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EFFECT OF NEED-BASED NITROGEN MANAGEMENT ON YIELD AND QUALITY OF *KHARIF* MAIZE (*ZEA MAYS* L.) UNDER CENTRAL PLAIN ZONE OF U.P., INDIA

Naveen Kumar Maurya[1], Addya Singh[2], Beena B. Geeda[3], Ankit Kumar[4], Hari Shankar Singh[5], Anurag[6], Mayank Kumar[6], Nisha Yadav[7], Durgesh Kumar Maurya[8] and Soni Yadav[2]*

[1]Department of Agronomy, C.S. Azad University of Agriculture & Technology, Kanpur (U.P.), India
[2]Department of Genetics and Plant Breeding, SVPUAT, Meerut, U.P., India.
[3]Collage of horticulture, SDAU, Jagudan, Mehsana, Gujarat, India
[4]Department Crop Improvement, YP1 IIWBR Karnal, Haryana, India
[5]Department of Soil Science and Agricultural Chemistry, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India
[6]Department of Soil Science and Agricultural Chemistry, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India
[7]Department Agricultural Extension Education, Sardar Vallabhbhai Patel University of Agriculture &Technology Modipuram, Meerut, Uttar Pradesh, India
[8]Krishi Vigyan Kendra Santkabirnager (ANDUA&T)-272162, India.
Corresponding author E-mail: ydvsonimau@gmail.com

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ABSTRACT

The experiment was conducted at Student Instructional Farm, C.S. Azad University of Agriculture and Technology, Kanpur during *kharif* and *rabi* season. There were eight treatments combinations *i.e.*, T_1: LCC 3, T_2: LCC 4, T_3: LCC 5, T_4: CCM 30, T_5: CCM 35, T_6: CCM 40, T_7:100% RDN as 3 splits (2:1:1) at basal, knee height and tasseling stage and T_8: 75% RDN as 3 equal splits at basal, knee height and tasseling stage. The experiment was laid out in RBD with four replications on silt loam soil with low organic carbon (0.43%) available nitrogen (161.43 kg ha^{-1}) and available phosphorus (14.71 kg ha^{-1}) while medium in potassium (240.33 kg ha^{-1}), respectively. Numerous treatments significantly influenced the yield of maize during both the years as well as in pooled analysis. Among all the treatment tested, treatment T_3 (LCC 5, i.e. application of 30 kg N ha^{-1} based on LCC critical value 5) recorded significantly higher yield during the years 2019, 2020 and on pooled basis. Treatment T_3 (LCC 5, i.e. application of 30 kg N ha^{-1} based on LCC critical value 5) found to be superior with respect to yield over rest of the treatments. The yield components like grain protein content, N, P, K content as well as N, P, K uptake in grain and stover were maximum with the treatment T_3 (LCC 5, i.e. application of 30 kg N ha^{-1} based on LCC critical value 5) and found to be greater over other treatments during the years 2019, 2020 and on pooled basis.

***Keyword* :** Nitrogen, Leaf colour chart, Chlorophyll meter, Yield, Qulality, Maize.

Introduction

Maize (*Zea mays* L.) is one of the most versatile crops grown throughout the tropical as well as temperate regions of the world. A crop of maize is sown and harvested somewhere in the world in every month of the year. Greatest genetic diversity of maize is available in South American continent, and the centre of origin are Peru, Bolivia and Equador (De Wilt *et al.,* 1972). Native Americons classified the major lineages of maize, *viz.,* dent, flint, flour, pop, and sweet corn. The name corn is derived from Indo-European word, which means 'small nugget'. It is third most important cereal crop in India after rice and wheat. Globally, maize is cultivated on 180.63 million ha in more than 150 countries, having wide variations in soil, climate, biodiversity and management practices.

The total production of maize in the world is about 113389 million metric tonnes with a productivity of 5.75 tonnes ha^{-1} during 2020-21 (USDA Special report: January 2021). In India, maize is cultivated on 9.2-million-hectare area with production and productivity of 27.8 million tonnes and 2706 kg ha^{-1}, respectively (Agricultural statistical a glance, 2018-19).

