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Influence of leaf colour chart, SPAD and GreenSeeker on soil nitrogen balance in sweet corn (*Zea mays saccharata* L.) during *rabi*

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ABSTRACT: *A field study was conducted during rabi 2014-15 at College of Agriculture, University of Agricultural Sciences, Raichur to study nitrogen management in sweet corn (Zea mays saccharata L.) using Leaf colour chart (LCC), SPAD meter, and GreenSeeker. The hybrid Sugar-75 was selected for the study. Treatment consists of RDN @ 150 kg ha^{-1} in two and three splits, LCC threshold 4 and 5, SPAD threshold 40 and 50 and NDVI 0.6 and 0.8 along with basal 50% followed by foliar spray @ 2 % at 30, 45 and 60 DAS and control as check. Intermittent N application was done by recording LCC, SPAD and NDVI values. Fertilizers applied based on pre fixed threshold levels of each tool. Randomized complete block design was followed with three replications. Significantly higher N uptake by leaf, stem and cobs was recorded with application of 150 kg N ha^{-1} in three splits (161.6 kg N ha^{-1}) followed by LCC threshold 5 (164.2 kg N ha^{-1}) and NDVI-0.8 (154.2 kg N ha^{-1}). Net gain of nitrogen was recorded with application of N based on LCC threshold 5 (5.5 kg ha^{-1}), NDVI at 0.8 (1.5 kg ha^{-1}). Based on the nitrogen uptake and nitrogen balance in soil, it can be inferred that split application of 150 kg N ha^{-1} and LCC threshold 5 and NDVI 0.8 were found to be better for sweet corn nitrogen recommendation.*

Key words: *Productivities, Economics, LCC, SPA and Green Seeker.*

INTRODUCTION

Sweet corn (*Zea mays saccharata* L.) also known as sugar corn, is a hybridized form of maize, specifically bred to increase the sugar content. It has a sugary rather than a starchy endosperm with a creamy texture. The sweet corn has good amount of calcium (Ca), phosphorus (P), iron (Fe) and potassium (K). Application of huge quantity of Nitrogenous fertilizers is common practice among Indian farmers. It may result in more greenness and quick growth response to N application. When N application is not synchronized with crop demand, N losses from the soil plant system are large leading to low N fertilizer use efficiency. There is a need to synchronize time of N fertilizer application and crop demand to optimize nutrient use and minimize environmental pollution. Innovative tool such as chlorophyll meter is faster than tissue testing for N and can help to find when plant need more N [1]. Soil nitrogen balance can be maintained with the use of modern tools of nutrient management such as LCC, SPAD and NDVI. Hence, the experiment conducted with an objective to find out nitrogen balance in soil using LCC, SPAD and NDVI readings in *vertisols* of Karnataka

MATERIAL AND METHODS

A field experiment was conducted at MARS, Raichur Karnataka during *Rabi* 2014-15. The soil of the experimental site was sandy loam with pH 7.8, Initial soil available N 280 kg ha^{-1}, P_2O_5 39.5 kg ha^{-1} and K_2O 296 kg ha^{-1}. The hybrid Sugar-75 was selected for the study. Treatments consists of RDN @ 150 kg ha^{-1} in two and three splits, LCC, SPAD and GreenSeeker readings each and subsequent N applications were done by observing the LCC threshold 4 and 5, SPAD threshold at 40 and 50, GreenSeeker values at 0.6 and 0.8. Amount of N applied in different treatments and total quantity is given in Table 1. In addition, basal application of 50 % recommended N followed by foliar spray of 2 % urea at 30, 45 and 60 DAS and without N application as check. Recommended dose of P and K (75: 37.5 kg P_2O_5 K_2O ha^{-1}) were applied at basal in the form of SSP and MOP. Seeds were hand

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dibbled at spacing 60 cm × 20 cm. The crop was harvested at milky stage (87 DAS) by removing the fresh cobs from net plot area of 19.2 m^2. Total nitrogen uptake was calculated by multiplying per cent nitrogen concentration in grain and stover and biomass yield. All data is statistically analyzed as per Fisher's method of analysis of variance and interpretation of the data [2]. The level of significance used in 'F' test was at p = 0.05.

RESULT AND DISCUSSION

Nitrogen uptake

The higher N uptake was recorded with application of 150 kg N ha^{-1} in three splits which was 21.6 per cent higher over 150 kg N ha^{-1} in two split. At harvest, leaf colour chart threshold 5 (164.2 kg N ha^{-1}) and NDVI-0.8 (154.2 kg N ha^{-1}) based N application was recorded higher N uptake over LCC-4, SPAD-40 and GreenSeeker NDVI-0.6 (Table 2). Uptake of nutrients is associated with the metabolic activities of plants, the concentration of the nutrients, dry matter production and distribution of ion in the external medium.

Among different N management techniques, application of 120 kg N ha^{-1} recorded significantly higher N uptake over of 150, 90 and 60 kg ha^{-1}. LCC-5 has recorded higher N uptake up to an extent of 1.59% over 150 kg N ha^{-1} in two and three splits and 45.6% over LCC-4 and SPAD-50. The uptake of N was higher due to more number of split applications besides greater mineralization of native N, as evidenced by significantly higher availability of N in the soils even after harvest of crop under N management through LCC-5 and NDVI-0.8. [3] reported that application of green manure combined with LCC-5 based N application significantly increased grain yield and nutrient uptake of hybrid rice. The higher N uptake with different N recommendation techniques could also be attributed to enhanced nutrient availability to the plant resulting in higher dry matter production, which might have contributed for higher nutrient uptake.

