Yield and economics of sweet corn (Zea mays) as affected by plant population and fertility levels

S.C. SAHOO* AND P.K. MAHAPATRA1

Regional Research and Technology Transfer Sub-station, Orissa University of Agriculture and Technology, Jashipur, Orissa 757 091

Received: April 2007

ABSTRACT

A field experiment was conducted at Jashipur, Orissa during rabi (dry) season of 2002-03 and 2003-04 to study the effect of plant population (111.1, 83.3, 66.7 and 55.6 x 10^3/ha) and fertility levels (0-0-0, 40-8.7-16.7, 80-17.5-33.3 and 120-26.2-50 kg NPK/ha) on yield and economics of sweet corn (Zea mays L.). Application of 120-26.2-50 kg NPK to 83.3 x 10^3 plants/ha produced 16.48 t/ha green cobs, which was 7.6% more than of 66.7 x 10^3 plants/ha with same level of fertility. It gave the maximum net profit of Rs 54,453/ha, followed by Rs 49,439/ha with 66.7 x 10^3 plants/ha fertilized with 120-26.2-50 kg NPK/ha. The benefit : cost ratio was the maximum with 83.3 x 10^3 plants fertilized with 120-26.2-50 kg NPK/ha. The increase in fertility level linearly increased the green-fodder yield. Maximum fodder yield (37.49 - 41.56 t/ha) was attained with application of 120-26.2-50 kg NPK/ha. Hence, a plant population of 83.3 x 10^3/ha with fertility level 120-26.2-50 kg NPK/ha should be adopted to obtain the maximum green-cob yield and net profit from sweet corn in Orissa.

Key words: Economics, Fertility level, Plant population, Sweet corn, Yield

Corn (Zea mays L.) is a versatile crop, which finds a place in the human food, animal feed, fodder and industrial raw material. Recently speciality corns such as baby corn and sweet corn have emerged as alternative food sources, especially for the affluent society. Sweet corn is used as a human food in the soft dough stage with succulent grain. The higher content of a water-soluble polysaccharide in the kernel adds texture and quality in addition to sweetness (Venkatesh et al., 2003). Sweet corn is gaining popularity both in rural and urban areas because of its high sugar and low starch content. It has a great market potential and high market value in India. In Orissa the tribal farmers consume a sizeable quantity of green cob, which generates potential for sweet corn cultivation in the area. As it is harvested at the green-cob stage, much before the maturity of grain, the requirement of plant population and fertility level need to be rescheduled for this crop. Effect of these factors on yield and economics of sweet corn are not known. With advent of sweet corn agronomy, it can be a profitable crop for the farmers, particularly for those residing in peri-urban areas. There are diversified reports about the effect of plant population and fertility level on its yield. Viswanatha et al. (2000) reported maximum green-cob yield with planting at 60 cm x 30 cm spacing, whereas Raja (2001) recommended a population of 88,888 with 120 kg N/ha to get its maximum yield. Keeping these facts in view, an experiment was conducted to work out the effect of plant population and fertility level on yield and economics of sweet corn.

MATERIALS AND METHODS

The experiment was conducted at Regional Research and Technology Transfer Substation, Jashipur, District Mayurbhanj in the North Central Plateau Zone of Orissa during rabi (November to February) season of 2002-03 and 2003-04. The soil was well-drained, sandy clay-loam in texture, with pH 5.6. The available N, P and K content of the soil was 181, 21.6 and 120 kg/ha, respectively. The experiment was laid out in split-plot design having 4 plant population, viz. 111.1, 83.3, 66.7 and 55.6 x 10^3 plants/ha, with spacing of 60 cm x 15 cm, 60 cm x 20 cm, 60 cm x 25 cm and 60 cm x 30 cm respectively in main plots; and 4 fertility levels, viz. 0-0-0, 40-8.7-16.7, 80-17.5-33.3 and 120-26.2-50 kg NPK/ha in subplots, and was replicated thrice. The sweet corn composite ‘Madhuri’ was sown on 15 November 2002 and 6 November 2003 in plot size of 14.4 m^2. Full P and K with 25% N as per treatment were

*Corresponding author (Email: skaskanya@yahoo.co.in)

Present address: College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa 751 003
applied basal in furrows. The 50% N was applied at knee-
high stage and the remaining N was applied at early tassell-
ing stage.

