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PRODUCTIVITY AND PROFITABILITY OF RABI MAIZE HYBRIDS UNDER NUTRIENTS MANAGEMENT PRACTICES

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ABSTRACT

The field experiment was conducted during rabi season of 2012-13 and 2013-14 at Crop Research Station, Bahraich, to study the productivity and profitability of popular maize hybrids at different levels of nutrients. The experiment was conducted in factorial randomized block design with three replications and consisted of three variety of hybrid maize and six nutrient treatments. The results revealed that the cobs/plot, cobs yield/ plot, length of cobs, grains/row, grain row cob^{-1}, grain yield, selling percentage, test weight and harvest index were significantly higher under the hybrid maize Dekalb 900 m gold over other varieties. Integrated use of 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 kg Zn SO_4 ha^{-1} shower higher values of plant height (176.8 cm), cobs/plot (138.5), length of cob (17.2 cm), grain/row (33.7), grain row/cob (18.2), test weight (245.8 g), over absolute control closely followed by 200 kg N + 60 kg P_2O_5 + 20 kg $ZnSO_4$ ha^{-1}. Among the different nutrient management practices, significantly highest mean grain yield (97.44 q ha^{-1}), stover yield (105.8 q ha^{-1}), net return (Rs.109196.0 ha^{-1}), benefit : cost ratio (3.80), total uptake of N (218.2 kg ha^{-1}), P (46.7 kg ha^{-1}) and K (121.8 kg ha^{-1}) were recorded with 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 kg $ZnSO_4$ ha^{-1}. Farmer fertilizer practice showed the higher values of all the parameters over control.

Keywords: Maize variety, nutrient levels, yield, economics.

INTRODUCTION

Maize (Zea mays L.) is the third most important crop after wheat and rice. In India maize is cultivated in 855 m ha^{-1} with a production of 21.7 m tonnes and the average yield is 2.51 t ha^{-1} (DES 2011). In Uttar Pradesh the total area of maize in rabi season is gradually increasing year by year and presently cover 1.25 m ha with production and productivity 4.5 mt and 3.8 ton ha^{-1}. It caters the meals of both human and animals by providing food and feed to them. It is a miracle crop because of its high yield potential and is also known as the queen of cereals. It is well known that maize is a heavy feeder of nutrients and being Cu plant type, it is a very efficient converter of solar energy into dry matter. The yield gap is due to inadequate and imbalanced fertilization and lack of distinct fertilizer recommendation for various varieties and hybrid of maize. The future sustainability of the crop production will depend on the improvement in soil resources base through the balanced fertilization. The concept of balanced fertilization paves the way for optimum nutrient supply to realize full yield potential of crop however, continuous use of imbalance fertilizers causes decline in soil fertility and yield reduction. Zinc also on important micro nutrient, plays an important role as a metal component in various enzymes or as functional, structural or regulator cofactor of large number of enzymes. A suitable combination of major nutrients (N, P and K) and zinc is, by and large, the most important single factor that affects the yield and quality of the crops. Maize hybrid variety plays an important role in increasing yield potential. Yield potential of any hybrid depends on the genetical quality of the variety. Thus the value of stable and high yielding hybrids has been universally recognized as an important non-cash input for boosting the production of any crop. Sinch, inadequate and scanty information on major nutrients and zinc nutrition of maize is available particularly on soils of Baharaich (Uttar Pradesh). The present investigation was carried out to study the effect of N, P, K and Zn fertilization on yield, economics and nutrient uptake in rabi maize hybrids.

MATERIALS AND METHODS

A field experiment was undertaken during rabi seaons of 2012-13 and 2013-14 at the Crop Research Station, Bahraich. The soil of the experimental field was sandy loam in texture, neutral in reaction (pH 7.5), low in available nitrogen (260 kg ha^{-1}), medium in available phosphorus (13 kg ha^{-1}) and potassium (250 kg ha^{-1}). The mean maximum temperature ranged

