

Original Research Article

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Effect of Nutrients Application Method on Productivity and Economics of Maize

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ABSTRACT

The concept of balanced fertilization with proper method at proper time paves the way for optimum profitability of farmers. Since most of the soils in Koshi region of Bihar are sandy clay in their textural class with medium to low in N, P, K and Zn. Due to that farmers of Koshi region applying nutrients unscientifically. Therefore, they enable to reap best harvest and to augment the profitability from this crop and hence an experiment was conducted at farmer fields of Katihar district by Krishi Vigyan Kendra, Katihar, (Bihar Agricultural University Sabour, Bhagalpur) during two consecutive years of 2015-16 and 2016-17 to study the effect of nutrients application method on productivity and economics of maize. The experiment was laid out in alluvial soil with three treatments and ten replications in RBD. The details of treatments was {(T₁–Farmer Practices (60:0: 0:: N:P:K Basal + 50:40:20 N:P:K at 30 DAS+ 30 kg N at 60 DAS), T₂–RDF (60:60:40:: N:P:K Basal + 45 kg N at 30 DAS+45 kg N at 60 DAS), T₃– RDF (60:60:40:25:: N:P:K:Zn Basal + 45 kg N at 30 DAS + 45 kg N at 60 DAS)}. Healthy and bold seeds of maize var. Pioneer 3522 were dibbled into the soil @ 1 seed hill⁻¹ at a spacing of 60 cm X 20 cm. The growth and yield attributes of maize viz., plant height, plant diameter, leaf length, leaf width, cob length, no of cob per plant, no of grains per cob, kernel and stover yield were significantly influenced by different method of nutrient application. There was a progressive increase in the growth and yield attributes with each application methods of nutrients applied from T₁ to T₂ and further increase in growth attributes were noticed when the graded levels fertility were supplemented with Zn as soil application T₃. There was a gradual and progressive increase in growth and yield attributes with basal application of P K and zinc in comparison to T₁ where P K applied at 30 days after sowing.

Keywords

Growth and yield attributes, Maize, Nutrient application method, Zinc

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Introduction

Maize is an important cereal in India, and both its area and production has been steadily

increased over the past two decades. In India, the major maize growing season is kharif which accounts for about 85% of the total maize area. However, in spite of maximum

share in area, the relative contribution of kharif maize is comparatively much lower than rabi maize. Rabi maize contributes more than 25% to annual production with less than 10% of total maize growing area. Several factors have been found to affect the productivity of rabi maize however; fertilizer management is one of the chief factors that affect the growth and yield of maize.

Maize is an exhaustive crop which requires adequate amounts of macro and micro nutrients in order to get better growth and exploit yield potential. Winter maize was proved to be more responsive to the fertilizer application (Savita Mehta *et al.*, 2011) due to its vigorous plant growth and longer duration.

NPK are critical input in agriculture and its importance on account of the vital role being played in major life processes and its availability to the growing crop in required levels is of very important. Among the micro nutrients, zinc is now been reported as the fourth most important limiting nutrient element in the crop production after N, P and K. Under Zn deficiency conditions, flowering and yields are reduced and growth period is prolonged resulting in delayed maturity and quality of the crop may also suffer. Since most of the soils in Koshi region of Bihar are sandy clay in their textural class with medium to low in N, P and K the nutrient requirement of this crop, especially with respect to the major nutrients needs to be scientifically quantified in proper time but farmers of Koshi region not applied as a basal dose of nutrients specially P, K and Zn.

Therefore, they enable to reap best harvest and to augment the profitability from this crop and hence the present investigation was conducted by Krishi Vigyan Kendra, Katihar to study the effect of nutrients application method on productivity and economics of maize.

Materials and Methods

The experiment was conducted at farmer fields of Katihar district by Krishi Vigyan Kendra, Katihar, (Bihar Agricultural University Sabour, Bhagalpur) during two consecutive years of 2015-16 and 2016-17 to study the effect of nutrients application method on productivity and economics of maize. It lies between Latitude 25°N to 26°N, Longitude 87° to 88°E with an altitude of 32 m above MSL. The climate is sub-tropical and humid having mean maximum and minimum temperature between 42°C and 4°C, respectively and the average annual rainfall of the district is about 1200 mm. The experimental soils are non-calcareous light gray flood plain belongs to the Alluvial Tract lies between three major rivers Mahananda, Kosi and Ganga. The soil samples were collected from different farmer field before start the experiment and after harvesting of the crop in each year and at each sampling site and analyzed with standard method.