The crop was harvested when the cobs had dried silk,
green-husk cover and soft kernel. The cost of cultivation
was calculated by taking the cost of labour Rs 50/day. The
prevailing price of N was taken Rs 10.91/kg, P Rs 21.06/
kg, K Rs 7.72/kg, green cob Rs 4/kg and green fodder Rs
100/t. The net profit and benefit: cost ratio were calcu-
lated by taking the difference and ratio between value of
produce and expenditure incurred, respectively.

**RESULTS AND DISCUSSION**

**Yield**

The maximum number of cobs (86.0 x 10³ /ha during
2002-03 and 84.5 x 10³ /ha during 2003-04) were pro-
duced at the highest population (111.1 x 10³ plants/ha) in
both the years. But owing to mutual competition for nutri-
ents, water and sunlight; there were maximum number of
barren plants (18.1 - 19.3%) at 111.1 x 10³ plants/ha. Densely
populated plants (111.1 x 10³ plants/ha) produced
lighter cobs (125 - 131.9 g/cob) with less number of
grains/cob (279 - 289) than widely spaced crop (83.3, 66.7
and 55.6 x 10³ plants/ha) (Table 1). With increase in plant-
ing density, many kernels did not develop into full size
owing to limitations in assimilation capacity, which caused
kernel and ear abortion. There was less cob yield (9.49
- 9.59 t/ha) at 55.6 x 10³ plants/ha, owing to lower number of
cobs/unit area. The population of 83.3 x 10³ /ha had
more number of cobs than 66.7 and 55.6 x 10³ plants/ha.
Although 111.1 x 10³ plants/ha produced the highest num-
ber of cobs (84.5 - 86.0 x 10³ /ha), the effect was not
reflected in the yield due to light weight of the cob. The
green-cob yield was the maximum (11.29 - 12.30 t/ha) at
83.3 x 10³ plants/ha, which was 32 and 23% more than
that at 111.1 x 10³ plants/ha during 2002-03 and 2003-04,
respectively. This is in close conformity with the earlier
findings by Raja (2001) from Hyderabad, who recom-
pended a plant population of 88,888/ha for obtaining
maximum sweet corn yield. Huseyin et al. (2003) also rec-
ommended 90 x 10³ plants/ha for the maximum grain yield
in maize.

The increase in plant population led to significantly
higher green fodder yield. Maximum population of 111.1
x 10³ plants/ha produced the maximum green fodder of
32.80 to 32.88 t/ha. The highest number of plants/unit area
(111.1 x 10³ plants/ha) contributed significantly towards
green-fodder yield. Widdicombe and Thelen (2002) also
observed that increase in plant density increased the fod-
der yield linearly.

The maximum green-cob yield of 14.42 t/ha in 2002-03
and 14.04 t/ha in 2003-04 was obtained with application of
120-26.2-50 kg NPK/ha due to more (91.0 to 93.9 x
10³/ha) and heavy cobs (183.3 to 205.9 g/cob) with fewer
barren plants (5.5 to 6.4 %). Earlier Sahoo and Mahapatra
(2004) also recommended 120 kg N/ha for maximum
green-cob yield. Yield attributes like number of cobs/plant,
cob weight and number of grains/cob increased with fer-
tilizer supply. In the absence of fertilizer, there were more
number of non-bearing plants (27.6 - 28.9%), light cobs
(67.3 - 100.8 g/cob) and fewer (142 - 146 /cob) kernels
due to poor nutrition. All these resulted in low cob yield
(3.16 - 3.26 t/ha) in the control plots. The green-cob yield
was relatively more during 2002-03 than 2003-04 due to
more number of cobs/unit area. The highest quantity of
fodder (37.49 - 41.56 t/ha) was produced at 120-
26.2-50 kg NPK/ha.

