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Effect of Nutrient Management on Nutrient Uptake and Economics of Maize (*Zea mays* L.) under Different Tillage Practices

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ABSTRACT

A field experiment was carried out during *kharif* season of 2016 at Research farm of Tirhut College of Agriculture, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar) to study the "Effect of nutrient management on nutrient uptake and economics of maize (*Zea mays* L.) under different tillage practices". The experiment was laid out in split plot design with three replications. Main plot consist of three different tillage practices *viz.*, a) Zero tillage (ZT) b) Conventional tillage (CT) and c) Bed planting (BP) and sub-plot comprised of four different level of nutrient management *viz.*, a) Recommended dose of fertilizer (RDF) (120, 60 and 50 kg/ha N, P_2O_5 and K_2O) b) Site Specific Nutrient Management (SSNM) based on nutrient expert and c) Farmers practice (FP) (150% of RDF + 10 ton FYM). Among the different tillage practices, bed planting recorded significantly higher gross returns (1,06,396 Rs/ha), net returns (64,111 Rs/ha) and total available nutrient uptake (N, P, K Fe and Zn) over rest of the tillage practices. Among the different nutrient management practices, SSNM recorded significantly higher net returns (63,523 Rs/ha), B: C ratio (1.89) and total available nutrient uptake (N, P, K Fe and Zn) over rest of nutrient management practices.

Introduction

Maize is the most important cereal crop of the world and in India, it is used as human food (23%), poultry feed (51%), animal feed (12%), industrial (starch) product (12%), beverages and seeds (1%). Maize grains contain about 10 per cent protein, 4 per cent oil, 70 per cent carbohydrates, 2.3 per cent crude fibres, 10.4 per cent albuminoids and 1.4 per cent ash. Maize grain has significant quantities of vitamin A & E. Maize being the highest yielding cereal crop in the world is of significant importance for countries like India, where rapidly increasing population has already out stripped the available food supplies. In India, maize is grown in an area of 92.58 lakh ha with a production of 236.73 lakh tonnes and productivity of 25.57 q/ha (Directorate of Economics and Statistics, 2016). Tillage has been an important aspect of technological development in the evolution of agriculture, particularly in food production. The objectives of tilling the soil include seedbed preparation, water and soil conservation and weed control. Tillage has various physical, chemical and biological effects on soil both positive and negative, depending on the appropriateness or otherwise of the methods used. The physical effects such as aggregate-stability, infiltration rate, soil and water conservation in particular, have direct influence on soil productivity and sustainability. In recent years, the productivity level has stagnated and in some situations declined even with the application of recommended dose of fertilizers. Because agriculture is a soil-based production system, that extracts nutrients from the soil very rapidly and hence effective and efficient approaches should be taken to slow down the removal and returning of nutrients to the soil in order to maintain and increase the crop productivity and sustain agriculture on long term basis. There exists significant opportunity to increase fertilizer efficiency and productivity of maize by adopting Nutrient Expert-based field specific fertilizer recommendations (Satyanarayana *et al.*, 2013). In this direction, an intervention on plant nutrition's like site-specific nutrient management and recommended dose of fertilizer based on proper field experimentations and crop response are urgently required. Therefore, it is essential to find out the suitable nutrient level with suitable tillage practices for maize crop to get the maximum profit per unit area.

Materials and Methods

The field experiment was conducted to study the "Effect of nutrient management on nutrient uptake and economics of maize (*Zea mays* L.) under different tillage practices" during *kharif* season of 2016 at Research farm of Tirhut College of Agriculture, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar). The experimental area falls under humid sub-tropical climatic zone, which is greatly influenced by monsoon. It is situated at 25.98ºN latitude, 85ºE longitude and 52.3 meters above mean sea level. The experiment was laid out in split plot design and replicated thrice. Main plot consist of three different tillage practices *viz.*, a) Zero tillage (ZT) b) Conventional tillage (CT) and c) Bed planting (BP) and sub-plot comprised of four different level of nutrient management *viz.*, a) Recommended dose of fertilizer (RDF) (120, 60 and 50 kg/ha N, P_2O_5 and K_2O) b) Site Specific Nutrient Management (SSNM) based on nutrient expert and c) Farmers practice (FP) (150% of RDF + 10 ton FYM). A plot having uniform fertility and even topography was selected for the experiment. The experimental area was ploughed except zero tillage with tractor driven plough and cross harrowing was done thrice with the help of disc harrow. Pre-sowing irrigation was given 7 days before land preparation to ensure adequate moisture in the soil for better germination. Seed rate of 20 kg/ha was used for sowing of maize. Seeds are placed in furrows at a depth of 3-4 cm maintaining plant to plant distance of 20 cm that were opened at 67 cm apart by narrow spade (kudali). Thinning and gap filling were done at 20 days after sowing, wherever required. One pre-emergence spray of atrazine @ 2.0 kg/ha was done after sowing followed by two manual weeding at 25 and 56 days after sowing for effective weed control in maize. Irrigations were scheduled at critical growth stages *viz.*, six leaf stage, knee height stage, tassel emergence, 50 per cent silking and at dough stage. Usual plant protection measures were adopted to protect the crop from insect pests and diseases as and when required. The crop was harvested from the net plot area when it attains the physiological maturity (yellowing). First, the cobs were removed from the standing crop and the stover was harvested later. The harvested cobs were kept in separate gunny bags for each plot and dried under the sun before shelling. After shelling, grain yield was recorded with the help of spring balance from each net plot area and converted into q/ha at 15 per cent moisture level.

