

Original Research Article

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Performance of Sweet Corn (*Zea mays L. saccharata*) Varieties under Varying Phosphorus Levels

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ABSTRACT

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A field experiment was conducted during *kharif* 2016 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P.). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.7), low in organic carbon (0.35%), available N (230 kg ha⁻¹), available P (20 kg ha⁻¹) and available K (189 kg ha⁻¹). The treatment consisted of 5 levels of Phosphorus *viz.* P₁ (40 kg P₂O₅ ha⁻¹), P₂ (50 kg P₂O₅ ha⁻¹), P₃ (60 kg P₂O₅ ha⁻¹) P₄ (70 kg P₂O₅ ha⁻¹) and P₅ (80 kg P₂O₅ ha⁻¹) whose effect is observed on sweet corn varieties *viz.* V₁ (Sweet Glory) and V₂ (Sweety). There were 10 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. The result showed that growth parameters *viz.*, plant height (213.00 cm) at 80 DAS, number of green leaves plant⁻¹ (5.87) at 40 DAS, Dry weight (200.77 g) at 80 DAS and CGR (32.52 g m⁻² day⁻¹) at 80 DAS and yield and yield attributes *viz.*, cob weight with husk (325.27 g), cob weight without husk (250.30 g), No. of seeds row⁻¹ (35.30), No. of seed rows cob⁻¹ (15.80), No. of seeds cob⁻¹ (500.53), 100-Grain Weight (23.93 g), Green cob Yield (5.32 t ha⁻¹) and Green fodder Yield (13.45 t ha⁻¹) were recorded maximum in treatment T₈ (Sweety + 60 kg P₂O₅ ha⁻¹). Maximum net return of ₹ 80134.91 and B.C. ratio 2.77 was recorded in treatment T₈ (Sweety + 60 kg P₂O₅ ha⁻¹).

Introduction

Maize (*Zea mays*) is a C₄ plant and has high yielding potential. It is important crop in the world grown in more than 150 countries having 600 million ha area with 600 million ton of production. The major maize producing countries are USA, China, Brazil, Mexico, France and India. USA has the largest area and production in the world. Italy having highest productivity in the world 9600 kg ha⁻¹ followed by France with 8800 kg ha⁻¹. India

stand is 5 position in total area, fourth in total production and third in yield per hectare after USA China, Brazil and Mexico but with regards to production its rank eleventh. It is a widely grown cereal and is categorized as primary staple food in many developing countries. India contributes merely about 2.5 percent in world maize production. It is third most important cereal crop after rice and wheat and is being grown throughout the year but mainly as *kharif* crop. At present maize is being grown in most of the states of the

country with annual grain production of 24.53 million tonnes and productivity 2583 kg ha⁻¹. The maize is cultivated throughout the year in all states of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, popcorn in peri-urban areas. Special corn *viz.*, sweet corn, popcorn, baby corn, high-oil corn *etc.* assume tremendous market potential not only in the international market but also in India. These corns with their high market value are perfectly suitable to *peri*-urban agriculture. Thus they promise higher income to maize growers. Out of the various special corn, sweet corn (*Zea mays* L. *saccharata*) has a big market potential. It is a hybridized variety of maize specifically bred to increase the sugar content. Sustainability of scientific sweet corn cultivation practices must be ensured to attain the goal of agricultural sustainability. Its consumption at immature stage as roasted and boiled ears is a popular practice as the kernels are sweet (12-20% sugar). After harvest green cobs, the plant of sweet corn are used green fresh or dry fodder and now a day's its cultivation is the first choice of the farmers. Maize is an exhaustive crop and requires high quantities of nitrogen and phosphorus. Low soil fertility is one of the bottlenecks to sustain agricultural production and productivity in India. Judicious use of fertilizers play an important role to boost up the productivity of maize, they alone can contribute 40-60 percent of the crop yield (Dayanand, 1998).

Among nutrient elements, phosphorus plays a vital role besides nitrogen in plant nutrient that influences vigour of plant, root growth and improves the quality of crop yield. Phosphorus is an essential factor for cell division because it is a constituent element of nucleoproteins which are involved in the cell reproduction processes. It is also a component of a chemical essential to the reactions of carbohydrate synthesis and degradation. It is important for seed and fruit formation and

crop maturation. Phosphorus hastens the ripening of fruits thus counteracting the effect of excess nitrogen application to the soil. It helps to strengthen the skeletal structure of the plant thereby preventing lodging. It also affects the quality of the grains and it may increase the plant resistance to diseases.

