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Effect of Planting Density and Nutrient Management on Performance of Full Season Maize Hybrids

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ABSTRACT

A field experiment was conducted in the Agricultural Research Station during the Kharif seasons from 2014-15 to 2017-18 to study the effect of planting density and nutrient management on the performance of full-season maize hybrids NK-6240 & K 3110 which were located in the main plot and two plant densities viz. 83,333 plants /ha (60 x 20 cm spacing) and 83,333 plants /ha (50 x 20 cm spacing) as well as three levels of nutrients viz. The recommended dose of fertilizers (RDF - 200: 60: 50 kg NPK ha^{-1}), Soil Test Crop Response (STCR - 260-94-61 kg NPK ha^{-1}) and Site Specific Nutrient Management (SSNM - 190-84-143 kg NPK ha^{-1}) were located in sub-sub plot in split plot design with three replications. Overall the results indicated that there was no significant difference observed among the different nutrient management practices (SSNM, STCR & RDF), plant density (60X 20cm & 50X 20cm), and hybrids (NK 6240 & K 3110) in terms of yield, yield attributes, net returns and B C Ratio. So farmers can go with a recommended dose of fertilizers to maize crops.

Keywords: *Maize, hybrids, genotype, planting density, spacing, nutrients management, returns, yield, SSNM, STCR, RDF.*

INTRODUCTION

Maize is considered the third most important food crop among the cereals in India contributing to nearly 9 percent of the national food basket. The demand and production of maize are increasing more rapidly as compared to other major commodities. The yield potential of maize depends on its genetic makeup as well as the environment in which it is grown. The genetic potential can be exploited to the maximum by providing favorable growth environments as the yield is the result of the interaction of genotype, management, and environmental factors Nutrient management is one of the key inputs which plays an important role in crop productivity (Sivamurugan et al., 2017). The stagnation in crop production in India is basically due to conventional fertilizer recommendations, low fertilizer use efficiency, and imbalanced use of fertilizers. The quantitative evaluation of fertilizer doses may assist in improving yield with a simultaneous increase in nutrient use efficiency (M. V. Singh, 2016). Generally, the recommended dose of fertilizer application is considered the most effective in realizing higher yields. At the field level for nutrient management, farmers may depend on awareness and resource availability. Recently the concept of Site Specific Nutrient Management (SSNM) has come up which aims to supply a crop's nutrient requirements tailored to a specific field or growing environment.

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Soil Test Crop Response (STCR) is another approach to fertilizer application. Hence, the present study was undertaken to see the variation in maize crop yield based on nutrient management.

MATERIALS AND METHODS

The experimental design was laid out in a split-plot with three replicates with the following maize NK-6240, K 3110, two plant densities (1,00,00 plants/ ha with a spacing of 50 cm x 20 cm and 83,333 plants/ ha with a spacing of 60 cm x 20 cm) along with three levels of nutrients *viz* recommended dose (RDF - 200: 60: 50 kg NPK ha^{-1}) Soil Test Crop Response *i.e* 260-94-61 kg NPK ha^{-1} and Site Specific Nutrient Management basis *i.e* 190-84-143 kg NPK ha^{-1}. The genotypes were located in the main plot, plant geometry was located in theplot, and nutrient levels were in the sub-subplots. 1/3 dose of N and a full dose of P and K were applied as basal at the time of sowing as urea, single superphosphate, and muriate of potash, respectively, and the remaining 2/3 dose of nitrogen was applied as top dressing in two equal splits, first at the time of knee height and second at flowering stage of the crop. The irrigation and weed control measures were adopted in the crop according to the needs of the crop from time to time. Intercultural operations were also done twice between 25 to 30 DAS and followed by earthing up. Biometric observations such as plant height, cobs/plot, length of cobs, grains row/cob, number of grains/row, test weight, grain, and Stover yield were recorded after harvesting the crop. The economics of each treatment was calculated on the basis of the nearest market prices of inputs and outputs.

RESULTS AND DISCUSSION

In the first year: The grain yield of full-season maize hybrids differed significantly with planting density. While the different nutrient management systems were tested and also the

interaction was non-significant. Among the two full-season maturity hybrids tested, there was no significant difference in grain yield, cob yield, net returns, and B: C ratio. The yield attributes also recorded non-significant differences. Among the planting density, the optimum planting density of 83,333 pl/ha i.e. with a spacing of 60x20 cm recorded significantly higher grain yield (10,071 kg/ha) and net returns (79,514 Rs./ha) than compared to the higher plant population of 1,00,000 pl/ha (50x20 cm spacing) at which significantly lower grain yield (9437 kg/ha) and net returns (70,201 Rs./ha) were observed. The kernel no. was significantly higher at 83,333 pl/ha population. The grain yield among the nutrient management systems i.e. site-specific nutrient management based (9738 kg/ha), Soil test-based crop response approach (9464 kg/ha), and Recommended dose of fertilizer (RDF) application (9854 kg/ha) were all found to be on par with each other. The net returns and B: C ratio also followed a similar trend (Table 1). And the yield attributes also follow the same trend as grain yield (Table 2). The results are in accordance with the findings of Paramasivan *et al*. (2011), Sharar *et al*. 2003 and Khalil *et al*. (1988)