The experiment was laid out in RBD with three treatments and ten replications in 4.0 m X 2.5 m plot size with treatments was {(T₁– Farmer Practices (60:0: 0:: N:P:K Basal + 50:40:20 N:P:K at 30 DAS+ 30 kg N at 60 DAS), T₂–RDF (Basal 60:60:40:: N:P:K + 45 kg N at 30 DAS+45 kg N at 60 DAS), T₃– RDF (Basal 60:60:40:25:: N:P:K:Zn + 45 kg N at 30 DAS + 45 kg N at 60 DAS)} respectively. Healthy and bold seeds of maize var. Pioneer 3522 were dibbled into the soil @ 1 seeds hill⁻¹ at a spacing of 60 cm X 20 cm i.e. plants density was 8300 plants ha⁻¹. The crop was harvested at maturity when the cobs dried and the entire plants turned yellow and analyzed standard statistical analysis of variance technique. The B C ratio and other calculation done as follows:

$$\text{Harvest index} = \frac{\text{Economic yield (seed yield)}}{\text{Biological yield (seed + stover yields)}}$$

Nutrient uptake by grain (kg ha^{-1}) =

$$\frac{\text{Nutrient content (\%)} \times \text{Kernel yield (kg ha}^{-1}\text{)}}{100}$$

Nutrient uptake by stover (kg ha^{-1}) =

$$\frac{\text{Nutrient content (\%)} \times \text{Stover yield (kg ha}^{-1}\text{)}}{100}$$

Net returns = Gross returns - Total operational cost (Rs. ha^{-1})

$$\text{B:C Ratio} = \frac{\text{Net returns (Rs.ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs.ha}^{-1}\text{)}}$$

Results and Discussion

Effect of treatments on growth attributes of maize

The growth parameters of maize *viz.*, plant height, plant diameter, length and width of leaves gradually increased with the advancement in the growth intervals of the crop till the final stage under all treatments. The rate of increase in plant height was most rapid during 30 to 60 DAS. The full height was attained by the plants at 90 DAS and thereafter the plant height was almost ceased or decreased at harvest. Plant growth attributes significantly affected by various treatments at all the growth intervals of maize. Plant height, plant diameter, leaf length and leaf width were at harvesting stage maximum (184.25 cm, 14.72 cm, 74.65 cm and 11.21 cm) under T₃- RDF (Basal 60:60:40:25:: N:P:K:Zn + 45 kg N at 30 DAS + 45 kg N at 60 DAS) which was significantly superior (182.64, 12.45, 74.28 and 10.73 cm) over T₂-RDF (Basal 60:60:40:: N:P:K + 45 kg N at 30 DAS+45 kg N at 60 DAS), While minimum (160.30, 11.34, 68.52 and 10.27 cm) growth attributes were recorded under T₁- where 60:0: 0:: N:P:K Basal + 50:40:20 N:P:K at 30 DAS+ 30 kg N at 60 DAS,

respectively. It is possible due to reduced loss of nutrients from Indiscriminant doses of nutrients. Similar findings were also supported by Singh *et al.*, (1995) and Chandrasekhar (2000) (Fig. 1).

Effect of different treatments on yield parameters of maize

The significant increase in yield attributes were observed under the application of different treatments *viz.* number of cob per plant, cob weight (g), cob length, cob girth and number of grain row per cob (Table 3 and 4). This might be due to the sufficient amount of nutrient availability for the better growth and development of the plant which ultimately resulted in the higher yield attributes. Secondly the increase yield attributing characters might be due to rapid mineralization of N from organics which might have met the N requirement of the crop at critical stages. Organic act as nutrient reservoir and upon decomposition produce organic acid, thereby absorbed ion were released slowly during entire growth period leading to higher yield attributing characters. These findings are in agreement with those of Kumar and Singh (1992), Rameshwar *et al.*, (1998), Sheeba *et al.*, (2000) and Kumar and Singh (1992).

