

## Effect of different levels of chemical fertilizers on growth and yield of Hybrid Maize (*Zea mays* L.)

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### Abstract

A field experiment was conducted during December, 2015 – March, 2016 Rabi season at the research farm of Department of Soil Science, Sam Higginbottom Institute of Agriculture, Technology and Sciences, (Deemed-to-be-University) Allahabad, India to study the Effect of different Levels of Chemical Fertilizers on growth and Yield of Maize (*Zea Mays* L.). The experiment was laid out as (RBD) Sample Randomized Block Design with three replications, nine treatments. The result shows that application of different levels combination of Inorganic fertilizers increased growth and yield of maize. It was concluded from trail that the application of chemical fertilizers in treatment T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) was found maximum plant height, number of leaves per plant, stem diameter, length of cob weight of 100 seed, and grain yield d parameter recorded maximum and high followed T<sub>7</sub> and also T<sub>2</sub> T<sub>3</sub> T<sub>4</sub> T<sub>5</sub> T<sub>6</sub> T<sub>8</sub> best from T<sub>0</sub> (control).

**Keywords:** Chemical fertilizers, Growth, maize, yield

### 1. Introduction

Maize is an important cereal crop which ranks the third after wheat and rice in the world. Maize is grown widely in many countries of the world (Onasanya *et al.*, 2009) [7]. Maize which is botanically called (*Zea mays* L) belongs to the family gramineae. It is a cereal monoecious shrub. (Echinger, D. 1926) [1]. It is one of the most widely grown cereals in the world and has great significance as human food, animal feed and raw material for large number of industrial products. In India, about 50 to 55 per cent of the total maize production is consumed as food, 30 to 35 per cent goes for poultry, piggery and fish meal industry and 10 to 12 per cent to wet milling industry. The green ears of maize are consumed directly as food in and around cities Maize has high production potential especially under irrigated condition when compared to any other cereal crop. The productivity of maize largely depends on its nutrient requirement and management particularly that of nitrogen, phosphorus and potassium. (Kumar *et al.*, 2007) [2].

Intensive land use with continuous use of higher doses of inorganic fertilizers significantly influences soil health and crop growth. This has raised concerns about the potential longterm adverse effects on soil health and environmental quality (Sarkar and Singh 1997). Marked deterioration in soil physical conditions resulting from continuous application of nitrogen (N), phosphorus (P), and potassium (K) fertilizers was reported (Parameswar *et al.*, 1989). Maize is one of the popular cereal crops grown throughout the globe. Being an exhaustive crop, maize requires high quantity of N for its optimum growth. Moreover in India, the higher subsidy rates on nitrogenous fertilizers artificially reduced their cost compared to P and K fertilizers. This encourages the farmers to use nitrogenous fertilizers in abundance ignoring their long-term effects on soil quality. (Sarma, *et al.*, 2015) [3].

### 2. Materials and Methods

The experiment was conducted at the research farm of Department of Soil Science, Sam Higginbottom Institute of

Agriculture, Technology and Sciences, (Deemed-to-be-University) Allahabad during Rabi season. The experiment area is located on the south of Allahabad on the right site of Yamuna River on the road at a distance of about 6 km from Allahabad city. It is situated at 25°57' N latitude, 81°59' E longitudes and the altitude of 98 meter above the near sea level. And fertilizers used in different levels. Nitrogen (120, 90, 50, 0) kg ha<sup>-1</sup>, phosphorus (60, 45, 30, 0) kg ha<sup>-1</sup>, potassium (40, 30, 20, 0) kg ha<sup>-1</sup> were applied under sandy loam soil.

