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Effects of Different Levels of Nitrogen and Phosphorus on Physico–chemical Properties of Soil on growth and yield of maize (*Zea mays* L.) Uttar Pardesh, India

[1] Safiullah Hakimi, [2] Narendra Swaroop

[1] Research Scholar, Department of Soil Science, Samhigginbottom Institute of Agriculture, Technology and Science Deemed-to-be-University Allahabad, Uttar Pardesh India

[2] Associate Professor, Department of Soil Science, Samhigginbottom Institute of Agriculture, Technology and Science Deemed-to-be-University Allahabad, Uttar Pardesh India

Abstract
A field experiment was conducted during Rabi season (Nov. 2015-March 2016) to study the "Effects of different levels of Nitrogen and phosphorus on Physico–chemical properties of soil, growth and yield of maize (*Zea mays* L.) Utraperdesh, India" at the research farm of department of soil science, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Allahabad, The experiment was laid out in randomized block design with three levels of Nitrogen (0 kg ha^{-1}, 100 kg ha^{-1}, 120 kg ha^{-1}) and three levels of Phosphorous (0 kg ha^{-1}, 80 kg ha^{-1} and 100 kg ha^{-1}). The treatments combinations were replicated three times and were allocated at random in each replication. The treatment combination T_8 [120 Kg N+ 100 kg P] gave the best result with the respect to plant height 172.33cm, number of leaves 12.22, stem diameter 2.86 cm, it gave highest grain seed yield 67.33, stove yield 171.33 and 1000 seed weight 224.44 g. Combined use of nitrogen and phosphorus resulted in significant increase on enrichment of soil fertility status. From the economical point of view,the same treatment gave the maximum profit of Rs90959.81 with C:B ratio of 2.50.

Keywords: Soil Physical and chemical properties, Soil amendment, nitrogen and phosphorus

Introduction
Maize is one of the world's leading crops cultivated over an area of 139 million hectares. with a production of about 600 million tones of grain. USA leads the largest area, followed by Brazil, China, Mexico and India. Maize is grown in almost all states of India occupying an area of 6 million hectares with the production and productivity of 9.7 mt and 1.7 t ha^{-1} respectively (Kumar *et al*. 2007) [6].

Maize is one of the important cereal crops in the world agricultural economy both as food grains for human and fodder and feed for cattle and poultry. Maize grain contains about 72% starch, 10% protein, 4.8% oil, 5.8% fiber, 3.0% sugar and 1.7% ash (Choudhary, 1994) [3]. Along with this, it is rich in vitamin A, vitamin E, nicotinic acid, riboflavin and contains fairly high phosphorus than rice and sorghum. Its fodder and hay contain 7-10% protein, 15-36% fiber, 2.09 to 2.62% ether extract, 0.42-0.70% Calcium, 0.28-0.29% phosphorus, 0.45% Magnesium, 1.34% Potassium and 56% carbohydrate, therefore, it has very nutritive fodder and hay. Besides food grain, fodder and feed, it has prime importance in textile, starch and dye industries (Rai 2006) [10].

Maize is one of the most important cereal crops in the world it is a member of family graminae (*poeceae*) sub family panicoideae. Maize is also known as 'Queen of cereals' and kind of fodder maize has been usually considered as poor man's crops and occupying the place in the rich communities due to its multifarious uses as industrial food and feed crops (Suke *et al.* 2011) [12].

One of these fertilizers is Phosphate bio-fertilizer (fertile 2). Its high capability as a solvent for phosphate, climatic adaptability, stability during the storage, easy consumption, cheap transport, and compatibility with other fertilizers and pesticides are mentioned as the features of this kind of fertilizer (Hashemi, 2008) [5]. Jat and Shaktawat showed that phosphate bio-fertilizer in comparison to triple super phosphate fertilizers considerably increased the yield. Phosphate solubilizing bacteria secrete phosphates and organic acids and thus make phosphate solution and increase the phosphate uptake by plants. (Peix *et al.* 2001) [9] reported that the use of phosphate solubilizing bacteria caused the increase solubility of insoluble phosphorus, increase of phosphorus uptake, and significant increase of yield in barley and peas. (Sylvia *et al.* 1993) [14] concluded that in treatments which used phosphate biological fertilizer, the concentration of phosphorus and copper increased in corn's shoots and seeds.
(Goenadi, 1998) [4] reported that the use of bio-fertilizers and 50-75% chemical fertilizer led to a yield similar to the yield of the consumption of 100% chemical fertilizer.