It is a crop of worldwide economic importance, provides approximately 30 per cent of the food calories to more than 4.5 billion people in 94 developing countries. The demand for maize is expected to be doubled worldwide by 2050. Maize is used as a staple human food, livestock and poultry feed, fermentation and many industrial purposes. About 85 per cent of the maize produced is consumed as human food and animal feed including poultry. However, there exists a scope for using maize as basic raw material to several industrial products, such as starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries. In India, greater increase in food and feed production is expected to come from coarse cereals, primarily from maize, which has a comparative advantage in assured rainfall areas. The future of maize is now brighter, than in the past. Today, increasing the maize productivity, production and utilization are not a matter of choice but a necessity due to high population pressure.

Nitrogen being the most yield-limiting factor in maize, its stress reduces growth and yield and considered as a most crucial nutrient. Poor nitrogen utilization in maize crop is due to inclusion of excessive nitrogenous fertilizers by farmers in the absence of nutrient recommendations as well as without assessing the crop-N demand and crop stage. Furthermore, problem associated with this nutrient is the high mobility in soil, causing loss by heavy rainfall. Many research reports indicated loss of fertilizer N in cereal production from 20 to 50 per cent. Fertilizer N losses in surface runoff range between 1 and 13% of the total N applied. Application of urea to the surface without incorporation, the losses of fertilizer N as NH_3 can be as high as 60 per cent (Rochette *et al.*, 2013), and generally greater with increasing temperature. Therefore, N management poses a serious challenge in addition to loss of N in such area having high rainfall and temperature. Hence higher yield of maize on sustainable basis is of paramount importance in this region.

Materials and Methods

The experiment was conducted during two consecutive *Kharif* season at Student's Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur.

Geographically experimental site is situated in subtropical and semi-arid zone and lies between the parallel of 25°26'and 26°58'north latitude and 79°31' and 80°34' East longitude with an elevation of 125.9 m from sea level in the alluvial belt of Indo-gangetic plains of central Uttar Pradesh. the soil of experimental field was alkaline in reaction (8.41 pH), low in organic carbon (0.43%) available nitrogen (190.20 kg ha^{-1}) and available phosphorus (11.80 kg ha^{-1}) while medium in potassium (170.76 kg ha^{-1}), respectively. The experiment consists of 8 treatments T_1 (LCC 3), T_2 (LCC 4), T_3 (LCC 5), T_4 (CCM 30), T_5 (CCM 35), T_6 (CCM 40), T_7 (100% RDN as 3 splits at basal, knee height and tasseling stage) and T_8 (75% RDN as 3 equal splits at basal, knee height and tasseling stage). Which were laid out in Randomized Block Design with four replications. The crop was fertilized as per the treatment.

Application of fertilizers

A basal dose of 30 kg N ha^{-1} (common to all treatments except treatment T_7) was applied in the form of urea in all the plots. For the treatment T_7 a basal dose of 60 kg N ha^{-1} was applied. Full dose of phosphorus was commonly applied as basal dressing in the form of single super phosphate. After fertilizer application, the furrows were covered with soil in such a way that the furrows remained partly opened for seed sowing. The top dressing of nitrogen was done based on LCC or CCM readings whenever the average readings of LCC or CCM were found equal or less than the critical value as per the treatments except the treatments T_7 and T_8 in which 30 kg N ha^{-1} was applied as top dressing at knee high and tasseling stages. The total quantity and the time of N applied in different treatments is given in Table-8

Leaf Color Chart (LCC) Readings

The LCC data was recorded from the middle portion of the topmost fully expanded first leaf using leaf color chart developed by Punjab Agricultural University, Ludhiana. The LCC readings were recorded at middle lamina of the third leaf from the top of maize at weekly interval from 21 days after sowing (DAS) and at weekly interval from until the tasseling stage. The third fully expanded leaf from top of maize was selected for leaf color measurement. Five youngest fully expanded and healthy leaves (third leaf from the top) were selected from 5 randomly selected maize plants in an area of uniform population for leaf color measurement.

