Effect of N_2 management on different growth attributes and yields contributing characters of BRRIdhan28 comparing to conventional and leaf colour chart urea management

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Abstract: An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during October/10 to February/11 to assess the efficiency of nitrogen application for *Boro* rice and appropriate amount of nitrogen to be top dressed on the basis of Leaf colour chart (LCC) compare to conventional system. The experiment contained 17 treatments including control, recommended N management and 15 LCC based N management treatments that were LCC 2.5, 3 and 3.5 and each of these contained 5 doses of N fertilizer (urea) that is 20, 25, 30, 35 and 40 kg N ha^{-1}top dressing. The experiment was conducted in randomized complete block design with three replications. LCC reading were taken on every 7 days from 14 days after transplanting up to flowering. Whenever LCC value dropped below the set critical level, nitrogen was top dressed. The result show that the highest grain yield was produced when the land was fertilized with LCC 3.5 based nitrogen top dressing at the rate of 30 kg ha^{-1} followed by LCC 3.5 kg N ha^{-1} top dressing and recommended nitrogen management. The LCC 3.5 based top dressing at the rate of 30 kg N ha^{-1} can be adopted in *Boro* rice for maximum nitrogen use efficiency and higher grain profit.
Key words: Urea applications, leaf colour chart, growth attributes, yield contributing characters.

Introduction

Need based N application would result in greater agronomic and physiological efficiency of N fertilizer than the commonly practiced method (Hussain *et al.,* 2000). Crop-demand based N application is one of the important options to reduce N loss and to increase N use efficiency of a crop. It has been observed that more than 60% of applied nitrogen is lost due to lack of synchronization between the nitrogen demand and nitrogen supply (Yadav *et al.,* 2004). Farmers generally apply nitrogen fertilizer in fixed time without taking into account whether the plant really requires N at that time which may lead to loss or may not be found adequate enough to synchronize nitrogen supply with actual crop nitrogen demand (Ladha *et al.,* 2000). Leaf Colour Chart (LCC) can be used for adjustment of fertilizer N application based on actual plant N status. It is an ideal and easier tool to optimize N use, irrespective of N applied (Balasubramanian *et al.,* 1999). Most research works have so far been focused mostly on the rate and timing of N application without considering the initial soil nitrogen and crop demand. So, a study is needed on crop demand based N management through LCC reading comparing to conventional approach for specific variety and season.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during October/10 to February/11 to assess the efficiency of nitrogen application for *Boro* rice and appropriate amount of nitrogen to be top dressed on the basis of LCC compare to conventional system. The experiment contained 17 treatments including control, recommended N management and 15 LCC based N management treatments that were LCC 2.5, 3 and 3.5 and each of these contained 5 doses of N fertilizers (urea) that is 20, 25, 30, 35 and 40 kg N ha^{-1}top dressing. The experiment was conducted in randomized complete block design with three replications where each of plot size was 4.0 m x 2.5 m having a space between blocks and plots were 0.75 m and 0.5 m respectively. The entire amount of TSP, MoP, gypsum and zinc sulphate were applied and incorporated into the soil at final land preparation. Later on nitrogen was top dressed in the form of urea. Thirty three days old seedling was transplanted at the rate of three hills^{-1} with 25 cm x 15 cm spacing. All intercultural operations were done as and when necessary. LCC reading were taken on every 7 days from 14 days after transplanting up to flowering. Whenever LCC value dropped below the set critical level, nitrogen was top dressed. Five hills (excluding border hills) from each plot were selected randomly and tagged just after transplanting for measuring different agronomic data at 30, 45 and 60 DAT but grain and straw yields were recorded from the harvest of central 1 m^2 area in each unit plot. Five hills were randomly selected at 30 DAT in each plot excluding border hills and tillers which had at least one leaf visible were counted as tiller hill^{-1}. In case of growth study, randomly selected 2 hills were carefully uprooted at each plot at each time excluding central 1m^2 and border hills. The leaf area of collected leaves from each plant sample was measured with leaf area meter. Uprooted 2 hills were packed separately in labeled brown paper bags and were oven dried at 80º C until constant weight was reached. Leaf area index was measured by leaf area /ground area (Redford, 1967). Biological yield (tha^{-1}) was calculated by adding grain yield (t ha^{-1}) and straw yield (t ha^{-1}) where harvest index (%) = grain yield / biological yield x 100 (Gardner *et al.,* 1985). The collected data were analyzed following the analysis of Variance technique and mean differences were adjusted by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Leaf area index: Leaf area index was found to be responsive to N management at different stages of growth (Table 1). At 30 DAT the highest LAI (0.93) was observed when the land was fertilized on the basis of LCC 3.5 based 35 kg N ha^{-1} top dressing and the lowest LAI (0.47 and 0.49) was observed at control treatment which was statistically identical at LCC 2.5 based 20 kg N ha^{-1} top dressing. At 45 DAT the highest LAI (2.96, 2.79 and 2.75) was observed when the land was fertilized on the basis of LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management and LCC 3.5 based 30 kg N ha^{-1} top dressing. At 60 DAT the highest LAI (5.83, 5.74, 5.70 and 6.50) was observed at LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management, LCC 3.5 based 30 kg N ha^{-1} top dressing.

