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Effect of planting geometry and nutrient combinations on yield and economics of hybrid maize in Chhattisgarh plain

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Abstract
Maize (*Zea mays* L.) is a revolutionary and exciting crop that makes a significant contribution to world agriculture and, more specifically, almost 2000 million metric tons of food supplies around in the world. The present investigation entitled "Effect of integrated nutrient management on growth and yield of hybrid maize (*Zea mays* L.), with different spacing in Vertisol of Chhattisgarh Plain" was carried out at Instructional Farm, DKS College of Agriculture and Research Station, Bhatapara during Kharif season of 2019-20, with the objective to study the effect of different spacing and integrated nutrient management on growth and yield of hybrid maize. Experiment was laid out in Split-Plot-Design (SPD) with three replications and eighteen treatment combination. Hybrid maize was sown on 14th July, 2019 in a split plot design with spacing as main plot and nutrient combinations in sub plot. There were three levels of spacing (cm) *viz.* S1-60×15, S2-60×20 and S3-60×30 and six level of nutrient combination *viz.* N1: Control treatment, N2: RDF (150 N kg/ha, 80 P2O5 kg/ha, 60 K2O kg/ha), N3: 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB culture, N4: 75% RDF + FYM 6 t/ha + seed treatment with Azotobactor + PSB culture, N5: 50% RDF + VC 2 t/ha + seed treatment with Azotobactor + PSB culture, N6: 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB culture.

Keywords: Planting, geometry, nutrient combinations economics

Introduction

Maize (*Zea mays* L.) chromosome number (2n) is 20 from the Poaceae family, the third most important cereal in the world, along with wheat and rice as well as in India (Paramasivam *et al*., 2010). In the North-Eastern Hilly (NEH) region of India, maize is the second most popular food crop after rice, and there is also a greater adaptability and high yield strength of maize, and its relevance as a food, feed and forage crop means the emphasis on maize. It is cultivated around the year, although more than 80 per cent is cultivated during most of the rainy or Kharif season.

Optimum crop geometry is one of the important factors for higher production, by using underground resources efficiently and also capturing as much as sunlight and, in effect, better formation of photosynthates. Plant density is an efficient grain yield management tool by increasing the capture of sunlight in the canopy (Monnveux *et al*., 2005). The Optimal plant population for the highest possible economic yield appears to exist for all crop species and varies with varietal and environmental changes. (Bruns and Abbas, 2005) [1]. Modern maize hybrids tolerate higher plant densities than traditionally used hybrids (Sangoi *et al*., 2002) [12, 14] and the use of narrow rows has greater potential to increase grain yields in crowded stands (Silva *et al*., 2006) [12, 14]. Narrow row spacing may also increase the amount of moisture available to the crop, such as maize (Karlen and Camp, 1985) [7].

Integrated use of organic and inorganic fertilizers not only increases mutual productivity but also helps to replace expensive chemical fertilizers (Hussain and Ahmed, 2000; and Ghosh and Sharma, 1999) [4, 5]. Generally speaking, the need for fertilizer varies with the day length of variety, growing season, soil types, climatic conditions and crop strength. The maize crop is very responsive to FYM that might be contributing to the supply of sufficient nutrients and improvement of physical properties in light soil during the kharif season. The Application of farmyard manure to crop is an age-old practice. Well-decomposed FYM serves as binding material besides providing plant nutrients and enhances the physical properties of the soil. It is also recognized that the FYM applied to maize crop will also provide a high response to produce crop. The use of FYM and its effect on cob quality requires thorough investigation to increase the efficiency of Nitrogen.

Material and Method

Grain yield (Kg/ha): The total kernel yield from each plot was separated from the sun-dried cobs, winnowing, and sun-dried to get at least 13% moisture. Grain weight was recorded in t/ha and expressed as grain yield.

Stover yield (Kg/ha): The stover yield from each plot was recorded when it was completely sun-dried and expressed as stover yield in t/ha.

Cost of cultivation (Rs/ha)

The expenses incurred for all the routine operations from preparatory tillage to harvesting including threshing, cleaning as well as the cost of inputs *viz*. seed, fertilizers, pesticides, irrigation etc. applied to each treatment were calculated on the basis of prevailing market rates and cost of cultivation was worked out and presented as (Rs/ha).

Gross return (Rs/ha)

The gross return in terms of rupees per hectare was worked out separately for each treatment converting seed and stover yield into gross return based on prevailing prices of the market.

Net returns (Rs/ha)

The net return of crop was obtained by deducting the cost of cultivation from gross return.

