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Productivity Potential, Quality and Profitability of Sweet Corn (*Zea mays* var. *saccharata*) under Diverse Nitrogen Management Practices in Mid-hills of Meghalaya

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ABSTRACT

A field experiment was conducted to find out suitable level and source of nitrogen (N) for sweet corn (Sugar 75) at experimental Farm, College of Post Graduate Studies (CAU, Imphal), Umiam, Meghalaya during the *Kharif* season of 2012. Results indicated that various nitrogen sources and level extended the significant effect on yield attributes, yield, quality and economic output of sweet corn. Variation in levels of N brought an increase in population, cob length, number of grains per cob, test weight, gross returns, net returns and B: C ratio was recorded with each increment in N levels up to 120 kg ha^{-1}. Though the difference between 80 and 120 kg ha^{-1} N for these parameters was at par but both these treatment recorded significantly high values over 40 kg N ha^{-1}. Maximum cob yield (8.2 t ha^{-1}) was observed from the treatment received nitrogen through poultry manure which was at par with FYM but produced significantly higher fresh cobs yield over compost and urea applied N sources. There was found no significant effect of levels and sources of N on harvest index. However, quality of sweet corn kernels did not differ either due to levels or source of N.

1. Introduction

Sweet corn (*Zea mays* var. *saccharata*) is a hybridized variety of maize specially bred to increase the sugar content in the grains. The kernels of sweet corn are sugary with creamy texture and have high edible quality at milking stage. Roasted green cobs provide starch, fat, protein; sugar, minerals and vitamins in palatable and digestible form at relatively low cost. In India, sweet corn is cultivated very small area by some farmers and private sectors to meet the demands of many industries. The demand for eating roasted cobs in cities and towns is increasing day by day which has resulted into opening of the counters of roasted cobs. Farmers of North-East Hill (NEH) region mainly cultivate locally available cultivars which are long in duration and have lower yield potential.

Green cobs of hybrid sweet corn are harvested within 70 to 80 days after sowing (DAS), which helps to vacate the land 35 to 45 days earlier than the normally cultivated maize. This region receives a plenty amount of rainfall. Sweet corn offers a good scope to fully utilize advantage of rainfall by taking at least two crops in a year. Due to its increasing demand, there is an increasing tendency for commercial production of sweet corn (Pradeep *et al.,* 2005). At one side it will help to the problem of shortage of green fodder for animals feeding and another side it will improve the living standard of farmers of NEH region (Efthimiadou *et al*., 2009). In addition, it has potential to generate employment opportunities in the rural areas if suitable arrangements are made for development of various processed products from this very corn. Sweet corn like grain maize is a nutrient exhaustive crop and it requires fertile soils to realize optimum economic yield. Nitrogen is an integral component of many compounds essential for plant's growth processes including chlorophyll and many

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enzymes and required by plants in comparatively larger amount than other elements (Derby *et al*., 2004.). Mohammadi *et al*. (2008) observed that yield reduction in corn due to nitrogen deficiency was more than other any elements deficiency. As per the estimates by CIMMYT, the most significant causes of yield loss on farmer's fields are low fertility, predominantly nitrogen deficiency (Edmeades and Deutsch, 1994). The lack of knowledge about the use and economic importance of sweet corn and non-availability of appropriate production technology are the major constraints for its popularization among farmers of NEH region. Keeping in view the above fact, an experiment entitled 'Effect of sources and levels of nitrogen on growth, yield and economics of sweet corn (*Zea mays* var. *saccharata*) in mid-hills of Meghalaya.

2. Materials and Methods

A field experiment was conducted at experimental Farm, College of Post Graduate Studies (CAU), Umiam, Meghalaya during the *Kharif* season of 2012. Experimental soil was sandy clay loam in texture, bulk density (1.4 g cm^{-3}), acidic in reaction 5.13 pH, high in organic carbon content (1.02%) and low in available nitrogen (240 kg N ha^{-1}), phosphorus (8.4 kg P_2O_5 ha^{-1}) and potassium (197.2 kg K_2O ha^{-1}).

