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Influence of integrated nutrient use on growth parameters of hybrid Maize (*Zea mays* L.) under central plain zone of Uttar Pradesh

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Abstract
An experiment was conducted on "To evaluate the integrated nutrient use on growth and yield of hybrid Maize (*Zea mays* L.) under central plain zone of Uttar Pradesh" during *Kharif* 2017, on Soil Conservation and Water Management Farm, CSA University of Agriculture and Technology, Kanpur on hybrid Maize with three level of inorganic fertilizers (kg/ha) *i.e.*100% RDF (100 N + 60 P + 40 K+ 20 Zn), 75% RDF (75+45+30+15), & 50% RDF (50+30+20+10) along with three Levels of organic manure *viz*; 15, 20 & 25 ton FYM/ha. On the basis of overall results it can be concluded that the fertility level 75% RDF + 25 t FYM/ha (F_2+O_3) was found better in all respect as compared to other combinations of fertility management in all respect of growth parameters *viz*, plant population initial and final stand, plant height, number of functional leaves per plant 30, 60 and at maturity Days to silking, tasselling and maturity.

Keywords: Integrated nutrient, growth parameters, hybrid maize, *Kharif* season

Introduction
The place of origin of maize or corn (*Zea mays* L.) is still uncertain. Some workers mention it to be in high lands of Peru, Bolivio and Equador, while other say it to be Southern Mexico and Central America. The first mentioned of records was 05 November, 1492 when Columbus reached American mainland and his scouts brought him the maize samples from the lsland of Cuba. Maize is an annual C_4 plant belonging to the grassy family Poaceae with its origin in Central America and considered as one of the oldest food sources. It is a fully domesticated plant as humans and maize have lived and evolved together since ancient times. Modern maize does not grow in the wild, cannot survive in nature and is completely dependent on human husbandry (Galinant, 1988; Doswell et al., 1996) [7, 6] but this crop have wider adaptability under varied agro-climatic conditions.

In India, total maize is grown in an area of about 9.2 mha with production of 23.29mt and productivity of 2563 kg/ha**.** Tamil Nadu rank Ist in productivity with 65.49 q/ha followed by Andhra Pradesh with 60.69 q/ha. With respect to Uttar Pradesh, the area, production and productivity is about 0.68 million hectare, 1.26 million tonnes and 18.48 q/ha, respectively. In Uttar Pradesh, cultivation of *Kharif* maize is concentrated in eastern parts. Madhya Pradesh rank first place in respect of area of *Kharif* maize (109.8 thousand hectare) followed by Maharastra (106.7 thousand hectare) and Rajasthan (86.7 thousand hectare). However, Karnataka ranks first in term of production (292.20 thousand tonnes) followed by Madhya Pradesh (25.80 thousand tonnes) while, Tamil Nadu gained first position respect of *Kharif* maize productivity (6534 kg/ha) followed by Punjab (3687 kg/ha) (Anonymous, 2016) [3].

Maize is the third most important cereal in the world. Maize growers are shifting to specially corn production due to higher returns and also opening opportunities for employment generation especially in semi-urban areas. Among corns, sweet corn has a very big market potential and has great genetic variability and scope to improve its nutritive value. The quality of sweet corn depends on the type of gene involved for sweetness. Besides, genetic architecture conferring the sweetness, crop management practices also play a critical role in realizing the desired sweetness in the cobs. Balanced nutrition of NPK is an essential component of nutrient management and plays a significant role in increasing crop production and its quality. The recommended nitrogen dose varies for the hybrids and the same may not be applicable for the composites.

As the information on fertilizer requirement for sweet corn is very meager, the present experiment was planned to study the influence of planting methods and fertilizer doses on yield and quality of hybrid maize. However, very limited or no scientific information is available in respect of hybrid maize in integrated nutrient management for central Uttar Pradesh region.

Materials and Methods

The field experiment was conducted during *Kharif* season of 2017 at Soil Conservation and Water Management Farm of the Chandra Shekhar Azad University of Agriculture and Technology, Kanpur.

Experimental Details: The experiment was laid out in Randomized Block Design (RBD) with three replications. The layout plan and other details of the experiment are given as under:

Treatments	Symbols
(A) Three level of inorganic fertilizers (N, P,K & Zn kg/ha)	
(i) 100% R.D.F. (100 + 60+ 40+ 20)	F_1
(ii)75% RDF (75+45+30+15)	F_2
(iii) 50% RDF (50+30+20+10)	F_3
(B) Levels of organic manure	
(i) 15 ton FYM/ha	O_1
(ii) 20 ton FYM / ha	O_2
(iii) 25 ton FYM/ha	O_3

The overall total number of treatment combinations (3x3=9) Areas follows

(1) F_1O_1 (4) F_2O_1 (7) F_3O_1
(2) F_1O_2 (5) F_2O_2 (8) F_3O_2
(3) F_1O_3 (6) F_2O_3 (9) F_3O_3

Number of replications	=	3
Number of treatment combinations	=	(3 x 3) = 9
Total number of plots	=	(9 x 3) = 27
Plot size	=	4.8 m x 4.0 m = 19.2 m^2
Replication border	=	1.0 m
Field bund	=	0.50m
Field border	=	2.0 m
Plot Border	=	0.5 m
Crop	=	Maize
Variety	=	Malika NMH-920
Seed Rate	=	20 kg/ ha

Cultural Operations

Field Preparation: The field was prepared by one ploughing with Disc plough and two ploughings with cultivator followed by planking.