Effect of different treatments on kernel and stover yield of maize

Enhanced levels of nutrient supply exerted a significant and positive influence on the kernel yield of maize (Table 3 and Fig. 2). The kernel yield increased progressively with apply of fertiliser with T₂ (60:60:40:: N:P:K basal + 45 kg N at 30 DAS+45 kg N at 60 DAS) 92.32 qt ha⁻¹ and the kernel yield was further escalated when these levels were supplemented with Zn through soil (T₃ - 102.34 qt ha⁻¹) 60:60:40:25:: N:P:K:Zn basal + 45 kg N at 30 DAS + 45 kg N at 60 DAS in

comparison with T₁ (65.45 qt ha⁻¹) where nutrients supplied in unscientific manner 60:0:0:: N:P:K as basal + 50:40:20 N:P:K at 30 DAS+ 30 kg N at 60 DAS. In the present investigation the grain and stover yields were significantly more under highest concentration of Zn with RDF (Table 4). As the grain yield is positively correlated with yield attributes, which were also higher (Table 4 and 3) due to the more availability of nutrients under the application of 25 kg Zn + RDF application at critical stages, which ultimately produced the higher yields. These findings are in agreement with those of Singh *et al.*, (1981), Hussien and Reddy (1985), Ramana *et al.*, (2002) and Motavalli *et al.*, (1993).

Harvest Index

As regarded harvest index it was not influenced markedly due to different treatments (Table 4). The maximum harvest index was obtained under T₃ - 60:60:40:25:: N:P:K:Zn basal + 45 kg N at 30 DAS + 45 kg

N at 60 DAS (0.58) which was close to T₂ - 60:60:40:: N:P:K basal + 45 kg N at 30 DAS+45 kg N at 60 DAS (0.56) and T₁ - 60:0:0:: N:P:K as basal + 50:40:20 N:P:K at 30 DAS+ 30 kg N at 60 DAS (0.52). It is possible due to excellent growth and development of maize plant under higher nutrient environment during critical period of crop growth and highly correlated with the findings of Singh *et al.*, (1995).

Effect on soil properties

Chemical properties of soil viz., pH, EC, OC, and available N, P and K status were determined before sowing and after harvest of crop under different treatments (Table 1) indicated that the different treatments did not altered the various properties of soil significantly. Since the present study concerned with the effect of RDF an application method with Zn on maize in experimental field only for two season, hence remarkable changes in soil properties was not observed.

Table.1 Effect of different treatments on physico-chemical properties of experimental soil

Treatments	pH		ECe		OC		N		P		K		Zn	
	(1 : 2.5)		(d Sm ⁻¹)		(%)		Available Nutrients (Kg ha ⁻¹)						(ppm)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
T ₁	6.92	6.83	0.19	0.21	0.26	0.26	189	180	22	19	235	232	0.42	0.40
T ₂	6.94	6.82	0.19	0.23	0.31	0.32	204	208	22	25	238	240	0.42	0.42
T ₃	6.95	6.88	0.21	0.30	0.33	0.35	215	224	23	27	241	248	0.45	0.48
CD (p=0.05)	0.02	0.02	NS	0.02	0.02	0.03	4.0	3.8	0.06	0.05	2.2	2.5	NS	0.2

Table.2 Effect of different treatments on uptake of different nutrients in seed and stover of maize

Treatments	Seed (Kgha ⁻¹)			Stover (Kgha ⁻¹)		
	N	P	K	N	P	K
T ₁	27.21	6.25	24.45	164.74	52.38	240.51
T ₂	31.42	6.54	27.39	167.36	57.35	252.25
T ₃	33.55	7.28	31.50	170.22	61.62	255.30
CD (p=0.05)	0.74	0.04	0.25	1.04	0.95	2.08

Table.3 Effect of different treatments on growth attributes of maize

Treatment	Plant height (cm)	Plant diameter (cm)	Leaf length (cm)	Leaf width (cm)	Cob length (cm)	Cob grith (cm)	No of cob plant ⁻¹	No of grains cob ⁻¹
T ₁	160.30	11.34	68.52	10.27	14.76	11.2	1.35	342
T ₂	182.64	12.45	74.28	10.73	16.31	14.8	1.38	365
T ₃	184.25	14.72	74.65	11.21	16.87	16.5	1.39	387
CD (p=0.05)	1.54	1.21	0.26	0.22	0.05	0.78	0.02	4.56

