Pak. j. life soc. sci. (2008), 6(1): 14-17

Pakistan Journal of
Life and Social Sciences

Growth and Yield Response of Fine Rice to Split Application of Nitrogen

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Abstract

In field experiment at Sheikhupra, Pakistan conducted during 2006, the effect of nitrogen in split application, full N (140 kg/ ha) during puddling, full N at 35 days after transplanting (DAT), ½ N during puddling + ½ N at 35 DAT, ½ N during puddling + ¼ N at 20 DAT +1/4 N at 40 DAT and ½ N during puddling +1/4 N at 25 DAT +1/4 N at 50 DAT on yield of rice was investigated. The significantly higher number of grains per panicle and maximum 1000- grain weight and ultimately the maximum yield was obtained by applying 70 kg/ha during puddling +35 kg/ha N at 20 DAT and 35.kg/ha N at 40 DAT.

Key words: *Oryza sativa* L., rice, nitrogen splits, yield

Introduction

Rice occupies an important place in cereal crops. It is the staple food of the teaming millions of South East Asia whose number is increasing rapidly, it plays a significant role in the economy of Pakistan and in addition to this, meets the dietary requirements of the people. It is an important source of foreign exchange earning of the country.

Rice is major food crop of Pakistan. Its average yield is 2117 kg/ha (GOP, 2005-06). This average yield is very discouraging since, because a big gap exists between the actual and potential yield per unit area of the crop. The major Agronomic and environmental factors stagnating in growth and yield are thought to be mismanagement in the use of inputs such as nitrogen application, social nutrient depletion, and poor quality seeds. Among these factors, nitrogen application is one of the most important variables affecting growth and yield to improve nitrogen use efficiency in rice fields, nitrogen application times should be adjusted as it is one of the key factors in achieving higher yield. It increases leaf area that positively effects interception of PAR factor and its use efficiency crop growth rate and consequently contributes towards higher yield. Increased supply of nitrogen results in faster rate of leaf expansion, increase leaf area Index, photosynthetic rate and ultimately increased the total dry matter production (Connor *et al*., 1993). There is a significant positive co relation between grain yield and yield components (panicles m^{-2}, panicle length, productive tillers per hill and spike let number) when nitrogen was applied in split doses at different growth stages. (Geethadevi *et al*., 2000). Time of nitrogen application in rice at different row stages significantly affects the yield and yield component of the crop. Increasing the number of splits from 2 to 4 resulted in higher fertilizer nitrogen recovery, total N up take and agronomic NUE, but hardly affected grain yield. Highest yield, partial N productivity and agronomic NUE, and second highest fertilizer nitrogen recovery were obtained with three equal dozes at transplanting, panicle initiations and booting. Increasing the number of splits to six (6) had no effect (Belder *et al*., 2005, Cabangon *et al*., 2004). The present study was, therefore, designed to determine the effect of nitrogen application time on yield and yield components of fine rice under the climatic conditions of Sheikhupra.

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Materials and Methods

A field experiment to evaluate the effect of time of nitrogen application and its effects on yield and yield components of fine rice was carried out at Adaptive Research Farm, Sheikhupra. The Experiment was laid out in randomized complete block design with three replications having a net plate size 6.52m x 9.90m. the experiment comprised full N (140 $kgha^{-1}$) during puddling, full N at 35 days after transplanting (DAT), ½ N during puddling + ½ N at 35 DAT, ½ N during puddling + ¼ N at 20 DAT + ¼ N at 40 DAT and ½ N during puddling + ¼ N at 25 DAT + ¼ N at 50 DAT. The experimental soil had 0.03% N, 8 ppm available phosphorus, 112 ppm available potash, 7.6 pH and 2.1 ms/cm EC. Recommended doses of NPK (140 kg, 80 kg and 60 kg ha^{-1}) were applied at the time of transplanting while nitrogen fertilizer was also applied as per treatment mentioned above.

Sources of NPK were Urea, DAP and Potassium sulphate. All other agronomic practices were kept normal and uniform for all the treatments. Yield contributing parameters were recorded and the data collected was analysed statistically by using Fisher's analysis of variance techniques and differences among treatment means were compared using least significant difference test at 5% probability level. (Steel *et al*., 1997).

Results and Discussion

Plant height reflexes the vegetative growth of crop plant in response to applied inputs. Plant height of rice crop was significantly affected by split application of nitrogen. The maximum height of rice was recorded by applying ½ N during puddling + ¼ N at 20 DAT +¼ N at 40 DAT. The maximum plant height with three splits of nitrogen might have been due to the availability of nitrogen during the whole growth period of rice crop. Adequate and balance supply of nitrogen promotes vigorous vegetative growth and deep green color of the crop and also influences the utilization of P, K and other plant nutrients which results better growth of the crop. These results are supported by Ha and Suh (1993), who reported more plant height by applying nitrogen in splits and lower plant height by applying whole nitrogen in one dose.