In the second year: The grain yield of full-season maize hybrids differed significantly with different nutrient management systems, while the grain yield did not differ significantly with the planting density and also the interaction was non-significant. Among the two full-season maize hybrids tested, there was no significant difference in grain yield, net returns, and B: C Ratio. The yield attributes also recorded non-non-significant differences. Among the planting density, the normal plant population of 83,333 pl/ha recorded high grain (8353 kg/ha) and also higher net returns (56604 Rs./ha) and B: C ratio (1.90) and all parameters were found to be on par at increased planting density of 1 lakh pl./ha (Table 1). The yield attribute also did not respond to the increased planting density (Table 2). These findings are in accordance with experimental results of Abuzar *et al.,* (2011). The grain yield among the nutrient management systems indicated that the soil test-based approach recorded significantly higher grain yield (8553 kg/ha) and was found to be on par with RDF application (8341 kg/ha) than compared to SSNM-based fertilizer application (7883 kg/ha). A similar trend was observed with net returns & B: C ratio. The yield attributes of cob length & girth kernel rows & no. kernel per row of cob all resulted significantly higher with the STCR approach and were on par with RDF application than compared to the SSNM-based approach (Table 2).

Third and fourth year: There was no significant difference observed among the different nutrient management practices, plant density, and hybrids (NK 6240 & K 3110) in terms of yield and net returns in the second and third years. But in the third and fourth years, STCR nutrient management treatment (9319 kg/ha &7730 kg/ha respectively) recorded the highest grain yield and net returns and it is on par with RDF treatment.

The pooled data revealed that significantly higher grain yield (8767 kg/ha) & B: C ratio (2.0) was recorded by Soil test crop response (260-94-61 kg NPK/ha) and was on par with recommended dose of fertilizer application (200-60-50 kg NPK/ha) and Site-specific nutrient management based approach (190-84-143 kg NPK/ha). But higher net returns (56008 Rs./ha) were recorded with a recommended dose of fertilizer and it is on par with each other. So, there was no significant difference observed among the different nutrient management practices (SSNM, STCR & RDF), plant density (60X 20cm & 50X 20cm), and hybrids (NK 6240 & K 3110) in terms of yield, yield attributes, net returns and B C Ratio (Table 1,2 &3). This is due to various stresses, including nitrogen deprivation and inter-plant competition by increasing plant population decreased ear size and kernel row number, as well as kernel set in maize and reduced yield (Sher *et al.,* 2017).

Conclusion

There was no significant difference observed among the different nutrient management practices (SSNM, STCR & RDF), plant density (60X 20cm & 50X 20cm), and hybrids (NK 6240 & K 3110) in terms of yield, yield attributes, net returns, and BC Ratio. So farmers can go with a recommended dose of fertilizers to maize crops. Better performance of yield attributes in 60 cm x 20 cm spacing was mainly due to better availability of light, aeration, and nutrients than 50cm x 20cm. Similar findings were reported by Lashkari *et al*. (2011).

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Table 1: Effect of planting density and nutrient management on grain yield and economics of full season maize hybrids during Kharif season.

	Grain yield (Kg/ha)					Net return (Rs./ha)					B:C ratio				
	First year	Second year	Third year	Fourth year	Pool data	First year	Second year	Third year	Fourth year	Pool data	First year	Second year	Third year	Fourth year	Pool data
Full season maize hybrid															
NK 6240	9703	8742	9323	7790	8890	74186	61668	58789	38887	58383	2.4	2.0	2.1	1.6	2.0
K 3110	9805	7775	8612	7485	8419	75529	47844	49469	33302	51536	2.4	1.8	2.4	1.5	2.0
SE(m) ±	267	291	337	312	302	3493	3452	4412	4310	3917	0.1	0.1	0.1	0.1	0.1
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Planting density															
1,00,000pl/ha (50x20 cm)	10007	8353	8948	7498	8702	79514	56604	54381	34854	56338	2.5	1.9	2.2	1.6	2.0
83,333 pl/ ha (60x20 cm)	9437	8165	8987	7777	8592	70201	52908	53878	37335	53581	2.3	1.8	2.3	1.6	2.0
SE(m) ±	125	165	291	284	216	1633	1523	3816	3756	2682	0.1	0.1	0.1	0.1	0.1
CD at 5%	361	NS	NS	NS	NS	4732	NS	NS	NS	NS	0.1	NS	NS	NS	NS

