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Effect of Split Application of Nitrogen Fertilizer on Leaf Color Chart Values in Hybrid Rice (GRH1)

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Abstract

A field trial to determine comparing of yield and yield components of hybrid rice (GRH1) in different application of nitrogen fertilizer, comprising of 2 treatments, nitrogen fertilizer at 100,200 and 300 kg/ha was main plot and spilt application at 3 level: T1=(1/2basal-1/2mid tillering), T2=(1/3basal-1/3mid tillering-1/3panicle initiation) and T3=(1/4basal-1/4 mid tillering-1/4panicle initiation-1/4 flowering) as sub plot. Using randomized complete block design (RCBD) with 3 replications in rice research institute of Iran-departy of mazandaran (amol) in 2006 cropping season. The results showed that leaf color chart (Lcc) values increased significantly with 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. Effect of different split application N-fertilizer was significantly on lcc values the each time.

Keywords: hybrid rice-nitrogen-spilt application-Lcc value

1. Introduction

Rice is most important food crop and a major food grain for more than a third of the world's population (Zhao et al., 2011). Nitrogen fertilizer is a major essential plant nutrient and key input for in increasing crop yield (Dastan et al., 2012). Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of n in excess promotes development of the above ground aground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increase the risk of loding and reduces the plants resistance to brash climatic condition and foliar diseases (Mohammadi et al., 2011). Nitrogen contributes to carbohydrate accumulation in culms and leaf sheaths during the pre-heading stage and in the grain during the ripening stage of rice (Swin et al., 2010).

Rata and timing of N rate critical for optimum rice grain yield (Doberman & fair Hurst, 2000). Judicious use of nitrogen (n) fertilizer in rice requires synchronizing n fertilizer application with plant needs. Predicting plant n requirement throught soil testing has not difficulty in predicting climatic variables that control soil n mineralization and crop growth (Babu et al., 2000). Chlorophyll, a green pigment present in plants, captures the sunlight that is used in photo synthesis (Swain et al., 2010). Leaves with different N content would, therefore, differ greatly at this band with, while differences in reflectance decrease towards both ends of the spectrum (witt et al., 2005). Leaf color is generally used as a visual and subjective indicator of the rice crops need for nitrogen (N) fertilizer leaf color intensity is directly related to leaf chlorophyll content and leaf N status. Here is a tool that can help farmers improve their decision-making process in N management (Balasubramanin, 2000). Deep placement of urea split N application and the chlorophyll meter and leaf color chart techniques are some N management strategies that could improve fertilizer use efficiency in rice (Kumar et al., 2000). Leaf color chart (LCC) is made of high quality plastic material. It consists of six colour ranging from light yellowish green (NO1) to dark green (NO_6) colour strips fabricated with veins resembling those of rice leaves (Nachimuthu et al., 2007). The lcc determines the right time of n application to the rice crop by measuring leaf color intensity which is related to leaf N status.in addition, it also helps optimize N use at reasonably high yield levels, ragaed less of N source identifying the correct threshold values of the lcc is essential as they differ according to location, season varity and rice ecosystem. Our investigation was conducted to study crop need-based N management using the lcc in irrigated rice (Islam et al., 2009). Inexpensive leaf color chart (Lcc) has proved quick and reliable tools to decide the time when fertilizer n needs to be applied to the crop (singh et al., 2006). In the real-time approach a prescribed of fertilizer N is applied whenever the color of rice leaves falls below the critical lcc value. The critical value might fall between two existing panels of the lcc, but guidelines can be adjusted so that color panels of the lcc, will not have to be changed (Witt et al., 2005).

2. Materials and Methods

In order to investigate the Effect of split application of nitrogen fertilizer on leaf color chart in of hybrid rice (GRH1), an experimental design in rice research institute of iran-deputy of mazandaran (amol) in 2006 cropping season. Nitrogen fertilizer at 100, 200 and 300 kg/ha was main plot and spilt application at 3 level (1/2basal -1/2mid tillering), (1/3basal-1/3mid tillering-1/3panicle initiation) and (1/4basal-1/4 mid tillering-1/4panicle initiation-1/4 flowering) as sub plot. Using randomized complete block desing (RCBD) with 3 replication. The soil was clay loam and slightly acidic (PH=6.91) with total N 0.13.1% and organic matter (OM) 29%. Hybrid rice (GRH1) variety was transplanted at spacing plots of 20cm×20cm. The plot size was kept as 3×4 meter. Chemical herbicides were employed against different weeds during the course of study. Plots received identical cultural treatments in terms of ploughing, cultivation seed rate. P and K fertilizes and disease control. Leaf color chart(lcc) reading were taken in all treatments at 25,35,45,55,65 day after transplanting unit first flowering,using the youngest fully expanded leaf of 10 randomly selected plants from each plot. The data were analysed following analysis by SAS software. The Duncan multiple range tests was used to compare the means at 5% of significant.