Since the phosphate availability is usually low in the soils, the plants have developed special adaptations to acquire the same with the help of multiple high affinity transporters (Raghothama, 1999). The needs of a sweet corn crop for supplemental nutrient can vary greatly among field's seasons and crop growing conditions. Hence, there is need to evaluate sweet corn varieties under optimum phosphorus fertilization under prevailing agro climatic conditions.

Materials and Methods

The experiment was conducted during the *kharif* season of 2016 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad. The Crop Research Farm is situated at 25^o 57' N latitude, 87^o 19' E longitude and at an altitude of 98 m above mean sea level. The soil of experimental plot was sandy loam in texture, neutral in soil reaction (pH 7.5), low in organic carbon (0.35%), available N (230 kg ha⁻¹), available P (20 kg ha⁻¹) and available K (98 kg ha⁻¹). The treatments comprised of 5 levels of Phosphorus *viz.* P₁ (40 kg P₂O₅ ha⁻¹), P₂ (50 kg P₂O₅ ha⁻¹), P₃ (60 kg P₂O₅ ha⁻¹) P₄ (70 kg P₂O₅ ha⁻¹) and P₅ (80 kg P₂O₅ ha⁻¹) whose effect is observed on sweet corn varieties *viz.* V₁ (Sweet Glory) and V₂ (Sweety). There were 10 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. Pre-harvest observation *viz.* Plant height, green leaves plant⁻¹, dry weight, Crop Growth Rate and Relative Growth Rate were

recorded. Post-harvest observation *viz.* Cobs plant⁻¹, Cob length, Cob weight With husk, Cob weight Without husk, Seeds row⁻¹, Seeds row cob⁻¹, Seeds cob⁻¹, 100-Grain weight, Green cob yield and Green fodder yield were also recorded. In addition to pre and post-harvest observation, economics of treatments was also studied to find out the best treatment combination for higher yield, maximum net return and highest B: C ratio of sweet corn.

Results and Discussion

Performance of Varieties

Among both varieties 'Sweety' significantly recorded maximum plant height at 80 DAS, Dry weight at 80 DAS and CGR at 80 DAS whereas, cob weight with husk, cob weight without husk, No. of seeds row⁻¹, No. of seed rows cob⁻¹, No. of seeds cob⁻¹, 100-Grain Weight, Green cob Yield and Green fodder Yield as compared to 'Sweet Glory'. However, Green leaves plant⁻¹, RGR, Cob length and number of cobs plant⁻¹ were found to be non-significant (Table 1). The maximum plant height (213.00 cm) at 80 DAS, Dry weight (200.77 g) at 80 DAS and CGR (32.52 g m⁻² day⁻¹) at 80 DAS (Table 2) whereas, cob weight with husk (325.27 g), cob weight without husk (250.30 g), No. of seeds row⁻¹ (35.30), No. of seed rows cob⁻¹ (15.80), No. of seeds cob⁻¹ (500.53), 100-Grain Weight (23.93 g), Green cob Yield (5.32 t ha⁻¹) and Green fodder Yield (13.45 t ha⁻¹) were recorded in 'Sweety' variety as compared to 'Sweet glory' variety (Table 3). Under present investigation the better performance of 'Sweety' seems to be on account of higher uptake of nitrogen and phosphorus from soil and its reallocation in grain and plant.

The higher availability of nitrogen and phosphorus seems to have promoted development of morphological structure by

virtue of multiplication of cell division which is well reflected through increased crop growth rate (Kumar, 2008).

Effect of phosphorus levels

Growth attributes *viz.*, plant height, Dry weight and CGR likewise, yield and yield attributes *viz.*, cob weight with husk, cob weight without husk, No. of seeds row⁻¹, No. of seed rows cob⁻¹, No. of seeds cob⁻¹, 100-Grain Weight, Green cob Yield and Green fodder Yield increased significantly in treatment T₈ with the application of 60 kg P₂O₅ ha⁻¹ (Table 2 & Table 3). However, number of green leaves plant⁻¹, RGR, Cob length and number of cob plant⁻¹ were found to be non-significant with the application 60 kg P₂O₅ ha⁻¹ (Table 1).