Chlorophyll meter measurements (SPAD-502)

The SPAD meter readings were recorded with Minolta SPAD 502 (soil and plant analysis division (SPAD) for measuring leaf N by inserting the middle portion of the topmost fully expanded first leaf (index leaf) in the slit of the SPAD meter. The SPAD meter was calibrated before collecting data. SPAD readings from randomly selected five plants (each plot) was taken and the average value is recorded as SPAD value for the plot. Whenever the average of leaf color readings fell below the pre-set critical value, N fertilizer was top dressed immediately to correct N deficiency.

Yield and quality parameters were estimated as per the standard methods.

Result and Discussion

Effect of treatments on yield

Grain Yield (kg ha^{-1})

It is clear from Table-1 the grain yield of maize was influenced significantly by the numerous treatments during both the years as well as in pooled analysis. Among all the treatment tested, treatment T_3 (LCC 5) recorded significantly higher grain yield 3121, 3167 and 3144 kg ha^{-1}, respectively during the years 2019, 2020 and on pooled basis. Treatment T_3 (LCC 5) found to be superior with respect to grain yield over rest of the treatments excluding the treatment T_6 (CCM 40) which persisted statistically at par with treatment T_3 during both the year as well as in pooled analysis. This might have happened due to greater availability of photosynthates, metabolites and nutrients to develop reproductive structures which resulted in increased numberof productive plants and ultimately increased crop yield. Similar results were also reported by Reena *et al.* (2017b) and Barad *et al.* (2018).

Stover Yield (kg ha^{-1})

It is apparent from the data presented in Table-2 that stover yield (kg ha^{-1}) significantly influenced due to various treatments during both the years 2019 and 2020 as well as in their combined results.

Among the different treatments tested, treatment T_3 (LCC 5) produced significantly the higher stover yield 8240, 8295 and 8267 kg ha^{-1} respectively, during experimental years 2019 and 2020 and in pooled results; however, treatment T_3 remained statistically at par with treatments T_6 (CCM 40) during both the experimental years i.e. 2019 and 2020 as well as in pooled analysis. Similar findings had also been reported Reena *et al.* (2017b) and Barad *et al.* (2018).

Biological Yield (kg ha^{-1})

It is apparent from the data presented in Table-2 treatment T_3 (LCC 5) produced significantly the higher stover yield 11361, 11462 and 11411 kg ha^{-1} respectively, during experimental years 2019 and 2020 and in pooled results; however, treatment T_3 remained statistically at par with treatments T_6 (CCM 40) and T_7 (100% RDN) during both the experimental years i.e. 2019 and 2020 as well as in pooled analysis. The result is in full agreement with the findings of Reena *et al.* (2017b) and Barad *et al.* (2018).

Harvest Index (%)

Data belong to the effect of various treatments on harvest index (%) are indicated in Table-2. Among the different treatments studied, treatment T_3 (LCC 5) produced significantly the higher harvest index 27.47, 27.63, 27.55 respectively, during experimental years 2019 and 2020 and in pooled results. Treatment T_3 (LCC 5).

Effect of Treatments On Quality Parameters

Observations recorded on different quality parameters viz. grain protein content (%), N, P, K content (%) in grain and stover as well as N, P, K uptake (kg ha^{-1}) by grain and stover during the years 2019, 2020 as well as on pooled basis.

Grain Protein Content (%)

It is clear from the data given in Table-3 that various treatments bring to stand significant influence on grain protein content (%) during both the years 2019 and 2020 as well as in the pooled analysis. Significantly higher grain protein content in maize 11.31, 11.34 and 11.32% recorded in the treatment T_3 (LCC 5) but did not differ significantly with the treatments T_6 (CCM 40) and T_7 (100% RDN) during the experimental year 2019 and 2020 as well as in pooled analysis. These results are in close conformity with findings of Mathukia *et al.* (2014) and Patel *et al.* (2018).