The crop responded to higher level of fertility with in-

Table 1. Effect of plant population and fertility on yield and yield attributes of sweet corn

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cobs/ha (x 10³)</th>
<th>Barrenness (%)</th>
<th>Weight of green cob (g)</th>
<th>Grains/cob</th>
<th>Green-cob yield (t/ha)</th>
<th>Green-fodder yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant population (x 10³ plants/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111.1</td>
<td>86.0</td>
<td>84.5</td>
<td>19.3</td>
<td>18.1</td>
<td>125.0</td>
<td>131.9</td>
</tr>
<tr>
<td>83.3</td>
<td>82.9</td>
<td>80.5</td>
<td>13.0</td>
<td>12.6</td>
<td>162.5</td>
<td>152.2</td>
</tr>
<tr>
<td>66.7</td>
<td>70.3</td>
<td>69.5</td>
<td>12.1</td>
<td>11.3</td>
<td>170.4</td>
<td>156.9</td>
</tr>
<tr>
<td>55.6</td>
<td>66.9</td>
<td>63.9</td>
<td>11.2</td>
<td>12.4</td>
<td>171.3</td>
<td>160.4</td>
</tr>
<tr>
<td>SEm±</td>
<td>1.3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>2.2</td>
<td>5.4</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>4.7</td>
<td>2.9</td>
<td>2.2</td>
<td>3.2</td>
<td>7.5</td>
<td>18.7</td>
</tr>
<tr>
<td>Fertility (N-P-K kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-0-0</td>
<td>46.0</td>
<td>46.9</td>
<td>28.9</td>
<td>27.6</td>
<td>100.8</td>
<td>67.3</td>
</tr>
<tr>
<td>40-8.7-16.7</td>
<td>79.2</td>
<td>77.7</td>
<td>13.5</td>
<td>12.3</td>
<td>166.3</td>
<td>154.8</td>
</tr>
<tr>
<td>80-17.5-33.3</td>
<td>87.0</td>
<td>82.9</td>
<td>7.6</td>
<td>8.0</td>
<td>178.8</td>
<td>173.5</td>
</tr>
<tr>
<td>120-26.2-50</td>
<td>93.9</td>
<td>91.0</td>
<td>5.5</td>
<td>6.4</td>
<td>183.3</td>
<td>205.9</td>
</tr>
<tr>
<td>SEm±</td>
<td>2.2</td>
<td>3.3</td>
<td>0.8</td>
<td>0.9</td>
<td>3.7</td>
<td>5.1</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>6.5</td>
<td>3.9</td>
<td>2.2</td>
<td>2.5</td>
<td>10.7</td>
<td>14.9</td>
</tr>
</tbody>
</table>
crease in plant density up to 83.3 x 10^3 plants/ha. Application of 120-26.2-50 kg NPK/ha to 83.3 x 10^3 plants/ha resulted in the maximum green-cob yield (16.48 t/ha), which was 7.6% more than that of 66.7 x 10^3 plants/ha with same level of fertility (Fig. 1). Compared with no fertilizer treatment, application of 120-26.2-50 kg NPK/ha to the population of 111.1, 83.3, 66.7 and 55.6 x 10^3 plants/ha increased the cob yield by 211, 374, 369 and 495%, respectively. Application of 40-8.7-16.7, 80-17.5-33.3 and 120-26.2-50 kg NPK/ha to 83.3 x 10^3 plants/ha increased the green-cob yield by 246, 337 and 374%, respectively over the control plots.

**Nutrient uptake**

A population of 83.3 x 10^3 plants/ha removed 56.3 kg N and 23.1 kg P/ha, which was significantly higher than of other populations (Table 2), whereas it removed 96.8 kg K/ha, which was on a par with that of 111.1 x 10^3 plants/ha. The highest yield of green cob could be obtained when the crop removed the maximum N, P and K at the population of 83.3 x 10^3 plants/ha. As maize is a heavy feeder, the uptake of NPK increased with application of every additional unit of fertilizer. High yield was associated with maximum uptake of 76.9 kg N, 32.0 kg P and 127.6 kg K/ha through application of 120-26.2-50 kg NPK/ha. Sofi *et al.* (2004) also observed maximum uptake of nutrients (97 kg N, 24 kg P and 108 kg K/ha) with application of 160 kg N and 80 kg K/ha. Poor root growth and low dry-matter production in the control plots resulted in less uptake of nutrients. Agronomic nutrient-use efficiency decreased with subsequent higher doses of fertilizer. Utilization of additional amount of nutrients decreased with subsequent