3. Results and Discussion

The analysis of variance showed significant responses of grain yield to N application (Table 1). Increasing the rate of nitrogen application increased significantly the grain yield (Table 2). Results showed that grain yield increased significantly with different split application of nitrogen fertilizer (Table 3). Grain yield increased when application of higher dose of nitrogen fertilizer (300 kg/ha) increased. 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. Grain yields of hybrid rice (GRH1) in the 100, 200 and 300kg/ha nitrogen fertilize was 6989.8, 7690, 8611 kg/ha respectively (Table 2). The nitrogen content in grain increased significantly with the increase in nitrogen level from 90 to 120 kg N ha^{1}. Throught highest value was recorded at 150 kg N ha^{-1} (Kaushal et al., 2010). Garin yield in 2 split to 4 split were 7702, 7741 and 7818 kg/ha respectively (Table 3). Split N fertilization there was a significant effect ($p<0.05$) on the grain yield and the highest values were obtained with (1) 33% n at sowing, 33% at tillering and 34% at panicle initiation and (2) 50% at swing and 50% at panicle initiation (Hirzel et al., 2011).

Table 1. Mean squares of split application of nitrogen fertilizer on lcc valuse in hybrid rice (GRH1)

source of variation	DF	M.S					
		15 DAT	25 DAT	35 DAT	45 DAT	55 DAT	yield
N	2	0/080 *	0/407 **	0/34 **	0/52 **	3/30 **	595690.78 **
T	2	0/038 *	0/029 ns	0/095 *	0/26 **	17/59 **	16875.44 **
N×T	4	0/002 ns	0/040 ns	0/003 ns	0/033 ns	0/79 ns	174413.55 ns
%C.V		4/195	4/39	2/84	4/49	3/36	6.36

* and ** respectively significant at 5% and 1%.

Table 2. Effects of nitrogen fertilizer level on lcc valuse in hybrid rice (GRH1)

Treatment	15 DAT	25 DAT	35 DAT	45 DAT	55 DAT	yield
100 kg/ha	2/72 [a]	3/40 [c]	3/46 [b]	3/76 [b]	3/56 [c]	6989.8 [c]
200 kg/ha	2/82 [ab]	3/56 [b]	3/62 [b]	4/06 [a]	3/94 [b]	7690.3 [b]
300 kg/ha	2/91 [a]	3/82 [a]	3/85 [a]	4/24 [a]	4/26 [a]	8611.9 [a]

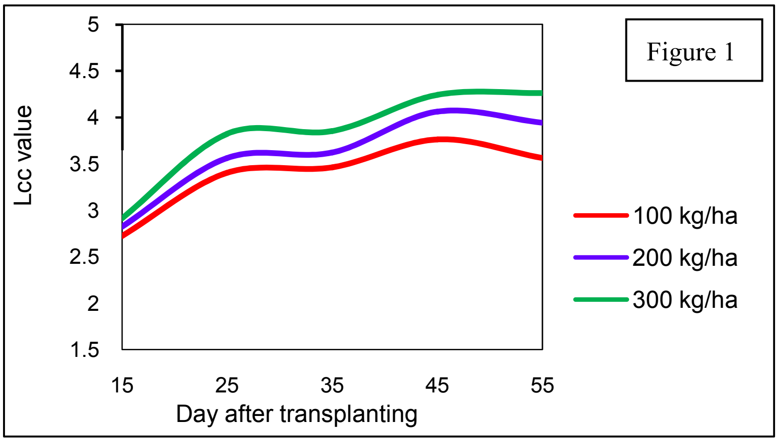
*Means separation in columns followed by the same letter(s) are not significantly different at $P<0.05$.