The field experiment consisted of four levels of nitrogen (Control, 40, 80 and N120 kg N ha^{-1}) and four sources of nitrogen (urea, farmyard manure, compost and poultry manure). Treatments were replicated thrice in randomized block design (RBD). The sweet corn variety (Sugar 75) sowing was done by placing of two seeds per hill at a spacing of 50 cm from row to raw and 25 cm from plant to plant on 11th of June, 2012 by opening small furrows up to 5 cm in depth with the help of furrow opener. To maintain desired plant population thinning was done by 15 DAS. To keep crop free from weeds, two manual hand weeding were done at 25 and 45 DAS. Other recommended management practices for state were adopted during the active growing period of the crop. The green cobs of sweet corn were harvested manually in different dates (3rd, 5th, 7th September, 2012) as crop reached to soft dough stage. Plant dry matter accumulation was recorded at 30 DAS at 30 days interval. Parameters *viz*. total soluble sugar, protein content related to quality were analyzed by following standard methods. Yield attributes like cob length, grain rows per cob, test weight and yield were recorded at harvest. Data obtained from various studies during investigation were statistically analyzed by using the technique of analysis of variance. The difference between the treatments means were examined as for their statistical significance with appropriate critical difference (CD) value at 5 per cent level of probability (Gomez and Gomez, 1984).

Table 1. Effect of sources and levels of nitrogen on yield attributes and productivity of sweet corn.

Treatments	**Yield attributes**					**Yields (t ha^{-1})**		
	Plant population (10^3 ha^{-1}) at harvest	**Cob length (cm)**	**Cobs $plant^{-1}$**	**Grains cob^{-1}**	**Test weight (g)**	**Fresh cob yield**	**Stover yield**	**Harvest index**
Control versus Fertilized								
Control	57.0	10.2	0.8	187.3	125.3	4.9	6.2	0.44
Fertilized	71.1	14.7	1.1	311.2	137.1	7.7	8.9	0.46
SEm (±)	1.3	0.5	0.1	19.0	4.3	0.4	0.5	0.02
CD (P=0.05)	3.8	1.4	NS	55.5	12.5	1.1	1.5	NS
Levels of Nitrogen (kg ha^{-1})								
40	68.8	13.2	1.0	252.8	127.3	6.4	7.3	0.47
80	71.8	14.6	1.1	323.4	138.7	7.7	9.2	0.46
120	72.7	16.3	1.2	357.3	145.2	8.9	10.4	0.46
SEm (±)	0.7	0.3	0.1	12.9	2.9	0.3	0.3	0.01
CD (P=0.05)	1.9	0.9	NS	37.7	8.5	0.7	1.0	NS
Sources of Nitrogen								
Urea	70.2	14.8	1.1	326.2	134.7	7.8	9.2	0.46
FYM	72.2	14.8	1.1	295.3	140.9	7.9	9.7	0.45
Compost	69.6	13.8	1.0	261.8	136.2	6.8	7.5	0.48
Poultry manure	72.4	15.4	1.2	361.3	136.4	8.2	9.4	0.47
SEm (±)	0.8	0.4	0.1	14.9	3.4	0.3	0.4	0.01
CD (P=0.05)	2.2	1.1	NS	43.5	NS	0.8	1.1	NS

3. Results and Discussion

3.1 Yield attributes

The data on yield attributes *viz.* plant population, numbers of cobs, cob length, grains per cob, test weight are presented in Table 1. Variation in levels of N brought significant difference in population, cob length, number of grains per cob and test weight at harvest. However, various level of nitrogen and failed to effect number of cobs per plant. The maximum plant population (10^3 x 72.7 ha^{-1}), cob length (16.3 cm), grains (357.0 cob^{-1}) and 1000 grains weight (145.2 g) recorded with the application of 120 kg N ha^{-1}but remained significantly at par with 80 kg N ha^{-1}. The maximum plant population (10^3 x 72.4 ha^{-1}), cob length (15.4 cm) and number of grains (361.3 cob^{-1}) were recorded with treatment received poultry manure except number of grains per cob, which was at par with FYM but significantly higher over compost. Various sources of nitrogen did not show any significant difference on number of cobs per plant and weight of 1000 grains. However, relatively higher value of number of cobs per plant was found with application of poultry manure and weight of 1000 grains (140.67 g) with application FYM over other. The increase yield attribute with various rate of nitrogen application was reported by (Sahoo and Mahapatra, 2005; Muhammad *et al*., 2010 and Khan *et al*., 2011).