Fertilizers were applied according to treatment combination. Amount of phosphorus was calculated on the basis general recommendation for maize crop (60 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>). SSP was supplied as the source of phosphorus and used difference doses in different plots. First phosphorus application calculated in 1ha and then in 1m<sup>2</sup>. The application of potassium were applied 20, 30, 40 kg ha<sup>-1</sup> and required amount of K<sub>2</sub>O (MOP 60%) needed for different treatment were calculated and was supplied as basal dose. Urea (46% Nitrogen) was applied as source of nitrogen 30 days after sowing, 60 days and 90 days by furrow replacement method at distance of 10 cm from the crop rows. Height of plants under three replications with different treatments recorded at 30, 60, 90, 120, days from three plants which were randomly selected of each plot. Height of plant recorded in centimeter from ground level up to last fully opened leaf of the main shoot. Total number of leaves recorded from each plot's three randomly selected plant after 30, 60, 90 and 120 days. Stem diameter of three selected plant from tree replication and different plots recorded by using vernier caliper. Under different treatments recorded at maturity of cob. For this three plants randomly selected from each plot and tagged for observation to be recorded. Length of cob in centimeter recorded from shoot tip to point of cob. Weight of 100 healthy seed randomly from each plot selected and then recorded. The crop plant of each plot harvested and put for sun drying. After the crops and plants properly dried threshing done manually (by beating and pressure) and seeds obtained weighed on a

single pan physical balance. The grain yield recorded in gram and then converted into kilogram.

### 3. Result and discussion

#### Growth of maize

The maximum plant height of maize at different days after sowing (DAS) at 30, 60, 90 and 120 were found in treatment T<sub>1</sub>(120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) which was 39.6, 84.67, 170.67 and 183.00 cm, by treatment respectively by treatments T<sub>4</sub>(120 kg N ha<sup>-1</sup>, 45 kg P ha<sup>-1</sup>, 30 kg K ha<sup>-1</sup>) were 34.22, 80.08, 160.80, and 182.66, cm while the minimum values of the result were found in treatments T<sub>0</sub>(control) which were 26.12, 45.76, 99.77, and 108.37 cm, respectively that the plant height of maize was found significant at different rate of compaction fertilizers and it was also observed that plant height of maize was gradually increased with rate of compaction Fertilizers. In treatment T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) gradually decrease as the rate of compaction, fertilizer and NPK levels increased plant height increased by moderate compaction and decrease by heavy compaction. Similar finding also reported by Khan *et al.*

(2014). The maximum number of leaves of maize at different days after sowing (DAS) at 30, 60, 90 and 120 were found in treatment T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) which was 7.11, 9.33, 11.67, and 12.10 by treatment respectively by treatments T<sub>4</sub>(120kg N ha<sup>-1</sup>, 45kg P ha<sup>-1</sup>, 30kg K ha<sup>-1</sup>) were 6.67, 9.00, 11.00, and 12.00 while the minimum values of the result were found in treatments T<sub>0</sub>(control) which were 4.78, 5.67, 8.78 and 9.00 respectively. The effect of NPK fertilizers on number of leaves of maize was also found significantly.

The maximum stem diameter of maize at different days after sowing (DAS) at 30, 60, 90 and 120 were found in treatment T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) which was 1.57, 2.34, 2.59 and 2.99 treatment respectively by treatments T<sub>4</sub>(120 kg N ha<sup>-1</sup>, 45 kg P ha<sup>-1</sup>, 30 kg K ha<sup>-1</sup>) were 1.44, 2.28, 2.77, and 2.97, while the minimum values of the result were found in treatments T<sub>0</sub>(control) which were 1.07, 1.47, 1.70, and 1.74 respectively. NPK fertilizer applications significantly increase plant height, stem girth, number of leaves, leaf area, leaf area index, dry matter accumulation and yield. Law-Ogbomo (2009) [5].

