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Response of *Kharif* Maize (*Zea mays* L.) to Planting Methods and Nitrogen Management Approach by Leaf Color Chart

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ABSTRACT

A field investigation entitled Response of *Kharif* Maize (*Zea mays* L.) to Planting Methods and Nitrogen Management approach by Leaf Color Chart (LCC) was conducted during the *kharif* of 2016 at the Students' Research farm, Khalsa College, Amritsar. The soil of the experimental site was sandy loam in texture with normal soil PH and electrical conductivity, medium in organic carbon and low in available N, medium in available P and high in K. Bed planted maize had significant higher grain yield (41.86 q/ha) and yield attribute as compared to ridge (36.57 q/ha) and flat (35.95 q/ha) planted Maize, but at par with zero tillage method planted maize (39.83 q/ha). However the growth attributes, straw yield and benefit cost ratio were higher in maize sowing by zero tillage. Among nitrogen management treatment, nitrogen applied by N_{LCC5} had significantly higher growth, yield and yield attributes than N_{LCC4} and Control N_o whereas at par with N_{LCC6}.

Key Words: Leaf Colour Chart, Maize Planting methods, Nitrogen management.

INTRODUCTION

Maize (*Zea mays* L.) can play an important role in the crop diversification in Punjab. It is used in poultry and animal feed and for the manufacturing of starch, glucose and corn flakes. It is also used as a human food during winter season. Traditionally maize was grown as *kharif* crop and now sowing during rabi season has also been started in some districts with the development of new varieties and hybrids. Maize can be grown successfully during spring season. Singh *et al* (2014) revealed that majority of farmers prefer to sow seeds of two hybrids namely 31Y45 and DKC 9108 with an average yield around 96q/ha during spring season. On the other hand, in order to boost up maize production during *kharif*, adoption of modern agro-management practices seems imperative and one of the major techniques is the use of proper method of sowing. Among the agronomic practices, planting technique is of considerable importance as proper adjustment of plant in the field not only ensures optimum plant population, but also enables the plants to utilize the land and other input resources more efficiently and resolutely towards growth and development and yield of maize.

Imbalanced use of nitrogen at wrong time may lead to bad quality of grain as well as makes plant succumb to lodging and attract to insect pests and diseases. Singh *et al* (2016) reported that farmers were applying urea in recommended dose but the time of application was different than the recommendations. As per recommendations, urea needs to be applied in three equal splits during basal, vegetative and tasseling stage whereas farmers were applying 75 per cent urea only during vegetative stage and 24 per cent during tasseling stage. In case of DAP, 63 per cent of farmers were adding higher quantity of phosphate fertilizer than the recommended dose. So, in maize also there is need to adjust nitrogen fertilizer application with timing of plant requirement to enhance nitrogen use efficiency because nitrogen requirement of maize plant is not same throughout the growing period. This adjustment should be based on leaf color intensity of crop because it is directly related to leaf chlorophyll content and leaf nitrogen status.

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Leaf color chart is technique for real time nitrogen management (Singh *et al,* 2002) which can be used for rapid and reliable monitoring of relative green color of the leaf as an indicator of leaf nitrogen status. The present study was planned to study the effect of planting methods and application of nitrogen based on LCC on growth and yield of maize.

MATERIALS AND METHODS

The present investigation was conducted during the *kharif* of 2016 at the Students' Research farm, Khalsa College, Amritsar. The soil of the experimental site was sandy loam in texture with normal soil PH and electrical conductivity, medium in organic carbon and low in available N, medium in available P and high in K. The experiment was laid out in split plot design heaving three replications. In each replication there nine treatment combinations heaving four planting methods *viz.,* zero tillage, flat, ridge and bed in the main plots and three nitrogen levels in sub plots including N_0, $N_{Rec,}$ N_{LCC4}, N_{LCC5} and N_{LCC6}. After the seed bed preparation, beds of 67.5cm width were prepared by bed planter, ridge of 60cm width were prepared. The pre treated seeds of variety PMH 1 were sown on 15th June, 2016 by *kera* method. 5 irrigations were applied as per the requirement of the crop. Three hoeing were performed after a interval of 15 days using *khurpa* (no chemical used in weed management).

