Original Research Article

Response of Spacing and Nitrogen on Yield and Economics 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).To study treatments consisting of three levels of Nitrogen such as,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) was recorded 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. 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)**. 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)**.

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 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).**

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. Maximum yield can be expected only when plant population allows individual plant to achieve their maximum inherent potential **(Rathod *et al.* 2018).**

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, 60x20 cm and 45x30 cm. 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)**.

RESULT AND DISCUSSION

Yield and Economics

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[Table 1]. Significantly, maximum number of cobs/plant was with 60x30cm^2 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 120kg/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).**

4.6 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 1].

4.7 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[Table 1].Significantly, 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).**

4.8 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[Table 1]. Significantly, 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)**.

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 1].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 60x30cm^2 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).**

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 1].Significant and higher stover yield was with 60x30cm^2 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)**.

Harvestindex (%)

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 1].

Economics

Cost of cultivation (INR/ha)

Cost of cultivation (50,286.00 INR/ha) was found to be highest in treatment-7 (Nitrogen 120 kg/ha + 75 x 10 cm) and minimum cost of cultivation (42,482.00 INR/ha) was found to be in treatment-3 (Nitrogen 80 kg/ha + 45 x 30 cm) as compared to other treatments [Table 2].

Gross return (INR/ha)

Gross returns (1,48,950.00 INR/ha) were found to be highest in treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) and minimum gross returns (12,4350.00 INR/ha) was found to be in treatment-1 (Nitrogen 80 kg/ha + 75 x 10) cm as compared to other treatments [Table 2].

Net returns (INR/ha)

Net returns (1,04,914.00 INR/ha) were found to be highest in treatment-8 (Nitrogen 120 kg/ha + 60 x 20 cm) and minimum net returns (74,368.00 INR/ha) was found to be in treatment-1 (Nitrogen 80 kg/ha + 75 x 10) cm as compared to other treatments [Table 2].

4.15 Benefit Cost ratio (B:C)

Benefit Cost ratio (2.38) was found to be highest in treatment-8 (Nitrogen 120 kg/ha + 75 x 20 cm) and minimum benefit cost ratio (1.49) was found to be in treatment-1 (Nitrogen 80 kg/ha + 75 x 10) cm as compared to other treatments[Table 2].

Table 1Influence of Spacing and Nitrogen on yield attributes of *Kharif* Sweet corn.

S. No.	Treatment 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
SEm (±)		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	-

Table 2Influence of Spacing and Nitrogen on Economics of Kharif Sweet corn.

S. No.	Treatment combinations		Cost of Cultivation (INR/ha)	Gross returns (INR/ha)	Net Return (INR/ha)	B:C ratio
1.	Nitrogen 80 kg/ha	+ 75 x 10 cm	49,982.00	1,24,350.00	74,368.00	1.49
2.	Nitrogen 80 kg/ha	+ 60 x 20 cm	43,732.00	1,34,200.00	90,468.00	2.06
3.	Nitrogen 80 kg/ha	+ 45 x 30 cm	42,482.00	1,26,800.00	84,318.00	1.98
4.	Nitrogen 100 kg/ha	+ 75 x 10 cm	50,132.00	1,29,450.00	79,318.00	1.58
5.	Nitrogen 100 kg/ha	+ 60 x 20 cm	43,882.00	1,39,200.00	95,318.00	2.17
6.	Nitrogen 100 kg/ha	+ 45 x 30 cm	42,632.00	1,31,800.00	89,168.00	2.09
7.	Nitrogen 120 kg/ha	+ 75 x 10 cm	50,286.00	1,30,000.00	79,714.00	1.58
8.	Nitrogen 120 kg/ha	+ 60 x 20 cm	44,036.00	1,48,950.00	1,04,914.00	2.38
9.	Nitrogen 120 kg/ha	+45 x 30 cm	42,786.00	1,39,500.00	96,714.00	2.26

CONCLUSION

Based on the above findings it was concluded that the Influence of spacing and Nitrogen perform effective improvement to yield and economics of Kharif sweet corn. The application of nitrogen 120 kg/ha along with spacing 60 x 20 cm for obtaining better production, net return and benefit cost ratio of sweet corn.

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