**Table 1:** Effect of different levels of chemical fertilizers on Plant height of maize

Treatments		30 DAS	60 DAS	90 DAS	120 DAS
T <sub>0</sub>	0 kg N ha <sup>-1</sup> , 0 kg P ha <sup>-1</sup> , 0 kg K ha <sup>-1</sup>	26.12	45.76	89.77	108.37
T <sub>1</sub>	120 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	39.06	84.67	160.67	183.00
T <sub>2</sub>	90 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	33.71	69.20	145.83	169.43
T <sub>3</sub>	60 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	26.78	52.50	141.83	159.98
T <sub>4</sub>	120 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	34.22	80.08	150.8	182.66
T <sub>5</sub>	60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	26.56	51.58	141.57	159.44
T <sub>6</sub>	90 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	29.89	60.32	139.33	158.22
T <sub>7</sub>	120 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	32.87	71.50	150.43	177.26
T <sub>8</sub>	60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	30.52	51.77	137.33	161.56
F- test S. Ed. (±)C. D. (P = 0.05)		S	S	S	S
		1.011	0.662	1.15	1.048
		2.087	1.367	2.39	2.162

**Table 2:** Effect of different treatment combination of fertilizers on number of leaves per plant in maize at different days intervals.

Treatments		30 DAS	60 DAS	90 DAS	120 DAS
T <sub>0</sub>	0 kg N ha <sup>-1</sup> , 0 kg P ha <sup>-1</sup> , 0 kg K ha <sup>-1</sup>	4.78	5.67	8.78	9.00
T <sub>1</sub>	120 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	7.11	9.33	11.67	12.10
T <sub>2</sub>	90 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	6.56	7.67	10.89	11.67
T <sub>3</sub>	60 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	5.56	6.33	9.11	9.67
T <sub>4</sub>	120 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	6.67	9.00	11.00	12.00
T <sub>5</sub>	60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	5.78	7.00	9.22	10.67
T <sub>6</sub>	90 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	5.56	6.67	9.78	11.67
T <sub>7</sub>	120 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	6.78	8.67	10.67	11.33
T <sub>8</sub>	60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	5.78	6.33	9.89	10.33
F- test S. Ed. (±) C. D. (P = 0.05)		NS	S	S	S
		0.662	0.396	0.273	0.090
		1.367	0.817	0.564	0.186

**Table 3:** Effect of different levels of chemical fertilizers stem diameter of maize

Treatments		30 DAS	60 DAS	90 DAS	120 DAS
T <sub>0</sub>	0 kg N ha <sup>-1</sup> , 0 kg P ha <sup>-1</sup> , 0 kg K ha <sup>-1</sup>	1.07	1.47	1.70	1.74
T <sub>1</sub>	120 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	1.57	2.34	2.59	2.99
T <sub>2</sub>	90 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	1.41	2.00	2.43	2.60
T <sub>3</sub>	60 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	1.23	1.78	1.97	2.21
T <sub>4</sub>	120 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	1.44	2.28	2.77	2.97
T <sub>5</sub>	60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	1.21	1.84	2.57	2.71

T <sub>6</sub>	90 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	1.23	1.87	2.17	2.51
T <sub>7</sub>	120 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	1.34	2.20	2.70	2.96
T <sub>8</sub>	60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	1.33	1.72	2.13	2.32
F- test S. Ed. (±) C. D. (P = 0.05)		NS	S	S	S
		0.450	0.043	0.083	0.108
		0.929	0.089	0.171	0.223

**Yield of maize**

The result of the data depicted that the maximum cob length was found in T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) (15.79 cm), followed by T<sub>7</sub> (120 kg N ha<sup>-1</sup>, 30 kg P ha<sup>-1</sup>, 40 kg K ha<sup>-1</sup>) (15.04cm) and minimum cob length recorded (9.30 cm) in T<sub>0</sub> (control). Cob length, cob diameter, 100 grain weight and grain yield, significantly (P=0.05) increased with N and P application such that 90kg N·ha<sup>-1</sup> and 30 kg N·ha<sup>-1</sup> gave the highest values. Therefore, further work should be carried out to ascertain the validity of this rate for maximum productivity. Olusegun. (2014) [6]

The result of the data depicted that the maximum weight of 1000 seed was found in T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) 27.47( g ), followed by T<sub>7</sub> (120 kg N ha<sup>-1</sup>, 30 kg P ha<sup>-1</sup>, 40 kg K ha<sup>-1</sup>) (26.50 g) and minimum weight of 1000 seed recorded (19.10) in T<sub>0</sub> (control).

