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Effect of Crop Geometry and Nitrogen Management on Growth Parameters, Yield and Quality Parameters of Baby Corn (*Zea mays* L.)

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ABSTRACT

A field experiment was conducted to observe yield and quality of baby corn in split plot design with three treatments of crop geometry (30 cm x 20 cm, 30 cm x 15 cm and 30 cm x 10 cm) in main plots and five levels of nitrogen management (60, 75, 90, 105 kg/ha and 45 kg/ha+ 5 t FYM) in sub plots with three replications. Crop geometry 30 cm x 10 cm have more number of plants per unit area as compared to other crop geometry *i.e* 30 cm x 20 cm and 30 cm x 15 cm. Crop geometry have non significant effect on crop phenology stages of baby corn *i.e* days taken for knee high, tasseling and silking. However, plant height, leaf area index (LAI), cob yield, baby corn yield, fodder yield, dry matter accumulation and total nitrogen uptake in 30 cm x 10 cm crop geometry were significantly higher than all other geometry treatments. Length of baby corn, weight of cob and baby corn weight were significantly higher in 30 cm x 20 cm crop geometry. Crude protein content of baby corn was significantly higher in 30 cm x 20 cm than other treatments. Growth and yield parameters like plant height, leaf area index, dry matter accumulation, cob yield, baby corn yield, total nitrogen, phosphorus and potassium uptake, cob weight, number of cobs per plant, baby corn length, girth, weight of baby corn were significantly improved by nitrogen application up to 105 kg N/ha. Significant increase in quality parameters such as crude protein, total sugar and starch of baby corn was in 105 kg N/ha treatment, but non significant effect on cob texture, TSS and total solids.

Key Words: Baby corn, Geometry, Growth, Nitrogen, Quality, Yield.

INTRODUCTION

Maize *(Zea mays* L.) is one of the most important staple food crop of the world and ranks third in acreage and production next to wheat and rice. Maize is a miracle crop called as "Queen of Cereals" and is grown with equal success in temperate, subtropical and tropical regions of the world in more than 130 countries. This accounts 30% of the total global grain production. Currently, nearly 1147.7 million MT of maize is being produced together by over 170 countries from an area of 193.7 million ha with average productivity of 5.75 t/ha (FAOSTAT, 2020). Among the maize growing countries, India rank 4th in area and 7th in production. During 2018-19, maize was grown on 9027.13 thousand hectare area with 27715.1 thousand metric ton production in India (Anonymous, 2021). It is rich source of carbohydrates and proteins, therefore, it is good human food as well as animal feed. Maize occupied 144.6 thousand hectares, with a production of 410.5 thousand tonnes in the Punjab state during 2019-20. The average yield was 35.82 quintal per hectare (Anonymous, 2020).

Baby corn is a recent innovative thought in the frontier line of research. Baby corn or mini corn is a new economic product of recent origin. It refers to tender flowering maize ears harvested 1-2d after silk emergence before fertilization. The dehusked corn ear can be eaten as a vegetable whose delicate, sweet flavour and crispness has much demand. This successfully cutlivated in countries like Thailand,

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Taiwan, Srilanka and Myanmar. The countries like Guatemala, Zambia, Zimbabwe and South Africa have also started its cultivation. Now, Thailand and China are the world leaders in baby corn production. It is widely accepted and habituated as a cereal vegetable in USA, Europe and in some Asian countries. Baby corn production has been directly integrated with dairying farms in different countries because only 13-20% of fresh ear weight is used as human food and the rest (silk, husk and green stalk) can be used as excellent feed materials for milch ruminants to improve their productivity.

In India, even in non tourist areas the commercial cultivation is gaining momentum, particularly around the metros and providing farmers huge profit margins. Attention is now being paid to explore its potential for earning foreign exchange and providing higher economic returns to the farmers. Its cultivation is increasing in Meghalaya, Western Uttar Pradesh, Haryana, Maharashtra, Karnataka and Andhra Pradesh (Ramachandrappa *et al,* 2004).