Net return (Rs/ha) = Gross return (Rs/ha) – Cost of cultivation Rs/ha)

Return per rupees investment

The return per rupee investment was worked out by using the following formula

Table 1: Grain yield, stover yield and harvest index of hybrid maze as influenced by different spacing and nutrient combination

Treatment	Yield		
	Grain yield (Kg/ha)	Stover yield (Kg/ha)	Harvest index (%)
Spacing (R×P)			
S1: 60 cm × 15 cm	2952	6081	32.5
S2: 60 cm × 20 cm	3538	5720	37.9
S3: 60 cm × 30 cm	3273	5183	39.1
S.Em±	73.50	104.8	0.505
CD (5%)	288.6	411.7	1.98
Nutrient combination			
N1: Control treatment	2359	5092	31.7
N2: 100% RDF (150 kg N, 80 kg P2O5, 60 kg K2O/ha)	3740	6472	37.7
N3: 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB.	4005	6166	39.3
N4: 75% RDF + FYM 6 t/ha + seed treatment with Azotobactor + PSB.	3338	5680	37.1
N5: 50% RDF +VC 2 t/ha + seed treatment with Azotobactor + PSB.	3117	5393	36.7
N6: 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB.	2967	5165	36.5
S.Em±	92.21	141.2	0.735
CD (5%)	266.3	407.8	2.12

Table 2: Economics of hybrid maize as influenced by different spacing and nutrient combinations

Treatment	Economics			
	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
Spacing (R×P)				
S1: 60 cm × 15 cm	29432	60706	31273	1.05
S2: 60 cm × 20 cm	29132	71178	42046	1.43
S3: 60 cm × 30 cm	28922	65741	36819	1.26
S.Em±		1343	1343	0.046
CD (5%)		5276	5276	0.182
Nutrient combination				
N_1: Control treatment	23613	48750	25137	1.06
N_2: RDF (150 N, 80 P_2O_5, 60 K_2O kg/ha)	30957	75668	44711	1.43
N_3: 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB.	29690	80269	50578	1.70
N_4: 75% RDF + FYM 6 t/ha + seed treatment with Azotobactor + PSB.	30590	67437	36846	1.20
N_5: 50% RDF + VC 2 t/ha + seed treatment with Azotobactor + PSB.	29161	63060	33898	1.16
N_6: 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB.	30961	60067	29106	0.94
S.Em±		1726	1726	0.059
CD (5%)		4986	4986	0.171

Result and Discussion

Grain yield

Different spacing and nutrient combinations influenced the grain yield significantly (Table 1). The Yield ability is an unique important quantitative characters in a crop and it depends on the well development of growth characters *viz.* dry matter accumulation, leaf area which turns results into higher growth parameters *viz*. crop growth rate, relative growth rate, and leaf area index and yield attributing characters *viz*. number of cobs/plant, kernels/cob, seed index etc. also responsible for grain yield. The varied planting geometries also have significant effect on grain yield of hybrid maize. The maximum grain yield was recorded under spacing 60 cm × 20 cm (S2) (3538 kg/ha) followed by 60 cm × 30 cm (S3) (3273 kg/ha). Verma *et al*. (2013) [15] reported similar results due to broader spacing. In case of nutrient combination, the significantly maximum grain yield was recorded with 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB (N3) (4005 kg/ha). However, it was recorded at par with 100% RDF (150 kg N, 80 kg P2O5, 60 kg K2O/ha) (N2) (3740 kg/ha) followed by 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB (N6) (2967 kg/ha) and control (2359 kg/ha). Jayaprakash *et al*. (2003) [6] reported highest grain yield of maize (6747 kg/ha) was obtained with the application of vermicompost at 2 t/ha and Powar (2004) [10] reported similar results due to effect of organic manure and spacing.

Stover yield

The data pertaining to stover yield has been presented in Table 1 Data on stover yield as affected by spacing and nutrient combination. Showed that the stover yield was observed significantly higher under spacing 60 cm × 15 cm (S1) (6081 kg/ha) and minimum stover yield under 60 cm × 30 cm (S3) (5183 kg/ha). Verma *et al*. (2013) [15] reported similar results due to narrow spacing. In case of nutrient combinations was recorded significant higher stover yield in 100% RDF (150 kg N, 80 kg P2O5, 60 kg K2O/ha) (N2) (6472 kg/ha) and minimum in control (5092 kg/ha). Uzma *et al*. (2014) agreed with this fact that the stover yield was significantly superior with combination of organic manure.

Harvest index (%)

The data on harvest index for different spacing and nutrient combinations have been presented in Table 1. The result indicated that significantly maximum harvest index was computed under spacing 60 cm × 30 cm (S3) and lowest under 60 cm × 15 cm (S1). Nutrient combinations was computed significant higher harvest index in 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB (N3) and minimum in control.

Cost of cultivation

The data on cost of cultivation for different spacing and nutrient combinations have been presented in Table 2. The cost of cultivation varies in all treatments related to spacing but same as all nutrient combinations.

Gross return

The data on gross return for different spacing and nutrient combinations have been presented in Table 2. The data revealed that significantly highest gross return recorded under spacing 60 cm × 20 cm (S2) (Rs 71,178/ha) and lowest under spacing 60 cm × 15 cm (S1) (RS 60,706/ha). In case of nutrient combinations was recorded significant higher gross return in 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB (N3) (Rs 80,269 /ha) and lowest in 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB (N6) (Rs 60,067/ha) followed by N1 control treatment (Rs 48,750/ha). Similar results have been noted by Dhruw (2004) [3], Ramu and Reddy (2007) [11].