The significantly maximum number of tiller m^{-2} were obtained with ½ N during puddling + ¼ N at 20 DAT +1/4 N at 40 DAT. The maximum number of total tiller m^{-2} with three split application of nitrogen might have been due more number of tillers per hill in these treatments and minimum number of total tillers m^{-2} with one split application of nitrogen could be attributed to minimum number of tillers per hill in these treatments. These results are inline with Maske *et al*. (1997) who reported higher number of total tillers per meter square with increased number of split application of nitrogen and minimum with applying full nitrogen during puddling.

Greater the number of productive tillers per meter square greater will be number of panicles per meter square and ultimately higher grain yield results. The significantly maximum number of panicles (322.64 m^{-2}) was obtained with ½ Nitrogen during puddling, ¼ Nitrogen at 25 DAT and ¼ Nitrogen at 40 DAT (N4) and was followed by treatment where ½ Nitrogen during puddling , ¼ Nitrogen at 25 DAT and ¼ nitrogen at 50 DAT was applied (N5). Full nitrogen during puddling (N1) produced minimum number of panicles per square meter.

The maximum number of grains per panicle (227.38) was obtained by applying ½ Nitrogen during puddling, ¼ Nitrogen at 20 DAT and ¼ Nitrogen at 40 DAT and was followed by that treatment where ½ Nitrogen during puddling, ¼ Nitrogen at 25 DAT and ¼ Nitrogen at 50 DAT was applied. The number of grains per panicle increased by increasing number of splits. The maximum number of grains per panicle with three splits might have been due to availability of nitrogen during reproductive stage of crop and minimum with one split due to unavailability of nitrogen at lateral growth stage of the crop because nitrogen is mobile in the soil and lost by leaching or denitrification if not absorbed by the crop plant. These results are in line with Ha and Suh (1993) who reported higher number of grains per panicle by applying nitrogen in splits. Significantly minimum 1000-grain weight (21.58g) was recorded by applying full nitrogen during puddling (N_1). The maximum 1000-grain weight (26.07) was obtained by applying ½ nitrogen during puddling, ¼ nitrogen at 20 DAT and ¼ nitrogen at 40 DAT (N_4) which was statistically at par with that treatment where ½ nitrogen during puddling, ¼ nitrogen at 25 DAT and ¼ at 50 DAT was applied (N_5). More 1000-grain weight with three splits than one was due to better growth and development of rice plants, which results in more photosynthetic assimilation in grains. These results are in line with those of Mathew *et al*. (1990) they reported minimum 1000-grain weight by applying full nitrogen during puddling.

Grain yield is a function of interaction among various yield components that are affected differentially by crop management practices. The significantly maximum grain yield (4.32 t ha^{-1}) was obtained by applying ½ nitrogen during puddling, ¼ nitrogen at 20 DAT and ¼ nitrogen at 40 DAT. The maximum grain yield by applying nitrogen in three splits could be attributed to higher number of tillers per hill, more fertile tillers per meter square, more number of spikelets per panicle and higher 1000-grain weight. Similar results are also obtained by Mathew *et al*. (1990). They reported increased grain yield by applying nitrogen in splits.

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Table-: 1. Effect of time of nitrogen application on yield and yield components of fine rice

Treatments	**Plant height (cm)**	**No. of tillers (m^{-2})**	**No. of panicle (m^{-2})**	**No. of grains/panicle**	**1000-grain weight (gm)**	**Grain yield (tha^{-1})**
Full nitrogen during puddling	123.95 d	242.47 e	219.59 e	195.28 d	21.58 d	3.18 e
Full nitrogen at 35 DAT	127.43 c	260.34 d	241.14 d	197.87 d	23.31 c	3.66 d
½ nitrogen dring puddling & ½ nitrogen at 35 DAT	132.27 b	289.12 c	271.97 c	207.82 c	24.27 b	3.88 c
½ nitrogen dring puddling, ¼ nitrogen at 20 DAT, ¼ nitrogen at 40 DAT	140.84 a	335.09 a	322.64 a	227.38 a	26.07 a	4.32 a
½ nitrogen dring puddling, ¼ nitrogen at 25 DAT, ¼ nitrogen at 50 DAT	139.87 a	329.26 b	316.01 b	222.48 b	25.78 a	4.11 b
LSD at 0.05	2.597	2.468	2.513	2.936	0.5392	0.1191