Total number of tillers: At 30 DAT higher number of tillers hill^{-1} (5.33. 5.30, 5.08, 5.11, 5.16 and 5.15) was produced by recommended N management which was statistically identical with LCC 2.5 based 40 kg N ha^{-1}, LCC 3.5 based 25, 30, 35, 40 kg N ha^{-1} top dressing. At 45 DAT significantly higher number of total tillers hill^{-1} (9.92, 9.32, 9.05, 9.26 and 9.30) was observed at LCC 3.5 based 40 kg N ha^{-1} top dressing which was statistically identical with recommended N management, LCC 2.5 based 40 kg N ha^{-1}, LCC 3.5 based 30, 35, 40 kg N ha^{-1} top dressing. At 60 DAT highest number of tiller hill^{-1} (12.55, 14.47 and 12.42) was observed at LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management, LCC 3.5 based 30 kg N ha^{-1} top dressing (Table 1).

Table1. Effect of nitrogen management on different growth attributes of *Boro* rice at different DAT

Treatments	LAI			No. of total tillers hill^{-1}			TDM (g m^{-2})		
	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT
T_1	0.47 l	1.74 g	3.57 g	3.02 c	7.132 c	10.08 e	68.54 b	154.90 k	246.90 i
T_2	0.81 b	2.79 ab	5.74 ab	5.33 a	9.32 a	12.47 a	97.97 ab	379.30 a	642.20 a
T_3	0.49 l	1.75 g	3.58 g	3.35 c	7.06 c	10.10 e	93.78 ab	215.50 j	319.60 h
T_4	0.53 k	1.77 g	3.60 g	3.45 c	7.10 c	10.11 e	94.79 ab	237.10 i	358.80 g
T_5	0.63 gh	1.97 f	4.30 de	4.93 b	8.77 b	10.78 cd	96.93 ab	291.70 ef	454.70 e
T_6	0.57 ij	1.86 f	4.11 ef	4.42 b	7.88 b	10.70 cd	95.64 ab	248.60 hi	400.40 f
T_7	0.66 fg	2.33 cde	5.15 c	5.30 a	9.05 a	12.20 b	96.62 ab	334.70 b	536.20 b
T_8	0.54 jk	1.80 f	3.75 f	3.95 b	7.76 b	10.17 d	94.55 ab	262.20 gh	399.30 f
T_9	0.68 ef	2.37 cde	5.40 bc	4.96 b	8.88 b	12.00 b	93.55 ab	306.40 de	480.50 d
T_{10}	0.62 gh	2.05 ef	4.48 de	4.98 b	8.80 b	11.21 bcd	93.20 ab	301.90 de	497.50 cd
T_{11}	0.64 fg	2.14 def	4.60 d	4.21 b	7.96 b	11.25 bc	98.04 ab	327.10 bc	504.40 cd
T_{12}	0.59 hi	1.86 f	4.10 ef	4.42 b	7.88 b	10.70 cd	94.40 ab	261.00 gh	402.10 f
T_{13}	0.63 gh	1.95 f	4.23 de	4.36 b	7.95 b	10.74 cd	95.70 ab	274.20 fg	423.10 f
T_{14}	0.71 d	2.42 cd	5.59 b	5.08 a	8.87 b	12.15 b	96.07 ab	313.60 cd	512.60 bc
T_{15}	0.76 c	2.75 af	5.70 ab	5.11 a	9.26 a	12.42 a	97.92 ab	377.10 a	642.10 a
T_{16}	0.93 a	2.96 a	5.83 a	5.16 a	9.30 a	12.55 a	99.98 a	387.50 a	646.20 a
T_{17}	0.73 cd	2.56 bc	5.50 bc	5.15 a	9.92 a	12.12 b	93.72 ab	310.70 cde	503.80 cd
$S\bar{x}$	0.01	0.07	0.13	0.16	0.21	0.33	2.01	6.27	8.61
Level of sign.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Mean values in a column having the same letter(s) or without letter do not differ significantly, whereas figures with dissimilar letter(s) differ significantly as per DMRT; T_1= Control (No nitrogen application), T_2= Recommended nitrogen management, T_3= LCC 2.5 based N top dressing (20 kg N ha^{-1}), T_4= LCC 2.5 based N top dressing (25 kg N ha^{-1}), T_5= LCC 2.5 based N top dressing (30 kg N ha^{-1}), T_6= LCC 2.5 based N top dressing (35 kg N ha^{-1}), T_7= LCC 2.5 based N top dressing (40 kg N ha^{-1}), T_8= LCC 3.0 based N top dressing (20 kg N ha^{-1}), T_9= LCC 3.0 based N top dressing (25 kg N ha^{-1}), T_{10}= LCC 3.0 based N top dressing (30 kg N ha^{-1}), T_{11}= LCC 3.0 based N top dressing (35 kg N ha^{-1}), T_{12}= LCC 3.0 based N top dressing (40 kg N ha^{-1}), T_{13}= LCC 3.5 based N top dressing (20 kg N ha^{-1}), T_{14}= LCC 3.5 based N top dressing (25 kg N ha^{-1}), T_{15}= LCC 3.5 based N top dressing (30 kg N ha^{-1}), T_{16}= LCC 3.5 based N top dressing (35 kg N ha^{-1}) and T_{17}= LCC 3.5 based N top dressing (40 kg N ha^{-1}).

