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Effect of planting geometry and nitrogen management on yield and economics of baby corn (*Zea mays* L.)

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Abstract
A field experiment was conducted during *Zaid* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The treatments which are different planting geometry with 40x20, 40x30 and 40x40 cm along with it Nitrogen applied at 120 kg/ha through different sources which are vermicompost, poultry manure and farm yard manure are used. The experiment was laid out in Randomized Block Design with twelve treatments each replicated thrice. The results showed that *viz*: the maximum no. of green cobs/plant (2.80), cob length (15.37 cm), girth of the cob (7.49 cm) and higher cob weight with husk (44.30 g/cob), cob weight without husk (17.11 g/cob), cob yield with husk (73.29 q/ha) and cob yield without husk (33.26 q/ha) were recorded in the treatment T2 which is with planting geometry of 40x20 cm + 75% nitrogen with urea+ 25% nitrogen with vermicompost as compared to all other treatments. However, the maximum gross returns (116410.00 INR/ha), net returns (73383.00 INR/ha) and B: C ratio (1.70) was significantly recorded in the treatment of T2 which is with planting geometry of 40x20 cm + 75% nitrogen with urea+ 25% nitrogen with vermicompost as compared to all other treatments.

Keywords: Baby corn, planting geometry, nitrogen management, yield and economics

Introduction
Maize, belongs to a family *Poaceae*, is an important cereal food grain crop of the world which is being grown in more than 166 countries across the globe including tropical, sub- tropical and temperate regions. There is no any other cereal on the earth, which has so immense yield potential as that of maize and hence, occupied a place of "Queen of Cereals". Maize is third most important cereal crop after rice and wheat, in human diet. Among the maize growing countries India rank 4th in area and 7th in production, representing around 4% of world maize area and 2% of total production. During 2018-19 in India, the maize area has reached to 9.2 million ha. During 1950-51 India used to produce 1.73 million MT maize, which has increased to 27.8 million MT by 2018-19, recording close to 16 times increase in production.

The average productivity during the period has increased by 5.42 times from 547 kg/ha to 2965 kg/ha, while area increased nearly by three times. Though the productivity in India is almost half of world the average per day productivity of Indian maize is at par with many lead maize producing countries. Among Indian states Madhya Pradesh and Karnataka has highest area (15% each) followed by Maharashtra (10%), Rajasthan (9%), Uttar Pradesh (8%) and others. After Karnataka and Madhya Pradesh Bihar is the highest maize producer. Andhra Pradesh is having highest state productivity (ICAR-Indian Institute of Maize Research). The cultivation of baby corn shows a successful result in countries like Thailand and Taiwan recently in India more attention is given to scientists and farmers in order to find out its potentials for obtaining more foreign earning as well as maximum returns to the growers.

The nitrogen is a vital nutrient for the activity of plant organs. It is a fraction of many components such as; amino acids, nucleic acids, chlorophyll and etc. Thus, plant growth can be affected by the amount of nitrogen, Najm *et al.* (2012) [5] and Taiz and Zeiger (2002) [10]. The integrated nutrient supply including organic (FYM) and inorganic fertilizers improved the productivity of major cropping systems along with maintaining better soil quality on cost effective basis (Rao *et al*., 2009) [7]. Previous studies have shown that nitrogen fertilizer can increase the growth characteristics, such as; plant height, shoot dry matter, and Leaf Area Index (LAI), Sincik *et al.* (2008) [8]. Nitrogen is an essential mineral nutrient for plant growth.

High rate of nitrogen application leads to more rapid leaf area development prolongs life of foliage, increases leaf area duration after flowering and enhance on the whole crop assimilation, consequently contributing to increase in seed production Khaliq *et al.* (2009) [4]. Nitrogen is one of the main plant nutrients affecting plant growth and yield Tafteh and Sepaskhah (2012) [9]. Leaf area and LAI increase with increase in N level, Bhatt (2013) [2]. Maize crop differs in its ability to maintain LAI, CGR and above ground dry matter production at different levels of N application.

Among the different agronomic practices, crop geometry is considered as one of the most important factors to harvest maximum solar radiations and utilizes the soil resources effectively and in turn better photosynthetic formation. The optimum plant population and nitrogen needs to be standardized for this crop. The main reason for poor productivity of baby corn is non-availability of suitable production technology. Though the spacing requirement has been standardized for grain and fodder maize, the information on the influence of spacing on yield of baby corn composite is still obscure. The requirement of crop planting management and nitrogen are yet to be standardized. In India much work has not been done so far for the baby corn. Maize is an exhaustive crop and requires high quantities of nitrogen. Hence, there is a need to work out the crop geometry and nitrogen requirement of Baby corn in India.