Nitrogen content in Grain (%)

A perusal of data given in Table-3 showed that treatment T_3 (LCC 5) recorded significantly higher nitrogen content in maize grain 1.81, 1.83 and 1.82 % respectively, during 2019, 2020 and in pooled analysis and it was found statistically at par with treatments T_6 (CCM 40) during the experimental year 2019 and 2020 as well as on pooled basis.

Nitrogen Content in Stover (%)

Data given in Table-3 revealed that various treatments showed significant effect on nitrogen content in maize stover. During 2019 nitrogen content in maize stover was significantly higher (0.61%) in treatment T_3 (LCC 5) and T_6 (CCM 40) together, which did not differ significantly with treatment T_7 (100% RDN), while, during 2020 and on pooled basis, significantly higher nitrogen content 0.63 and 0.62% in maize stover was recorded under the treatment T_3 but it remained statistically at par with the treatments T_6 and T_7 during the year 2020 and on pooled basis.

Phosphorous Content in Grain (%)

A perusal of data given in Table-4 revealed that treatment T_3 (LCC 5) recorded significantly higher phosphorous content in maize grain 0.36, 0.38 and 0.37 % respectively, during 2019, 2020 and in pooled analysis, and it found was statistically at par with treatments T_6 (CCM 40) and T_7 (100% RDN) during the experimental year 2019 and 2020 as well as on pooled basis.

Phosphorous Content in Stover (%)

Data given in Table-4 tells that various treatments showed significant effect on phosphorous content in maize stover. During 2019 nitrogen content in maize stover was significantly higher (0.15%) in treatment T_3 (LCC 5) and T_6 (CCM 40) together, which did not differ significantly with treatment T_7 (100% RDN). While, during 2020 and on pooled basis, significantly higher phosphorous content 0.17 and 0.16% in maize stover was recorded under the treatment T_3 but it remained statistically at par with the treatments T_6 and T_7 during the year 2020 and on pooled basis.

Potash content in Grain (%)

A perusal of the data given in Table-4 revealed that treatment T_3 (LCC 5) recorded significantly higher potash content in maize grain 2.61, 2.63 and 2.62 % during 2019, 2020 and in pooled analysis, and it was statistically at par with treatments T_6 (CCM 40) and T_7 (100% RDN) during the experimental year 2019 and 2020 as well as on pooled basis.

Potash content in Stover (%)

Data given in Table-4 reveal that various treatments showed significant effect on potash content in maize stover. During 2019, 2020 and on pooled basis, significantly higher potash content 3.79 and 3.81%, 3.80 respectively under the treatment T_3 but it remained statistically at par with the treatments T_6 and T_7 during the year 2020 and on pooled basis. Whereas, lowest potash content 3.02, 3.05 and 3.03 % in maize stover was reported under treatment T_1 (LCC 3) during both the years and in pooled analysis.

Nitrogen Uptake by Grain (kg ha^{-1})

As it is clear from the data given in Table-5 that numerous treatments significantly influenced the N uptake (kg ha^{-1}) by maize grain during both the years as well as in pooled analysis. Among all the treatment tested, treatment T_3 (LCC 5) recorded significantly higher N uptake 56.45, 57.95 and 57.20 kg ha^{-1}, respectively during the years 2019, 2020 and on pooled basis and found superior over rest of the treatments. On pooled basis, increase in N uptake by maize grain over treatment T_7 (100% RDN) was to the tune of 26.68 and 17.14%, respectively in the treatment T_3 and T_6. These results are in closeagreement with the findings of Singh *et al.* (2015) and Barad *et al.* (2018).