Estimation of N, P, K, Zn and Fe content in plant

The plant samples of maize crop was collected from each plot at the harvesting time and dried for 48 hours in hot air oven at 65±5^{O}C temperature. These dried samples were ground to fine powder separately and passed through 0.5 mm mesh sieve. These plant samples were examined for nitrogen, phosphorus, potassium, zinc and iron content. The dried and processed samples of grain and straw of maize was separately digested in block digester and nitrogen content (%) was estimated according to the fundamental system depicted by Jackson (1973). The refining procedure was conveyed out by Nitrogen Analyzer (Gerhardt) and titration by computerized burette (Brand).

5 ml aliquot was taken in 50 ml volumetric flask and 5 ml vanadomolybdate solution was included. The volume was made up to the imprint with refined water and blended altogether. Following 25 minutes when yellow shading had completely grown, then the rate transmittance was persued on UV-obvious spectrophotometer at 440 nm (Jackson, 1973).

The concentration of K in plant sample was determined by flame photometer in digested material after standardizing the flame photometer with concentration of K (Jackson, 1973).

The Zn and Fe in acid digest of plant samples can be determined with the help of atomic absorption spectrophotometer (AAS). The AAS is based on the principle that atoms of metallic elements (Zn and Fe) which normally remain in ground state, flame conditions absorb energy when subjected to radiation of specific wavelength. The absorption of radiation is proportional to the concentration of atoms of that element. The absorption of radiation by the atoms is independent of the wavelength of absorption and temperature.

Nutrient uptake (N, P, K, Zn and Fe) by plant was computed by the following formula:-

Nutrient uptake (kg/ha) =

$$\frac{\text{Per cent nutrient content in sample} \times \text{Yield (Kg/ha)}}{100}$$

Economics

Economic indices were worked out based on the prevailing market prices in each case. Cost of cultivation was worked out by taking into consideration all the expenses incurred in raising the crop.

Cost of cultivation under different treatments was worked out separately. Labour and requirement of mechanical power of different operations such as land preparation, seed implements, fertilizers, irrigation, weeding, and harvesting were calculated as per the local rates.

Gross returns were calculated by multiplying the yield (grain, stover and stone) separately/hectare under various treatments with prevailing market rate.

Net returns were obtained by subtracting the cost of cultivation from gross returns of the individual treatments.

Benefit: cost ratio was calculated by the following formula:-

$$\text{B: C ratio} = \frac{\text{Net profit (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Results and Discussion

The results obtained from the present investigation are presented in table 1, 2 & 3.

Nutrient (N, P, K, Zn and Fe) uptake by plant

Effect of tillage practices

Data on total N, P and K uptake by the crop indicates that tillage practices significantly influenced the nitrogen uptake by the crop. Maximum uptake of N, P and K was recorded under bed planting tillage practices. The maximum total nitrogen uptake of 216.02 kg/ha was recorded with the bed planting tillage practices followed by zero tillage (185.33 kg/ha) and conventional tillage (164.99 kg/ha). The maximum total P uptake was obtained with bed planting (77.35 kg/ha) followed in order by zero tillage (65.90 kg/ha) and conventional tillage (57.67 kg/ha). Tillage practices significantly influenced the total available K uptake by the crop. The maximum total K-uptake by crop was found with the bed planting (168.70 kg/ha) and minimum with the conventional tillage (129.58 kg/ha). Bed planting was significantly superior over zero tillage and conventional tillage practices. Similarly, maximum total Zn & Fe uptake was recorded under bed planting tillage practices 497.27 and 827.87 g/ha, respectively. The lowest total Zn and Fe uptake found under conventional tillage practices 438.03 & 717.52 g/ha, respectively.

