

Effect Nitrogen Management on fertility Percentage in Rice (oryza sativa L.)

S. Yoseftabar

Young Researchers Club, Iran Islamic Azad University, sari Branch, sari, Iran

Corresponding author Email: sy_1981@rocketmail.com

ABSTRACT: Nitrogen is the most important and the most limiting element in rice growth. This experiment was carried out in randomized complete block design with 3 replication. Main plot was nitrogen rates including (100, 200 and 300 kg N/ha) applied as urea and sub plot was split application at three levels T1 (1/2 basal-1/2 mid tillering), T2 (1/3 basal-1/3 mid tillering-1/3 panicle initiation) and T3 (1/4 basal-1/4 mid tillering-1/4 panicle initiation-1/4 flowering). The analysis of variance showed that the different rate and split application of nitrogen fertilizer on total tiller, fertile tiller, fertile tiller percentage(%), bearing tiller percentage(%), total spikelet, fertile spikelet, fertile spikelet percentage(%), spikelet sterility percentage(%), 1000-grain weight and grain yield were significant in different probability level. Results showed that maximum of this parameter was observed for 300 kg/ha nitrogen fertilizer except the fertile tiller percentage(%), bearing tiller percentage(%) and spikelet sterility percentage(%). Also split application N-fertilizer increased the fertile spikelet percentage (%), fertile spikelet, fertile spikelet percentage(%), 1000-grain weight and grain yield but decreased in the total tiller, bearing tiller percentage% and spikelet sterility percentage(%). Nitrogen management (different rate and timing split) is important in improving the fertility percentage that productive high grain yield with the balance between crop N demand and applied fertilizer.

Keywords: rice-nitrogen-split application- fertility Percentage

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world in terms of food, area and production (Bakhsh et al, 2011). Application of suitable nutrition elements is a critical strategy for increasing rice yield (Bahmanyar & Ranjbar, 2007). Nitrogen is required by plants in comparatively larger amounts than other elements, nitrogen among nutrients, is the most important and the most limiting element in rice growth (Azarpour et al, 2011). Nitrogen (N) is a constituent of compounds such as amino acids, proteins, RNA, DNA and several phytohormones and is thereby an essential macro element for plants (Wang & Schjoerring, 2012). Rate and timing of nitrogen are critical in terms of their effects on yield, nitrogen increases plant height, panicle number, leaf size, spikelet number and number of filled spikelets (Shakouri et al, 2012). Nitrogen plays a predominant role on the growth and yield of rice, moreover nitrogen is absorbed by the plants at all stages (Vennila et al, 2007). Major constraint for low yield in rice is the unbalanced and injudicious use of fertilizer. Generally 50% of the applied nitrogen is used by rice plant and the rest of it is lost through volatilization, denitrification and/or leaching and thereby resulting in very low N-use efficiency. Nitrogen use efficiency may be increased through, it is appropriate level and split application (Ehsanullah et al, 2001). For efficient management of N in the cropping systems, adequate rate, appropriate source and timing of application during crop growth cycle play an important role (Fajeria et al, 2011). Growing conditions can also influence the percentage of filled grains. In lowland rice, for example, drought stress during late panicle development sharply decreases the percentage of filled grains (Wei et al, 2011). Increasing rate of nitrogen application significantly enhanced both paddy yield and TDM yield over control or lower rate of nitrogen application, moreover, plant height, panicle length, tiller per hill and panicle bearing tillers per hill

were also significantly affected by nitrogen application and 100kgN/ha was found to be an appropriate dose(Jamil&Hussain,2000). Rate and timing of nitrogen are critical in terms of their effects on yield, nitrogen increases plants, panicle number, leaf size, spikelet number and number of filled spikelets(kazemi posht mosari et al,2007). Nitrogen application in three equal splits at transplanting, tillering and panicle emergence is essential,as nitrogen applied in applied in splits is utilized in a better way towards increasing grain yield(Ehsanullah et al,2001). Nitrogen significantly improved yield of rice by improving yield components like panicle number,thousand grain weight and reduced grain sterility(Fajerla et al, 2011). The present study was designed to evaluate the effect of nitrogen management on fertility percentage in rice(*oryza sativa* L.)

