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EFFECT OF LCC AND SPAD BASED NITROGEN MANAGEMENT ON GROWTH AND YIELD OF LOWLAND RICE (*ORYZA SATIVA* L.)

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ABSTRACT
A field experiment was conducted at Raichur during *kharif*-2009 to validate the effect of Leaf Colour Chart (LCC) and Soil and Plant Analysis Development meter (SPAD) based nitrogen (N) management on growth and yield of lowland rice (*Oryza sativa* L.). Treatments consists of N application based on LCC thresholds (3.5 to 5.0) and SPAD values (30 to 40) compared with state recommendation and farmers' practice (220 kg ha^{-1}), were imposed through RCBD replicating thrice. The results revealed that N application based on LCC values @ 5 (120 kg ha^{-1}) and SPAD @ 37.5 (120 kg ha^{-1}) were more beneficial in enhancing the growth and yield of the low land rice. The split application of N at higher doses enhances its uptake over basal application. Significantly better growth parameters were recorded when N requirement for rice was applied based on LCC @ 5 (120 kg ha^{-1})) and SPAD @ 37.5 (120 kg ha^{-1}). These were also recorded better yield parameters over farmers' method and low N rates treatments. The results of the study implied that LCC threshold @ 5.0 or SPAD @ 37.5 are found to be effective as a decision tool for optimum N application in rice.

INTRODUCTION

Rice (Oryza sativa L.) is one of the most important cereal crops of the India, grown in wide range of climatic zones, to nourish the mankind, but for maximizing the yields requires the input of supplemental nutrients. Rice farmers often apply fertilizer N at higher rates and application times not well matched to the needs of the crop for supplemental N, Only a fraction of the fertilizer N applied to rice is taken up by the crop. Hence, the amount of fertilizer N required depends on the efficiency of fertilizer N use by rice, which is defined as the agronomic efficiency of fertilizer N (AEN) or the increase in grain yield per unit of applied fertilizer N.

An adequate supply of nitrogen can increase the yield as much as 60% (Mikkelsen *et al.,* 1995). Top dressing by split application of N is needed when the crop has a great need for N and when the rate of N uptake is large (Dobermann and Fairhurst, 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. Chlorophyll meter (SPAD) or leaf colour chart (LCC) can be used for adjustment of fertilizer N application based on actual plant N status (Balasubramanian *et al.,* 1999). Need based N application would result in greater agronomic and physiological efficiency of N fertilizer than the commonly practiced method (Hussain *et al.,* 2000). Ali (2005) revealed that the requirement of N fertilizer based on SPAD reading was found 15 and 40 kg N/ha lower compared to conventional N management during wet and dry seasons, respectively. However, in India, 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 assessing the soil plant analysis development (SPAD) value and to correlate SPAD values with leaf colour chart (LCC) reading for specific variety and season. There are two nondestructive diagnosis tools to know the N status of leaves *viz*., chlorophyll meter (SPAD 502) and leaf colour chart (Balasubramanian *et al.,* 1999). Of the two, the leaf colour chart (LCC) developed by IRRI, Manila, Philippines is a simple and inexpensive tool to determine the time of N application in rice so as to synchronise it with the crop demand. It is an ideal and easier tool to optimize N use, irrespective of N applied (Balasubramanian *et al*., 1999).

Studies conducted on the real-time N management through LCC and SPAD indicated that the optimum LCC value varied from 3 to 5 and SPAD reading from 35 to 40 depending on the soil, climate and cultivars (Jayanthi *et al*., 2007; Balaji and Jawahar, 2007 and Singh *et al*., 2000) they have opined that relationship between LCC and SPAD needs to be calibrated for local cultivars and crop conditions. Considering all these aspects, the present investigation on rice was carried out with the following objectives;

To study the effect of Real-time N management through LCC and SPAD meter on the growth and yield of *kharif* rice.