Nutrient management															
SSNM (190-84-143 kg NPK ha-1)	9738	7883	8671	7620	8478	74643	49805	50670	36263	52845	2.4	1.8	2.4	1.6	2.0
STCR (260-94-61 kg NPK ha-1)	9464	8553	9319	7730	8767	71057	57412	57186	35731	55347	2.3	1.9	2.2	1.6	2.0
RDF(200: 60: 50 kg NPK ha-1)	9854	8341	8912	7562	8667	76161	57051	54531	36290	56008	2.4	1.9	2.2	1.6	2.0
SE(m) ±	176	201	288	281	237	2309	2128	3776	3681	3255	0.1	0.1	0.1	0.1	0.1
CD at 5%	NS	447	NS	NS	NS	NS	6386	NS	NS	NS	NS	0.1	NS	NS	NS
Interaction AxBxC															
SE(m) ±	530	510	576	552	542	510	520	7553	7450	4008	0.2	0.2	0.2	0.2	0.2
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of planting density and nutrient management on cob length and cob girth of full season maize hybrids during Kharif season.

	Cob length (cm)					Cob girth (cm)				
	First year	Second year	Third year	Fourth year	Pool data	First year	Second year	Third year	Fourth year	Pool data
Full season maize hybrid										
NK 6240	18.6	18.2	18.6	18.0	18.4	16.1	14.8	15.9	15.5	15.6
K 3110	18.7	18.0	19.1	18.3	18.5	16.2	15.2	16.2	15.7	15.8
SE(m) ±	0.5	0.4	0.3	0.0	0.3	0.2	0.3	0.6	0.1	0.3
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Planting density										
1,00,000 pl/ ha (50x20 cm)	19.0	18.3	18.8	18.2	18.6	16.3	15.2	16.0	15.8	15.8
83,333 pl/ ha (60x20 cm)	18.3	18.0	18.8	18.1	18.3	16.1	14.8	16.1	15.4	15.6
SE(m) ±	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.1
CD at 5%	0.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nutrient management										
SSNM (190-84-143 kg NPK ha-1)	17.6	17.7	18.6	18.0	18.0	15.7	14.7	16.1	15.8	15.6
STCR (260-94-61 kg NPK ha-1)	18.4	18.3	18.7	18.1	18.4	16.1	15.2	16.0	15.6	15.7
RDF(200: 60: 50 kg NPK ha-1)	19.4	18.3	19.2	18.3	18.8	16.6	15.0	16.0	15.4	15.8
SE(m) ±	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2
CD at 5%	0.7	0.5	NS	NS	NS	0.5	0.4	NS	NS	NS
Interaction AxBxC										
SE(m) ±	0.4	0.4	0.4	0.4	0.4	0.2	0.3	0.2	0.5	0.3
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of planting density and nutrient management on kernel rows and number of kernel per row of cob of full season maize hybrids during Kharif season.

	Kernel rows					Kernels / row of cob				
	First year	Second year	Third year	Fourth year	Pool data	First year	Second year	Third year	Fourth year	Pool data
Full season maize hybrid										
NK 6240	14.6	13.9	13.6	13.6	13.9	34.0	34.8	32.5	30.5	33.0
K 3110	14.2	13.3	13.9	13.0	13.6	35.4	38.1	38.4	34.7	36.7
SE(m) ±	0.2	0.2	0.4	0.1	0.2	1.9	1.8	0.3	0.7	1.2
CD at 5%	NS	NS	NS	NS	NS	NS	2.1	1.9	1.4	NS
Planting density										
1,00,000 pl/ ha (50x20 cm)	14.7	13.7	13.8	13.2	13.9	35.3	37.1	35.7	33.2	35.3
83,333 pl/ ha (60x20 cm)	14.1	13.5	13.8	13.5	13.7	34.0	35.8	35.2	31.9	34.2
SE(m) ±	0.2	0.2	0.1	0.2	0.2	0.4	0.3	0.3	0.6	0.4
CD at 5%	NS	0.2	NS	NS	NS	1.1	NS	NS	1.1	NS
Nutrient management										
SSNM (190-84-143 kg NPK ha-1)	13.9	13.3	13.8	13.6	13.7	33.3	34.8	35.0	36.4	34.9
STCR (260-94-61 kg NPK ha-1)	14.2	13.7	13.9	13.1	13.7	34.3	37.2	35.2	35.7	35.6
RDF(200: 60: 50 kg NPK ha-1)	15.0	13.6	13.6	13.3	13.9	35.9	36.4	36.3	35.9	36.1
SE(m) ±	0.3	0.3	0.2	0.2	0.3	0.6	0.6	0.8	0.6	0.6
CD at 5%	NS	0.3	NS	NS	NS	1.7	2.1	NS	NS	NS
Interaction AxBxC										
SE(m) ±	0.4	0.5	0.4	0.4	0.4	1.4	1.4	1.5	1.2	1.4
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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