---

**Fig. 1.** Effect of plant population and fertility on yield and net profit of sweet corn

**Table 2.** Effect of plant population and fertility on nutrient uptake and economics of sweet corn

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Nutrient uptake (kg/ha)*</th>
<th>ANUE* (kg green cob/kg nutrient applied)</th>
<th>Net profit (Rs/ha)</th>
<th>Benefit : cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant population (x 10^3 plants/ha)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111.1</td>
<td>50.4</td>
<td>21.0</td>
<td>94.8</td>
<td>63.7</td>
</tr>
<tr>
<td>83.3</td>
<td>56.3</td>
<td>23.1</td>
<td>96.8</td>
<td>95.5</td>
</tr>
<tr>
<td>66.7</td>
<td>49.3</td>
<td>19.9</td>
<td>80.9</td>
<td>81.2</td>
</tr>
<tr>
<td>55.6</td>
<td>46.1</td>
<td>18.2</td>
<td>71.8</td>
<td>84.2</td>
</tr>
<tr>
<td>SEm+</td>
<td>1.2</td>
<td>0.6</td>
<td>2.1</td>
<td>-</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>3.7</td>
<td>1.8</td>
<td>6.6</td>
<td>-</td>
</tr>
<tr>
<td><strong>Fertility (N-P-K kg/ha)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-0-0</td>
<td>18.1</td>
<td>6.6</td>
<td>35.0</td>
<td>-</td>
</tr>
<tr>
<td>40-8.7-16.7</td>
<td>43.0</td>
<td>17.8</td>
<td>72.4</td>
<td>111.3</td>
</tr>
<tr>
<td>80-17.5-33.3</td>
<td>64.1</td>
<td>26.0</td>
<td>109.4</td>
<td>76.3</td>
</tr>
<tr>
<td>120-26.2-50</td>
<td>76.9</td>
<td>32.0</td>
<td>127.6</td>
<td>56.2</td>
</tr>
<tr>
<td>SEm+</td>
<td>1.2</td>
<td>0.4</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>3.3</td>
<td>1.1</td>
<td>4.7</td>
<td>-</td>
</tr>
</tbody>
</table>

*Pooled data of 2 years
levels. A plant population of $83.3 \times 10^3$/ha had the maximum agronomic nutrient-use efficiency of 95.5 kg green-cob yield/kg NPK applied (Table 2).

**Economics**

The population of $83.3 \times 10^3$ plants/ha gave the highest net profit of Rs 33,241 to 37,345 /ha due to maximum cob yield (Table 2). This was followed by $66.7 \times 10^3$ plants/ha, which gave a net profit of Rs 31,680 /ha during 2002-03 and Rs 27,807 /ha during 2003-04. Maximum benefit : cost ratio (3.18 - 3.42) was recorded at the population $83.3 \times 10^3$ plants/ha, which was significantly higher than other plant population.

The highest level of fertility (120-26.2-50 kg NPK/ha) recorded the maximum net profit of Rs 44,215 - 45,952 /ha, which was significantly higher than other fertility levels. The net profit was 7.1-13.7% higher at 120-26.2-50 kg NPK/ha than at 80-17.5-33.3 kg NPK/ha. The benefit : cost ratio was the maximum (3.89 in 2002-03 and 3.82 in 2003-04) at fertility level 120-26.2-50 kg NPK/ha. The net returns were the lowest from the crop grown without fertilizer. Due to maximum green-cob yield, application of 120-26.2-50 kg NPK/ha to a population of $83.3 \times 10^3$ plants/ha resulted in significantly higher net profit of Rs 54,453 /ha than other treatments (Fig. 1). It was 10.1% more than the next highest treatment, i.e. $66.7 \times 10^3$ plants/ha at 120-26.2-50 kg NPK/ha.

It is concluded that to get the maximum yield and net profit, sweet corn should be grown at a population of $83.3 \times 10^3$ plants/ha with fertility level of 120-26.2-50 kg NPK/ha during *rabi* season under Orissa situation.

**REFERENCES**