The maize crop was harvested manually with sickles on 16th Sept., 2016 when more than 80 per cent of the cobs turned yellowish brown, grains become hard. The cobs along with stalk were stacked in upright position in the field for seven days. The cobs were dehusked manually and were allowed to dry for seven and thereafter the threshing was done using maize dehusker cum thresher. The maize grain yield was recorded from each plot at uniform moisture and expressed in q/ ha. Statistical analysis of the data was done as per split plot design.

RESULTS AND DISCUSSION

Growth

Growth of maize was significantly different due to different planting methods and nitrogen levels. Maximum growth parameters like plant height, leaf area index (LAI) and dry matter accumulation (Table 2) were recorded in zero tillage which was statistically at par with bed planting. Further, it was observed that planting techniques zero and bed planting methods produced significantly more growth than flat. Growth was significantly higher in plot which treated with N_{LCC6}, N_{LCC5} and N_{REC} over N_{LCC4} and N_0 plots. Treatment N_{LCC6} produced tallest plants which remained significantly superior over N_{LCC4}, N_{REC} and N_0 plots where as it was statistically at par with N_{LCC5} plots. The increase in plant height with respect to increased nitrogen application rate indicates maximum vegetative growth of the plants under higher nitrogen availability due to the increase in cell elongation as nitrogen is essential for plant growth process including chlorophyll which is responsible for dark green color of stem and leaves which enhance vigorous vegetative growth and branching.

Greater leaf expansion in maize was ascribed

Table 1. Dose and time of application of nitrogen Fertilizer.

Treatment	Total N fertilizer dose (kg/ha)	Dose and Time of application
N_0	0	-
N_{Rec}	125	$^1/^3$ at sowing, $^1/^3$ knee height (22 DAS) and $^1/_3$ pre-tassling (45 DAS)
N_{LCC4}	90	30 kg N/ha each applied at sowing, 31 DAS and 50 DAS.
N_{LCC5}	120	30 kg N/ha each applied at sowing, 24 DAS, 40 DAS and 52 DAS.
N_{LCC6}	150	30 kg N each/ha applied at sowing,18 DAS, 29 DAS, 42 DAS and 55 DAS.

Table 2. Effect of planting methods and nitrogen on growth of maize.

Treatment	Plant height (cm)	Leaf Area Index (LAI)	Dry matter accumulation (q/ha)
Method of Planting			
Zero	174.0	3.83	114.2
Flat	163.2	3.32	102.1
Ridge	167.7	3.49	105.5
Bed	171.2	3.79	113.2
CD (p= 0.05)	7.4	0.26	9.2
Nitrogen Level			
N_0	131.2	3.12	79.7
N_{Rec}	174.1	3.61	116.1
N_{LCC4}	170.6	3.55	109.6
N_{LCC5}	176.8	3.80	118.6
N_{LCC6}	177.4	3.99	122.7
CD (p= 0.05)	6.3	0.37	6.9
Interaction	NS	NS	NS

to higher rate of cell division and cell enlargement. Promotive effect of N on LAI of maize has been reported by Andera *et al* (2006). The results were in agreement with reported by Karasu (2012) to obtained significant increase in various growth parameters of maize with higher rates of nitrogen fertilizer. Interaction effects were found no significant results.

Yield attributing characters

Planting methods did not show any significant difference in number of cobs per plant and test weight (Table 3). Higher number of cobs per plant and test weight was recorded in bed planting and minimum was in flat planting. Maximum cob length and number of grains per cob were recorded under bed planting which was statistically at par with planting method zero tillage whereas both these planting methods produced significantly higher number of grains per cob than planting methods ridge and flat. The minimum number of grain per cob was recorded in Flat. The highest length (20.73 cm) was recorded in Bed planting and lowest length (16.06 cm) was recorded in flat planting. Cob length was recorded in zero (19.95 cm) and ridge(18.89 cm) planting methods.

