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Original Research Article

Effect of Plant Density and Soil Test Crop Response on Growth and Yield of Maize (*Zea mays* L.) During *Kharif* Season

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A B S T R A C T

A field experiment was conducted during *kharif* 2016 at Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar, to assess the growth and yield of maize. The soil of the experimental field was alluvial having sandy loam texture with uniform topography. The treatments consist of genotypes in main plot, density in sub plot and nutrient management in sub-sub plot was carried out in split-split plot design with three replications. The result revolted that effect of density was found grain yield 5.49 tons/ha under 60X20cm density and effect of Soil Test Crop Response (STCR) nutrient management was recorded grain yield tons 5.81 tons/ha of maize. In Site Specific Nutrient Management (SSNM) grain yield was recorded 5.26 tons/ha, which was statistically at par with Recommended Dose of Fertilizer (RDF). It is concluded that 60X20cm plant density and STCR nutrient management for maximum production of grain yield of maize during *kharif* season.

Keywords

Response on Growth and Yield of Maize (*Zea mays* L.)

Introduction

Maize is an important cereal food crop of the world with highest production and productivity as compared to rice and wheat. It has been referred to the "Queen of cereals". It is the most versatile crop which is being grown in more than 166 countries across the globe including tropical, sub-tropical and temperate regions from sea level to 3000 m msl. In India, maize is cultivated in over 92.58 lakh hectare with a production of 236.73 Lakh tons having average productivity of 25.57 q/ha. In Bihar, it is cultivated in about 7.14 Lakh ha with a production of 21.78 Lakh tons having average productivity of 30.49 q/ha (Directorate of Economics and Statistics 2016).

Plant density is one of the most important cultural practices determining grain yield, as well as other important agronomic attributes of this crop. Stand density affects plant architecture, alters growth and developmental patterns and influences carbohydrate production and partition. Maize is more sensitive to variations in plant density than other members of the grass family. Within the grass family, maize is likely the species that presents the highest grain yield potential. In order to fully explore its capacity to transform solar radiation into grain production, it is necessary to understand how plants interact morphologically and physiologically in a community and to identify management practices which allow them to maximize the use of growth resources in their environment. To enhance the farm profitability under different soil-climate conditions it is necessary to have information on optimum dose of fertilizer for crops. The ICAR project on soil test crop response (STCR) correlation used the targeted yield approach to develop relationship between crop yields on the one hand and soil test values and fertilizer input on the other.

Materials and Methods

Experimental details

The experiment entitled 'Effect of plant density and soil test crop response on growth and yield of maize (*Zea mays* L.) during *Kharif* season' was conducted during 2016 at experimental farm of the Department of Agronomy, Tirhut College of Agriculture, Dholi, Muzaffarpur (Bihar). The experiment consisted of genotypes in main plot, density in sub plot and nutrient management in sub-sub plot was carried out in split-split plot design. Treatments were replicated thrice. The level of variety, density and nutrient management were 2, 2 and 3, respectively. The details are given below:-

Main Plot

Genotypes (Medium maturity)

Hybrid Pioneer 3540
Hybrid Rasi 4595

Sub Plot

Plant density

50 X 20 cm
60 X 20 cm

Sub-Sub Plot

Nutrient management

Recommended dose of fertilizer (RDF) (120, 60 and 40 kg/ha N, P_2O_5 and K_2O)

STCR based nutrient application for yield target of 6.0 t/ha

Site specific nutrient management (SSNM)

Observation recorded

Plant height

Height of marked five plants was measured at 90 days after sowing.

The plant height was measured from the base of the plant to the tip of the upper most leaf. The value were averaged and expressed in cm.

Number of leaves/plant

The number of leaves was counted at 90 days after sowing from five randomly selected plants from each plot.

Dry matter accumulation (g/plant)

Randomly five plants were chosen from observation rows of every plot and cut simply over the ground level with the assistance of sickle at 90 days after sowing.

Grain yield (tons/ha)

The cobs were dehusked and air-dried for four days and then these were shelled separately. The shelled grains were cleaned and sun dried to obtain a constant weight.

This gave the yield in kg/plot and then it was converted to yield in tons/ha.

Stover yield (tons/ha)

The plants of each plot were cut from ground level after removal of the cobs. The stover was allowed to sundry to obtain a constant weight, which gave the stover yield in kg/plot and converted into tons/ha.

Stone yield (tons/ha)

The cobs after shelled remain stone were sun dried to obtain a constant weight which gave the stone yield in kg/plot and converted into tons/ha.

Harvest index (%)

The harvest index was calculated by dividing the economic (grain) yield to the total biological yield (grain + stover) and multiplying the factor by 100.

Results and Discussion

Plant height was significantly influenced due to plant density on maize crop depicted in Table 1. At 90 DAS, the maximum plant height 233.06cm was recorded in 60x20cm density and lowest plant height 227.75cm, in 50x20cm density. This increase in height may be due to low competition for space, light and nutrients of plants.

Similar result of increased plant height with increasing moisture regimes was reported by (Boomsma *et al.,* 2009). Significant effect of nutrient management was recorded at 90DAS of plant height. At 90 DAS, the maximum plant height 234.55cm, was recorded in STCR, which was statistically at par with SSNM. The lowest plant height 224.22cm was recorded in RDF. This might be due to increase rate of nutrients and better translocation of photosynthates from source to sink. The results are in conformity with the findings of Biradar *et al., (*2013).