MATERIALS AND METHODS

This experiment was conducted with three level of nitrogen fertilizer (N1=100, N2=200 and N3=300 kg/ha) and three times of split(T1=(1/2 basal-1/2 mid tillering), T2=(1/3 basal-1/3 mid tillering-1/3 panicle initiation) and T3(1/4 basal-1/4 mid tillering- 1/4 panicle initiation-1/4 flowering)). The field experiment was laid out in factorial randomized complete block design with three replications. The soil of the experimental field was moderately drained deep clay loam classified taxonomically. The soil was low in available N(total N 0.13%), slightly acidic (pH=6.91)and organic matter (OM) 29%. The rice variety hybrid rice was used for the study. The seeds were soaked in water overnight and incubated for 24 hours and emergence date was considered to be five days after sowing, when 90% of the seedlings showed coleoptile. seed spread with hands into an area of 12m²(3×4). Sowing arrangement was 20×20cm². The water depth was controlled at 3 to 5cm. Phosphorus and potassium fertilizers were used at the rates on P₂O₅ 100kg/ha triple superphosphate and K₂O 100kg/ha potassium sulphate. Basal fertilizer were applied in all plots one day before transplanting. Nitrogen was applied by designing map arrangement. Nitrogen was three rates that applied three times. Weeding was made different days after sowing by hand. 10 hill were randomly collected at harvesting time from each plot to measure total tiller , fertile tiller ,total spikelet, fertile spikelet, spikelet sterility,1000-grain weight and grain yeild. The data were analysed following analysis by SAS software. The duncan multiple range tests was used to compare the means at 5% of significant.

RESULTS AND DISCUSSION

The analysis of variance showed that the nitrogen fertilizer on total tiller, total spikelet, fertile spikelet , fertile spikelet percentage(%), 1000-grain weight and grain yeild were significant in 1%probability level and fertile tiller, fertile tiller percentage(%)and Spikelet sterility percentage (%) were significant in 5% probability level. These parameter increased with increase rate of Nitrogen fertilizer, but fertile tiller percentage(%), bearing tiller percentage(%) and spikelet sterility percentage(%) decrease with increase rate of nitrogen fertilizer. Interesting in comparison to 100 and 200 kg/ha level application of higher N-fertilizer 300 kg/ha showed a positive respond to application of high nitrogen hybrid cultivar. total tiller, fertile tiller, total spikelet, fertile spikelet, fertile spikelet percentage(%), 1000-grain weight and grain yeild increased when application of higher dose of nitrogen fertilizer (300 kg/ha)(table1).

The split application of nitrogen fertilizer on total tiller and 1000-grain weight was significant in 1%probability level and fertile tiller percentage(%), bearing tiller percentage(%), total spikelet, fertile spikelet, fertile spikelet percentage(%), spikelet sterility percentage (%), and grain yeild was significant in 5% probability level (table2). The interaction of rate and split application of nitrogen fertilizer on total spikelet and fertile spikelet was significant in 1% probability level and total tiller and 1000-grain weight was significant in 5% probability level(table3).

Table 1. effect of rate of N-fertilizer on fertility percentage in rice

Treatment	Total tiller(No)	Fertile tiller	Fertile tiller percentage (%)	Bearing Tiller percentage (%)	total spikelet	fertile spikelet	fertile spikelet percentage (%)	Spikelet sterility percentage (%)	1000-grain weight	grain yeild
N1=100kg/ha	15.2	10.7	70.0	30.0	190.3	126.35	66.4	33.35	23.38	6989
N2=200kg/ha	16.8	11.2	66.9	33.1	199.4	133.96	67.2	23.74	23.50	7690
N3=300kg/ha	18.3	12.4	67.5	32.5	209.9	146.11	69.2	21.86	25.52	8611

Means separation in columns followed by the same letter(s) are not significantly different at P≤0.05

Table 2. effect of different spilt application N-fertilizer on fertility percentage in rice

Treatment	Total tiller(No)	Fertile tiller	Fertile tiller percentage (%)	Bearing Tiller percentage (%)	total spikelet	fertile spikelet	fertile spikelet percentage (%)	Spikelet sterility percentage (%)	1000-grain weight	grain yield
T1=2spilt application	17.9	11.3	62.8	37.2	193.2	121.07	62.7	37.34	22.86	7702
T2= 3spilt application	16.5	12.0	72.6	27.4	204.1	138.77	68.0	32.00	23.94	7741
T3= 4spilt application	15.0	11.0	73.4	26.6	200.9	146.61	73.0	27.03	25.06	7818

Means separation in columns followed by the same letter(s) are not significantly different at $P \leq 0.05$

Maximum tiller number under nitrogen fertilizer treatment was (18.3) observed for 300 kg/ha nitrogen and minimum of that was (15.2) obtained for 100 kg/ha nitrogen fertilizer (table1) and tiller number under different split application nitrogen fertilizer treatment in T1 to T3 was (17.9), (16.5) and (15.0) respectively (table2). Maximum tiller number under interaction of rate and spilt application of nitrogen fertilizer was (22.25) observed for (N3T3) 300 kg/ha nitrogen with 4 stage spilt, 1/4 basal-1/4 mid tillering-1/4 panicle initiation-1/4 flowering and minimum of that was (14.88) obtained for (N1T1) 100 kg/ha nitrogen fertilizer with 2 stage spilt, 1/2 basal-1/2 mid tillering. Generally increased number of tiller per unit area was the most important component of yield associated with rice yield and number of fertile tillers or percent filled grains per tiller are on the other important factor (Bahmanyar & Ranjbar, 2007). The maximum number of tillers (14.78) was recorded with the application of 100 kgN/ha followed by 50 kgN/ha (10.91) and 0 kgN/ha (8.51) respectively, application of N at enhanced rate led to the production of more tillers than with control treatment (Jamil & Hussain, 2000).