from 15^0 C to 38^0 C and minimum from 8.5^0 C to 20.5 ^{0} C. The treatment consisted of three varieties of maize hybrid viz. Dekalb 900 m gold, Hybrid 1144 and hybrid Sahara 51 (main plot) and 6 levels of nutrients viz. T_1 100:30:30:10, T_2 150:45:45:15, T_3 200:40:40:20, T_4 250:75:75:25 N, P_2O_5 ,K_2O, $ZnSO_4$ kg ha^{-1} T_5 farmer practice (120:30:30 kg ha^{-1} NPK) and T_6 control were located in sub plot. The factorial RBD design was used and treatments were replicated thrice. The crop was sown on first week of November in both the years. The distance of 60 cm row to row and 20 cm plant to plant was maintained. The nutrients were applied in field according to treatments. Full dose of P_2O_5, K_2O, Zn and 1/3 dose of nitrogen was applied in field at the time of sowing as basal dressing through single superphosphate, muriate of potash, zinc Sulphate and urea. Rest 2/3 dose of nitrogen was used in two splits as top dressing, first at knee height of crop and second at silking stage of corp. The pre emergence herbicide Atrazine @ 1.0 kg ai ha^{-1} was applied followed by one hand weeding at 35 days after sowing to control the weeds. Agronomic practices such as irrigation and intercultural operation were done according to need of the crop, The plant height and yield attributes (number of cobs/plots, length of cobs, grains row/cob, no. of grain/row and cob girth) were recorded in randomly selected five plants from each treatment. The plant population, cob yield, grain yield and stover yield were also recorded. The grain and stover samples were analyzed for their N, P and K content by adopting standard procedures (Jackson, 1973). The economic parameters like net profit and benefit cost ratio were calculated on the basis of prevailing market prise of inputs and produce.

RESULTS AND DISCUSSION

Hybrids

The maximum plant height (187.7 cm) was recorded in hybrid Sahara 51. The highest yield attributing character such as cobs/plot (145.7). length of cobs (20.7 cm), grains/row (33.6), grain row/cob (17.8), cobs yield /plot (16.8 kg) were recorded in maize hybrid Dekalb 900 m gold which proved significantly superior to hybrid 1144 and Sahara-51. This might be due the genetical variation among the hybrid so similar findings were also reported by Singh *et al.* (2014). The lowest plant height (174.45 cm) was recorded in Dekalb 900 m gold which was due to its dwarf nature. The lowest value of yield contributing characters were recorded in variety Hybrid 1144 due to less yield potential of the variety. The highest grain yield (95.66 q ha^{-1}) and stover yield (112.5 q ha^{-1}) were recorded in variety Dekalb 900 m gold which was significantly superior to other hybrids. This might be due to the higher yield contributing characters. The grain yield of this hybrid was found 14.8 and 27.8% higher over the hybrid 1144 and Sahara 51, respectively. The same pattern was also recorded in stover yield.

Table 1: Effect of nutrients and maize hybrids on growth, yield attributes and yield of rabi maize (Means of 2 years)

Treatments	Plant height (cm)	Cobs /plot	Length of cobs (cm)	Grains /row	Grain row /cobs	Test weight (g)	Grain Yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index %
Hybrids									
Dekalb 900 m gold	144.45	145.7	20.7	33.6	17.8	248.5	95.66	112.5	46.40
Hybrid 1144	178.6	135.6	18.8	30.8	16.5	240.5	83.33	100.7	42.50
Hybrid Sahara 51	181.7	132.4	17.9	31.7	16.2	238.7	74.86	87.5	44.39
SEm±	1.25	1.32	0.16	0.18	0.15	2.5	3.65	3.90	
CD (P=0.05)	3.80	3.95	0.46	0.56	0.42	7.32	10.22	11.50	
N, P, K and Zn (kg ha^{-1})									
100:30:30:10	168.8	120.2	10.8	28.5	15.4	220.8	58.5	68.4	46.09
150:45:45:15	172.5	127.5	11.6	30.4	16.8	232.7	63.63	76.5	45.37
200:60:60:20	175.7	135.6	15.82	31.8	17.5	240.5	87.88	94.50	48.18
250:75:75:25	176.8	138.5	17.2	33.7	18.2	245.8	97.44	105.8	47.94
Farmer Practice120:30:30)	162.7	118.6	11.5	28.5	15.0	218.5	60.29	72.5	45.40
Control	130.2	110.4	4.5	15.7	8.0	180.5	23.12	46.8	33.06
SEm±	1.35	1.25	0.25	0.21	2.5	2.25	2.5	2.82	
CD (P=0.05)	3.80	3.58	0.72	0.60	8.3	7.2	1.65	6.50	

The test weight (248.5 g) and harvest index (46.40 %) were also highest in Dekalb 900 m gold. The data (Table 2) indicated that the highest N (214.2 kg ha^{-1}), P (45.9 kg ha^{-1}) and K (119.5 kg ha^{-1}) uptake was recorded in Dekalb 900 m gold followed by Hybrid 1144. The higher uptake of nutrients by Dekalb 900m gold may be ascribed to its higher yield. The result (Table 2) indicated that maximum net profit (Rs.108424) and B:C ratio (3.93) was obtained with variety Dekalb 900 (m gold) and lowest with Hybrid Sahara 51. This might be due to higher yield of grain and stover yields compared to other varities.

