UNIVERSITY OF AGRICULTURAL SCIENCES

RAICHUR

RESEARCH PROJECT REPORT

On

Evaluation of leaf colour chart for real time nitrogen fertilizers for maize hybrids and transplanted rice during rabi/summer

Submitted to
Nitrogen Parameters
PB No. 8707
Adambakkam
Chennai-600088

Submitted by
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Sl. No.	Details		
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iii	Name of the trial	:	Evaluation of leaf colour chart for real time nitrogen fertilizers for maize hybrids and transplanted rice during rabi/summer
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Background of the project

Improving fertilizer NUE in maize is vital to achieve and sustain high crop yields and reduce N losses. N-fertilizers are expensive input, but farmers tend to apply in large amounts to minimize the risk of deficiency intended to achieve higher crop yields. Efficiency of applied N generally declines with increased fertilizer use, and seldom exceeds 40%. Maize N requirement can vary greatly across fields, seasons and growing years because of high variability among fields, in-season soil N-supplying capacity as well as differences in climatic factors. In recent years, maize hybrids with short-duration and higher yield potentials are being developed to replace the conventional inbred cultivars. N requirement of these maize hybrids is expected to be different from that of inbred. Therefore, to enhance NUE in the hybrid maize it is necessary to know the actual amounts of N required and the right time of its application. The real time N management approach can help to avoid application of excessive amount of N fertilizer at fixed intervals by matching time of application with plant need.

The guidelines evolved using tools including leaf color chart (LCC), can help to apply crop demand-driven site-specific N applications and result in high productivity with profits.The need-based N management in hybrid maize using LCC has the potential to replace the blanket uniform fertilizer rates recommended across *Vertisol*. It has already been found very useful in efficient management of fertilizer N in inbred maize cultivars in Indo-Gangetic alluvial soils. Objectives of the proposal to optimize LCC threshold and to manage N according to LCC to achieve higher NUF and productivity in hybrid maize and rice varieties. Approaches were application of fertilizer N at fixed critical growth stages and need-based N management using LCC to achieve synchrony between crop needs and supply. Hence this research proposal was formulated to evaluate the feasibility of nitrogen management through leaf colour chart manufactured by Nitrogen Parameters, Chennai for rice and maize in *Vertisol* of Karnataka.

The study was conducted at the Main Agricultural Research station, Raichur (16.6° N, 77.3° E, 329.6 m) Karnataka over consecutive rabi 2020-21 on clay loam soil with soil of pH of 8.2 and 292, 42.1, 372 kg $ha^{-1}$and available N, P_2O_5 and available K_2O. The climate is subtropical, semi-arid with average annual rainfall of 690 mm. About 80 % of the annual rainfall is received during June to September. The mean monthly temperatures prevailed during the period varied from 20 to 32^0C. The experiment carried out in split plot design consisted of 18 treatment combinations with three replications. Maize hybrids RCRMH-2 (H1), RCRMH-4 (H2) and NK 6240 (H3) are in main plots. Whereas, LCC thresholds -LCC shade $\leq$3.0 (L_1), LCC shade $\leq$3.5(L_2), LCC shade $\leq$4.0 (L_3), LCC shade $\leq$4.5(L_4), LCC shade $\leq$5.0 (L_5) and LCC shade $\leq$6.0(L_6) are in sub plots. Treatments are compared with blanket recommended N @ 150 kg ha^{-1} (RDN) applied equally at basal and 45 DAS and control without N fertilizers (Table 1). Recommended dose of P and K (75: 37.5 kg P_2O_5 K_2O ha^{-1}) were applied to the soil in the form of SSP and MOP at the time of sowing.

All the hybrid seeds were hand dibbled up to 4 to 5 cm deep at a spacing of 60 cm × 20 cm and other production practices were followed as per package of practices. Gross plot size was 6.0 m x 5.4 m and at final harvest plants from 16.56 m^2. Seed bed was prepared by ploughing to a depth of 0.3 m followed by a secondary tillage with field cultivator. Crop was sown in November by hand dibbling and immediately after planting light irrigation was provided to ensure uniform and quick germination. Irrigations were given during dry spells to ensure adequate soil moisture throughout the crop season. Weeds, pests and diseases were controlled by proper prophylactic measures. Kernel and straw N contents were analyzed by following micro kjeldhal method. N uptake by grain and straw was estimated by multiplying concentration into respective dry weight.