Total Dry Matter: At 30 DAT the treatments had no significant effect on TDM except control treatment. At 45 DAT the highest total dry matter (gm^{-2}) (387.5, 379.3 and 377.1) was produced at LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management and LCC 3.5 based 30 kg N ha^{-1} top dressing. At 60 DAT highest total dry matter (gm^{-2}) (646.2, 642.2 and 642.1) was observed at LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management and LCC 3.5 based 30 kg ha^{-1} top dressing (Table 1).

Number of total tillers^{-1}: The highest of number of total tillers hill^{-1} (10.65, 10.36 and 10.34) was observed from LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management and LCC 3.5 based 30 kg N ha^{-1} top dressing. On the other hand, the lowest number of total tillers hill^{-1} (7.40, 7.58 and 7.60) was found at control treatment which was statistically identical with LCC 2.5 based 20, 25 kg N ha^{-1} top dressing (Table 2).

Number of effective tillers hill^{-1}: Significant difference in the production of number of effective tillers hill^{-1} was observed in different treatments (Table 2). The highest number of effective tillers hill^{-1} (10.65, 10.36 and 10.34) was observed from LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with recommended N management and LCC 3.5 based 30 kg N ha^{-1} top dressing. The lowest number of effective tillers hill^{-1} (7.40, 7.58 and 7.60) was found at control treatment which was statistically identical with LCC 2.5 based 20 and 25 kg N ha^{-1} top dressing.

No. of grains panical^{-1}: The treatments exhibited significant differences in respect of number of grains panicle^{-1}. The highest number of grains panicle^{-1} (98.60, 97.91 and 97.35) was recorded at LCC 3.5 based 30 kg N ha^{-1} top dressing which was statistically identical with recommended with N management and LCC 3.5 based 35 kg N ha^{-1} top dressing. The lowest number of grains panicle^{-1} (73.93) was recorded at control treatment (Table 2).

Weight of 1000-grains: The effect of treatments with respect to 1000-grains weight was found to be statistically non-significant (Table 2).

Grain yield: The highest grain yield (4.546 t ha^{-1}, 4.52 ha^{-1} and 4.5 t ha^{-1}) was recorded from LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with LCC 3.5 based 30 kg N ha^{-1} top dressing and recommended N management. Improvement in yield obtained in these treatments because the plants received right amount of fertilizer in the right time. The results are in agreement with the findings of Angadi *et al.* (2002) (Table 2).

Straw yield: The highest straw yield (5.09 t ha^{-1}, 4.90 ha^{-1} and 4.8 t ha^{-1}) was found from LCC 2.5 based 40 kg N ha^{-1} top dressing which was statistically identical with LCC 3.5 based 35 and 30 kg N ha^{-1} top dressing. The increase in straw yield occurred due to production of more hill^{-1} (Table 2).