Nutrients

The plant height (176.8 cm), cobs/plot (138.5), length of cobs (21.4 cm), grain /row (33.7), grains row/cobs (18.2) selling percentage (82) and test weight (245.7 g) were recorded maximum with application of 250 kg N + 75 kg P_2O_5+ 75 kg K_2O + 20 kg $ZnSO_4$ ha^{-1} followed by 200 kg N + 60 kg P_2O_5+ 60 kg K_2O + 20 kg $ZnSO_4$ ha^{-1} (Table 1). The lowest values of yield attributing characters recorded under the control plot which might be due to non application of chemical fertilizers. This might be due to maximum nutrient application which ultimately increased plant and root development resulting highest value of these characters. Similar finding were also reported by Prassad et al (2005), Panwar *et al.* (2006), Sahoo *et al.* (2006) and Meena *et al.* (2007). The grain and stover yield of maize crop gradually increased with increasing levels of nutrients. Significantly higher grain and stover yields (97.44 q ha^{-1} and 105.8 q ha^{-1}), respectively were recorded with the application 250 kg N + 75 kg P_2O_5+ 75 kg K_2O + 25 kg $ZnSO_4$ ha^{-1} . The application of 200 kg N + 60 kg P_2O_5+ 60 kg K_2O + 20 kg $ZnSO_4$ ha^{-1} resulted in the next highest grain and stover yields (87.88 q and 94.50 q ha^{-1}). The increase in yields owing to application of nutrients may be ascribed to improved growth and yield attribute and yield is directly related to these attributes. The lowest grain yield and stover yields 23.12 and 46.80 q ha^{-1} were noted under control plot. Similar finding was also reported by (Ramchandrappa et. al. 2007 and Singh et. al. 2014).

Table 2: Effect of levels of nutrients and hybrids on economics and nutrient uptake of rabi maize (Means of 2 years)

Treatments	Total profit (Rs ha^{-1})	Net profit (Rs ha^{-1})	B:C ratio	Total nutrient uptake by grain and stover (kg ha^{-1})		
Hybrids						
Dekalb 900 m gold	145424.0	1084240.0	3.93	214.2	45.9	119.5
Hybrid 1144	127932.0	90932.0	3.45	186.6	39.9	104.1
Hybrid Sahara 51	113554.0	76554.0	3.26	167.6	35.9	93.5
CD (P=0.05)	1650.0	450.0	0.015	14.6	4.8	6.2
N, P, K and Zn (kg ha^{-1})						
100:30:30:10	88740.0	64240.0	2.57	131.0	28.0	73.1
150:45:45:15	96732.0	60932.0	2.74	142.5	30.5	79.5
200:60:60:20	132482.0	105682.0	3.64	196.8	42.1	109.8
250:75:75:25	146996.0	109196.0	3.80	218.2	46.7	121.8
Farmer Practice(120:30:30)	91656.0	56656.0	2.61	135.0	28.9	75.3
Control	37048.0	9048.0	1.32	51.7	11.0	28.9
CD (P=0.05)	1780.0	525.0	0.014	15.85	3.78	6.85

The total nitrogen uptake by maize crop increased from 131.0 kg ha^{-1} with control to 218.2 kg ha^{-1} at 250 kg N + 75 kg P_2O_5 + 25 kg $ZnSO_4$ ha^{-1}. This increase in N uptake by maize grain and straw may be attributed to higher grain and straw production of maize due to application of nutrients in balanced form. Meena *et al.* (2007) observed the same trend of results in maize. Application of nutrients resulted in significant increase in P uptake by maize crop over control. The maximum values of total P uptake (46.7 kg ha^{-1}) were recorded with treatment 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 kg $ZnSO_4$ ha^{-1} (Singh *et al.* 2014). The K uptake by the maize crop increased from 73.1 to 121.8 kg ha^{-1} as the doses of nutrients increased from 0 to 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 $ZnSO_4$ kg ha^{-1}. This increase in K uptake may be ascribed to higher grain and stover production and K content in maize due to balanced use of nutrients (Singh *et al.* 2014).

Each successive increment in nutrients level from 0 to 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 kg Zn SO_4 ha^{-1} increased the net returns and benefit : cost ratio significantly over the control. The significantly highest net returns (Rs.109196.0 ha^{-1}) and benefit : cost ratio (3.80) were obtained with 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 kg $ZnSO_4$ ha^{-1}, which have proved more remunerative than the other levels of nutrients. This means that the higher net quantity of nutrients required for obtaining higher yield which resulted in higher net returns.

It may be concluded that the significant effects of balanced use of nutrients was recorded on maize hybrids for increasing crop productivity and profitability. Hybrid maize Dekalb 900 m gold was found better for productivity and net returns. Application of 250 kg N + 75 kg P_2O_5 + 75 kg K_2O + 25 kg $ZnSO_4$ ha^{-1} proved superior most in respect to most of the yield attributes and yield and economics of maize in Bahraich district of eastern Uttar Pradesh.

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