Nitrogen is a vitally important for plant nutrient. Nitrogen is essential constituent of protein and is present in many other compound of great physiological importance in plant metabolism. Nitrogen is called a basic constituent of life. Nitrogen also impart vigorous vegetative growth dark green colour to plant and it produce early growth of maize. Nitrogen governs the utilization of potassium, phosphorus and other elements in maize crop. Phosphorus has a great role in energy

storage and transfer and closely related to cell division and development of maize. Phosphorus is a constituent of nucleic acid, phytin and phosphor-lipid. Phosphorus compound acts as energy within plants. Phosphorus is essential for transformation of energy, in carbohydrate metabolism, in fat metabolism, in respiration of plant and early maturity of maize. Potassium play important role in formation of protein and chlorophyll and it provide much of osmotic "pull" that draw water into plant roots. Potassium produces strong stiff straw in maize and reduce lodging in maize. Potassium imparts increase vigor and disease resistance to plant. Phosphorus has a great role in energy storage and transfer and closely related to cell division and development of maize**.**

Material and Methods

Soil Sampling

The soil of experimental area falls in order of Inceptisol and in experimental plots is alluvial soil in nature. The soil samples randomly collect from five different sites in the experiment plot prior to tillage operation from a depth of 0-15 cm. The size of the soil sample reduce by conning and quartering the composites soil sample is air dry and pass through a 2 mm sieve by way of preparing the sample for physical and chemical analysis. The experimental details are given below under different heading:

Design and treatment

The experiment was carried out in 3×3 factorial randomized block design with three levels of Nitrogen, three levels of phosphorus. The treatments were replicated three times and were allocated at random in each replication.

Experimental sites

The experiment was conducted on the research farm of department of Soil Science, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad which situated six km away from Allahabad city on the right bank of yamuna river, the experimental site is located in the sub – tropical region with 25^0 N *latitude* 81.50^0 E longitude and 95 *MSLaltitude.*

The fertilizers were applied in each plot according to treatment combinations. The nitrogen requirement meets with urea 46%. The nitrogen was applied with the three different levels *i.e.* 0 kg N ha^{-1}, 100 kg N ha^{-1} and 120kg N ha^{-1}. The amount phosphorus was given in equal quantity to each plot which was calculated on the basis of general recommendation for maize as 0 kg, 80 kg, 100kg ha^{-1} was supplied. On the basis of treatment combination the fertilizer used are described in table below.

Table 1: Fertilizer applications

S. NO.	Treatments	Dose ha^{-1}	Symbol
1.	Levels of Nitrogen	0 kg ha^{-1}	N_0
		100 kg ha^{-1}	N_1
		120 kg ha^{-1}	N_2
2**.**	Levels of Phosphorous	0 kg ha^{-1}	P_0
		80 kg ha^{-1}	P_1
		100 kg ha^{-1}	P_2

Sowing of seed

Seed were sown at a depth of 2.5 to 3.0 cm in rows with a seed rate of 25 kg ha^{-1}. The row to row spacing was 0.60 plant to plan 0.25m.

Sowing of seeds

The maize was sown at 25 kg ha^{-1}.The ridges had drawn maintaining row to row distance 25 cm and plant to plant distance 60 cm.

Irrigation

Light irrigation was given at 16 days after sowing, second irrigation at 43 days after sowing, third irrigation 70 days after sowing and fourth irrigation at 95 days after sowing five irrigation 120 DAS.

Weeding

1st Hand weeding was done with the help of khurpi at 25 days after sowing and 2nd hand weeding was done at 45 days after sowing to control the weeds.

Harvesting

Crop was harvested plot-wise at maturity stage.

Results and Discussion

Plant height (cm)

Perusal of table 1 reveals the mean plant height at successive stages of growth under various treatmentss. The maximum plant height was recorded 172.33 cm with (N_{120} P_{100}) treatment combination followed by 170.89 cm with (N_{120} P_{80}) treatment combination whereas the minimum plant height was observed 129.56 with control (N_0P_0) treatment. The statistical analysis of plant height data indicates that there was significant difference in plant height interaction between nitrogen and phosphorus. Similar result also found by Nanwal (1991) [8]. Whereas the maximum number of leaves was found 12.22 respectively with (N_{120} P_{100}) treatment combination followed by 11.89 with (N_{120} P_{80}) treatment combination whereas the minimum number of leaves was recorded 9.44 with control (N_0P_0) treatment. The statistical analysis of number of leaves data indicates that there was a significant difference in number of leaves interaction between nitrogen and phosphorus. Same result also reported by Shivy *et al.* (1999) [11]. The maximum stem diameter was recorded 2.86 with (N_{120} P_{100}) treatment combination followed by 2.64 with (N_{100} P_{100}) treatment combination whereas the minimum stem diameter was observed 1.70 with control (N_0P_0) treatment. The statistical analysis of stem diameter data indicates that there was a significant difference in stem diameter at 30, 60, 90 and 120 DAS interaction between nitrogen and phosphorus. Same result also found by Choudhary *et al*. (2002) [2]. The maximum 1000 seed weight (g) 224.44 was recorded with (N_{120} P_{100}) treatment combination followed by 199.7 with (N_{120} P_{80}) treatment combination whereas the minimum 85.5 1000 seed weight (g) was recorded with control (N_0P_0) treatment. The statistical analysis of 1000 seed weight (g) data indicates that there was a significant difference in 1000 seed weight (g) interaction between nitrogen and phosphorus. Same result also found by Ali (2010). The maximum seed yield 67.33 was recorded with (N_{120} P_{100}) treatment combination followed by