To determine the efficiency and relationship between LCC

Table 1: Influence of N application on Plant height, Effective tillers, Leaf area and leaf area Index of low land rice

N application	Plant height(cm)	Tillers hill^{-1}	Leaf area (cm hill^{-1})	Leaf area index
LCC threshold 3.5	36.1	13.1	720.1	3.60
LCC threshold 4.0	38.8	14.3	779.3	3.80
LCC threshold 4.5	39.7	16.4	870.0	4.35
LCC threshold 5.0	40.3	17.0	1286.7	6.43
LCC threshold 5.5	42.4	17.2	1296.8	6.48
SPAD threshold 30.0	36.0	13.9	683.7	3.42
SPAD threshold 32.5	38.4	14.2	796.0	3.98
SPAD threshold 35.0	39.6	14.9	862.0	4.31
SPAD threshold 37.5	41.1	16.1	1208.0	6.07
SPAD threshold 40.0	42.5	17.2	1294.0	6.47
Farmers' method	42.0	16.1	1270.6	6.37
Recommended N	40.4	14.6	1216.0	6.08
S. Em.±	1.2	0.8	51.09	0.19
C.D. at 5%	3.5	2.2	158.78	0.55

Table 2: Effect of N application on days to 50% flowering, yield and yield parameters as influenced by N management

N application	N applied (kg ha^{-1})	Panicle length (cm)	Number of grains	per panicle
Grain yield(t ha^{-1})				
LCC threshold 3.5	90	12.63	108	2.93
LCC threshold 4.0	100	12.93	110	3.48
LCC threshold 4.5	110	13.27	113	3.88
LCC threshold 5.0	120	14.83	123	4.24
LCC threshold 5.5	130	15.80	124	4.33
SPAD threshold 30.0	90	12.33	110	3.06
SPAD threshold 32.5	100	12.87	111	3.60
SPAD threshold 35.0	100	13.23	116	3.92
SPAD threshold 37.5	120	14.83	123	4.25
SPAD threshold 40.0	130	16.00	125	4.38
Farmers' method	220	15.03	123	4.45
Recommended N	150	13.80	122	4.30
S. Em.±	5.29	0.51	3.88	0.12
C.D. at 5%	15.50	1.50	11.35	0.35

and SPAD meter values in N management.

To workout the economics of different Real-time N management.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2009 to study the effect of Leaf Colour Chart and SPAD based nitrogen management on growth and yield parameters of lowland rice (*Oryza sativa* L.) at Raichur (16º12' N and 77º 20' E), Karnataka, India. The average rainfall of this site was. 850 mm. Soils are well drained and deep black with pH 8.32. The available N, P and K were 208, 25 and 139 kg ha^{-1}, respectively. The experiment was laid out in RBD with three replications. The treatments consists of LCC and SPAD thresholds compared with state recommendations (150 kg N/ha) and farmers' method of N application with three replications. In recommended and farmers' method (220 kg N ha^{-1}) of N applications was applied in three splits at basal, tillering (30 DAT) and panicle initiation stage (45 DAT). Where as in LCC and SPAD based N application 30 kg N ha^{-1} was applied at transplanting. The LCC and SPAD readings were taken once in every seven days starting at 14 days after transplanting till flowering. Rice variety selected for the study was Sonamasuri (BPT-5204). The amount of N was applied when the critical level falls below threshold values as per guidelines of IRRI, Philippines. As per the guidelines N applied at early growth phase (20 kg N/ha), at rapid growth (30 kg N/ha) at late growth phase (20 kg N/ha). A uniform dose of 75 kg P/ha and 75 kg K/ha were applied to all the treatment at transplanting. Other agronomic practices were carried out as per the state recommendations. LCC and SPAD measurements were recorded at seven days interval starting from fourteenth day after transplanting till the first flower appears. The colour of the single leaf was measured by holding the leaf colour chart vertically and placing the middle part of leaf in front of colour strip for comparison, as prescribed by IRRI, Philippines in 1996. The chlorophyll meter readings were taken with SPAD-502 chlorophyll meter by selecting top most fully expanded leaf up to 50 % flowering stage (Babu *et al*., 2000).