Nitrogen Uptake by Stover (kg ha^{-1})

It is observed from data in Table-5 that the nitrogen uptake by maize stover differed significantly due to various treatments. Significantly higher nitrogen uptake 50.26, 52.25 and 51.25 kg ha^{-1} during 2019, 2020 and in pooled by maize stover was observed under the treatment of T_3 (LCC 5) and remained statistically at par with the treatment T_6 (CCM 40) during both the experimental years and in pooled analysis. On the basis of pooled analysis, increase in N uptake by maize stover over the treatment T_7 (100% RDN) was to the tune of 24.26 and 18.88%, respectively in the treatment T_3 and T_6.

Phosphorous Uptake by Grain (kg ha^{-1})

As it is clear from the data given in Table-5 that numerous treatments significantly influenced the phosphorous uptake (kg ha^{-1}) by maize grain during both the years as well as in pooled analysis. Among all the treatment tested, treatment T_3 (LCC 5) recorded significantly higher P uptake 11.23, 12.03 and 11.63 kg ha^{-1} during the years 2019, 2020 and on pooled basis and found superior over rest of the treatments.

Phosphorous Uptake by Stover (kg ha^{-1})

It is observed from the given data in Table-5 that the P uptake by maize stover differed significantly due to various treatments. Significantly higher P uptake 12.36, 14.10 and 13.23 kg ha^{-1}by maize stover was observed under the treatment of T_3 (LCC 5) and remained statistically at par with the treatment T_6 (CCM 40) during both the experimental years and in pooled analysis.

Potash uptake by Grain (kg ha^{-1})

As it is obvious from Table-5 that numerous treatments significantly influenced the potash uptake (kg ha^{-1}) by maize grain during both the years as well as in pooled analysis. Among all the treatment tested, treatment T_3 (LCC 5) recorded significantly higher P uptake 118.28, 120.66 and 119.47 kg ha^{-1}during the years 2019, 2020 and on pooled basis and found superior over rest of the treatments.

Potash uptake by Stover (kg ha^{-1})

It is observed from data given in Table-5 that the K uptake by maize stover differed significantly due to various treatments. Significantly higher K uptake 215.06, 216.31 and 215.68 kg ha^{-1} by maize stover was observed under the treatment of T_3 (LCC 5) and remained statistically at par with the treatment T_6 (CCM 40) during both the experimental years and in pooled analysis.

Conclusion

Need-based nitrogen management significantly improved yield and quality of kharif maize. Among all treatments, T3 (LCC 5 with 30 kg N ha^{-1}) recorded the highest grain yield, protein content, and nutrient (N, P, K) uptake during both years and in pooled analysis. Thus, LCC-based nitrogen management at critical value 5 is an efficient and sustainable practice for enhancing maize productivity in the Central Plain Zone of Uttar Pradesh.

Table 1: Grain yield (kg ha^{-1}) and Stover Yield (kg ha^{-1}) influenced by different treatments

S.N.	Treatments combination	Grain yield (kg ha^{-1})			Stover Yield (kg ha^{-1})		
		2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
T_1	LCC 3	1999	2010	2004.50	5491	5619	5555.25
T_2	LCC 4	2556	2579	2567.50	7028	7109	7068..50
T_3	LCC 5	3121	3167	3144.00	8240	8295	8267.50
T_4	CCM 30	2437	2479	2458.00	6540	6610	6575.00
T_5	CCM 35	2628	2633	2630.50	7146	7190	7168.00
T_6	CCM 40	2993	3018	3005.50	8051	8135	8093.00
T_7	100% RDN as 3 equal splits (2:1:1)	2741	2783	2762	7281	7325	7303.00
T_8	75% RDN as 3 equal splits (2:1:1)	2495	2509	2502	6586	6615	6600.50
SE(m)		**57.54**	**67.64**	**44.43**	**85.95**	**134.16**	**79.93**
C.D. (P=0.05)		**169.29**	**199.00**	**126.59**	**252.86**	**394.68**	**227.76**

Table 2: Biological yield (kg ha^{-1}) and Harvest index (%) influenced by different treatments