The maximum plant height (213.00 cm) at 80 DAS, Dry weight (200.77 g) at 80 DAS, cob weight without husk (250.30 g), No. of seeds row⁻¹ (35.30), 100-Grain Weight (23.93 g), Green cob Yield (5.32 t ha⁻¹) and Green fodder Yield (13.45 t ha⁻¹) were recorded in treatment T₈ with the application of 60 kg P₂O₅ ha⁻¹ followed by treatment T₅ and it was found to be at par to treatment T₈ (Table 2 & Table 3) whereas, CGR (32.52 g m⁻² day⁻¹) at 80 DAS was recorded in treatment T₈ with the application of 60 kg P₂O₅ ha⁻¹ followed by treatment T₅ and T₄ it was found to be at par to treatment T₈ (Table 2) and cob weight with husk (325.27 g), No. of seed rows cob⁻¹ (15.80), No. of seeds cob⁻¹ (500.53) were recorded in treatment T₈ with the application of 60 kg P₂O₅ ha⁻¹ followed by treatment T₇ and it was found to be at par to treatment T₈ (Table 3). Application of 120-60 kg N-P₂O₅ ha⁻¹ might have increased interception, absorption and utilization of radiant energy which in turn increased photosynthesis and thereby plant height and finally accumulation of dry matter.

Table.1 Effect of different Phosphorus levels on Green leaves plant⁻¹, RGR, cobs plant⁻¹ and Cob length of Sweet corn varieties

| Treatments | | Green leaves plant ⁻¹ at 80 DAS | RGR at 80 DAS | Cobs plant ⁻¹ | Cob length |
|-------------------------|--|--|---------------|--------------------------|------------|
| T ₁ | Sweet Glory + 40 kg P ₂ O ₅ ha ⁻¹ | 8.53 | 0.04 | 1.00 | 16.00 |
| T ₂ | Sweet Glory + 50 kg P ₂ O ₅ ha ⁻¹ | 8.60 | 0.04 | 1.07 | 17.50 |
| T ₃ | Sweet Glory + 60 kg P ₂ O ₅ ha ⁻¹ | 8.67 | 0.03 | 1.20 | 18.00 |
| T ₄ | Sweet Glory + 70 kg P ₂ O ₅ ha ⁻¹ | 8.73 | 0.03 | 1.20 | 18.03 |
| T ₅ | Sweet Glory + 80 kg P ₂ O ₅ ha ⁻¹ | 8.80 | 0.03 | 1.20 | 18.07 |
| T ₆ | Sweety + 40 kg P ₂ O ₅ ha ⁻¹ | 8.60 | 0.04 | 1.00 | 16.20 |
| T ₇ | Sweety + 50 kg P ₂ O ₅ ha ⁻¹ | 8.67 | 0.03 | 1.00 | 17.70 |
| T ₈ | Sweety + 60 kg P ₂ O ₅ ha ⁻¹ | 8.73 | 0.03 | 1.20 | 18.20 |
| T ₉ | Sweety + 70 kg P ₂ O ₅ ha ⁻¹ | 8.80 | 0.03 | 1.20 | 18.23 |
| T ₁₀ | Sweety + 80 kg P ₂ O ₅ ha ⁻¹ | 8.87 | 0.03 | 1.20 | 18.27 |
| F- test | | NS | NS | NS | NS |
| S. Ed. (±) | | 0.201 | 0.002 | 0.128 | 1.173 |
| C. D. (P = 0.05) | | 0.416 | 0.004 | 0.263 | 2.421 |

Table.2 Effect of different phosphorus levels on plant height, dry weight and CGR of Sweet corn varieties

| Treatments | | Plant height At 80 DAS | Dry weight At 80 DAS | CGR At 80 DAS |
|-------------------------|--|------------------------|----------------------|---------------|
| T ₁ | Sweet Glory + 40 kg P ₂ O ₅ ha ⁻¹ | 191.60 | 157.75 | 27.45 |
| T ₂ | Sweet Glory + 50 kg P ₂ O ₅ ha ⁻¹ | 202.27 | 182.21 | 30.44 |
| T ₃ | Sweet Glory + 60 kg P ₂ O ₅ ha ⁻¹ | 212.47 | 197.02 | 32.32 |
| T ₄ | Sweet Glory + 70 kg P ₂ O ₅ ha ⁻¹ | 212.52 | 197.05 | 32.33 |
| T ₅ | Sweet Glory + 80 kg P ₂ O ₅ ha ⁻¹ | 212.53 | 197.06 | 32.33 |
| T ₆ | Sweety + 40 kg P ₂ O ₅ ha ⁻¹ | 194.87 | 162.98 | 27.57 |
| T ₇ | Sweety + 50 kg P ₂ O ₅ ha ⁻¹ | 203.77 | 185.02 | 29.70 |
| T ₈ | Sweety + 60 kg P ₂ O ₅ ha ⁻¹ | 213.00 | 200.77 | 32.52 |
| T ₉ | Sweety + 70 kg P ₂ O ₅ ha ⁻¹ | 213.13 | 200.80 | 32.53 |
| T ₁₀ | Sweety + 80 kg P ₂ O ₅ ha ⁻¹ | 213.17 | 200.82 | 32.53 |
| F- test | | S | S | S |
| S. Ed. (±) | | 5.356 | 2.024 | 1.022 |
| C. D. (P = 0.05) | | 11.055 | 4.178 | 2.109 |

