Original Research Article

Influence of Spacing and Nitrogen on Growth and Yield of *Kharif* Sweetcorn (*Zea mays* L. *saccharata)*

ABSTRACT

A field experiment was conducted during *Kharif* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) ~~on the topic "Influence of Spacing and Nitrogen on growth and yield of *Kharif* Sweet corn (*Zea mays* L. *saccharatam)*",~~ to study treatments consisting of three levels of Nitrogen *viz.* 80, 100 and 120 kg/ha with spacing such as 75x10 cm^2, 60x20 cm^2 and 45x30 cm^2. ~~The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28 %), available N (225 kg/ha), available P (19.50 kg/ha) and available K (92 kg/ha)~~. There were 9 treatments each being replicated thrice and laid out in Randomized Block Design. The results revealed that treatment 8 (Nitrogen 120 kg/ha + 65x20 cm^2) was recorded higher plant height (190.82 cm), higher plant dry weight (81.49 g), maximum number of cobs/plant (2.33), higher seeds/row (41.33), maximum row/cob (14.40), weight of green cob (351.20 g), higher green cob yield (4.15 t/ha), higher stover yield (4.59 t/ha), harvest index (45.90 %), gross returns (1,48,950.00 INR/ha), net returns (1,04,914.00 INR/ha) and benefit cost ratio (2.38).

Keywords: *Nitrogen, Spacing, Growth, Yield, Economics.*

INTRODUCTION

Sweet corn (*Zea mays* L. *saccharata*), 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, subtropical 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" . The term "Sweet Corn is commonly used by food industry. It is a new economic maize species having higher sugar content (14-20%) in green cobs. Green cob of sweet corn consumed directly as roasted or boiled cob in cities. It

Comment [L1]: Delete it

Comment [L2]: This sentence is written in the material

Comment [L3]: 60

Comment [L4]: Put references

contains Carbohydrates 19 g, Sugar 3.2 g. Dietary fiber 2.7 g, Fat 1.2 g, Protein 3.2 g, Vitamin A 10 mg, Foliate (Vit B9) 46 µg, Vitamin C 7 mg, Iron 0.5 mg, Magnesium 37 mg and Potassium 270 mg nutritional value per 100 g sweet corn seed . It is a warm weather crop and grows from sea level 3000m altitude and optimum temperature for better growth is 28-32^{o}C. It grows well in areas with annual rainfall 250-400 cm. It can be grown successfully in soils with pH ranging from 6.5-7.5. The alluvial soils of Uttar Pradesh are well suitable for raising sweet corn. The soils with sandy loam to silty loam texture are best for the crop **(Tomar *et al.* 2011)**.

Comment [L5]: Put references

Comment [L6]: 2014

Globally, sweet corn is cultivated in nearly 201 m ha with a production of 1162 m tonnes and productivity of 5754.7 kg/ha all over the world, having wider diversity of soil, climate, biodiversity and management practices **(FAO 2020).** India produced 31.51 million tonnes in an area of 9.9 million hectares in 2020-21, whereas in *kharif* 2021-22, maize production was 21.24 million tonnes (1st advance estimates) in an area of 8.15 million hectares**.** In Uttar Pradesh, the area, production and productivity of maize are 0.78 million hectare, 1.19 million tonnes and 1504 kg/ha, respectively **(GOI, 2021)**.

Comment [L7]: tons

Comment [L8]: tons

Comment [L9]: tons

Nitrogen is a vital plant nutrient and a major yield determining factor required for maize production. It is essential for carbohydrates metabolism within plants and stimulates vegetative and along with development uptake of other nutrients **(Khan *et al.* 2014)**. When more nitrogen is applied, excess vegetative growth occurs, and the plant lodges with a high wind velocity. Crop maturity is delayed, and the plants are more susceptible to pest and disease. Deficiency of nitrogen results in low plant growth which reduces the grain yield, leaf area duration and rate of photosynthesis. It imparts dark green color to plants. **(Pooja *et al.* 2018).** Nitrogen fertilizer is universally accepted as a key component to high yield and optimum economic return as it plays very important part in crop productivity and its deficiency is one of the major yield limiting factors for cereals production. Balanced and optimum use of nitrogen plays a pivotal role in increasing the yield of maize **(Sanjeev and Bangarwa, 1997)**. Nitrogen increases biomass production of a crop which largely depends on the function of leaf area development and consequential photosynthetic activity. Nitrogen in sweet corn growing is an important component influencing both yield and amino acids, which decide on the taste and nutrient value of kernels. **(Natr *et al.* 1992).**

Comment [L10]: Fahad

Comment [L11]: Phurailatpa

Comment [L12]: Don't found in references

Comment [L13]: Don't found in references

Plant spacing is another important factor which plays a significant role on growth, development and yield of maize. Optimum plant population provides scope to the plants for efficient utilization of solar radiation and nutrients. Closer spacing hampers intercultural operations and as such more competition arises among the plant for nutrients, air and light. As results, plant becomes shorter, weaker, thinner and consequently reduces yield of maize.