Application of Fertilizer: As per treatment of fertilizers levels of N + P_2O_5+ K_2O + $ZnSO_4$(Kg/ha) were applied through Urea, Diammonium phosphate (DAP), Muriate of potash and Zinc sulphate, respectively. Full dose of phosphorus, potash as well as Zinc sulphate and half dose of nitrogen were applied through band placement 2-3 cm below the seed with the help of Nai (attached behind Deshi plough) at the time of sowing. Remaining half dose of nitrogen was topdressed at 20 days after sowing.

Seed Rate and Sowing: Sowing of maize (Malika NMH-920) was done on 16-07-2017 in furrows behind Deshi plough deploying seed @ 20 kg/ha with row spacing of 60× 15 cm at a depth of 5-6 cm from the soil surface. The furrows were covered by light planking just after sowing.

Thinning: Thinning was done with a view to maintain the desired plant geometry spaced at 60×15 cm, row to row and plant to plant. It was done on 29.07.2017.

Weeding and Hoeing: At 20 days after sowing, the crop was weeded out and simultaneously surface soil was loosed by *khurpi* to check the growth of weeds.

Ridging and Furrowing: As per treatment, furrows were formed in between the crop rows with the help of spade and soil of the furrows was put on the sides of the plants. Furrowing was done after 25 days of sowing.

Harvesting and Processing: Crop was harvested at maturity. One row from each side and half metre crop from other two sides was harvested as border and then the net plot area was harvested. The plants were cut near to the ground and left in the plot for sun drying. After sun drying, the plants were gathered and weighed plot wise. The cobs from the sun dried plants were separated and shelling of maize seed through Hand Maize Sheller. The plot wise yield of the stover was recorded on sundry basis. The grain as well as stover yield of each plot was recorded separately and finally computed in terms of quintal per hectare.

Observation recorded

Plant Population: This study was carried out to know about the uniformity in plant population under different treatments. After final thinning, plants/ plot were counted. Plant population/ plot were also counted at harvest. The figures of plant stand were converted into plants/ha for each treatment.

Plant Height (cm): Height of three tagged plants in each plot was measured in cm with the help of meter scale from the lowest node to the base of the top most fully unfurled leaf of the plant.

Number of functional Leaves /Plant: The total number of functional leaves was counted from the tagged three plants and then average per plant was worked out.

Days taken to silking: Number of days taken to silking was recorded to the date of sowing from the time when silking on each plants were found under each treatment.

Days taken to tasseling: The day taken tasseling was noticed to the date of sowing to the time when tasseling on each plant were found under each treatment.

Days taken to maturity: The day taken to maturity was noticed to the date of sowing to the time when maturity noticed on each plant of treatment.

Statistical Analysis

The data collected during the experimental period and after the completion of the experiment were statistically analysed with the help of the following statistical techniques.

Analysis of Variance: Since, the experiment was conducted in Randomized Block Design with 3 replications and 9 treatments (three level of inorganic fertilizer and three level of

organic fertilizer) the analysis of variance of the data was worked out on the basis of the Randomized Block Design, as explained by Cochran and Cox (1963) [5].

Results and Discussion

Plant Population

Data on plant population are presented in (Table-1) the variations in the final plant population due to fertility management were found non-significant. The highest plant stand was found under F_2 and O_3 (75% RDF and 25 Ton FYM/ha) the treatment and the lowest was found under F_3 and O_1 (50% RDF and 15 Ton FYM/ha). The results are in conformity with the findings of Singh *et al.* (1998) [13] and Anjum *et al.* (2014) [2].

Plant height

The tallest plants height recorded with F_2 and O_3 (75% RDF and 25t FYM/ha) treatment in comparison to other treatment (Table- 1). The plant height at maturity stage were recorded 245.73 cm & 243.92 cm under F_2 and O_3 (75% RDF and 25t FYM/ ha) whereas, lowest in F_3 and O_1 (50% RDF and 15 Ton FYM /ha) *i.e.* (236.60 cm and 235.99 cm) respectively. The results are in conformity with the findings of Singh *et al.* (2006) [8, 14] and Mohammed *et al.* (2014).