Net return

The data on net return for different spacing and nutrient combinations is presented in Table 2. The data revealed that significantly highest net return recorded under spacing 60 cm × 20 cm (S2) (Rs 42, 046 /ha) and lowest under spacing 60 cm × 15 cm (S1) (Rs 31, 273 /ha). In case of nutrient combinations was recorded significantly highest net return in 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB (N3) (Rs 50, 578/ha) and lowest in 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB (N6) (Rs 29, 106 /ha) followed by N1 control (Rs 25, 137 /ha). 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB (N3) (Rs 80,269/ha) and at par with spacing 60 cm × 20 cm (S2) with nutrient combinations 100% RDF (N2) and lowest under spacing 60 cm × 15 cm (S1) under control treatment. Similar results have been noted by Dhruw (2004) [3], Ramu and Reddy (2007) [11].

B:C ratio

The data on B:C ratio for different spacing and nutrient combinations have been presented in Table 2. The data revealed that significantly higher B:C ratio recorded under spacing 60 cm × 20 cm (S2) and lowest under spacing 60 cm × 15 cm (S1). A nutrient combination was recorded significant higher B:C ratio in 75% RDF + VC 1 t/ha + seed treatment with Azotobactor + PSB (N3) and lowest in 50% RDF + FYM 12 t/ha + seed treatment with Azotobactor + PSB (N6). The results are corroborate with the findings of Sahoo and Mahapatra (2008) [13].

Reference

1. Bruns HA, Abbas HK. Ultra-high plant population and nitrogen fertility effects on corn in the Mississippi valley. Agronomy Journal 2005;97(4):11.
2. Chaudhary AR. Maize in Pakistan: Punjab Agricultural Research Coordination Board, University of Agriculture, Faisalabad, Pakistan 1983, P312-317.
3. Dhruw IK. Effect of spacing and nitrogen management on production potential and economics of hybrid maize (*Zea mays* L.) under Inceptjsol of Chhattisgarh Plains. M.Sc. Thesis, Indira Gandhi Agricultural University, Raipur, Chhattisgarh 2004, P75-79.
4. Ghosh A, Sharma AR. Effect of combined use of organic manure and nitrogen fertilizer on the performance of rice under flood-prone lowland conditions. Journal of Agriculture Science 1999;132:461-465.
5. Hussain TI, Ahmed MA. EM Technology- A new looks for IPNM. In: Proc. Symp., Integrated Plant Nutrient Management. NFDC. Islamabad, Pakistan 2000.
6. Jayaprakash TC, Nagalikar VP, Pujari BT, Shetty RA. Effect of organics and inorganics on yield and yield attributes of maize under irrigation. Karnataka Journal of Agricultural Sciences 2003;16(3):451-453.
7. Karlen DL, Camp CR. Row Spacing, Plant Population and Water Management Effects on Corn in the Atlantic Coastal Plain. Agronomy Journal 1985;77(3):393-398.
8. Monneveux P, Zaidi PH, Sanchez C. Population density and low nitrogen affects yield associated traits in tropical maize. Crop Science 2005;45:2-7.
9. Paramasivan M, Kumaresan KR, Malar*vizh*i P, Mahimairaja S, Velayudham K. Effect of different levels of NPK and Zn on yield and nutrient uptake of hybrid maize (*Zea mays* L.) in Madhukkur (Mdk) series of soils of Tamil Nadu. Asian Journal of Soil Science 2010;5(2): 236-240.
10. Powar SL. Effect of organic and inorganic fertilizers on rice yield, nutrient availability and uptake in medium black soil. Journal of Maharashtra Agricultural Universities 2004;29(2):231-233.
11. Ramu YR, Reddy DS. Yield, nutrient uptake and economics of hybrid maize as influence by plant stand, levels and time of nitrogen application. Crop Research 2007;33(3):41- 45.

12. Sangoi L, Almeid M, Silva PRF, Argenta G. Morpho-physiological bases for greater tolerance of modern corn hybrids to high plant densities. Bragantia 2002;61(2): 101-110.
13. Sahoo SC, Mahapatra PK. Response of sweet corn (*Zea mays* L.) to nitrogen levels and plant population. Range Management and Agro forestry 2008;29(2):143-145.
14. Silva PRF, Sangoi L, Argenta G, Strieder ML. Plant arrangement importance in defining the productivity of maize. Department of crop plants. UFRGS 2006, P64.
15. Verma A, Tomar GS. Effect of planting geometry and nitrogen levels on grass yield and quality of sweet corn (*Zea mays* saccharata Sturt). Journal Agricultural Issues 2013;18(1 & 2):31-33.
16. Uzma B, Tahir A, Qureshi F. Effect of Integrated Nutrient Management on Growth, Yield and Quality of Maize (*Zea mays* L.) in Temperate Conditions. Indian Journal of Soil Conservation 2014;14(3):276-281.