Nutrient uptake is the function of total biomass production and nutrient content in the biomass. The higher N, P, K, Zn and Fe content was the cumulative effect of better crop growth and development facilitated by conductive growing environment under bed planting that recorded significantly higher N, P, K, Zn and Fe. Meena *et al.,* (2012) also recorded significantly higher N, P, K, Zn and Fe removal in baby corn under bed planting followed by zero tillage and conventional tillage mainly because of enhanced fertilizer use efficiency, reduced crop lodging and low incidence of disease.

Effect of nutrient management

The effect of nutrient management on total N-uptake in crop was found to be significant. Maximum N, P & K uptake by the crop was recorded with farmer practices. Maximum nitrogen uptake by crop was recorded with farmer practices (200.60 kg/ha) followed by SSNM (189.14 kg/ha) and RDF (178.73 kg/ha) nutrient management. The maximum P-uptake was recorded with farmer practices (69.48 kg/ha) followed by SSNM (64.99 kg/ha) and RDF (61.55 kg/ha) nutrient management. The effect of nutrient management on total K-uptake was found significant. The maximum total K-uptake was observed in farmer practices (136.81 kg/ha) nutrient level. The lowest data total K-uptake by found under RDF (128.46 kg/ha). The effect of nutrient management on total Zn & Fe uptake was also found significant. The maximum total Zn and Fe uptake was recorded in farmer practices *viz.,* 478.90 and 789.51 g/ha, respectively.

The N, P, K, Fe and Zn content in crop affected significantly by nutrient management and the highest value were observed under farmer practices followed by SSNM and RDF. Singh *et al.,* (2012) also observed higher content and removal of N, P, K, Zn and Fe with higher level of applied fertilizer.

Economics

Gross returns

The statistical analysis of experimental data revealed that the tillage practices significantly influenced gross returns of *kharif* maize.

Table.1 Effect of nutrient management and different tillage practices on total available N, P and K uptake by plant

Treatments	N(kg/ha)			P(kg/ha)			K(kg/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Tillage Practices									
ZT	107.09	78.24	185.33	36.97	28.93	65.90	37.32	108.03	145.35
CT	96.89	68.10	164.99	33.52	24.15	57.67	33.85	95.73	129.58
BP	125.08	90.94	216.02	42.18	35.17	77.35	43.19	125.51	168.70
S.E m ±	2.05	1.31	3.46	1.07	1.78	2.86	0.29	0.97	2.34
C.D.(P=0.05)	8.26	4.56	11.28	3.72	3.13	6.92	1.17	3.91	6.57
Nutrient Management									
RDF	105.50	73.23	178.73	35.82	25.73	61.55	37.24	106.14	143.38
SSNM	109.51	79.63	189.14	37.24	27.75	64.99	38.59	111.25	149.84
FP	114.03	86.57	169.56	39.37	30.11	69.48	40.64	119.19	159.83
S.E m ±	1.99	0.99	2.19	0.19	0.18	0.46	0.28	0.95	0.92
C.D.(P=0.05)	6.21	3.09	6.84	0.59	0.56	1.45	1.09	2.97	2.87

Table.2 Effect of nutrient management and different tillage practices on total uptake Fe and Zn by plant (g/ha)

Treatments	Fe (g/ha)			Zn (g/ha)		
	Grain	Straw	Total	Grain	Straw	Total
Tillage Practices						
ZT	512.48	256.84	769.32	329.80	137.70	467.50
CT	483.14	234.38	717.52	314.30	123.74	438.04
BP	540.27	287.62	827.89	344.53	152.74	497.27
S.E m ±	4.49	1.66	2.21	4.40	1.32	1.94
C.D.(P=0.05)	18.08	6.68	8.91	17.73	5.34	7.85
Nutrient Management						
RDF	501.00	251.99	752.99	324.04	133.82	457.86
SSNM	513.61	258.62	772.23	328.88	137.63	466.51
FP	521.28	268.23	789.51	335.70	142.74	478.44
S.E m ±	3.02	1.27	2.43	1.68	0.83	2.03
C.D.(P=0.05)	9.42	3.97	7.56	5.22	2.59	6.32