S.N.	Treatments combination	Biological yield (kg ha^{-1})			Harvest index (%)		
		2019	2020	Pooled	2019	2020	Pooled
T_1	LCC 3	7490	7629	7559	26.68	26.34	26.51
T_2	LCC 4	9584	9688	9636	26.66	26.62	26.64
T_3	LCC 5	11361	11462	11411	27.47	27.63	27.55
T_4	CCM 30	8727	9079	8903	27.14	27.27	27.20
T_5	CCM 35	9774	9823	9798	26.88	28.30	27.50
T_6	CCM 40	11044	11153	11098	27.10	27.05	27.07
T_7	100% RDN as 3 equal splits (2:1:1)	10072	10108	10090	27.34	27.53	27.43
T_8	75% RDN as 3 equal splits (2:1:1)	9028	9124	9102	27.40	27.49	27.4
SE(m)		**291.42**	**302.00**	**210.12**	**0.14**	**0.25**	**0.14**
C.D. (P=0.05)		**857.30**	**888.41**	**599.59**	**0.42**	**0.75**	**0.42**

Table 3: Nitrogen content in grain and in Stover, protein content in grain influenced by different treatments

S.N.	Treatments combination	Nitrogen content in grain			Nitrogen content in Stover			Protein Content (%)		
		2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
T_1	LCC 3	1.44	1.46	1.45	0.42	0.43	0.42	9.00	9.05	9.02
T_2	LCC 4	1.55	1.56	1.55	0.53	0.55	0.54	9.66	9.71	9.68
T_3	LCC 5	1.81	1.83	1.82	0.61	0.63	0.62	11.31	11.34	11.32
T_4	CCM 30	1.5	1.52	1.51	0.46	0.47	0.46	9.42	9.45	9.43
T_5	CCM 35	1.61	1.63	1.62	0.54	0.55	0.54	10.06	10.10	10.08
T_6	CCM 40	1.75	1.77	1.76	0.59	0.62	0.60	10.93	11.22	11.07
T_7	100% RDN as 3 equal splits (2:1:1)	1.63	1.64	1.63	0.56	0.57	0.56	10.18	10.21	10.19
T_8	75% RDN as 3 equal splits (2:1:1)	1.54	1.55	1.54	0.48	0.48	0.485	9.62	9.66	9.64
SE(m)		**0.02**	**0.02**	**0.01**	**0.02**	**0.02**	**0.01**	**0.06**	**0.12**	**0.06**
C.D. (P=0.05)		**0.06**	**0.08**	**0.05**	**0.06**	**0.08**	**0.05**	**0.19**	**0.35**	**0.19**

Table 4: Phosphorous and Potash content in grain and Stover influenced by different treatments.

S. N.	Treatments combination	P content in grain			P content in Stover			K content in grain			K content in Stover		
		2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
T_1	LCC 3	0.28	0.29	0.28	0.12	0.13	0.12	1.82	1.85	1.83	3.02	3.05	3.03
T_2	LCC 4	0.32	0.34	0.33	0.14	0.16	0.15	2.12	2.15	2.13	3.52	3.54	3.53
T_3	LCC 5	0.36	0.38	0.37	0.15	0.17	0.16	2.61	2.63	2.62	3.79	3.81	3.80
T_4	CCM 30	0.29	0.30	0.29	0.14	0.15	0.14	1.93	1.94	1.93	3.32	3.34	3.33
T_5	CCM 35	0.32	0.33	0.32	0.14	0.15	0.14	2.24	2.26	2.25	3.64	3.66	3.65
T_6	CCM 40	0.34	0.35	0.34	0.15	0.17	0.16	2.55	2.57	2.56	3.75	3.77	3.76
T_7	100% RDN as 3 equal splits	0.33	0.34	0.33	0.14	0.15	0.14	2.52	2.54	2.53	3.67	3.68	3.67
T_8	75% RDN as 3 equal splits	0.29	0.30	0.29	0.14	0.15	0.14	2.0	2.03	2.01	3.44	3.46	3.53
SE(m)		**0.012**	**0.014**	**0.009**	**0.006**	**0.006**	**0.004**	**0.08**	**0.09**	**0.06**	**0.04**	**0.05**	**0.03**
C.D. (P=0.05)		**0.038**	**0.042**	**0.027**	**0.017**	**0.021**	**0.013**	**0.25**	**0.26**	**0.17**	**0.13**	**0.14**	**0.09**