Table.4 Effect of different treatments on yield attributes of maize

Treatment	No of grains plant ⁻¹	Kernel wt plant ⁻¹ (g)	Stove wt. plant ⁻¹ (g)	Test wt 1000 seeds (g)	Grain yield (qt ha ⁻¹)	Stove yield (qt ha ⁻¹)	Harvesting Index
T ₁	461.70	108.04	147.24	234	65.45	125.25	0.52
T ₂	503.70	134.99	161.45	268	92.32	165.60	0.56
T ₃	537.93	153.31	175.63	285	102.34	175.16	0.58
CD (p=0.05)	12.61	15.85	8.24	14.70	11.45	9.36	0.01

Table.5 Effect of different treatments on economics of maize

Treatment	Cost of cultivation (Rs ha ⁻¹)	Gross Income (Rs ha ⁻¹)	Net Income (Rs ha ⁻¹)	BC
T ₁	48206	123574	75368	1.56
T ₂	48806	150650	101844	2.09
T ₃	50840	169805	118965	2.34
CD (p=0.05)	44.53	32.85	38.50	NA

Fig.1

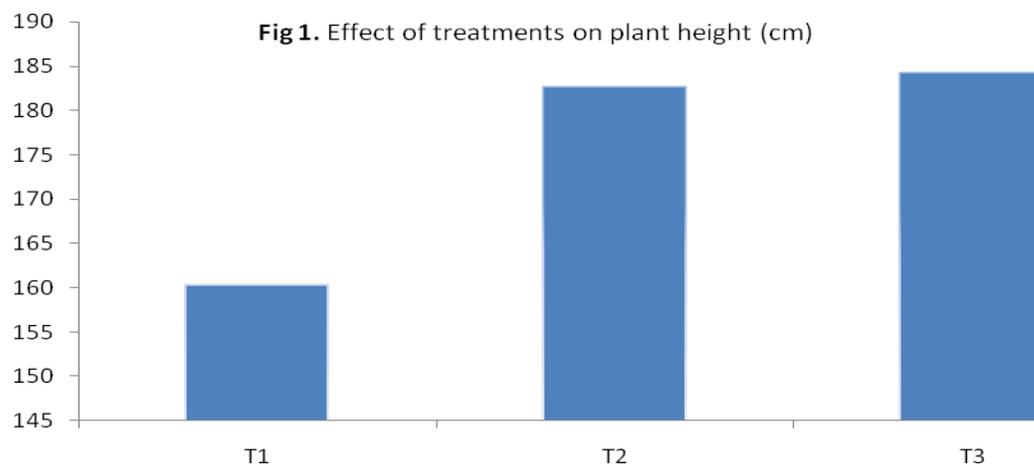


Fig.2

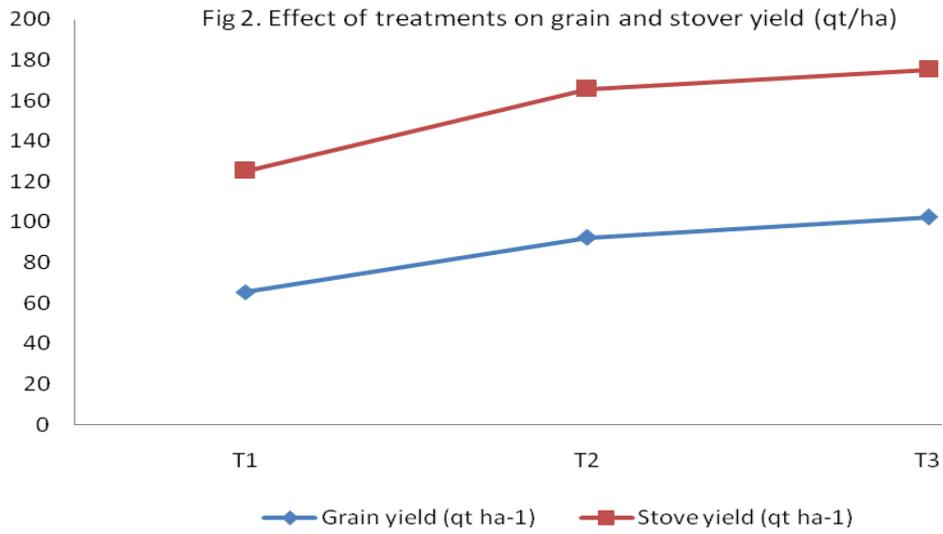


Fig.3

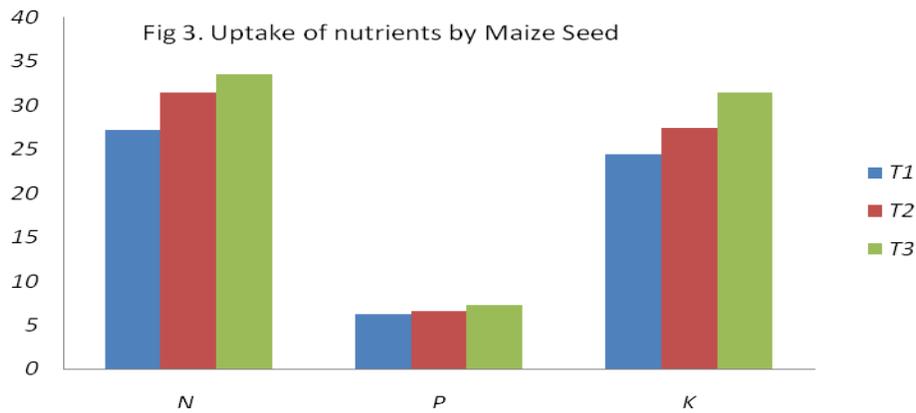


Fig.4

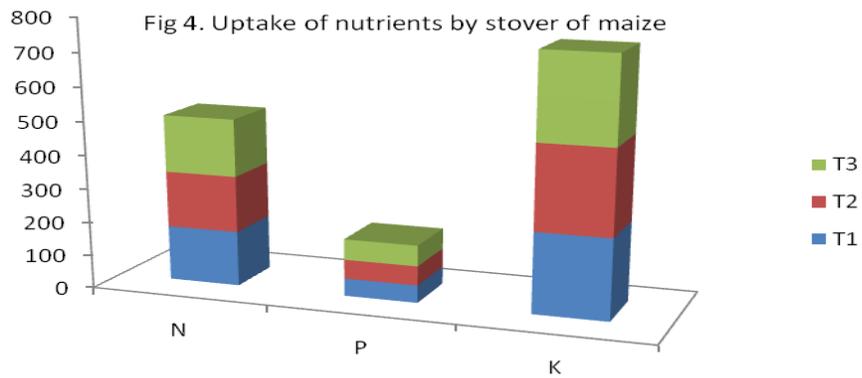
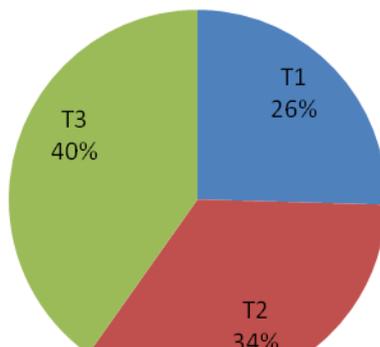


Fig.5

Fig 5. Effect of treatments on net income



Total N, P and K uptake by crop

On considering the nutrients uptake in grain and stover (Table 2, Fig. 3 & 4) maximum N, P and K uptake in grain and stover were obtained under T₃ as compared to T₂ and T₁. The increase in nutrient contents and uptake could be attributed to increase supply of nutrients to the plant, which in turn might have resulted in profuse shoot and root growth thereby activating greater absorption of N, P and K from the soil. These results were also supported by Prasad *et al.*, (2010).

Effect of different treatments on economics of maize

The economic analysis of the treatment is the most important from the farmer's point of view regarding implementation of the practices evolved under any investigation. Economic analysis of treatment was determined on per hectare area basis, which includes cost of cultivation, gross monetary returns, net monetary returns and benefit cost ratio as affected by various treatments (Fig. 5 and Table 5). The cost of cultivation was noted minimum under T₁ and it increased orderly with different treatments due to increase in addition of application method with Zn. The higher gross income were observed under T₃ due to obtaining higher grain and stover yields with these treatments. The maximum B:C ratio was noticed under the application of nutrients as 60:60:40:25:: N:P:K:Zn basal + 45 kg N at 30

DAS + 45 kg N at 60 DAS (2.34) thus indicate that for achieving the maximum benefit. The maximum benefit per rupee investment might be due to the application of nutrients in three split as one third N with full doses of P and K with 25 kg Zn as compared to other treatments.

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