Treatment N_{LCC6} produced significantly higher number of grains per cob over N_{LCC5} , N_{LCC4} , N_{REC} and N_0 whereas cob length was found statistically at par with N_{LCC5}.The maximum number of grains per cob and cob length were obtained from N_{LCC6} and lowest number of grains per cob and cob length were obtained from $N_{0.}$The probable reason for lesser grain number cob was N deficiency which reduced biomass production traits *i.e.* leaf area and light capture of plant which could be primarily relate to number of grain. These results substantiate the findings of Rasheed *et al* (2004) who concluded that increasing level of N enhance the number of grains cob. Similarly, N_{LCC6} plots had significant higher test weight and number of cobs per plant than $N_{0,}$ whereas it was at par with $N_{LCC5,}$ N_{REC}, N_{LCC4} .However, data in table shows that among nitrogen levels, trend of test weight and number of cobs per plant was $N_{LCC6} > N_{LCC5} > N_{REC} > N_{LCC4} > N_0$ .The result suggested that the adequate N supply might have enhanced the source efficiency (more dry matter accumulation per unit area) as well kernel weight. An increase in grain weight of maize in response to N fertilization has been reported by Imran *et al* (2015). Jaidka *et al* (2018) studied correlation analysis of all the parameters with grain yield and revealed a significant and highly positive correlation of maize cob weight, cob weight, grain weight per cob and cob girth at top with grain yield of hybrids.

Grain yield

Grain yield is a net result of interaction of various factors influencing growth and yield attributing characters during the life cycle of the crop .The data with respect to grain yield showed that different methods had significant effect on grain yield of maize. Higher grain yield (40.36 q/ha) was obtained from Bed planting followed by (39.43 q/ha) zero tillage planting method. The planting methods, bed and zero tillage were statistically at par with each other but significantly superior over flat and ridge planting method. The higher grain yield in bed and zero tillage methods might be due to more number of cobs per plant, length of cobs, and more number of grains per cob and 1000-grain-weight. Similar results were observed by Lashkari *et al* (2011).

The data (Table 3) revealed that effect of different nitrogen levels on grain yield of maize was significant. The treatment N_{LCC6} recorded highest grain yield (46.50 q/ha). It was significantly higher than N_0 (25.27 q/ha) but statistically at par with N_{LCC5} (43.05 q/ha).Where maximum grain yield was observed with N_{LCC6} (46.50 q/ha) followed by N_{LCC5} (43.05 q/ha), N_{REC} (40.36 q/ha) ,N_{LCC4} (34.50 q/ha) and N_0 (25.27 q/ha) .Greater grain yield at higher nitrogen application was probably due to higher grain weight, per cob as well as more 1000-grain weight, which was due to better vegetative growth of crop plant. These results were in line with finding of Ahmad *et al* (2009) who also found that grain yield increased by increasing nitrogen levels. Similarly, the data showed that all the four planting methods did exhibit significant difference in stover yield . Stover yield of planting methods bed (87.28 q/ha) was followed by zero (84.28 q/ha) ,ridge (80.0 q/ha) and flat (78.21q/ha). In case of nitrogen treatments maximum stover yield was observed in N_{LCC6} (93.38 q/ha) followed N_{LCC5} (86.80 q/ha) ,N_{REC} (81.91 q/ha) , N_{LCC4} (79.54 q/ha) and N_0 (71.86 q/ha). Interaction effects of planting methods and nitrogen in maize were found to be non significant.

Table 3. Effect of planting methods and nitrogen on yield attributing characters of maize.