MATERIALS AND METHODS

The field experiment was conducted at the Students' Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana, which is situated at 30°56' N latitude and 75°52' E longitude with a mean height of 247 meter above the mean sea level. The experimental field was loamy sand in texture. The chemical analysis of soil (top 15 cm) showed neutral pH (7.5), low in organic carbon (0.27%) and available nitrogen (134.1kg/ha) determined by Alkaline potassium permanganate method, phosphorus (20.4 kg/ha) by Olsen's method and potassium (131.1kg/ha) by ammonium acetate extractable K using flame photometer (Jackson, 1973). The experiment was laid out in split plot design with three treatments of crop geometry *i.e* 30 cm x 20 cm (1, 66, 666 plants/ha), 30 cm x 15 cm (2, 22, 222 plants/ha) and 30 cm x 10 cm (3, 33, 333 plants/ ha) in main plots and five levels of nitrogen (60, 75, 90, 105 kg/ha and 45 kg/ha+ 5 t FYM) in sub plots with three replications. Plot size was 31.2 m^2. Nitrogen applied in three spilt doses. Half of the nitrogen as per the treatment (60, 75, 90, 105 and 45 kg N/ha + 5 tonne FYM) is applied at the time of sowing. The remaining half dose of nitrogen was applied in two equal splits by broadcasting at 30 and 45 DAS. Well rotten farmyard manure was applied as per treatments to the respective plots at the time of field preparation by properly mixing with soil with the help of power tiller. The plant height was taken periodically at 15d interval. Leaf area index is measured with the help of planimeter or leaf area meter. Nitrogen content in baby corn was estimated by modified Kjeldahl's distillation method. The protein percentage in baby corn of each plot was worked out by multiplying its nitrogen content by 6.25. Texture measurement was done using texture analyser. The total soluble solids (ºBrix) were determined using hand refractometer with range 0-32 ºB (Erma, Tokyo) and readings were expressed ºB at 20ºC using reference tables. Total sugar content of baby corn cob was estimated by Nelson and Somogyi (1945) method with modification suggested by Asana and Saini (1962). The total solids were estimated by drying weighed sample (10-15g) in the pre-weighed aluminium dish to a constant weight in a hot air oven at 70 ºC for 16-18 hrs. Dried samples were cooled down to room temperature in desiccators prior to weighing. Five pickings of baby corn (variety "Composite Kesri") were taken at an interval of 3-4 days. Statistical analysis was carried out using analysis of variance in split plot design (Cochran and Cox, 1967) with the help of statistical software CPCS1 developed by Department of Mathematics and Statistics, PAU, Ludhiana and statistical mean differences were found by Fisher's protected least significant difference test at $P<0.05$.

RESULTS AND DISCUSSION

The data (Table 1) revealed that plant height was significantly higher in 30 cm x 10 cm crop geometry as compared to 30 cm x 15 cm and 30 cm x 20 cm crop geometry. Taller plants might be due to competition of light under 30 cm x 10 cm with closer plant to plant space for want of light.

Thavaprakaash *et al* (2005), Moosavi *et al* (2012) and Verma *et al* (2012) who also recorded higher plant height with closer spacing as compared to wider spacing. Plant height was significantly higher in 105 kg N/ha than all other nitrogen management treatments. However, plant height by 45 kg N/ha+ 5t FYM is statistically at par with 90 kg N/ha at all growth stages. Maximun LAI (4.22) was recorded in 30 cm x 10 cm crop geometry than all other crop geometries *i.e* 30 cm x 15 cm (3.72) and 30 cm x 20 cm (3.21). This may be due to more number of plants per unit area in 30 cm x 10 cm crop geometry. There was a significant increase in leaf area index with increase in level of nitrogen application from 0 to 105 kg N/ha. Maximum LAI had been recorded in105 kg N/ha. The results get support from the findings of Thavaprakaash and Velayudham (2009) and Rakib *et al* (2011). Baby corn length (10.24cm) was significantly higher in 30 cm x 20 cm crop geometry as compared to all other geometry. Length of baby corn was lowest in 30 cm x 10 cm.