Materials and Methods

The present investigation was carried out during *Zaid* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28oN latitude, 81.54oE longitude and 98 m altitude above the mean sea level baby corn with G-5141. The experimentation put down in Randomized Block Design which containing of 12 treatments with T1-40cm x 20cm + 100% Nitrogen through Urea, T2- -40cm x 20cm + 75% Nitrogen through Urea + 25% Nitrogen through Vermicompost, T3-40cm x 20cm + 75% Nitrogen through Urea + 25% Nitrogen through Poultry manure, T4-40cm x 20cm + 75% Nitrogen through Urea + 25% Nitrogen through FYM, T5- 40cm x 30cm + 100% Nitrogen through Urea, T6- 40cm x 30cm + 75% Nitrogen through Urea + 25% Nitrogen through Vermicompost, T7- 40cm x 30cm + 75% Nitrogen through Urea + 25% Nitrogen through Poultry manure, T8- 40cm x 30cm + 75% Nitrogen through Urea + 25% Nitrogen through FYM, T9 -40cm x 40cm + 100% Nitrogen through Urea, T10- 40cm x 40cm + 75% Nitrogen through Urea + 25% Nitrogen through Vermicompost T11-40cm x 40cm + 75% Nitrogen through Urea + 25% Nitrogen through Poultry manure T12- 40cm x 40cm + 75% Nitrogen through Urea + 25% Nitrogen through FYM were replicated thrice.

The experimental site was uniform in topography and sandy loam in texture, basal in soil reaction (PH 8.29), low in Organic carbon (0.36%), medium available N (171.48 kg ha-1), higher available P (15.2 kg ha-1) and medium available K (232.5 kg ha-1). Nutrient sources were Urea+ Vermicompost+ Poultry manure+ Farm yard manure, DAP and MOP to fulfill the requirement of Nitrogen, phosphorous and potassium. The used fertilizers were applied as basal at the time of seeding. Ten days after the sowing gap filling was done and irrigation given at frequent intervals. In the period from germination to harvest, after harvest several yield parameters were recorded those parameters are maximum green cobs /plant, cob length , girth of the cob, cob weight with husk and cob weight without husk were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984). Several Economics on Baby corn crop also recorded and presented parameters like Gross returns, Net returns and B:C ratio were presented.

Results

Effect of Planting Geometry and Nitrogen Management on yield and yield parameters of Baby corn

Data in table no.1 Tabulated the No. of green cobs per plant, Cob length (cm), Cob girth (cm), Cob without husk (g), Cob weight with husk (g), Cob yield without husk (q/ha) and Cob yield with husk (q/ha) were recorded after harvest and the "effect of planting geometry and nitrogen management shown significantly higher numbers at harvest. When it comes to No. of green cobs per plant, (2.80 q/ha) it was recorded maximum in treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost when compare to other treatments apart from treatment(2.79 q/ha, 2.78 q/ha and 2.70 q/ha) 3, 4 and 6 with planting geometry (40x20 cm) (40x30 cm)+ N(75%) by urea+ N(25%) by vermicompost and poultry manure respectively are statistically at par with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments. In other yield parameters like Cob length (15.37 cm) in treatment 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost recorded significantly higher value when compare to other treatments apart from treatments (15.06 cm, 14.57 cm and 14.62 cm) 3, 4 and 6 with planting geometry (40x20 cm) (40x30 cm)+ N(75%) by urea+ N(25%) by vermicompost and poultry manure respectively are statistically at pare with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments, and in Cob girth (7.49 cm) treatment 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost recorded significantly higher value when compare to other treatments apart from treatments (7.42 cm, 7.18 cm and 7.71 cm) 3, 4 and 6 with planting geometry (40x20 cm) (40x30 cm)+ N(75%) by urea+ N(25%) by vermicompost and poultry manure respectively are statistically at pare with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments, Cob without husk (17.11 g) in treatment 2 with 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost recorded significantly higher value when compare to other treatments apart from treatments (16.38 g and 16.94 g) 3 and 4 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost are statistically at pare with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments, Cob weight with husk (44.03 g) in treatment 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost recorded significantly higher value when compare to other treatments apart from treatments (43.85 g, 43.65 g and 43.18 g) 3, 4 and 6 with planting geometry (40x20 cm) (40x30 cm)+ N(75%) by urea+ N(25%) by vermicompost and poultry manure respectively are statistically at pare with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments, Cob yield without husk (33.26 q/ha) in treatment 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost recorded significantly higher value when

compare to other treatments apart from treatments (32.14 q/ha) 3 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost is statistically at pare with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments and Cob yield with husk (73.29 q/ha) in treatment 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost recorded significantly higher value when compare to other treatments apart from treatments (72.14 q/ha and 72.40 q/ha) 3 and 4 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by vermicompost, farm yard manure were statistically at pare with treatment 2 with planting geometry of 40x30+ N(75%) by urea+ N(25%) by Vermicompost compares to other treatments.

Effect of Planting Geometry and Nitrogen Management on Economics of Baby corn

Data in table no.2 Tabulated the Cost of cultivation (INR/ha), Gross returns (INR/ha), Net returns (INR/ha) and B:C ratio were recorded after harvest and the "effect of planting geometry and nitrogen management shown higher returns and B:C ratio were recorded after harvest.