Table 2. Effect of nitrogen management on different yield contributing characters and yield of *Boro* rice at harvest

Treatments	No. of total tillers hills^{-1}	No. of effective tillers hills^{-1}	No. of grains panical^{-1}	Weight of 1000-grains (g)	Grain yield (t hac^{-1})	Straw yield (t hac^{-1})	Biological yield (t hac^{-1})	Harvest index (%)
T_1	7.40 g	5.39 g	73.93 g	21.83	2.33 h	3.80 d	6.13 i	38.01 h
T_2	10.36 ab	7.86 a	97.91 a	21.92	4.50 a	4.69 b	9.19 ab	48.96 a
T_3	7.58 g	5.49 f	89.45 de	22.19	2.84 g	4.11 bc	6.95 gh	40.86 g
T_4	7.60 g	6.74 cd	89.77 cde	21.71	3.48 de	4.19 bc	6.69 h	45.37 cd
T_5	8.49 ef	5.99 ef	88.51 e	22.09	3.10 fg	4.28 bc	7.38 fg	42.01 fg
T_6	8.40 ef	5.90 ef	94.20 b	21.83	3.25 ef	3.91 c	7.06 gh	46.03 c
T_7	9.74 bc	6.91 cd	91.33 bcd	21.84	3.69 cd	5.09 a	8.78 bc	42.03 fg
T_8	7.89 af	5.46 f	91.80 bcd	22.46	2.92 fg	3.87 c	6.79 gh	43.00 ef
T_9	9.30 cd	6.79 cd	89.41 de	21.72	3.66 cde	4.90 a	8.45 cd	42.01 fg
T_{10}	8.93 de	7.55 ab	92.77 bc	22.10	4.15 b	4.70 b	7.83 ef	46.89 bc
T_{11}	8.90 de	6.43 de	92.03 bcd	21.82	3.46 de	4.77 a	8.23 cde	42.04 fg
T_{12}	8.40 ef	6.98 cd	93.59 b	21.73	3.82 bcd	4.30 b	7.07 gh	47.04 bc
T_{13}	8.40 ef	5.92 ef	85.80 f	21.98	2.97 fg	4.12 bc	7.09 gh	41.89 fg
T_{14}	9.72 bc	6.94 cd	91.18 bcd	21.94	3.70 cd	4.71 b	8.41 cd	44.00 de
T_{15}	10.34 ab	7.84 a	98.60 a	21.83	4.56 a	4.80 a	9.36 ab	48.72 ab
T_{16}	10.65 a	8.01 a	97.35 a	22.12	4.52 a	4.90 a	9.42 a	47.98 ab
T_{17}	9.73 bc	7.17 bc	93.02 b	22.12	3.90 bc	4.05 bc	7.95 de	49.06 a
$S\bar{x}$	0.23	0.18	0.93	0.59	0.12	0.13	0.18	0.55
Level of sign.	0.01	0.01	0.01	NS	0.01	0.01	0.01	0.01

Mean values in a column having the same letter(s) or without letter do not differ significantly, whereas figures with dissimilar letter(s) differ significantly as per DMRT; T_1= Control (No nitrogen application), T_2= Recommended nitrogen management, T_3= LCC 2.5 based N top dressing (20 kg N ha^{-1}), T_4= LCC 2.5 based N top dressing (25 kg N ha^{-1}), T_5= LCC 2.5 based N top dressing (30 kg N ha^{-1}), T_6= LCC 2.5 based N top dressing (35 kg N ha^{-1}), T_7= LCC 2.5 based N top dressing (40 kg N ha^{-1}), T_8= LCC 3.0 based N top dressing (20 kg N ha^{-1}), T_9= LCC 3.0 based N top dressing (25 kg N ha^{-1}), T_{10}= LCC 3.0 based N top dressing (30 kg N ha^{-1}), T_{11}= LCC 3.0 based N top dressing (35 kg N ha^{-1}), T_{12}= LCC 3.0 based N top dressing (40 kg N ha^{-1}), T_{13}= LCC 3.5 based N top dressing (20 kg N ha^{-1}), T_{14}= LCC 3.5 based N top dressing (25 kg N ha^{-1}), T_{15}= LCC 3.5 based N top dressing (30 kg N ha^{-1}), T_{16}= LCC 3.5 based N top dressing (35 kg N ha^{-1}) and T_{17}= LCC 3.5 based N top dressing (40 kg N ha^{-1}).

Biological yield: The highest biological yield (9.346 t ha^{-1}, 9.32 ha^{-1} and 9.19 t ha^{-1}) was recorded from LCC 3.5 based 35 kg N ha^{-1} top dressing which was statistically identical with LCC 3.5 based 30 kg N ha^{-1} top dressing and recommended N management (Table 2).

Harvest index: The highest harvest index (49.06 %, 48.96%, 48.49% and 48.20%) was found in LCC 3.5 based40 kg N ha^{-1} top dressing which was statistically identical with recommended N management and LCC 3.5 based 30, 35 kg N ha^{-1} top dressing (Table 2).

From the above findings it can be concluded that 3.5 based 30 kg N ha^{-1} is the best one over the rest of the treatments for potential and better N management in respect of greater nitrogen efficiency, higher grains yield, higher profit and net return in *Boro* rice.

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