There was non significant effect of crop geometry on girth of baby corn, However, 30 cm x 20 cm crop geometry have numerically more baby corn girth (1.57) than 30 cm x 10 cm. Weight of green cob and baby corn in 30 cm x 20 cm crop geometry was significantly more than 30 cm x 15 cm and 30 cm x 10 cm. However, minimum baby corn weight was in 30 cm x 10 cm. Length, girth and weight of baby corn increased with the increase in level of nitrogen application. Maximum baby corn length was observed in 105 kg N/ha which was statistically at par with 45 kg N/ha + 5 t FYM. Minimum corn length was observed in 60 kg N/ha. Data revealed that nitrogen level had significant effect on girth of baby corn. Maximum cob and corn weight was found in application of 105 kg N/ha which was superior than all other nitrogen treatments. Panchanathan *et al* (1987), Sahoo and Panda (1999) and Sahoo and Mahapatra (2004) also reported higher length, girth and weight of baby corn with increase in level of nitrogen application.

Table 1. Effect of crop geometry and nitrogen management on growth and fodder yield of baby corn (q/ha).

Treatment	Plant height (cm)	Leaf area index	Corn Length (cm)	Corn Girth (cm)	Cob weight (g)	Baby corn weight (g)	Baby corn yield (q/ha)	Fodder yield (q/ ha)
Crop geometry (cm)								
30 x 20	180.8	3.21	10.24	1.57	23.21	6.09	5.1	250.8
30 x 15	182.1	3.72	10.09	1.51	21.63	5.68	17.9	296.9
30 x 10	185.7	4.22	9.98	1.49	20.65	5.42	19.4	342.4
CD(p=0.05)	4.65	0.40	0.14	NS	0.83	0.20	2.23	44.54
Nitrogen management								
60 kg ha^{-1}	177.3	3.28	9.95	1.34	19.97	5.24	15.1	281.3
75 kg ha^{-1}	179.5	3.49	10.05	1.50	20.47	5.38	16.5	298.7
90 kg ha^{-1}	182.7	3.67	10.20	1.57	22.13	5.82	17.9	321.5
105 kg ha^{-1}	187.4	3.88	10.33	1.71	23.93	6.28	19.6	343.8
45 kg ha^{-1} + 5t FYM	183.1	3.72	10.26	1.64	23.35	6.14	18.3	323.8
CD(p=0.05)	4.58	0.19	0.12	0.09	0.60	0.18	1.24	38.40
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

Crop geometry 30 cm x 10 cm recorded significantly higher baby corn yield as well as green fodder yield as compared to 30 cm x 20 cm but it was statistically at par with crop geometry 30 cm x 15 cm. The crop geometry 30 x 10 cm and 30 x 15 cm increased baby corn yield by 28.48 per cent and 19.25 per cent over 30 x 20 cm crop geometry (15.1q/ha). This may be due to 30 cm x 10 cm have double number of plants than 30 cm x 20 cm crop geometry. Highest baby corn yield 19.6 q/ha was produced with 105 kg N/ha which was 29.80% higher than recommended (60 kg N/ha) dose of nitrogen but it was statistically similar with 45kg N/ha + 5t FYM treatment. Similar results of increasing baby corn yield with higher plant population has also been reported by Thakur *et al* (2000), Pandey *et al* (2002) and Kunjir *et al* (2007). Highest baby corn yield and fodder yield was observed when 105 kg N/ha is applied. The per cent increase in the yield over recommended dose of fertilizer (60 kg N/ha) in 75, 90, 45 kg N/ ha + 5 t FYM and 105kg N/ha treatments was 9.3, 18.5, 21.2 and 29.8 per cent, respectively. The reason could be increase in the number of cobs, cob weight, cob girth etc. Green fodder yield in 30 x 10 cm and 30 x 15 cm was 35.50 per cent and 18.50 per cent higher over 30 x 20 cm crop geometry (281.3 q/ha).

The protein is formed by the nitrogen assimilation in the plant. Nitrogen is a constituent of protein. The data demonstrated that with increment in the nitrogen level the protein content increased and varied from 10.41% to 12.54%. The maximum protein content was observed in 105 kg N/ha treatment *i.e.* 20.74% which was significantly higher than 60 kg N/ha (recommended) treatment. This may be due to the direct relation of nitrogen with protein content and more nitrogen uptake. It is an important observation from the quality point of view. As the quality of the baby corn is very important for the higher economic value of the crop. The data (Table 2) revealed that crop geometry of 30 cm x 20 cm recorded significantly high protein content of baby corn as compared to 30 cm x 10 cm crop geometry. The protein content in 30 cm x 20 cm and 30 cm x 15 cm was significantly higher over 30 cm x 10. Crop geometry 30 cm x 10 cm showed lowest crude protein content. Higher crude protein content in wider spacing may be due to less

Table 2. Effect of crop geometry and nitrogen management on quality parameters of baby corn.