Table.3 Effect of nutrient management and different tillage practices on Economics

Treatments	Cost of cultivation	Gross returns	Net returns	B:C
ZT	35270	96215	60945	1.72
CT	37785	89130	51345	1.35
BP	42285	106396	64111	1.51
S.E m ±	298	428	353	0.001
C.D. (P=0.05)	1048.96	1728	907	0.006
RDF	32911	94227	61316	1.86
SSNM	33593	97116	63523	1.89
FP	40181	100524	60343	1.50
S.E m ±	314	267	298	0.001
C.D. (P=0.05)	1011	857	1168	0.004

The maximum gross return was found under bed planting tillage practices (106396 ₹/ha). The lowest gross returns was found under conventional tillage practices (89130 ₹/ha). The gross returns were significantly influenced by nutrient management. The maximum gross returns was found under farmer practices nutrient management (100524 ₹/ha). The lowest gross return was recorded under in RDF nutrient level (94227 ₹/ha). Gross returns are the directive of total biological and economical yield of any crop. Data recorded under different components revealed that gross return increased with increasing grain, stover and stone yield obtained under different treatments. Maximum gross return was found under bed planting tillage practices. This is due to higher production of grain, stover, and stone yield and higher increase in output in comparison to input.

Net returns

A critical analysis of data revealed that net returns significantly influenced by different tillage practices. The maximum net return was recorded in bed planting tillage (64111₹/ha). The lowest net return was found under conventional tillage practices (51345 ₹/ha). There was significant influenced of nutrient management on net return. The maximum net return (63523 ₹/ha) was recorded in SSNM nutrient management. The lowest net return (61316 ₹/ha) found in RDF nutrient level. Net return with bed planting was found to be maximum which was significant superior over rest of the treatments. The reason of high net return due higher grain yield, stover yield and stone yield.

B:C ratio

Observation on data that revealed that tillage practices significantly influenced the B: C ratio. The maximum B: C ratio (1.72) was recorded with zero tillage practices followed by bed planting (1.60) and conventional tillage practices (1.35). Analysis of data revealed that nutrient management significantly influenced the B: C ratio. The maximum B: C ratio was recorded with SSNM (1.89) followed by RDF (1.86) and farmer practices (1.50). This might due to low cost of cultivation. Similar results found were reported by Yadav *et al.,* (2016).

It was concluded that maximum total nutrient uptake was recorded under bed planting which was significantly superior over rest of tillage practices while under nutrient management practices, maximum nutrient uptake was obtained under farmer practices. Maximum gross and net returns were obtained under the bed planting which was significantly superior over rest of the tillage practices while maximum net returns and B: C ratio were observed under SSNM which was significantly superior over other nutrient management practices.

References

Directorate of Economics and Statistics, 2016.

Jackson, M.L. 1973. Soil chemical analysis practice hall of India Pvt. Ltd., New Delhi, Pp. 498.

Meena, S. R., Kumar A., Jat, N. K., Meena, B. P., Rana, D. S. and Idnani, L. k. 2012. Influence of nutrient sources on growth, productivity and economics of baby corn (*Zea mays*) mung bean (*Vigna radiata*) cropping system. *Indian Journal of Agron*omy 57(3): 217-221.

Satyanarayana, T., Majumdar, K., Pampolino, M., Johnston, A.M., Jat, M.L., Kuchanur, P., Sreelatha, D., Sekhar, J.C., Kumar, Y., Maheswaran, R., Karthikeyan, R., Velayutham, A., Dheebakaran, G., Sakthivel, N., Vallalkannan, N., Bharathi, C., Sherene, T., Suganya, S., Janaki, P., Baskar, R., Ranjith, T. H., Shivamurthy, D., Aladakatti, Y. R., Chiplonkar, D., Gupta, R., Biradar, D.P., Jeyaraman, S. and Patil, S.G. 2013. Nutrient Expert TM: A Tool to Optimize Nutrient Use and Improve Productivity of Maize. *Better Crops -South Asia* **97**(1): 21–24.

Singh, G., Sharma, G. L. and Shankar. 2012. Effect of integrated nutrient management on quality protein maize. Crop Research 44(1&2): 26-29.

Yadav, A. K., Chand, S. and Thenua, O. V. S. 2016. Effect of integrated nutrient management on productivity of maize with mungbean intercropping. *Global Journal of Bio-Science and Biotech* 5-118.

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