Leaf color chart with six green shades having 3, 3.5, 4, 4.5, 5, and 6 (manufactured by N Parameters, Chennai, India) was used in this study. The third fully expanded leaf from top was

selected for leaf colour measurement because this leaf is more related to the N status of maize plants Selected leaf was placed on the LCC and the color of the middle part of the leaf was matched with greenness of the panels on the LCC. The chlorophyll meter used was the hand-held Minolta SPAD-502.The SPAD values were recorded by inserting the middle portion of the index leaf in the slit of SPAD meter. From each plot, readings from ten randomly selected plants were averaged. Dry matter accumulation was determined from five samples taken at the major phenological stages of maize and at harvest. The sampling size was one meter row length per plot at all stages except at final harvest. Sampling rows are second from border. Dry weight was determined after oven drying at 65^{o}C for 48 hours. The crop was harvested at physiological maturity stage grain and stover yield was recorded.

Results:

Leaf colour chart thresholds recorded at different intervals have shown that there was no significant difference among hybrids at intervals except at 52 and 68 DAS (Table 1). Whereas, LCC readings at 30 DAS were not significantly influenced nitrogen application because of uniform basal application of fertilizers to all the plots. However, readings at subsequent intervals indicated that N application has significantly influenced LCC readings. Application of N fertilizers based on LCC shade 5 and 6 has increased leaf greenness and showed greater LCC readings. In LCC shade <3.0 and 3.5 continuously showed lower values.

LCC readings

Result of lower LCC thresholds nitrogen fertilizers in the form urea at the rate of 25 kg acre. There was no difference quantity of N fertilizers application among LCC thresholds 3, 3.5 and 4.0. Whereas LCC 4.5, 5.0 and 6.0 have shown higher dose 112.5 to 137.5 kg /ha it resulted

in saving of 8.3 to 25 % as compared to recommended N fertilizers. Interaction of hybrids and LCC thresholds has shown varied fertilizer levels. It indicate nitrogen requirement for maize was greater and based on LCC thresholds <4.0 may not sufficient to get higher grain yield. To maintain higher maize leaves greenness need to apply fertilizers based on LCC thresholds 4.5, 5 and 6.

Cobs per plant

Leaf colour chart based nitrogen application has on significant effect on number of cobs per plant among maize hybrids (Table 3). Among LCC threshold treatments application of N fertilizers based LCC threshold <5.0 gave more number of cobs/plant and least in LCC<3.0. Interaction effect of maize hybrids and LCC thresholds on cobs/plant was found non-significant.

Grain yield per plant

There was no significant difference in grain yield per plant among maize hybrids under LCC based N management. Greater grain yield per plant was recorded with application of N fertilizers based on LCC<5.0 but it was on par with LCC<6.0 and least in LCC<3.0 (Table 3). LCC 5.0 and 6.0 has produced 38.7% and 18.3 % higher grain yield over RDN respectively. Interaction of maize hybrids and LCC thresholds had no significant effect on grain yield per plant. Graded levels of 125 % RDN recorded

No. of seeds/row

Among maize hybrids, there was no significant difference in number of seeds per row. Whereas LCC based N fertilizer application has significant effect on seeds/row. It was greater in LCC 5.0 (36.5) and 6.0 (36.0) based N application and least in LCC 3.0 (23.9). Similarly interaction effect of maize hybrids and LCC based N application had significant effect on seeds per row.

No. of rows cob

There was no significant difference of number rows per cob among maize hybrids and LCC thresholds based N application and also their interaction effect. It was implied that seeds per row is almost similar in all the treatments.

Test weight (g)

Individual grain weight was not significantly influenced by maize hybrids (Table 3). However application of N fertilizers based on LCC thresholds had significant effect on test weight of maize. It was higher in LCC<5.0 (32.2 g) and LCC<6.0 (31.89 g). It was mainly because of sufficient N availability throughout the growth period. It ultimately increased grain yield per hectare. It was also recorded 25% higher RDF has resulted greater test weight as compared to lower levels of N fertilizers application.