Treatment	Protein content (%)	Total Sugar (%)	Starch (%)	TSS (°B)	Cob texture Tenderness (N)	Total solids (%)
Crop geometry (cm)						
30 x 20	12.20	7.43	2.41	8.7	66.38	15.07
30 x 15	11.70	7.01	2.41	8.6	66.35	14.95
30 x 10	10.95	6.56	2.40	8.6	66.33	14.90
CD(p=0.05)	0.52	0.28	NS	NS	NS	NS
Nitrogen management						
60 kg ha^{-1}	10.41	6.27	2.40	8.5	66.14	14.90
75 kg ha^{-1}	11.16	6.71	2.40	8.6	66.21	14.93
90 kg ha^{-1}	11.93	7.21	2.41	8.6	66.29	14.99
105 kg ha^{-1}	12.54	7.75	2.42	8.7	66.36	15.12
45 kg ha^{-1} + 5t FYM	12.28	7.51	2.41	8.8	66.31	15.06
CD(p=0.05)	0.30	0.26	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS

plant population, resulting in availability of more nitrogen per plant. Similar findings were reported by Sukanya et al (2000), Ramchandrappa *et al* (2004), Kar *et al* (2006), Kunjir *et el* (2007).

The perusal of data (Table 2) indicated that sugar content was higher in wider spacing than narrow spacing. Nitrogen levels have significant effect on total sugar content of baby corn. Higher sugar content was recorded in 30 cm x 20 cm which was significantly more than 30 cm x 10 cm. Application of 105 kg N/ha recorded significantly higher total sugar percentage in baby corn than the remaining nitrogen levels and recorded significantly higher sugar content than the remaining nitrogen levels *viz*. 90 kg/ha, 75 kg/ha and 60 kg/ha. The minimum sugar content was observed in 60 kg N/ha and decrease in protein and sugar content with decrease in spacing. Similar finding were given by Gosavi and Bhagat (2009). Bindhani *et al* (2007) also recorded increase in protein content with increased nitrogen rates. Crop geometry and nitrogen levels have no significant effect on starch content.

Crop geometry and different nitrogen levels have non significant effect on TSS. However, the 30 cm x 20 cm crop geometry have more TSS than 30 cm x 10 cm but not statistically significant. The TSS was numerically higher in 45 kg N/ha + 5 t FYM treatments than alone chemical nitrogen treatments but the difference was non-significant. There is non significant effect of crop geometry on total solid. As high solid percentage deteriorate the quality of baby cob. The increase in total solid was numerically high in the nitrogen level 105 kg/ha but difference among the treatments were non-significant. The results revealed that cob texture was not significantly affected by crop geometry and nutrition levels.

CONCLUSION

Crop geometry 30 cm x 10 cm had more number of plants per unit area as compared to other crop geometry *i.e.,* 30 cm x 20 cm and 30 cm x 15 cm. Plant height, LAI, cob yield, baby corn yield, fodder yield, dry matter accumulation and total nitrogen uptake in 30 cm x 10 cm crop geometry were significantly higher than all other crop geometry treatments. Length of baby corn, weight of cob, baby corn weight and crude protein content were significantly higher in 30 cm x 20 cm crop geometry. Crop geometry have non significant effect on crop phenology stages of baby corn *i.e.,* days taken for knee high, tasseling and silking. Nitrogen application up to 105 kg N/ha significantly improved growth and yield parameters like plant height, leaf area index, dry matter accumulation, cob yield, baby corn yield, total nitrogen, phosphorus and potassium uptake, cob weight, number of cobs per plant, baby corn length, girth and weight of baby corn. Significant increase in quality parameters such as crude protein, total sugar and starch of baby corn was in 105 kg N/ha treatment, but cob texture, TSS and total solids were not significantly affected by this treatment.