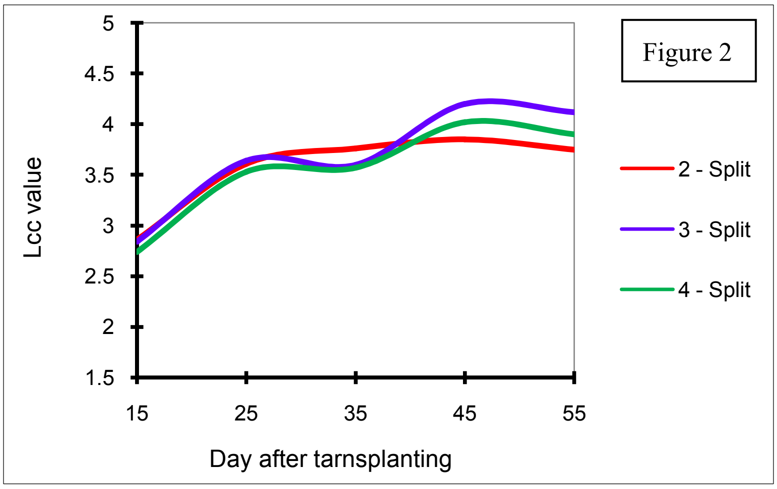
Table 3. Effects of split application on lcc valuse in hybrid rice (GRH1)

Treatment	15 DAT	25 DAT	35 DAT	45 DAT	55 DAT	yield
2 split	2/86 [a]	3/61 [a]	3/76 [a]	3/85 [b]	3/75 [c]	7702.3 [c]
3 split	2/84 [a]	3/64 [a]	3/60 [b]	4/20 [a]	4/12 [a]	7741.6 [b]
4 split	2/74 [b]	3/53 [b]	3/57 [c]	4/02 [ab]	3/90 [b]	7818.1 [a]

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

The results showed that the fertilizer treatment had significant effect on Lcc values at different growth stages. The lcc can be used to guide the application of fertilizer N to maintain an optimal leaf N content for achieving high rice yield with effective N management, optimization of nitrogen level as well as split doses to different crop growth stages is more important to produce higher grain yield (Sathiya & Ramesh, 2009). Farmers use leaf color as a visual and subjective indicator of the crop need for N fertilizer,the use of Lcc in rice aims at need based nitrogen application to top crop based on soil N supply and crop demand,there by increasing the nitrogen use efficiency in rice (Nachimuthu et al., 2007). This parameter increased significantly with increased nitrogen fertilizer. These data suggested Nitrogen fertilizer supplying increase Lcc values 300 kg/ha N fertilizer had maximum Lcc values at each growth stage (Table 2). Improving the synchronization between crop N demand and the available N supply is an important key to improve N use efficiency. There is opportunity to reducing N application with the lcc with the use of a lower critical lcc value and the lower dose of N fertilizer applied whenever leaf color fell below a critical Lcc value (Hushmadfar & Kimaro, 2011). Lcc values in N1 to N3 were 2.27, 2.82 and 2.91 at 15 DAT and 3.4, 3.56 and 3.82 at 25 DAT respectively. Buresh (2006) showed that do not use the lcc with the early N application because rice plants are too small for accurate reading of leaf color with the lcc. Application of fertilizer N can be adjusted upward or downward based on leaf color, which reflects the crops relative need for nitrogen, the real time N management strategie were obtained by applying 60 to 120 kg N, this large variation in N application rate suggests that the strategy can guide N application to rice as per need of the crop while not adversely affecting yield (Sen et al., 2011). Lcc values in N1 to N3 were 3.46, 3.62 and 3.85 at 35 DAT and 3.76, 3.62 and 3.85 at 45 DAT respectively. Spad values in N1 to N3 were 3.56, 3.94 and 4.26 at 55 DAT respectively (Table 2). The lcc values recorded had a direct influence on the index leaf N content. The concomitance increase in the index leaf N with increasing Lcc levels revealed that leaf N contraction was directly related to leaf greenness (Nachimuthu et al., 2007). Nitrogen fertilization amount had an important role in improving morpho physiological characteristics of rice, nitrogen could be increase rice leaves and roots growth to prepare appropriate LAI for obtained most grain yield (Barai tari et al., 2009). The analysis of variance showed split application increase significant Lcc values at 15, 35, 45 and 55 days after transplanting (DAT). Lcc-based, real-time N management can be practiced in rice by monitoring leaf color at 7 to 10 day intervals during the growing season. Fertilizer N is applied whenever the leaves are less greenish than a threshold Lcc value, which corresponds to a critical leaf N content (Singh et al., 2010). Effects of split application on Lcc values at 15, 35 and 45 days after transplanting was significant. Lcc values at 2split to 4split were 2.86, 2.84 and 2.74 in DAT and 3.76, 3.60 and 3.57 in 35DAT respectively. Lcc values at 2split to 4split were 3.85, 4.20 and 4.02 in 45DAT and 3.75, 4.12 and 3.90 in 55DAT respectively. The Lcc values at 25 day after transplanting were not significant (Table 3). Application of nitrogen in split according to the crop needs was the reason for better rice growth parameter (Sathiya & Ramesh, 2009). The interaction rate and split application of nitrogen fertilizer had no significant in Lcc values (Table 1). The use of Lcc for scheduling N application may not be uniformly applicable to all varieties, that differ inherent leaf color and regions that differ in climate, thereby necessitating individual or group standardization in different (Hushmandfar & Kimaro, 2011).