Number of functional leaves

Data on Fertility management practices given in (Table- 2) revealed that significant effect on number of functional leaves per plants were observed during different growth stages of crop. Maximum number of functioning leaves i.e. 6.58, 12.17 and 7.45 per plant was recorded at different stage of plant growth under the treatment F_2 and O_3 (75% RDF and 25t FYM/ ha) and minimum number of functioning leaves were 6.47, 11.72 and 6.15 at F_3 and O_1 (50% RDF and 15 Ton FYM /ha). Similar findings had also been reported by Kumar *et al.* (2008) [9].

The various growth characters showed increasing trend with advancement in age of crop i.e. height and no of functional leaves plant^{-1} during investigation. The plant height and no. of functional leave plant^{-1}. Maximum growth was observed with combined application of FYM and 75% RDF between 30 DAS to maturity. These growth characteristics are to be affect with physiological active leaves which helped the plant to synthesize and store more food material through the process of photosynthesis. During latter stages, because of the age factor, the activity of the older leaves retarded and the formation of new leaves stopped resulting in decreased photosynthesis. Fertility management is one of the important natural characteristics of different varieties. The result are in conformity with the findings of Singh *et al.* (1998) [13], Nyamudeza *et al.* (2003) [12], Singh *et al.* (2006) [8, 14] and Anjum *et al.* (2014) [2].

All the growth characters increased significantly with increasing levels of fertilizer during the year, the growth parameters were noted lowest under F_3 and O_1 (50% RDF and 15 Ton FYM /ha) and increased with increasing levels of fertilizer being highest with F_2 and O_3 (75% RDF and 25t FYM/ha). This might be due to increase in the availability of nutrients with an additional dose of fertilizer application. The results are supported by reports of Mahal *et al.* (2000) [10] and Amanolahi-Baharvand *et al.* (2014) [1].

Days to silking, days to tasseling and days to maturity

The days taken in tasseling, silking and maturity recorded are presented in (Table-2) higher under fertility management practices treatment F_2 (75% RDF) and O_3 (25t FYM/ha) and lower was recorded under treatment F_3 (50% RDF) and O_1 (15t FYM/ha). These similar findings are in accordance with Arun and Singh (2004) [4] and Kaundal and Sharma (2006) [8, 14].

Table 1: Effect of integrated nutrient management by using Inorganic and Organic fertilizers on plant population (000ha^{-1}), Plant height and no. of functional leaves/per plant

Treatments	Plant population (000 ha^{-1})		Plant height (cm)		
	Initial	Final	30 DAS	60 DAS	At maturity
Inorganic Fertilizer					
F_1=100% RDF	162	158	108.27	205.16	238.88
F_2=75% RDF	164	160	111.38	211.04	245.73
F_3=50% RDF	161	158	107.23	203.19	236.60
SE(d)	1.54	1.39	1.09	1.67	2.36
C.D. (P=0.05)	NS	NS	2.31	3.55	5.02
Organic manure level					
O_1=15t FYM/ha	163	158	106.96	202.67	235.99
O_2=20t FYM/ha	162	159	109.36	207.23	241.30
O_3=25t FYM/ha	162	160	110.56	209.49	243.92
SE(d)	1.54	1.39	1.09	1.67	2.36
C.D. (P=0.05)	NS	NS	2.31	3.55	5.02

Table 2: Effect of integrated nutrient management by using Inorganic and Organic fertilizers on no. of functional leaves/per plant, Days to silking, days to tasseling and days to maturity of hybrid Maize

Treatments	Number of functional leaves/plant			Days taken to silking	Days taken to tasseling	Days taken to Maturity
	30 DAS	60 DAS	At maturity			
Inorganic Fertilizer						
F_1=100% RDF	6.38	11.78	6.21	43.31	39.92	76.44
F_2=75% RDF	6.58	12.17	7.45	44.57	41.16	78.66
F_3=50% RDF	6.47	11.72	6.15	42.89	39.48	75.68
SE(d)	0.17	0.06	0.06	0.42	0.37	0.57
C.D. (P=0.05)	NS	0.13	0.13	0.89	0.79	1.21
Organic manure level						
O_1=15t FYM/ha	6.30	11.69	6.47	42.79	36.43	75.50

O_2=20t FYM/ha	6.52	11.90	6.67	43.75	40.32	77.24
O_3=25t FYM/ha	6.61	12.08	6.67	44.22	40.81	78.04
SE(d)	0.17	0.06	0.06	0.42	0.37	0.57
C.D. (P=0.05)	NS	0.13	0.13	0.89	0.79	1.21

Conclusion

It can be concluded that in the case of fertility levels of 75% RDF + 25 t FYM/ha (F_2+O_3) was found superior in yield attributing parameters as compared to other combinations of fertility management. So, it may be recommended that growing of hybrid maize in Kharif season was found most suitable and remunerative in central plain zone of Uttar Pradesh.

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