REFERENCES

Anonymous (2020). *Package of Practices of Kharif Crops*. Punjab Agricultural University, Ludhiana.

Anonymous (2021). *Statistical Abstract of Punjab*, Government of India.

Asana R D and Saini A D (1962). Studies on physiological analysis of yield. *J Pl Physio* **5**: 12831.

Bindhani A, Barik K C, Garnayak L M, and Mahapatra P K (2007). Nitrogen management in baby corn (*Zea mays* L.). *Indian J Agron* **52**: 135-38.

Cochran W G, and Cox G M (1967). *Experimental Designs*. Jhon Willy and Sons Inc., New York.

FAOSTAT (2020). Food and Agriculture Organization of the United Nations, Rome.

Gosavi S P and Bhagat S B (2009). Effect of nitrogen levels and spacing on yield attributes, yield and quality parameters of baby corn (*Zea mays*). *Ann Agric Res* **30**: 125-128.

Kar P P, Barik K C, Mahapatra P K, Garnayak L M, Rath B S, Bastia D K and Khanda C M (2006). Effect of planting geometry and nitrogen on yield, economics and nitrogen uptake of sweet corn. *Indian J Agron* **51**: 43-45.

Kunjir S S, Chavan S A, Bhagat S B and Zende N B (2007). Effect of planting geometry, nitrogen levels and micronutrients on the growth and yield of sweet corn. *Crop Prot and Prod* **2**: 25-27.

Moosavi S G, Seghatoleslami M J and Moazeni A (2012). Effect of planting date and plant density on morphological traits, LAI and forage corn (Sc. 370) yield in second cultivation. *Int Res J Appl and Basic Sci* **3**: 57-63.

Nelson M and Somogyi M A (1945). A new reagent for the determination of sugars. *J Bio Chem* **60**: 61-68.

Panchanathan R M, Mohandas S and Kandaswamy P (1987). Effect of moisture regimes and nitrogen application on maize. *Indian J Agron* **32**: 471-72.

Pandey A K, Mani V P, Ved Prakash, Singh R D and Gupta H S (2002). Effect of varieties and plant densities on yield, yield attributes and economics of baby corn (*Zea mays*). *Indian J Agron* **47**: 221-26.

Rakib M, Banerjee M and Malik G C (2011). Effect of integrated nutrient management on biometric parameters, yield parameters and economics of baby corn (*Zea mays* L.). *Int J Agric Environ Biotech* **4**: 21- 26.

Ramachandrappa B K, Nanjappa H V and Shivakumar H K (2004). Yield and quality of baby corn (*Zea mays* L.) as influenced by spacing and fertilizer levels. *Acta-Agronomica-Hungarica* **52**: 237-43.

Sahoo S C and Mahapatra P K (2004). Response of sweet corn (*Zea mays*) to nitrogen levels and plant population. *Indian J Agric Sci* **74**: 337-38.

Sahoo S C and Panda M M (1999). Effect of level of nitrogen and plant population on the yield of baby corn (*Zea mays*). *Indian J Agric Sci* **69**: 157-58.

Sukanya T S, Najnappa H V and Ramchandrappa B K (2000). Effect of spacings on the growth, development and yield of baby corn varieties. *Karnataka J Agric Sci* **12**: 10-14.

Thakur D R, Sharma V and Sharma V (2000). Effect of planting geometry on baby corn yield in hybrid and composite cultivars of maize. *J Agric Sci* **70**: 246-47.

Thavaprakaash N and Velayudham K (2009). Influence of crop geometry, intercropping systems and INM practices on productivity of baby corn based intercropping system. *Mysore J Agric Sci* **43**: 686-95.

Thavaprakaash N, Velayudham K and Muthukumar V B (2005). Effect of crop geometry, intercropping systems and integrated nutrient management practices on the productivity of baby corn (*Zea mays* L.) based intercropping systems. *Res J Agric & Biol Sci* **1**: 295-302.

Verma A K, Harika A S, Singh P K, Kaur K and Yadav A (2012). International Conference on Sustainable Agriculture for Food and Livelihood Security (701- 702), Punjab Agricultural University, Ludhiana.

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