Adjustment of proper plant spacing in the maize field is important to ensure maximum utilization of solar energy by the crop and reduce evaporation of soil moisture (**FAO, 2012**). So, optimum population should be maintained to exploit maximum natural resources, such as nutrients, sunlight, and soil moisture, to ensure satisfactory growth and yield. Narrow row spacing and higher plant density results to delay initiation of intraspecific competition (**Duncan, 1984**). Maximum yield can be expected only when plant population allows individual plant to achieve their maximum inherent potential **(Rathod *et al.* 2018).**

Comment [L14]: Don't found in references

Comment [L15]: Don't found in references

Materials and Methods

The experiment was conducted during *Kharif* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on the topic "Influence of Spacing and Nitrogen on growth and yield of *Kharif* Sweet corn (*Zea mays* L. *saccharatam)*", to study treatments consisting of three levels of Nitrogen *viz.* 80, 100 and 120 kg/ha with spacing such as 75x10 cm^2, 60x20 cm^2 and 45x30 cm^2. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28 %), available N (225 kg/ha), available P (19.50 kg/ha) and available K (92 kg/ha). There were 9 treatments each being replicated thrice and laid out in Randomized Block Design. The treatment combinations are treatment 1 (Nitrogen 80 kg/ha + 75x10 cm), treatment 2 (Nitrogen 80 kg/ha + 60x20 cm), treatment 3 (Nitrogen 80 kg/ha + 45x30 cm), treatment 4 (Nitrogen 100 kg/ha + 75x10 cm), treatment 5 (Nitrogen 100 kg/ha + 60x20 cm), treatment 6 (Nitrogen 100 kg/ha + 45x30 cm), treatment 7 (Nitrogen 120 kg/ha + 75x10 cm), treatment 8 (Nitrogen 120 kg/ha + 60x20 cm), treatment 9 (Nitrogen 120 kg/ha + 45x30 cm). The data recorded on different aspects of crop such as, growth parameters, yield attributes and economics were subjected to statistical analysis by variance method **Gomez and Gomez, (1984)**.

Comment [L16]: Don't found in references

RESULT AND DISCUSSION

Growth parameters

Plant height (cm)

The data revealed that, significant and higher plant height (190.82 cm) was recorded in treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) as compared to rest of the treatments. However, treatment-7 (Nitrogen 120 kg/ha + 75 x 10 cm), treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 1]. Significant and higher plant height was with application of nitrogen (120kg/ha) might be due greater synthesis of amino acids, proteins and growth promoting substances enhance the activity and increased the cell division and elongation leads to increase in growth of plant. Similar results were also reported by **Naik *et al.* (2019)**. Further, higher plant height was with (60x20 cm^2) spacing might be due to the competition between plants might have reduced and equal distribution of all resources like solar radiation, minerals, nutrients and water. Similar findings have also reported by **Reddy *et al.* (2021)**.

Comment [L17]: Don't found in references

Comment [L18]: Don't found in references

Plant dry weight (g)

The data revealed that, significant and higher plant dry weight (81.49 g) was recorded in treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) as compared to rest of the treatments. However, the treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 1]. Significantly, maximum plant dry weight was with application of nitrogen 120kg/ha might be due to translocation of sugars and starch in plants leads to increase in growth and accumulation of dry matter. Similar result was also reported by **Rahman *et al.* (2016).** Further, maximum dry weight was with 60x20cm^2 spacing might be due to maximum exploitation of ground area and optimum availability of space and resources led to better translocation of photosynthates and accumulation of dry matter in plants. Similar findings were also reported by **Dankhar *et al.* (2019)**.

Comment [L19]: Don't found in references

Yield attributes

Number of cobs/plant

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum number of Cobs/plant (2.33) which was superior over all other treatments. However, the treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 2]. Significant and maximum number of cobs/plant was with 60x30cm spacing might be due to higher photosynthetic rate and accumulation of more assimilates which in turn increased the sink size, resulted in increased cobs/plant. Similar result was also reported by **Naik *et al.* (2019)**. Further, maximum number of cobs/plant was with application of nitrogen 120 kg/ha might be due to the increase supply of nitrogen and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and leads to increased yield attributes. Similar result was also reported by **Maurya *et al.* (2021).**

Comment [L20]: Don't found in references

Number of seeds/row

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum number of Seeds/row (41.33) which was superior over all other treatments and there was no significantly difference between the treatments [Table 2].