RESULTS AND DISCUSSION

Growth and yield parameters

The data depicted in the Table. 1 showed significant variation in growth components of rice *Viz.,* number of tillers hill^{-1}, plant height, Leaf area and Leaf Area Index (LAI) over the lower N rate (90 and 100 kg N ha^{-1}) application of N either at 20 or 30 kg ha^{-1} per application under LCC and SPAD guidance. Increase in number of tillers varied in accordance with the quantity of N applied, higher value recorded in treatments receiving higher quantity of N application. At harvest the highest number of tillers hill^{-1} were noticed with application of 120 kg N in five splits *i.e.*, 30 kg N ha^{-1} as basal plus the remaining quantity in four splits @ 20 or 30 kg N ha^{-1} based on LCC and SPAD guidance. The farmers and recommended practices were also received a total of 220 and 150 kg N ha^{-1}, respectively recorded lowest number of tillers hill^{-1}. Ahmed et al. (2005) found higher number of tillers with higher dose of N application. The plant height increased progressively with the growth of crop. At harvest the treatments which received N @ 30 kg ha^{-1} as basal plus LCC-5.5 and SPAD-40 threshold values based N recorded significantly highest plant height (42.4 and 42.5 cm, respectively). The lowest plant height (36.0 cm) was recorded in treatment which received N @ 90 kg ha^{-1} based on biweekly LCC observation. The low plant height in LCC-3.5 and SPAD-30 threshold values could be due to less amount of N (90 kg ha^{-1}) applied during crop period. Balasubramanian *et al*. (1999) had also noticed increase in plant height with application of 30 kg N ha^{-1} as basal plus SP AD based N. Leaf area index (LAI) increased rapidly upto panicle initiation but decreased at harvest. This could be due to senescence of leaves after the reproductive phase. The influence of LCC based N application on LAI followed the same trend as that of number of tillers hill^{-1}. At harvest, the treatments which received 20 kg N ha^{-1} or 30 kg N ha^{-1} per application at weekly observations (LCC-5 to 5.5, SPAD-40, Farmers and recommended practice) recorded higher and on par LAI values. Application of N in more number of splits upto reproductive phase as per LCC guidance was responsible for retaining more number of active leaves till the maturity in the above treatments.

The data on yield components (panicle length, number of

grains panicle^{-1} and grain yield of rice as influenced by different treatments are furnished in Table 2. All the yield parameters and grain yield were favourably influenced when N was applied under LCC and SPAD guidance especially at higher rate *i.e.,* 20 or 30 kg N ha^{-1} per application. Adequate N supply during reproductive growth phase was probably responsible in enhancing yield parameters and in turn the yield. The maximum yield of 4.4 t ha^{-1} was recorded in SPAD-40 threshold valve (30 kg N ha^{-1} basal + 100 kg N ha^{-1} based on weekly SPAD reading), but it was statistically on par with the yield recorded in Farmers and recommended practice with saving of 40 and 13% N, respectively. Balasubramanian *et al*. (1999) observed increase in growth and yield parameters with the SPAD based N application. The application of N @ 90 & 100 kg ha^{-1} per application under LCC guidance accounted for lower values of yield parameters which could be attributed to inadequate N to meet the crop needs. Kumar *et al*. (2000) and stalin *et al*. (2000) described the increased grain yield to the combined favourable effects of improved leaf N concentration, photosynthetic rate of flag leaves and increased filled grain percentage. Farmers and recommended practice, though received a total of 220 and 150 kg N ha^{-1} in three splits at fixed intervals, recorded on par values for yield parameters and yield than LCC based N application at higher rate. This could be due to low availability of N at grain filling phase of the crop. Kenchaiah *et al*. (2000) also found higher grain yield under LCC based N management than the blanket recommendation. Considering the influence of LCC based nitrogen application on growth and yield of rice and saving of fertilizer N, application of nitrogen to syncronise it with the crop demand as determined by LCC and SPAD threshold value observations appears to be a better method of N management A better response of N dose upto 130 kg N/ha in rice was reported already by many workers (Morales *et al*., 2000, Stalin *et al*., 2000; Babu *et al*., 2000). This stresses the need for careful designing of top dressing doses in TBP area of Karnataka.

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