Cost of Cultivation, (49207.00 INR/ha) is maximum recorded in treatments 4, 8, and 12 with planting geometry (40x40 cm)+ N(75%) by urea+ N(25%) by Farm yard manure and minimum cost of cultivation, (39123.60 INR/ha) were recorded in treatments 1, 5 and 9 with planting geometry (40x40 cm, 40x30 cm and 40x40 cm)+ N(100%) by urea.

Gross returns (116410.00 INR/ha), is maximum gross recorded in treatments 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by Vermicompost and minimum gross, (51072.40 INR/ha) were recorded in treatments 5 with planting geometry (40x30 cm)+ N(100%) by urea.

Net returns (73383.00 INR/ha), is maximum net recorded in treatments 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by Vermicompost and minimum net returns, (51072.40 INR/ha) were recorded in treatments 5 with planting geometry (40x30 cm)+ N(100%) by urea.

Benefit cost ratio (1.70 %), is maximum B:C ratio recorded in treatments 2 with planting geometry (40x20 cm)+ N(75%) by urea+ N(25%) by Vermicompost and minimum net returns, (1.02 %) were recorded in treatments 12 with planting geometry (40x40 cm)+ N(75%) by urea+ N(25 %) by farm yard manure.

Discussion

Effect of Planting Geometry and Nitrogen Management on yield and yield parameters and Economics of Baby corn

Ashoka and his co-workers in the year of (2008) stated similar results with application of nitrogen and vermicompost which resulted in maximum yield and yield attributes this may due to the adequate availability of nitrogen and vermicompost which is rich sources macro and micro nutrients and several plant growth regulators which leads to higher yield in baby corn, and in similar way in the year of (2018) [6] Neelam and his co-workers stated that with planting geometry or spacing of 45x20 cm which resulted in maximum values in yield and growth attributes this may due to the higher translocation of required nutrients to crop growth, Thakur DR *et al*,. (1998) [11] conducted research trail and stated that the optimum plant population with adequate fertilization are key factors to exploit the full potential of the genotype. Baby corn may be planted at 40 × 20 cm spacing with N 150-200 kg/ha to harvest maximum yield. This may be supplying of adequate amount of fertilizers through different available sources which leads to the improvement in the yield and yield parameters in baby corn.

Table 1: Effect of Planting Geometry and Nitrogen Management on yield and yield attributes of Baby corn

Tr.	No. of green cobs per plant	Cob length/plant (cm)	Cob girth/plant (cm)	Cob weight without husk (g)	Cob weight with husk (g)	Cob yield without husk (q /ha)	Cob yield with husk (q/ha)
T1	1.91	11.56	6.19	15.62	38.07	27.32	58.75
T2	2.80	15.37	7.49	17.11	44.03	33.26	73.29
T3	2.79	15.09	7.42	16.83	43.85	32.14	72.16
T4	2.78	14.75	7.18	16.94	43.65	30.97	72.40
T5	1.93	11.57	6.22	15.59	38.04	25.77	58.85
T6	2.70	14.62	6.81	16.68	43.18	29.89	66.76
T7	2.67	13.78	7.71	16.56	42.73	28.70	64.91
T8	2.62	13.69	6.57	16.43	42.01	28.73	62.43
T9	2.03	11.68	6.11	15.59	39.33	25.12	58.71
T10	2.52	13.07	6.63	16.27	41.20	31.20	62.81
T11	2.32	12.59	6.51	16.15	41.02	28.36	60.32
T12	2.13	12.78	6.37	15.89	40.09	28.85	60.81
F test	S	S	S	S	S	S	S
SEM	0.04	0.26	0.11	0.13	0.34	0.39	0.42
CD (5%)	0.12	0.76	0.32	0.39	1.01	1.14	1.23

Table 2: Effect of Planting Geometry and Nitrogen Management on Economics of Baby corn

Tr.	Cost of cultivation	Gross returns	Net returns	B:C ratio
T1	39123.60	95620.00	56496.40	1.44
T2	43027.00	116410.00	73383.00	1.70
T3	45027.00	112105.00	67078.00	1.48
T4	49027.00	108395.00	59368.00	1.21
T5	39123.60	90195.00	51072.40	1.30
T6	43027.00	104615.00	61588.00	1.43
T7	45027.00	100450.00	55423.00	1.23
T8	49027.00	100555.00	51528.00	1.05

T9	39123.60	87920.00	48796.40	1.24
T10	43027.00	102200.00	59173.00	1.37
T11	45027.00	102760.00	57733.00	1.28
T12	49027.00	99225.00	50198.00	1.02

Conclusion

On the basis of one season of experimentation application of planting geometry with 40x20 cm+ 75% nitrogen through urea+ 25% nitrogen through vermicompost was found more productive (33.26 q/ha) as well as economically (73383.00 INR/ha). The conclusions drawn are based on one year data only which requires further confirmation for recommend.

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