Number of rows/cob

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum number of Rows/cob (14.40) which was superior over all other treatments. However, the treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 2]. Significant and maximum number of rows/cob was with application of nitrogen 120kg/ha might be due increased availability of nitrogen might have increased cell number and cell size leading to better growth of rows in cob. Similar result was also reported by **Dankhar *et al.* (2019)**.

Comment [L21]: Don't found in references

Weight of green cob (g)

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum weight of green cob (351.20 g) which was superior over all other treatments. However, the treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 2]. Significant and higher green cob weight was with application of nitrogen 120kg/ha might be due to greater synthesis of proteins, amino acids and growth promoting substances, which seems to have enhanced the meristematic activity and increased cell division and cell elongation leads to increase the cob weight. Similar result was also reported by **Naik *et al.* (2019)**.

Comment [L22]: Don't found in references

Green cob yield (t/ha)

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum green cob yield (4.59 t/ha) which was superior over all other treatments. However, the treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 2]. Significant and higher green cob yield was with application of nitrogen 120kg/ha might be due to increasing rate of nitrogen could be attributed to enhanced availability of the nutrient for uptake by the plants and increased photo assimilates production that would eventually lead to improved partitioning of carbohydrates to the grains. Similar result was also reported by **Dankhar *et al.* (2019)**. Further, significant and higher green cob yield was with 60 x 30cm spacing might be due to the competition between the plants might have reduced and equal distribution of all resources and increased nutrient uptake results in increase the yield of sweetcorn. Similar result was also reported by **Reddy *et al.* (2021)**.

Comment [L23]: Don't found in references

Stover yield (t/ha)

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum stover yield (4.59 t/ha) which was superior over all other treatments. However, the treatment-9 (Nitrogen 120 kg/ha + 45 x 30 cm) was found to be statistically at par with treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) [Table 2]. Significant and higher stover yield was with 60x30cm spacing might be due to increased number of leaves, leads to increase photosynthetic rate and accumulation of more assimilates, increase the sink size of plant which leads to increase the stover yield of the crop. Similar result was also reported by **Naik *et al.* (2019)**. Further, higher stover yield was with application of nitrogen 120kg/ha might be due to higher availability of nitrogen to plants have stimulates various physiological process in plants and leads to increased growth parameters and stover yield of crop. Similar result was also reported by **Maurya *et al.* (2021)**.

Comment [L24]: Don't found in references

Comment [L25]: Don't found in references

Harvest index (%)

The data revealed that, Treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) was recorded significantly maximum harvest index (45.90 %) which was superior over all other treatments and there was no significantly difference between the treatments [Table 2].

Table 1 Influence of Spacing and Nitrogen on growth attributes of *Kharif* sweet corn

S. No.	Treatments combinations	Plant height (g) (80 DAS)	Dry weight (g) (80 DAS)	CGR (40-60 DAS)	RGR (40-60 DAS)
1	Nitrogen 80 kg/ha + 75 x 10 cm	144.13	78.30	30.70	0.0661
2	Nitrogen 80 kg/ha + 60 x 20 cm	159.53	78.78	18.18	0.0624
3	Nitrogen 80 kg/ha + 45 x 30 cm	155.00	78.41	16.12	0.0628
4	Nitrogen 100 kg/ha + 75 x 10 cm	156.79	79.06	29.00	0.0669

5	Nitrogen 100 kg/ha + 60 x 20 cm	168.82	79.58	17.57	0.0615
6	Nitrogen 100 kg/ha + 45 x 30 cm	172.27	79.27	15.16	0.0584
7	Nitrogen 120 kg/ha + 75 x 10 cm	176.37	79.96	27.15	0.0572
8	Nitrogen 120 kg/ha + 60 x 20 cm	190.82	81.49	16.81	0.0528
9	Nitrogen 120 kg/ha + 45 x 30 cm	184.73	80.28	15.36	0.0587
	F- test	S	S	S	NS
	S Em (±)	4.62	0.28	0.40	0.0029
	CD (p =0.05)	13.74	0.85	1.21	-

Table 2 Influence of Spacing and Nitrogen on Yield attributes of *Kharif* Sweetcorn

S.No.	Treatments combinations	Cobs/plant	Seeds/ Row	Rows/ Cob	Weight of Green cob(g)	Green Cob yield (t/ha)	Green fodder yield (t/ha)	Harvest Index (%)
1	Nitrogen 80 kg/ha + 75 x 10 cm	1.53	35.00	12.40	222.67	3.45	4.17	45.26
2	Nitrogen 80 kg/ha + 60 x 20 cm	1.93	36.33	13.20	245.87	3.73	4.46	45.58
3	Nitrogen 80 kg/ha + 45 x 30 cm	1.73	35.67	13.00	229.07	3.50	4.36	44.52