Grain yield per hectare

Greater grain yield improvement was observed by application of N based on N threshold as compared to control and RDF (Table 4). Grain yield of maize hybrids was significantly influenced by application of N fertilizers based LCC thresholds. Significantly higher grain yield was recorded in RCRMH-4 (6716 kg/ha) over RCRMH-2 (6391 kg/ha) and NK 6240 (5954 kg/ha). Improvement in seed yield in RCRMH-4 was upto 12.8% over private hybrids. Apart from genetic potential of maize hybrids, N management also contribute for higher grain yield. Among LCC thresholds, application of N fertilizers based on LCC<6.0 recorded higher grain yield (7358 kg/ha) but significantly on par with LCC<5.0 (7178 kg/ha). It has resulted in 25.0 and 21.9% higher grain yield over recommended N fertilizers respectively. Grain yield was least by LCC 3.0 based N application (5302 kg/ha). Further increase in N rate beyond LCC 5.0 thresholds did not cause

significant improvement in the grain yield of maize. It indicated that maize grown in *Vertisol* LCC 5.0 was found to be optimum instead of fixed intervals. Interaction of maize hybrids and LCC thresholds also significantly increased the grain yield.

Straw yield of maize

Application of N fertilizers based on LCC thresholds increased the stover yield of maize hybrids (Table 4). Maize hybrid RCRMH-4 (7870 kg/ha) recorded significantly higher straw yield over RCRMH-2 (6700 kg/ha) and NK 6240 (6981 kg/ha). Improvement of straw yield in RCRMH-4 was upto 11.30 % over private hybrid NK 6240. Application of N fertilizers based on LCC 4.5, 5.0 and 6.0 recorded greatly higher straw yields compared to lower LCC threshold levels. Straw yield of maize was also greater by application of recommended N fertilizers and 125% RDF. Harvest index of maize hybrids was not significantly influenced and LCC based N fertilizer application. It was inferred that applied N fertilizers can e used efficiently through LCC by matching N supply with crop N demand without sacrificing grain yield of maize hybrids.

Economic Returns

The economics of maize hybrids depends on relative yield of maize as influenced by LCC based N management and prevailed market price of the produce. The total cost cultivation was varied from Rs. 41250 to Rs. 43200 ha^{-1}. The major variation in cost of production was towards N fertilizer for different LCC thresholds. Economic returns realized from maize hybrids were upto Rs. 95018 to Rs. 100802 ha^{-1}. Higher economic return was realized from LCC based N fertilizer LCC 5 (Rs. 113322 ha^{-1}) and LCC 6 (Rs. 115882 ha^{-1}) it also resulted higher net returns and benefit cost ratio. It was mainly owing to higher yield levels coupled with lower cost of cultivation in terms of fertilizers.

Conclusion of experiment #1

Results of the field experiments conducted during rabi/summer all the evaluated maize hybrids responded similarly to the fertilizer N application based on leaf colour chart. Among different LCC shades, application of N fertilizers based on LCC 5 was found effective to enhance growth, yield and profitability of maize than any other treatment combination.

Management of nitrogen through IRRI Leaf colour chart in summer Transplanted Rice 2020-21

Grain yield and yield parameters:

Plant height:

Among the LCC levels the plant height was significantly higher (61.60 cm) at LCC as 5 compared to LCC 3 (54.77 cm) and LCC-4 (58.88 cm). Amount the varieties RNR-15048 registered maximum plant height (68.77 cm) as compared to MTU-1010 (56.55 cm) and Jyothi (50.0 cm). The interaction was significant with the treatment combination of M3V1 (LCC 5 X RNR-15048) registering higher plant height (71.7 cm) as compared to control which recorded 67.5 cm plant height

NDVI:

The NDVI which indicates the extent of canopy coverage indicated that at LCC 5 maximum NDVI value (0.689) was reached and indicating better growth of the crop. Among the varieties RNR-15048 recorded higher NDVI value of 0.634 which was significantly superior to MTU-1010 and Jyothi.