Figures 1 and 2. Effect of nitrogen fertilizer level (Figure 1) and Split application (Figure 2) on LCC valuse in hybrid rice (GRH1)

The result showed that Variation of Lcc values under different rate and split application of nitrogen fertilizer reflected nitrogen need of rice plant at different stage. Other evaluation of the lcc in rice producion systems of asia have often reported saving in n fertilizer use, which can result in increased N use efficiency.these results indicated that the application of N based on lcc effectively matched the rice crop N demand (Hushmadfar & Kimaro, 2011). It was found that application of N fertilizers increased the Lcc values significantly. Lcc values increased when application of higher dose of nitrogen fertilizer increased (Figure 1). Application of fertilizer nitrogen based on leaf color chart was found effective to maintain optimal leaf nitrogen which resulted in better crop growth and high rice grain yield (Sathiya & ramesh, 2009).

Interesting in compariso to 4 split application of 3 and 2 split application showed increase split application decrease Lcc values at 15 DAT (Figure 2). Young rice before the tillering stage grows slowly and dose not need much N- fertilizer therefore with site specific nutrient management only a small to mode rate amount of fertilizer N is applied to young rice withn 14 day after transplanting or 21 day after direct sowing. Apply only a moderate amount of fertilizer N to young rice within 14 day after transplanting (DAT) or 21 day after sowing (DAS), when the growth and need of the plant for supplemental N is small (Buresh et al., 2006). The lcc values never fall below the early growth stages could maintain leaf greenness even upto reproductive phase (Nachimuthu et al., 2007).

When application fertilizer at the fixed timing basal- tillering (20DAT) panicle initiation (40DAT) variation Lcc values were maximum than other times. After top dressing N fertilizer, Lcc value clearly increased from 1 unit of LCC that showed depending on N application. Split application at 2 stage comparison 3 and 4 stage increased Lcc values significantly at 25 DAT. This means Lcc reading at 25DAT varies more than Lcc reading at 15DAT (Figure 2). Critical Lcc values vary considerably among different rice genotypes having different genetic backgroung, plant type and leaf color and this critical color shade on the Lcc needs to be determined to guide N application (Sen et al., 2011). Chen (1991) reported that the chlorophyll level in the normal leaves decreased progressively with age.

Lcc values reduced at 25 and 45 DAT, then it quickly increased after application nitrogen fertilizer at panicle initiation stage (40DAT) and increase significantly at (45 and 55DAT). Timing of N application can apply three or four times based on crop need and Lcc threshold and crop-growing condition at each location (Figures 1 and 2). Application nitrogen fertilizer at the right timing helped rice plant grow well and led to got higher grain yield. Lcc is easy to use and is an inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator for the plant N status and can be used as an alternative to chlorophyll meter (Sen et al., 2011).

4. Discussions

Split application N fertilizer and using leaf color chart resulted showed lcc values increase by application N fertilizer at different growth stage.Thus, used lcc in rice field and split application N fertilizer based lcc values can reduction of used nitrogen fertilizer. It was also revealed that grain yield increased significantly with nitrogen fertilizer. Total N uptake by rice showed trends similar to the grain yield of rice. Critical or thershold lcc values are known as those that optimize simultaneously the grain yield and N use efficiency. It has been reported that higher agronomic efficiency of N with consistent high grain yield could be regarded as an indicator for efficient N management in rice.

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