Table 5: NPK uptake in grain and in Stover influenced by different treatments

S. N.	Treatments combination	N uptake in grain			N uptake in Stover			P uptake in grain			P uptake in Stover			K uptake in grain			K uptake in Stover		
		2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
T_1	LCC 3	29.98	30.55	30.26	25.25	26.40	25.82	5.79	6.03	5.91	7.68	8.42	8.05	66.36	67.13	66.74	105.97	109.00	107.48
T_2	LCC 4	39.61	40.23	39.92	37.24	39.09	38.16	8.17	8.76	8.46	9.83	11.37	10.60	89.97	91.29	90.63	149.24	152.84	151.04
T_3	LCC 5	56.45	57.95	57.20	50.26	52.25	51.25	11.23	12.03	11.63	12.36	14.10	13.23	118.28	120.66	119.47	215.06	216.31	215.68
T_4	CCM 30	35.09	36.19	35.64	27.46	28.42	27.94	6.82	7.18	7.0	7.84	8.59	8.21	73.05	75.60	74.325	120.30	122.28	121.29
T_5	CCM 35	42.31	42.91	42.61	38.58	39.54	39.06	8.40	8.68	8.54	10.00	10.78	10.39	95.65	96.36	96.005	161.05	162.49	161.77
T_6	CCM 40	52.37	53.41	52.89	47.67	50.43	49.05	10.17	10.56	10.36	12.07	13.82	12.94	112.23	113.77	113.00	207.44	209.06	208.25
T_7	100% RDN as 3 equal splits	44.67	45.64	45.15	40.77	41.75	41.26	9.13	9.29	9.21	10.19	10.98	10.58	100.59	102.41	101.50	184.59	186..06	185.32
T_8	75% RDN as 3 equal splits	38.42	38.88	38.65	31.61	31.75	31.68	7.23	7.52	7.37	9.22	9.92	9.57	85.82	86.81	86.31	132.30	134.28	133.29
SE(m)		**0.85**	**1.00**	**0.65**	**0.73**	**0.87**	**0.57**	**0.30**	**0.42**	**0.26**	**0.44**	**0.57**	**0.36**	**1.77**	**1.91**	**1.30**	**2.86**	**3.14**	**2.12**
C.D. (P=0.05)		**2.52**	**2.94**	**1.87**	**2.17**	**2.56**	**1.63**	**0.88**	**1.26**	**0.75**	**1.30**	**1.68**	**1.03**	**5.23**	**5.62**	**3.72**	**4.04**	**9.25**	**6.06**

Table 6: Quantity and timing of N application in different treatments during 2019-20

Treatments	Nitrogen applied (kg ha^{-1}) on respective dates based on critical LCC and CCM values						
	Basal (16-7-2019)	**21 DAS (06-8-2019)**	**28 DAS (13-8-2019)**	**35 DAS (20-8-2019)**	**42 DAS (27-8-2019)**	**49 DAS (04-9-2019)**	**Total**
LCC 3	30			30			60
LCC 4	30		30		30		90
LCC 5	30	30		30	30		120
CCM 30	30			30			60
CCM 35	30		30		30		90
CCM 40	30	30		30		30	120
100% RDN as 3 equal splits (2:1:1)	60	Fixed time N application of 30 kg N ha^{-1} at knee high and tasseling stages each (25 DAS and 45 DAS)					120
75% RDN as 3 equal splits (2:1:1)	30	Fixed time N application of 30 kg N ha^{-1} at knee high and tasseling stages each (25 DAS and 45 DAS)					90

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