Panicles/sqm

The number of panicle/Sqm was significantly higher with LCC-5 as compared to LCC-3 and LCC-4 indicating better yield parameters at higher LCC-5. Among the varieties MTU-1010 and Jyothi recorded higher number of panicles than RNR -15048. The interaction revealed that LCC-5 X Jyothi recorded significantly more number of panicles/sqm

Panicle weight

The panicle weight was significantly higher with LCC-5 and LCC-4 as compared to LCC-3. Among the cultivars RNR-15048 recorded higher panicle weight (2.57 g) than MTU-1010 (2.32 g) and Jyothi (2.31 g). Among the treatment combination LCC-4 x RNR-15048 registered higher panicle weight (2.85 g).

Seeds/panicle

The number of seeds per panicle were significantly higher at LCC-5 (129 No.) than LCC-3 (115 No.) but on par with LCC-4. Among the varieties number of seeds /panicles were significantly higher with RNR-15048 (189 No.) than MTU-1010 and Jyothi. Among the treatment combinations LCC-4 x RNR -15048 registered higher seeds/panicle (207 No.)

Test weight

There was no significant difference in test weight among various LCC levels. However, varieties showed significant difference in test weight and Jyothi recorded highest test weight (24.75 g) followed by MTU-1010 (22.12 g) and was lowest in RNR -15048 (12.00 g). Among the treatment combinations test weight was significantly higher with LCC 4 X Jyothi (25.25 g)

Grain Yield

The grain yield was significantly higher with LCC-5 (57.56 q/ha) and was superior to LCC-3 (44.95) and LCC-4 (51.68) representing 21.9 and 10.2 percent increase in grain yield respectively. Among the cultivars MTU-1010 recorded higher grain yield (54.05 q/ha) than Jyothi (51.49 q/ha) and was lowest in RNR-15048 (48.65 q/ha). Among the treatment combinations LCC 5 X MTU-1010 recorded higher grain yield (64.63 q/ha) as compared to other treatments. This

treatment recorded 29.3 % higher grain yield than control treatment with a grain yield of 45.67 q/ha. The treatment combination of M3V1 (LCC-5 x RNR-15048) recorded a grain yield of 52.13 q/ha which was 6.46 % higher than control treatment (45.67 q/ha).

Straw yield

The straw yield was significantly higher with LCC-5 (6.62 t/ha) than LCC-3 and LCC-4. Among the cultivars MTU-1010 recorded higher straw yield than other cultivars. Among the treatments a combination of LCC-5 X MTU-1010 recorded higher straw yield (7.43 t/ha). The higher grain yield observed in the case of LCC-5 was mainly attributed to higher growth parameters as included by higher NDV1 value and superior yield parameters like more number of panicles/sqm, higher panicle weight and more number of spikelets/panicle

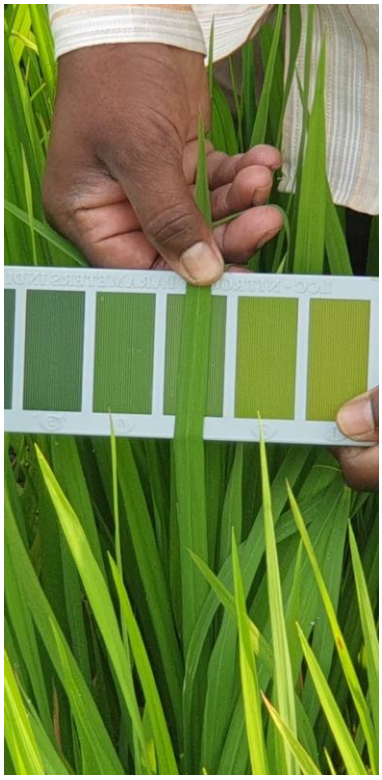
Among the cultivars higher grain yield in the case of MTU-1010 was mainly attributed to more number of panicles/sqm and higher test weight. Among the treatment combination higher grain yield in the case of M3V2 (LCC-5 x MTU-1010) were attributed to more number of panicles/sqm and higher test weight.

Amount of N applied: The amount of N applied was 75, 105, 165 and 200 kg/ha for LCC-3, LCC-4, LCC-5, and control treatments respectively. The amount of N applied in LCC-5 was 17.5 % lower than control treatment.