3.2 Productivity

Data on yields presented in Table 1 clearly indicate that N fertilized treatments improved cob yield over control. Cob yield and stover yield also differed significantly due to various levels of nitrogen. The highest cob yield (8.9 t ha^{-1}) and stover yield (10.4 t ha^{-1}) were recorded with application of nitrogen at the rate of 120 kg ha^{-1} which was significantly superior over with 80 kg N ha^{-1} and 40 kg N ha^{-1}. On an average, 120 kg N ha^{-1} produced 51% and 10%higher cob yield over 40 and 80 kg N ha^{-1} respectively. Various sources of N also brought significant difference in cob yield and stover yield of sweet corn. The maximum cob yield (8.2 t ha^{-1}) was observed with application of poultry manure and remains at par. However, it produced significantly higher yields over the compost and urea. The magnitude of increase in cob yield due to poultry manure N supplied treatment was 20, 8 and 3% cob yield over compost, urea, and FYM N supplied treatment, respectively. However, maximum stover yield was recorded from FYM treatment (9.65 t ha^{-1}) which was being at par with poultry manure and urea but produced significantly more stover yield when compost was used as source of nitrogen. Harvest index did not affected significantly either due to levels or sources of nitrogen. However, N applied treatments reported slightly higher value of harvest index. These results are in agreement with (Raja, 2001; Harikrishna *et al*., 2005 and Kumar, 2008) who reported that application of different rate of nitrogen increased cob yield.

Table 2. Effect of sources and levels of nitrogen on quality and economic return of sweet corn.

Treatments	**Quality parameters (%)**			**Economics**		
	TSS in grains	**Protein in grains**	**Protein content in stover**	**Gross return (Rs 10^3 ha^{-1})**	**Net return (Rs 10^3 ha^{-1})**	**B: C ratio**
Control versus Fertilized						
Control	13.8	11.9	4.9	55.2	6	1.1
Fertilized	15.3	13.6	6.8	85.8	30.2	1.5
SEm (±)	0.6	0.2	0.3	3.8	3.8	0.07
CD (P=0.05)	NS	0.7	0.7	11	11	0.21
Levels of Nitrogen (kg ha^{-1})						
40	15.4	13.4	5.7	71.3	18.6	1.4
80	14.9	13.6	7.1	86.5	31	1.6
120	14.8	13.9	7.5	99.5	41.1	1.7
SEm (±)	0.4	0.2	0.2	2.6	2.6	0.05
CD (P=0.05)	NS	NS	0.5	7.5	7.5	0.14
Sources of Nitrogen						
Urea	15.1	13.8	7.1	86.7	36.3	1.7
FYM	15.2	13.5	6.4	89	33.8	1.6
Compost	15.2	13.5	6.6	75.9	18.3	1.3
Poultry manure	14.7	13.8	7	91.5	32.5	1.5
SEm (±)	0.4	0.2	0.2	3	3	0.1
CD (P=0.05)	NS	NS	NS	8.7	8.7	0.028

Quality and economic return

Quality of sweet corn in terms of total soluble solids (TSS) and protein content in grains and stover was significantly differed among the nitrogen management practices (Table 2). There was no significant difference of levels and sources of nitrogen on total soluble solids, protein content in grains. Stover protein content differed significantly by only various levels of nitrogen. The highest protein content in stover (7.5%) was recorded with the application of 120 nitrogen ha^{-1} which was being at par with 80 kg N ha^{-1} (7.0%) but significantly superior over 40 kg N ha^{-1}**.** Various sources of N did not show any marked difference on stover protein content of sweet corn. Similar findings were also reported by (Almodares *et al*., 2009). Economic analysis revealed (Table 2) that N fertilized treatments resulted in significantly higher values of gross return and net return and benefit cost ratio (B: C ratio) over control. The highest gross returns (Rs 10^3 x 99.5 ha^{-1}), net returns (Rs 10^3 x 41.1ha^{-1}) and B: C ratio (1.7) was recorded with the application of 120 kg N ha^{-1} which was significantly higher over other level of nitrogen. Various sources of nitrogen also showed significant difference on gross returns and net returns and benefit cost ratio (B: C ratio) in sweet corn. The maximum gross return was received from poultry manure (Rs 10^3 x 91.5 ha^{-1}) which was at par with FYM but significantly higher over urea and compost. However, maximum net returns of (Rs 10^3 x 36.3 ha^{-1} andbenefit cost ratio 1.7) were found with the application of urea, which was at par with FYM.These results are in close conformity with the findings of (Verma *et al.*, 2003 and Kumar, 2009).

Conclusion

The yield attributes, yields, quality and economics of sweet corn was influenced by various levels and sources of nitrogen. Significantly higher values of yield attribute, productivity, quality and economic return was recorded from fertilized to control plot. Significantly difference was found among the attributes and yields, with the application of 120 kg N ha^{-1}. Thus, the study suggested that application 120 kg N ha^{-1}through urea resulted in better yield and economics of the sweet corn in Ri-Bhoi district of Meghalaya. Hence it can be recommended for profitable sweet corn production in mid hill ecosystem of Meghalaya.

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