The optimum level of NPK 15:15:15 fertilizer for successful production of maize grains was 400 (60 kg N + 27.16 kg P + 49.80 kg K) kg / ha compound fertilizer based on the fact that it had the greatest dry cob yield (12.44 t ha<sup>-1</sup>), grain yield (7.95 t ha<sup>-1</sup>), relative grain yield (2.26) and 100-seeds weight (11.62 g). Law-Ogbomo (2009) [5].

The result of the data depicted that the maximum grain yield was found in T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) (7325.53 kg ), followed by T<sub>7</sub> (120 kg N ha<sup>-1</sup>, 30 kg P ha<sup>-1</sup>, 40 kg K ha<sup>-1</sup>) (6964.37 kg) and minimum grain yield recorded (2826.87 kg) in T<sub>0</sub> (control) and also Cob length, cob diameter, 100 grain weight and grain yield, significantly (P=0.05) increased with N and P application such that 90kg N·ha<sup>-1</sup> and 30kg N·ha<sup>-1</sup> gave the highest values. Therefore, further work should be carried out to ascertain the validity of this rate for maximum productivity. Olusegun (2014) [6].

**Table 4:** Effect of different treatment combination of chemical fertilizers on yield of maize (*Zea mays* L.)

Treatments	Cob length (cm)	Weight of 100 seeds (g)	Grain yield (kg ha <sup>-1</sup> )	Cost of cultivation (Rs ha <sup>-1</sup> )	Gross return (Rs ha <sup>-1</sup> )	Net return Rs ha <sup>-1</sup> )	Benefit cost ratio
T <sub>0</sub> 0 kg N ha <sup>-1</sup> , 0 kg P ha <sup>-1</sup> , 0 kg K ha <sup>-1</sup>	9.3	19.10	2826.87	52950.0	49472.1	3477.89	0.93
T <sub>1</sub> 120 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	15.79	27.47	7325.53	57021.5	128203.	71182.0	2.25
T <sub>2</sub> 90 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	14.97	25.63	6516.43	62773.0	114031.	51258.2	1.82
T <sub>3</sub> 60 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	12.68	19.90	3351.17	55950.0	58643.0	2693.01	1.05
T <sub>4</sub> 120 kg N ha <sup>-1</sup> , 45 kg P ha <sup>-1</sup> , 30 kg K ha <sup>-1</sup>	14.27	24.77	6964.37	58254.0	121871.	63617.0	2.09
T <sub>5</sub> 60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 20 kg K ha <sup>-1</sup>	10.17	20.73	4424.47	63773.0	77421.4	13648.3	1.21
T <sub>6</sub> 90 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	11.76	23.13	4929.83	56950.0	86274.4	29324.4	1.51
T <sub>7</sub> 120 kg N ha <sup>-1</sup> , 30 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	15.04	26.50	6659.87	59253.	116549.	57295.8	1.97
T <sub>8</sub> 60 kg N ha <sup>-1</sup> , 60 kg P ha <sup>-1</sup> , 40 kg K ha <sup>-1</sup>	12.3	22.13	5166.73	64773.0	90421.6	25648.6	1.40
F- test	S	S	S	Not subjected to statistical analysis			
S. Ed. (±)	0.627	0.378	104.649				
C. D. (P = 0.05)	1.294	0.780	215.997				

**4. Conclusion**

It was concluded from trail that the application of chemical fertilizer in treatment number T<sub>1</sub> (120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup>, 20 kg K ha<sup>-1</sup>) was found best in increasing plant height, no. of leaves per plant, stem diameter, length of cob weight of 100 seed, and grain yield. The physical. The maximum net return 71182.02 ha<sup>-1</sup>. Since the result is based on one season experiment, further trial is needed to substantiate the results.

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