who showed that highest physiological efficiency was recorded by FYM due to small increase in total N uptake over no – N control.

Table 3. Effect of manures and fertilizer on nitrogen addition, uptake, recovery and physiological efficiency

Treatment	Dry matter added (g/pot)	Nitrogen added (g/pot)	Grain yield (g/pot)	Nitrogen uptake (g/pot)	Nitrogen Recovery (%)	Physiological efficiency (g grain/ g N uptake)
Control	-	-	35	0.74	-	-
Dhaincha +75%N	43	1.38	64	1.72	71.0	29.60
Sunnhemp+75%N	45	1.51	56	1.33	39.1	35.60
Moong+75%N	40	1.55	58	1.45	45.8	32.40
Compost	16.03	0.12	42	0.92	1.50	38.90
Dhaincha + Compost	43+16.03	1.32	52	1.26	39.4	32.70
Sunnhemp + Compost	45+16.03	1.24	48	1.09	28.2	37.1
Moong+ Compost	40+16.03	1.28	50	1.17	33.6	37.1

Conclusion

It is inferred from this study that combination of green manure and 75%N was more useful to enhance the rice yield. Among the three green manures tried in this study, dhaincha along with 75%N was found more efficient to enhance rice yield and soil N.

References

Duhan BS, Grewal KS, Satyavan, Dahiya SS and Narender Singh 2004. Comparative efficiency of different green manures in improving yield and nutrition of rice. Haryana Agric. Univ. J. Res. **34**:71-74.

Jackson ML 1967. *Soil Chemical Analysis*. Prentice Hall of India Publications, New Delhi.

Johnston AE 1986. Soil organic matter, effects on soil and crop. Soil Use and Management 2:97-105.

Moris RA, Eurol RE and Dizon MA 1986. Rice response to short duration green manure. 1. Grain yield. Agronomy J. **78**:409-12.

Patnayak SK, Mishra, KN, Jena MK and Nayak RK 2001. Evaluation of green manure crops fertilized with various P sources and their effect on subsequent rice crop. J. Indian Soc. Soil Sci. **49**:285-91.

Raju RA and Reddy MN 2000. Integrated management of green leaves, compost, crop residues and inorganic fertilizers in rice (*Oryza sativa*) – rice system. Indian J. Agron. **45**:629-35.

Yadvinder Singh, Bijay Singh, Khera, TS and Meelu OP 1994. Integrated management of green manure, FYM and nitrogen fertilizer in a rice – wheat rotation in north western India. Arid Soil Res. Rehabilitation **8**:199-205.

Yadvinder Singh, Bijay Singh, Maskina MS and Meelu OP 1988. Effect of organic manures, crop residues and green manure (*Sesbania aculeate*) on nitrogen and phosphorus transformations in a sandy loam soil at field capacity and under water- logged conditions. Biol. Fertility Soils 6:183-87.