Treatment	Cob length (cm)	Number of grains per cob	Test Weight (g)	Grain Yield (q/ha)	Stover Yield (q/ha)
Method of Planting					
Zero	19.94	300.13	20.72	39.43	84.28
Flat	16.06	282.33	19.60	35.25	78.21
Ridge	18.90	289.20	20.20	36.27	80.50
Bed	20.70	308.53	21.40	40.36	87.28
CD (p=0.05)	2.17	15.69	NS	3.43	6.68
Nitrogen Levels					
N_0	13.62	213.75	17.91	27.27	69.86
N_{Rec}	19.73	312.33	20.48	40.36	81.91
N_{LCC4}	17.40	286.75	20.23	36.27	79.54
N_{LCC5}	21.43	325.58	21.33	43.05	86.80
N_{LCC6}	22.33	328.33	22.41	4514	90.38
CD (p=0.05)	2.21	10.14	3.01	3.88	4.36
Interaction	NS	NS	NS	NS	NS

Benefit Cost Ratio (B: C ratio)

The data (Table 4) revealed that among all the sowing methods maximum income was obtained with bed planting method (Rs 62040/ ha) followed by zero tillage planting (Rs 59145/ ha), ridge planting (Rs 54405/ha) and flat planting (Rs 52815/ha) methods. The data also revealed that all the nitrogen management treatments gave higher income over control (no nitrogen). Maximum income obtained with LCC_6 (Rs 65453/ha) and minimum was obtained with N_0 (Rs 39541/ha).

CONCLUSION

It may be concluded that bed planting method and zero tillage were superior than flat and ridge. Among the different nitrogen levels the application using leaf color chart (N_{LCC5}) was more beneficial than other treatments which had higher benefit cost ratio.

REFERENCES

Ahmad I, Iqbal M, Ahmad B, Ahmad G and Shah N (2009). Maize yield, plant tissue and residual soil nitrogen as affected by nitrogen management. *J Agric Bio Sci* **1**(1):19-21

Andrea D, Cirilo A G and Eyherabide G H (2006). Genotypic variability in morphological physiological traits among maize inbred lines response to nitrogen availability. *Crop Sci* **46**:1266-276.

Imran S, Muhammad A, Khan A, Khan M, Shah W and Abdul L (2015). Effect of nitrogen levels and plant population on yield and yield component of maize. *Adv Crop Sci and Tech* **3**(2): 2-7

Jaidka M, Brar N S and Sharma M (2018). Evaluation of spring maize hybrids under irrigated conditions. *Int J Curr Microbiol App Sci* **7** (08): 3212-3217

Karasu A (2012). Effect of nitrogen levels on grain yield and some attributes of some hybrids maize (*Zea mays* L.) cultivar grown for silage as second crop. *Bulagrian J Agric Sci* **18**(1): 42-48

Manan J, Sharma M , Singh G and Singh G(2016).Effect of application of various inputs by the farmers and the yield of spring maize hybrids. *J Krishi Vigyan* **4**(2) : 22-27

Rasheed M, Al H, Tariq M (2004).Impact of nitrogen and sulphur application on growth and yield of maize (*Zea mays* L.) crop. *J Res Sci* **15**(2): 153-57

Sharma M, Singh O, Singh G and Kaur G (2014). A snap shot of spring maize cultivation in Kapurthala and Jalandhar district under central plain zone of Punjab. *J Krishi Vigyan* **3** (1) : 1-4

Singh B, Singh Y, Ladha J K, Bronson K F, Balasubramanian V, Singh J and Thind C S (2002). Chlorophyll meter and leaf colour chart based nitrogen management for rice and wheat in Northwest India. *Agron J* **94**: 821-29

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Table 4. Comparative economics of planting method and nitrogen management in Maize.

Treatment	Benefit cost ratio			
Method of Planting	**Total cost (Rs/ha)**	**Total income (Rs/ha)**	**Net profit (Rs/ha)**	**B:C**
Zero	35,780	59,145	23,365	1.65
Flat	37,580	52,815	15,775	1.40
Ridge	38,230	54,405	16,175	1.42
Bed	38,810	62,040	23,230	1.59
Nitrogen Levels				
N_0	35,730	39,541	3,811	1.10
N_{Rec}	39,250	58,522	19,272	1.49
N_{LCC4}	38,215	48,241	10,026	1.26
N_{LCC5}	39,500	64,597	25,097	1.63
N_{LCC6}	40,550	65,453	24,903	1.61