Usually, a relatively large proportion of fertilizer-N is applied to the rice at early vegetative growth to promote tillering, and this contributes significantly to final grain yield (Wei et al, 2011). Effect of nitrogen fertilizer on fertile tiller was significant, maximum of that was (12.4) observed for (N31) 300 kg/ha nitrogen and minimum of that was (10.7) obtained for (N1) 100 kg/ha nitrogen fertilizer. However different split application on fertile tiller no significant effect but the maximum in this was 12.00 that obtained in 3 split application (1/3 basal-1/3 mid tillering-1/3 panicle initiation) nitrogen fertilizer. This experiment showed that application of nitrogen fertilizer in panicle initiation increased the fertile tiller. Also (Bahmanyar & Ranjbar, 2007) reported that the number of fertile tillers and 1000-grain weight have also been increased by application of N fertilizer, however, numbers of grain per panicle have been reduced. The methods of nitrogen application had significant effect on number of productive tillers per meter (Kaushal et al, 2011). The number of panicle bearing tillers per plants was not influenced significantly by nitrogen split application (Ehsanullah et al, 2001).

Maximum fertile tiller percentage (%), under nitrogen fertilizer treatment was (70.00) observed for 100 kg/ha nitrogen and minimum of that was (67.5) obtained for 300 kg/ha nitrogen fertilizer (table1) and fertile tiller percentage (%), under different application nitrogen fertilizer treatment in T1 to T3 was (62.8), (72.6) and (73.4) respectively (table2).

Bearing tiller percentage% under nitrogen fertilizer treatment in N1 to N3 was (30.0), (33.1) and (32.5) respectively (table1) and Maximum bearing tiller percentage% under split application nitrogen fertilizer treatment was (37.2) observed for 2spilt application nitrogen and minimum of that was (26.6) obtained for 4 split application nitrogen fertilizer (table2). However application of high rate of nitrogen fertilizer produced high number of total tiller and followed fertile tiller but it can produce the lowest rate of fertile tiller percentage% and also produced highest rate of bearing tiller percentage%.

Number of spikelets per panicle is highly associated with number of grain per panicle, which is very important component of rice (Zhang et al, 2009). Maximum of total spikelet, fertile spikelet and 1000-grain weight were 223.16, 162.03 and 26.92 respectively, that obtained at 300 kg/ha N-fertilizer at 4spilt application. The minimum of fertile spikelet and 1000-grain weight were 114.03 and 22.11g respectively, that recorded in N1T1 and minimum of total spikelet was 181.33 that obtained at N1T3 (Table 3). The number of filled grain per panicle was significantly increase up to 120 kg/ha and number of filled grain per panicle (124) were obtained with nitrogen application as 1/2 basal, 1/4 at tillering and 1/4 at panicle initiation stage (Kaushal et al, 2011). Different nitrogen levels also significantly affected the number of spikelets per panicle lineary, among the fertilizer levels (100, 50 and 0 kgN/ha), the application of 100 kgN/ha produced the higher number of spikelets panicle (Jamil & Hussain, 2000). The number of spikelets per panicle was not influenced significantly by nitrogen split application (Ehsanullah et al, 2001). Although grain weight is one of the important characters in determine grain yield performance but it is not as important as the number of grain which is determined by the number of fertile panicle or tiller (Bahmanyar & Ranjbar, 2007). Different levels of nitrogen significantly affected the 1000-grain weight and this response was linear (Jamil & Hussain, 2000).

Application nitrogen fertilizer(1/3 at swing+1/3 at tillering+1/3 at panicle emergence gave the maximum 1000-grain weight compared to all the other treatment(Ehsanullah et al,2001).

The percentage of filled grains depends on the grain filling rate and grain filling duration of superior and inferior grains, which may be fast synchronous, slow synchronous, or asynchronous (wei et al,2011). Maximum fertile spikelet percentage(%) under nitrogen fertilizer treatment was (69.2) observed for 300 kg/ha nitrogen and minimum of that was(66.4) obtained for 100 kg/ha nitrogen fertilizer(table1) and fertile spikelet percentage% under different application nitrogen fertilizer treatment in T1 to T3 was (62.7), (68.0) and (73.0) respectively(table2). In lower nitrogen levels,insufficient nutrients for filling of grains led to diminished grain numbers per panicle. they in this state,lower competition is the cause of decreased hallow grain percentage in panicle(Bahmanyar & Soodaei Mashae,2010). Shortage of assimilate supply due to inhibition of photosynthetic processes is one of the major factors determining grain filling,Inhibition of photosynthesis during the grain filling period due to environmental stresses such as shading or water deficit can result in a major reduction in grain dry matter in rice(Abou-Khalifa,2012).