Number of leaves/plant

Density affected the number of leaves/plant significantly depicted in Table 1, while maximum number of leaves/plant 12.53 was recorded at 90 days after sowing in 60X20cm density and lowest number of leaves/plant 12.21 was recorded in 50x20cm density.

Non-significant effect of levels of nutrient management on number of leaves was recorded at 90 days after sowing.

However the maximum number of leaves/plant 12.85 was recorded during both the years under STCR.

Dry matter accumulation (g/plant)

Plant dry matter production at 90 DAS of maize noticed difference significantly due to density depicted in Table 1.

At 90 DAS, the maximum dry matter accumulation 222.49 g/plant was recorded with 60x20cm density. Higher dry matter production could be mainly attributed to increased plant height. Similar observations were reported by Sayed and Hossein (2010) and Siamak *et al.,* (2014).

Significant effect of nutrient management on dry matter accumulation was recorded at 90 DAS. At 90 DAS, the maximum dry matter accumulation 223.14 g/plant was recorded by STCR.

In SSNM, dry matter accumulation 210.86 g/plant was observed which was statistically at par with RDF. This may be due to the fact that nutrient improved soil structure, rooting behavior of the crop and also enhanced soil organic matter and soil fertility. Similar findings have been reported by Verma *et al., (*2006).

Table.1 Effect of different treatments on plant height (cm), number of leaves/plant and dry matter accumulation (g/plant) of maize

Genotypes	Plant height (cm) at 90 DAS	Number of leaves/plant at 90 DAS	Dry matter accumulation (g/plant) at 90 DAS
Pioneer 3540	234.61	12.44	216.14
Rasi 4595	226.20	12.29	211.81
SEm ±	0.96	0.06	1.51
CD (P=0.05)	5.93	NS	NS
Density (cm)			
50X20	227.75	12.21	205.46
60X20	233.06	12.53	222.49
SEm ±	1.11	0.08	1.63
CD (P=0.05)	4.33	0.31	6.36
Nutrient management			
RDF	224.22	12.22	207.92
STCR	234.55	12.55	223.14
SSNM	232.45	12.34	210.86
SEm ±	2.31	0.16	3.59
CD (P=0.05)	6.93	NS	10.77

Table.2 Effect of different treatments on grain yield, stover yield, stone yield and H.I. of maize

Genotypes	Grain yield (tons/ha)	Stover yield (tons/ha)	Stone yield (tons/ha)	H.I. (%)
Pioneer 3540	5.54	9.80	1.91	32.10
Rasi 4595	5.20	9.68	1.86	31.05
SEm ±	0.04	0.04	0.01	0.13
CD (P=0.05)	0.24	NS	0.05	0.81
Density (cm)				
50X20	5.25	10.05	2.02	30.27
60X20	5.49	9.43	1.75	32.89
SEm ±	0.04	0.05	0.01	0.14
CD (P=0.05)	0.15	0.18	0.03	0.56
Nutrient management				
RDF	5.03	9.58	1.83	30.64
STCR	5.81	9.95	1.97	32.77
SSNM	5.26	9.70	1.84	31.34
SEm ±	0.09	0.10	0.02	0.31
CD (P=0.05)	0.27	0.29	0.06	0.95

Grain yield (tons/ha)

Plant density had significant effect on grain yield of maize depicted in Table 2. Significantly higher grain yield obtained (5.49 tons/ha) was obtained under 60x20cm density. The lowest grain yield was obtained (5.25 tons/ha) with 50x20cm density. This might be due to might be increase of yield attributes of maize under 60X20cm density. These findings are in accordance with experimental results of Abuzar *et al.*, (2011)

Significantly higher grain yield of maize 5.81 tons/ha respectively were recorded in STCR. In SSNM, the grain yield recorded 5.26 tons/ha, respectively which was statistically at par with recommended dose of fertilizer.

Stover yield (tons/ha)

Density had significant effect on stover yield of maize depicted in Table 2. Maximum stover yield was obtained (10.05 tons/ha) under 50x20cm density and lowest stover yield recorded (9.43 tons/ha) under the 60x20cm density. This might be due to higher number of plant population in 50X20 cm increase stover yield of maize.

Nutrient management had significant effect on the stover yield of maize. The maximum stover yield of maize 9.95 tons/ha was recorded in STCR. In SSNM, the stover yield of maize was recorded 9.70 tons/ha and which was statistically at par with RDF. This might be due to increased uptake of major nutrients nitrogen, phosphorus and potassium being part of essential nutrients, required for the production of meristematic tissues and physiological activities of leaves, roots and shoots *etc*. leading to an efficient translocation of water and nutrients. These physiological activities increased the nutrient uptake which resulted in higher total dry matter production. These findings are in accordance with experimental results of Dey and Sarma (1996).

Harvest index (%)

Plant density had significant effect on harvest index of maize depicted in Table 2. Significantly higher harvest index (32.89 percent) was obtained under the 60x20cm density. The lowest harvest index (30.27 percent) was obtained under 50x20cm density.

Nutrient management had significant effect on the harvest index of maize. Significantly higher harvest index of maize (32.77 percent) was recorded under STCR.

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