59.93 with (N_{120} P_{80}) treatment combination whereas the minimum 25.67 seed yield was recorded with control (N_0P_0) treatment. The statistical analysis of seed yield data indicates that there was a significant difference in seed yield interaction between nitrogen and phosphorus. Same result also found by Mahesh (2010) [7]. The maximum stove yield 171.33 was recorded with (N_{120} P_{100}) treatment combination followed by 168.00 with (N_{120} P_{80}) treatment combination whereas the minimum 96.63 stove yield was recorded with control (N_0P_0) treatment. The statistical analysis of stove yield data indicates that there was a significant difference in stove yield interaction between nitrogen and phosphorus. Similar finding also found by Surendra Mohan (2015) [13].

Table 1a: Effect of different levels of Nitrogen and Phosphorus on plant height (cm), number of leaves/plant and stem diameter (cm).

Levels of Nitrogen (N)	Plant height (cm)				Number of leaves/plant				Stem diameter (cm)			
	Levels of Phosphorous (P)			Mean (N)	Levels of Phosphorous (P)			Mean (N)	Levels of Phosphorous (P)			Mean (N)
	0 kg ha^{-1}	80 kg ha^{-1}	100 kg ha^{-1}		0 kg ha^{-1}	80 kg ha^{-1}	100 kg ha^{-1}		0 kg ha^{-1}	80 kg ha^{-1}	100 kg ha^{-1}	
0 kg ha^{-1}	129.56	155.67	157.00	147.41	9.44	10.67	11.11	10.41	1.70	2.24	2.40	2.11
100 kg ha^{-1}	167.44	166.78	168.56	167.59	11.22	11.33	11.44	11.33	2.46	2.34	2.54	2.45
120 kg ha^{-1}	163.89	170.89	172.33	169.04	10.78	11.89	12.22	11.63	2.44	2.64	2.86	2.65
Mean (P)	153.6	164.4	166		10.48	11.3	11.59		2.2	2.41	2.6	
	F-test	S. E m. (±)	C.D. at 5%		F-test	S. E m. (±)	C.D. at 5%		F-test	S. Em. (±)	C.D. at 5%	
Due Nitrogen (N)	S	0.60482	1.28221		S	0.05197	0.11017		S	0.06236	0.13221	
Due to Phosphorus (P)	S	0.60482	1.28221		S	0.05197	0.11017		S	0.06236	0.13221	
Inter (N x P)	S	1.04757	2.22085		S	0.09001	0.19082		S	0.10801	0.22899	

Table 1b: Effect of different levels of Nitrogen and Phosphorus on 1000 seed weight (g), seed yield (q/ha) and stover yield (q/ha).

Levels of Nitrogen (N)	1000 seed weight (g)				Seed yield (q ha^{-1})				Stover yield (q ha^{-1})			
	Levels of Phosphorous (P)			Mean (N)	Levels of Phosphorous (P)			Mean (N)	Levels of Phosphorous (P)			Mean (N)
	0 kg ha^{-1}	80 kg ha^{-1}	100 kg ha^{-1}		0 kg ha^{-1}	80 kg ha^{-1}	100 kg ha^{-1}		0 kg ha^{-1}	80 kg ha^{-1}	100 kg ha^{-1}	
0 kg ha^{-1}	85.56	115.49	138.87	113.30	25.67	34.65	41.66	33.99	96.63	115.67	124.67	112.34
100 kg ha^{-1}	160.99	185.00	185.00	177.00	48.30	55.50	55.50	53.10	117.00	160.67	162.67	146.78
120 kg ha^{-1}	176.11	199.78	224.44	200.11	52.83	59.93	67.33	60.03	139.33	168.00	171.33	159.55
Mean (P)	140.89	166.76	182.77		42.27	50.03	54.83		117.67	148.11	152.89	
	F-test	S. Em. (±)	C.D. at 5%		F-test	S. Em. (±)	C.D. at 5%		F-test	S. Em. (±)	C.D. at 5%	
Due Nitrogen (N)	S	6.41799	13.6061		S	1.55902	3.30513		S	0.881	2.977	
Due to Phosphorus (P)	S	6.41799	13.6061		S	1.55902	3.30513		S	0.881	2.977	
Inter (N x P)	S	11.1163	23.5665		S	2.70031	5.72465		S	2.251	5.881	

Conclusion

It may be concluded the application of 120 kg ha^{-1} Nitrogen, 100 kg ha^{-1} Phosphorus supplied through inorganic fertilizers gave the best results it term of growth and yield of maize and soil phsico-chmical properties. Since the result is based on one year experiment further trail is needed to substantiate the results.

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