Balance of nitrogen

The nitrogen was balanced by considering estimated and actual soil N status indicated that higher net loss of N was recorded in basal application of 50 per cent recommended N and urea foliar spray at 2 per cent (-107.6kg ha^{-1}), without N application (-89.4kg ha^{-1}) and 150 kg N ha^{-1} applied in two split (-47.1kg ha^{-1}). Net gain of nitrogen was recorded with application of N based on LCC threshold 5 (5.5 kg ha^{-1}), NDVI at 0.8 (1.5 kg ha^{-1}). Rests of the treatments are found to be intermediate (Table 5). Similar results are also reported by [4].

Nitrogen balance is an important parameter in deciding sustainable soil fertility management. The crop removal, actual balance and net gain were higher with LCC-5 and GreenSeeker based NDVI-0.8 practices. The higher net gain with these treatments was associated with higher split doses of Nitrogen and uptake by crop. Higher available NPK status after harvest of maize with graded levels of NPK application was also reported by [5].

Table 1
Quantity of N applied for different treatments (kg ha^{-1}) based on LCC, SPAD and GreenSeeker values

Treatment	*Basal*	*15 DAS*	*30 DAS*	*45 DAS*	*60 DAS*	*Total*	*Saving 'N' fertilizer-over RDF*
T_1: 150 kg N ha^{-1} in 2 splits (30, 45 DAS)	75	-	37.5	37.5	-	150	-
T_2: 150 kg N ha^{-1} in 3 splits (30, 45 and 60 DAS)	75	-	25	25	25	150	-
T_3: LCC based 'N' at threshold 4	-	30	30	30		90	60
T_4: LCC based 'N' at threshold 5	-	30	30	30	30	120	30
T_5: SPAD based 'N' at threshold 40	-	30	30	-	-	60	90
T_6: SPAD based 'N' at threshold 50	-	30	30	30	-	90	60
T_7: GreenSeeker based NDVI at 0.6	-	30	30	-	-	60	90
T_8: GreenSeeker based NDVI at 0.8	-	30	30	30	30	120	30
T_9: Basal application of 50 % recommended N and urea foliar spray @ 2 % at 30, 45 and 60 DAS	75	-	-	-	-	75	75
T_{10}: Control (without N application)	-	-	-	-	-	-	-

Table 2
Total Nitrogen uptake by leaf, stem, grain and plant by sweet corn at harvest as influenced by N application based on LCC, SPAD and GreenSeeker threshold values

Treatment	*Nitrogen uptake (kg ha^{-1})*			
	Leaf	*Stem*	*Grain*	*Total*
T_1: 150 kg N ha^{-1} in 2 splits (30, 45 DAS)	42.6	15.5	74.9	133
T_2: 150 kg N ha^{-1} in 3 splits (30, 45 and 60 DAS)	51.4	19.8	90.4	161.6
T_3: LCC based 'N' at threshold 4	38.6	13.5	65.4	117.5
T_4: LCC based 'N' at threshold 5	53.9	18.0	92.3	164.2
T_5: SPAD based 'N' at threshold 40	34.1	11.1	56.6	101.8
T_6: SPAD based 'N' at threshold 50	37.2	12.7	63.0	112.9
T_7: GreenSeeker based NDVI at 0.6	33.2	11.4	53.9	98.5
T_8: GreenSeeker based NDVI at 0.8	52.1	16.3	85.8	154.2
T_9: 50 % N at basal and urea spray @ 2 % at 30, 45 and 60 DAS	26.8	9.0	42.3	78.1
T_{10}: Control (without N application)	23.6	7.3	32.4	63.3
S.Em.±	3.1	0.9	3.6	6.9
C.D. (p=0.05)	9.1	2.6	10.7	20.6

LCC: Leaf colour chart; **SPAD:** Soil plant analysis development; **NDVI:** Normalized difference vegetation index

Table 3
Nitrogen balance under different N application levels based on LCC, SPAD, and GreenSeeker threshold values

Treatment	*Initial soil N (kg ha^{-1})* *1*	*Applied N (kg ha^{-1})* *2*	*Total N (kg ha^{-1})* *3=1+2*	*N uptake (kg ha^{-1})* *4*	*Estimated N (kg ha^{-1})* *5=3-4*	*Actual N (kg ha^{-1})* *6*	*Net gain (+) or loss(-)* *7=6-5*
T_1: 150 kg N ha^{-1} in 2 splits (30, 45 DAS)	280	150	430	133.0	297.0	204.7	-92.3
T_2: 150 kg N ha^{-1} in 3 splits (30, 45 and 60 DAS)	280	150	430	161.6	268.4	221.3	-47.1
T_3: LCC threshold 4	280	90	370	117.5	252.5	212.0	-40.5
T_4: LCC threshold 5	280	120	400	164.2	235.8	241.3	5.5
T_5: SPAD threshold 40	280	60	340	101.8	238.2	198.0	-40.2
T_6: SPAD threshold 50	280	90	370	112.9	257.1	220.7	-36.4
T_7: NDVI 0.6	280	60	340	98.5	241.5	190.0	-51.5
T_8: NDVI 0.8	280	120	400	154.2	245.8	247.3	1.5
T_9: 50 % N at basal and urea spray @ 2 % at 30, 45 and 60 DAS	280	75	355	78.1	276.9	169.3	-107.6
T_{10}: Control (without N application)	280	-	280	63.3	216.7	127.3	-89.4

CONCLUSION

Based on the nitrogen uptake and nitrogen balance in soil, it can be inferred that split application of 150 kg N ha^{-1} and LCC threshold 5 and NDVI 0.8 were found to be better for sweet corn nitrogen recommendation.

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