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## Nitrogen Use Efficiency in Rice (*Oryza sativa* L.) as Affected by Green Manuring Plant Dhaincha (*Sesbania aculeata* L.)

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**Abstract:** The present study was undertaken to see the possibilities of growing green manure crop in the wheat-rice rotation during the vacant period of about 10-12 weeks available between harvesting and transplanting of the two major crops and consequently see its effect on the yield of rice. Six different doses of nitrogen (sub-plots) i.e. Control, 50 kg, 75 kg, 100 kg, 125 kg and 150 kg ha<sup>-1</sup> were applied to both the green manured plots and un-green manured plots (main plots). Application of N-fertilizer alongwith organic matter significantly increased the plant height at maturity, number of tillers plant<sup>-1</sup>, number of spikelets panicle<sup>-1</sup>, 1000-grain weight, paddy yield, and harvest index than control. The maximum paddy yield of 7.15 t ha<sup>-1</sup> was produced by plot where 150 kg N ha<sup>-1</sup> was applied. The control plot produced minimum yield of 4.63 t ha<sup>-1</sup>.

**Key words:** *Oryza sativa*, *Sesbania aculeata*, Green manure, Tillers, Panicles, Spikelets, Paddy, Harvest index

### Introduction

With the increased use of chemical fertilizers, increased cropping intensity, introduction of mechanical cultivation, burning of farm wastes and crop residues as fuel, the availability of F.Y.M. and other biological sources has fallen far short of the organic matter requirements for successful crop raising in agriculture. The situation may lead to further deterioration of physical condition of soils. Efforts are therefore, required to be made to bring into the cropping system the suitable green manures so that the soil condition is not only maintained but also improved, which may consequently help to improve the crop yield. It is believed that nitrogen use efficiency can be enhanced by organic manuring specially in soils low in organic matter. Green manuring with a suitable legume crop is a time honoured practice for increasing fertility through improvement in soil physical, chemical and biological characteristics. Yield increasing effects of dhaincha as a green manure crop has been demonstrated especially for rice (Azeez and Shafi, 1964; Mian *et al.*, 1985). The average rice grain yield improved considerably by nitrogen application on green manured plots compared to the fallow plots, revealing an increased nitrogen utilization efficiency by dhaincha green manuring (Dargan *et al.*, 1975). The present study was, therefore, undertaken to see the efficacy of growing green manure crop in the wheat-rice rotation during the vacant period of about 10-11 weeks available between harvesting and transplanting of the two major crops and consequently see its effect on the yield of rice.

### Materials and Methods

The research was conducted at the Faculty of Agriculture, Gomal University, Dera Ismail Khan during the year 1996. The experiment was laid out in split-plot with three replications. The net plot size was 3x5 (15 m<sup>2</sup>) with 15 rows. The green and un-green manure (fallow) treatments were kept in main plots and nitrogen doses were kept in sub-plots. The dhaincha was sown immediately after harvesting the wheat crop and buried/incorporated one day before transplanting the rice seedlings (Singh and Singh, 1982). A recommended doses of 90 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> as SSP and 60 kg K<sub>2</sub>O ha<sup>-1</sup> as SOP were applied at the time of final land preparation. The different doses of nitrogen as Urea were applied at the time of final land preparation and at panicle emergence stage. Transplanting was done by trained manual labour using 30-days old seedlings. Row to

row and plant to plant distances were maintained at 20 cm.

**Statistical analysis:** The data were analyzed statistically by using the Analysis of Variance Technique (Steel and Torrie, 1980) and Duncan's Multiple Range Test (Duncan, 1955) was used to see the significance of differences of treatment means at 5 percent level of probability.

### Results and Discussion

Table 1 revealed that the plant height was affected by both the green manure as well as the different N-doses. Among the treatments, however, green manure resulted in tall plants than un-green manure. This might be due to the sufficient nitrogen efficiency and organic matter in dhaincha treated plots where the slow released N remained available throughout the growth stages of the plant. The taller plants were obtained with the application of higher doses of N as compared to other treatments. Sanchez and Lopez (1983) observed that N fertilizer increased rice yields upto 120 kg N ha<sup>-1</sup> and increased plant height and N concentration.

Table 2 indicated that green manured plots produced more number of tillers plant<sup>-1</sup> as compared to un-green manured plots. In green manured plots the supply of N-content in the soil at tillering stage was made sure. Among the different doses of N-application, the fertilizer dose of 150 kg ha<sup>-1</sup> produced more tillers as compared to other treatments. The minimum number of tillers plant<sup>-1</sup> was produced in the control treatment. Siddique *et al.* (1984) compared Azolla with fertilizer and manure and obtained highest number of tillers in combination of Azolla + 80 kg N ha<sup>-1</sup> (starter nitrogen). The different doses of N influenced the number of panicles per plant and less panicles plant<sup>-1</sup> were observed in control plot. The highest number of panicles plant<sup>-1</sup> were obtained with highest dose of nitrogen (Table 3). The plants which were treated with N-fertilizer took the advantage of available N and consequently produced more panicles. The other reason might be the organic matter which helped to increase the soil fertility through improvement in soil physical, chemical and biological characteristics. The mean values elucidated that the spikelets panicle<sup>-1</sup> were significantly affected by both the green manure as well as the N-treatments. Dhaincha green manure plots produced more spikelets panicle<sup>-1</sup> than un-green manure plots.