Conclusions:

The summer season data thus indicated that applying nitrogen to transplanted rice on the basis of LCC threshold value 5 resulted in higher grain and straw yield. Among the varieties MTU-1010 performed superior to RNR-15048 and Jyothi mainly due to more number of panicles/sqm

and higher test weight. A treatment combination of LCC-5 x MTU-1010 proved superior to other treatments. Applying nitrogen to transplanted rice on the basis of LCC threshold value 5 resulted in 17.5% saving in nitrogen as compared to recommended practice and also recorded higher grain yield and found optimum.



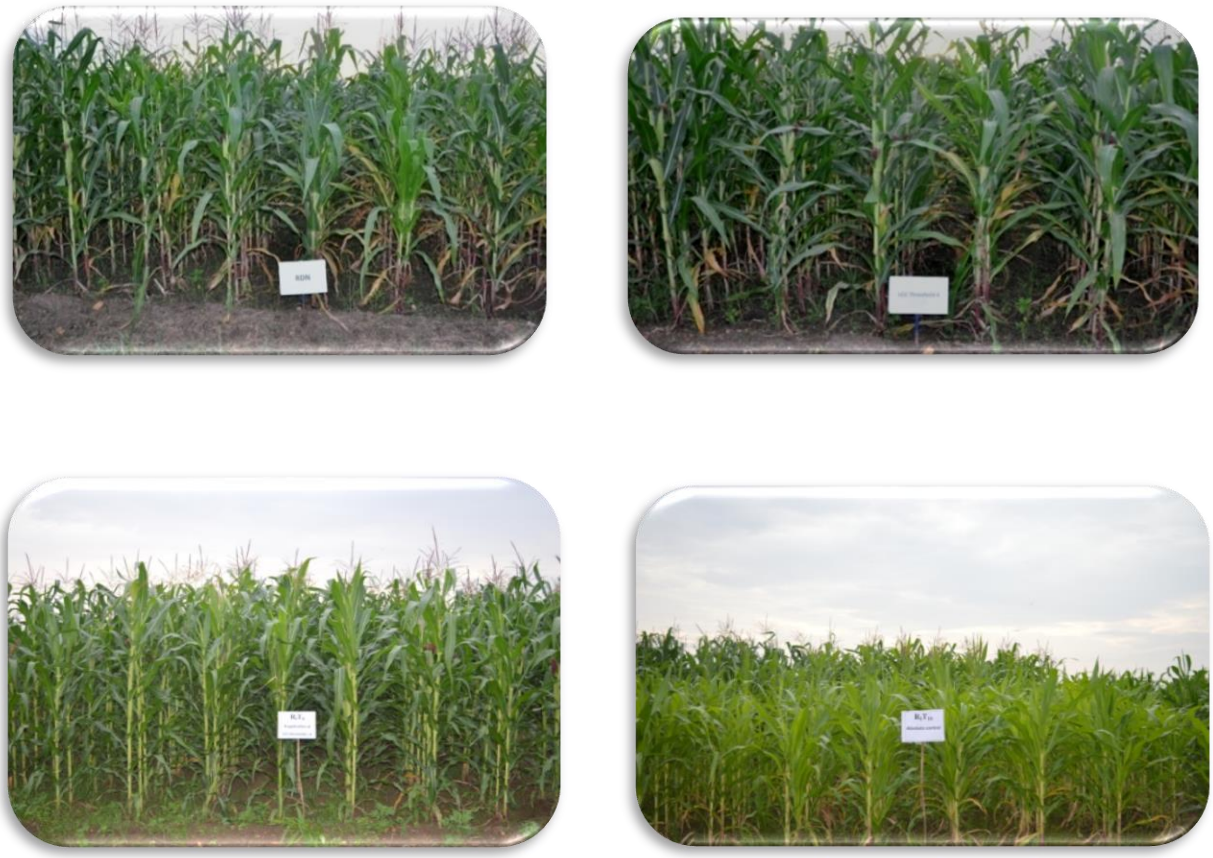


Plate: Photographs showing plant stand at grand growth stage of maize hybrids nitrogen management using leaf colour chart