4	Nitrogen 100 kg/ha + 75 x 10 cm	1.53	36.00	12.80	244.27	3.60	4.29	45.62
5	Nitrogen 100 kg/ha + 60 x 20 cm	2.13	38.33	13.60	301.87	3.87	4.62	45.54
6	Nitrogen 100 kg/ha + 45 x 30 cm	1.93	37.33	13.20	266.47	3.64	4.52	49.48
7	Nitrogen 120 kg/ha + 75 x 10 cm	1.73	36.67	13.00	262.27	3.61	4.34	45.15
8	Nitrogen 120 kg/ha + 60 x 20 cm	2.33	41.33	14.40	351.20	4.15	4.89	45.90
9	Nitrogen 120 kg/ha + 45 x 30 cm	1.93	41.00	14.07	345.07	3.85	4.80	45.78
	F- test	S	NS	S	S	S	S	NS
	S Em (±)	1.62	1.06	0.02	2.10	0.03	0.02	0.58
	CD (p =0.05)	0.00	-	0.06	6.26	0.11	0.08	-

CONCLUSION

Based on the above findings it was concluded that the Influence of spacing and Nitrogen perform effective improvement ~~to the~~ growth and yield parameters of Kharif sweet corn. The application of nitrogen 120 kg/ha along with spacing 60 x 20 cm for obtaining better growth and production of sweet corn in addition to recommended doses of fertilizer.

Comment [L26]:

References

1. A., Anjaneyulu Naik, M., Srinivasa, Reddy., P.V., Ramesh, Babu and P., Kavitha. 2019. Effect of plant density and nitrogen management of sweet corn (*Zea mays* var. Saccharata). The Pharma Innovation Journal, 8(6):839-842.

Comment [L27]: Don't found in article

2. Chowdam, Reddy., Jayasimha, Virat and Shikha, Singh. 2021. Effect of nutrient and spacing on growth and yield of pearl millet (Pennisetum glaucum L.). The Pharma Innovation Journal, **10**(10):1866-1870.

Comment [L28]: Don't found in article

3. FAO (2020). Food and Agricultural Organization. Website: https://fao.org.in.
4. GOI (2020). Agricultural Statistics at a Glance, Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi, https://eands.dacnet.nic.in.
5. M. M., Rahman, S. K., Paul and M. M., Rahman., 2016. Effects of spacing and nitrogen levels on yield and yield contributing characters of maize. J. Bangladesh Agril. Univ. **14**(1): 43-48, 2016

Comment [L29]: Rahman,M.M;Paul,S.K ; and Rahman.M.M

6. Minal, Dankhra, V.J., Patel and P.S., Panchal., 2019. Effect of twin row system and levels of nitrogen on yield and economics of rabi maize (*Zea mays* L.). International Journal of Chemical Studies, **7**(6): 1891-189.

Comment [L30]: Dankhra , M

7. Manisha, Rathod, V.G., Bavalgave, Bhumika, Tandel and N.N., Gudadhe., 2018. Effect of spacing and INM practices on growth, yield and economics of Rabi sweet corn (*Zea mays* L. var. saccharata Sturt) under south Gujarat condition. International Journal of Chemical Studies, **6**(5): 247-250.

Comment [L31]: Rathod,M

8. Prakhar, Maurya., Joy, Dawson., Ravi, Ranjan, Kumar., Alok, Kumar, Verma and Ritikesh, Raj, 2021. Effect of Nitrogen Level and Plant Growth Regulators in Maize (*Zea mays* L.). International Journal of Current Microbiology and Applied Sciences, **10**(01): 1283-1288.

Comment [L32]: Maurya P,

9. Phurailatpa Pooja Sharma, Girish Pandey, S. Jawahar, C. Kalaiyarasan and K., Suseendran, 2018. Effect of different levels of nitrogenand phosphorus on yield and economic of hybrid maize (*Zea mays* L.). International journal of research and analytical reviews, 2349-5138.

10. Tomar, G.S., Tomar, S.P.S. and Khajanji, S.N., 2014. Science of Crop Production, Part-1 *Kharif* Crops, pp: 98-99.

11. Fahad Khan, Sehrish Khan, Shah Fahad , Shah Faisal , Saddam Hussain, saqib Ali, Ashfaq Ali, 2014. Effect of Different Levels of Nitrogen on the Phenology and yield of Maize Varities. American Journal of Plant Science ,2014,5,2582-2590

Comment [L33]: Don't found in article

Comment [L34]: Fahad,K