Among the nitrogen treatments, T6 produced more spikelets as compared to other treatments. The treatments

Table 1: Plant height (cm) of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	86.67 NS	82.00
N1	50	89.20	84.53
N2	75	92.12	87.17
N3	100	94.77	89.80
N4	125	97.33	92.50
N5	150	99.73	95.00
Means	93.30 a	88.50 b	

Table 2: Number of tillers plant<sup>-1</sup> of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	8.00 f	7.50 f
N1	50	9.67 e	8.00 f
N2	75	11.00 d	9.66 e
N3	100	12.67 c	11.33 d
N4	125	14.33 b	12.33 c
N5	150	16.66 a	13.66 b
Means	12.05 a	10.33 b	

Table 3: Number of panicles plant<sup>-1</sup> of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	7.33 h	6.33 l
N1	50	9.33 g	7.00 l
N2	75	10.33 f	9.33 g
N3	100	12.00 cd	10.66 ef
N4	125	13.66 b	11.33 de
N5	150	15.66 a	12.33 c
Means	11.38 a	9.50 b	

Table 4: Number of spikelets panicle<sup>-1</sup> of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	105.00	101.33
N1	50	107.33	103.33
N2	75	109.33	105.33
N3	100	112.66	106.66
N4	125	115.66	108.66
N5	150	118.00	110.33
Means	111.33 a	105.94 b	

Table 5: 1000-Grain weight (g) of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	20.50 l	19.45 l
N1	50	20.84 g	19.83 k
N2	75	21.18 e	20.20 j
N3	100	21.57 c	20.64 h
N4	125	21.96 b	21.04 f
N5	150	22.30 a	21.45 d
Means	21.39 a	20.43 b	

Table 6: Paddy yield (t ha<sup>-1</sup>) of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	5.02 l	4.63 j
N1	50	5.40 h	5.04 i
N2	75	5.82 f	5.37 h
N3	100	6.19 d	5.70 g
N4	125	6.60 b	6.04 e
N5	150	7.15 a	6.36 c
Means	6.03 a	5.52 b	

Table 7: Harvest index (%) of rice as affected by green manuring crop dhaincha

Treatments N-Doses (kg ha <sup>-1</sup> )	Green Manure	Un-Green Manure	Means
N0	-	27.88 g	27.04 h
N1	50	28.72 f	28.15 g
N2	75	29.67 e	28.93 f
N3	100	30.36 d	29.56 e
N4	125	31.13 b	30.24 d
N5	150	32.27 a	30.81 c
Means	30.01 a	29.12 b	

Any two means not sharing a common letter are significant at 5 percent probability level.

without N application produced minimum number of spikelets panicle<sup>-1</sup>. Table 5 indicated that both the green manuring and nitrogen doses did influence the 1000-grain weight substantially. More seed weight was obtained in green manured plots as compared to un-green manured.

As for as the treatments are concerned, T6 resulted in more 1000-grain weight. The minimum weight was produced in T1. The interaction between dhaincha green manuring and different doses of N might have increased the 1000-grain weight through adequate supply of organic matter, nitrogen and other nutrient elements mobilized through all the developmental stages. Sanchez and Lopez (1983) reported that there was a significantly lower empty grain percentage and grain weight in rice after cowpea incorporation than rice with no green manure. It is clear from the data that paddy yield was affected by both green manuring and different N doses (Table 6). The paddy yield was raised significantly by dhaincha green manure as against obtained from un-green manured plot. Among different doses of nitrogen, the application of 150 kg N ha<sup>-1</sup> produced higher paddy yield as against without N-application. The nitrogen utilization efficiency might be increased with dhaincha green manuring which increased in the respective yield components. Tiwari *et al.* (1980) observed that green manure crop dhaincha increased the paddy yield, N, P and K contents in the plants and their availability in soil. Bhardwaj *et al.* (1981) obtained significantly higher rice yield with dhaincha than with no green manure. Bhatti *et al.* (1983) observed that dhaincha green manuring substantially improved grain yield of rice upto 72% higher. It is evident from the data given in Table 7 that dhaincha green manuring treated plots resulted more harvest index as compared to un-green manured plots. Among the different treatments of N-application, the more harvest index was produced in T6 as compared to T1. The crop indices were increased by the supply of sufficient amount of plant nutrients and organic matter through green manuring and hence the nitrogen utilization efficiency was increased. Khind *et al.* (1983) reported that amount of green matter dry matter and N added, increased with green manure crop dhaincha.

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