Maximum spikelet sterility percentage(%) under nitrogen fertilizer treatment was (33.5) observed for 100kg/ha nitrogen fertilizer and minimum of that was(21.86) obtained for 300kg/ha nitrogen fertilizer(table2) . spikelet sterility percentage under different application of nitrogen fertilizer treatment in T1 to T3 was (37.34), (32.00) and (27.03) respectively(table2). Panicle with a low percentage of sterile flowers permit the application of higher doses of nitrogen and produce better yields (Chaturvedi,2005). Low spikelet sterility at high N rate is considered one of the important selection criteria for N responsive rice cultivars(Metwally et al,2011).

Crop yield was determined primarily by the numbers of harvest kernels per unit of land area, which was related to the total amount of spikelets per unit land area and the percentage of grain filling(Wei et al,2011). The highest grain yield 8797kg,was produced when 300 kg/ ha N-fertilizer was applied in 4 stage,1/4basal-1/4 mid tillering-1/4panicle initiation-1/4 flowering.The highest grain yield was 6447.0kg,when 100kg/ha N-fertilizer application in 2 stage,1/2basal-1/2 mid tillering(Table3). Rice grain yield increased with increase in nitrogen levels from 90 to 150 kg.ha⁻¹ in green manured wetland rice field (kaushal et al,2011). Application of N in three equal splits at planting,active tillering and panicle initiation significantly increased grain yield than application of N in two splits at planting and panicle initiation(Pushpanathan et al,2005). Split application of N fertilizer at sowing, tillering and panicle emergence produced the highest paddy yield(Ehsanullah et al,2001).

Table 3. introduction effect of rate and split application of N-fertilizer on on fertility percentage in rice.

Treatment	Total tiller(No)	Fertile tiller	Fertile tiller percentage (%)	Bearing Tiller percentage (%)	total spikelet	fertile spikelet	fertile spikelet percentage (%)	Spikelet sterility percentage (%)	1000-grain weight	grain yeild
N1T1	16.33	14.0	72.0	28.0	192.56	114.03	59.2	40.78	22.11	7202
N1T2	15.57	10.75	69.0	31.0	200.06	132.76	66.4	33.64	22.76	7020
N1T3	13.66	11.41	83.5	16.5	181.3	132.2	72.9	33.72	24.24	6447
N2T1	18.46	10.5	56.9	43.1	190.43	117.5	61.7	38.30	22.49	7490
N2T2	14.0	11.66	83.3	16.7	202.36	138.8	68.6	31.38	23.41	7701
N2T3	15.66	9.83	62.8	37.2	198.36	145.53	73.4	26.60	25.65	7880
N3T1	19.86	11.75	70.5	29.5	196.36	131.7	67.0	33.03	23.98	8595
N3T2	18.46	13.58	73.6	26.4	209.73	144.63	69.0	31.04	25.67	8443
N3T3	16.66	11.83	71.0	29.0	223.16	162.03	72.6	21.97	26.92	8797

Means separation in columns followed by the same letter(s) are not significantly different at $P \leq 0.05$

CONCLUSION

According to results of this study, total tiller, fertile tiller, total spikelet, fertile spikelet, fertile spikelet percentage(%),1000grain weight and grain yield were increased by increasing the nitrogen fertilizer. Among the split application of nitrogen fertilizer ,four equal split at (1/4basel-1/4 mid tillering-1/4 panicle initiation-1/4 flowering.) produced the highest fertile tiller percentage(%), fertile spikelet, fertile spikelet percentage(%),1000grain weight and grain yield. Growth of rice plant was greatly influenced by different methods of application of nitrogen fertilizer. Nitrogen taken up during early growth stages accumulation in the vegetative parts of the plant and is utilized for grain formation. Top dressing of nitrogen fertilizer is needed when the crop has great need for N and when the rate of N uptake is large . However application of high rate of nitrogen fertilizer with lowest split producted high growth parameter but that not follow than observe the highest yield parameter . The N content of rice at the panicle formation stage (about 10–15 d before flowering) has been shown to be an important determinant of sink size and eventual yields. It has been suggested that to improve N-use efficiency, the crop's

demand for N, and its supply from indigenous and fertilizer sources, must be synchronized through proper timing, application rate, and place-ment of fertilizer(sheehy et al,2005). Nitrogen managemet (rate and timing split) is important in improving the balance between crop N demand and N supply from soil and applied fertilizer that resulted of these productive the high grain yield.

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