Table.3 Effect of different phosphorus levels on Cob weight with husk, Cob weight without husk, Seeds row⁻¹, Seed rows cob⁻¹, Seeds cob⁻¹, 100- Grain Weight, Green cob Yield and Green fodder Yield of Sweet corn varieties

| Treatments | | Cob weight with husk (g) | Cob weight without husk (g) | Seeds row ⁻¹ | Seed rows cob ⁻¹ | Seeds cob ⁻¹ | 100- Grain Weight (g) | Green cob Yield (t ha ⁻¹) | Green fodder Yield (t ha ⁻¹) |
|-------------------------|--|--------------------------|-----------------------------|-------------------------|-----------------------------|-------------------------|-----------------------|---------------------------------------|--|
| T ₁ | Sweet Glory + 40 kg P ₂ O ₅ ha ⁻¹ | 230.47 | 180.80 | 29.27 | 14.47 | 423.53 | 21.63 | 5.03 | 11.84 |
| T ₂ | Sweet Glory + 50 kg P ₂ O ₅ ha ⁻¹ | 270.47 | 210.80 | 32.77 | 14.67 | 448.80 | 22.73 | 5.15 | 12.87 |
| T ₃ | Sweet Glory + 60 kg P ₂ O ₅ ha ⁻¹ | 295.97 | 231.05 | 34.03 | 15.07 | 463.73 | 23.63 | 5.32 | 13.44 |
| T ₄ | Sweet Glory + 70 kg P ₂ O ₅ ha ⁻¹ | 296.00 | 231.07 | 34.10 | 15.13 | 463.77 | 23.67 | 5.32 | 13.45 |
| T ₅ | Sweet Glory + 80 kg P ₂ O ₅ ha ⁻¹ | 296.00 | 231.08 | 34.13 | 15.17 | 463.80 | 23.67 | 5.32 | 13.45 |
| T ₆ | Sweety + 40 kg P ₂ O ₅ ha ⁻¹ | 280.00 | 200.00 | 29.67 | 15.00 | 460.00 | 21.90 | 5.04 | 11.85 |
| T ₇ | Sweety + 50 kg P ₂ O ₅ ha ⁻¹ | 310.00 | 230.30 | 33.00 | 15.40 | 485.47 | 22.93 | 5.16 | 12.88 |
| T ₈ | Sweety + 60 kg P ₂ O ₅ ha ⁻¹ | 325.27 | 250.30 | 35.30 | 15.80 | 500.53 | 23.93 | 5.32 | 13.45 |
| T ₉ | Sweety + 70 kg P ₂ O ₅ ha ⁻¹ | 325.30 | 250.33 | 35.37 | 15.83 | 500.57 | 23.97 | 5.33 | 13.46 |
| T ₁₀ | Sweety + 80 kg P ₂ O ₅ ha ⁻¹ | 325.33 | 250.35 | 35.40 | 15.87 | 500.60 | 24.00 | 5.33 | 13.46 |
| F- test | | S | S | S | S | S | S | S | S |
| S. Ed. (±) | | 15.913 | 9.400 | 1.408 | 0.219 | 9.658 | 0.623 | 0.10 | 0.21 |
| C. D. (P = 0.05) | | 32.844 | 19.75 | 2.906 | 0.452 | 19.934 | 1.286 | 0.21 | 0.44 |

Table.4 Effect of sweet corn varieties and phosphorus levels on economics of treatment

| Treatments | Cost of Cultivation | Yield | | Sale rate (₹) | | Gross return (₹ ha ⁻¹) | Net return (₹ ha ⁻¹) | B:C ratio |
|-----------------|---------------------|-----------------------------|------------------------------------|---------------------------------|------------------------------------|------------------------------------|----------------------------------|-----------|
| | | Yield (t ha ⁻¹) | Green Fodder (t ha ⁻¹) | Green Cob (t ha ⁻¹) | Green Fodder (t ha ⁻¹) | | | |
| T ₁ | 44261.61 | 5.03 | 11.84 | 80480 | 35520 | 116000 | 71738.39 | 2.62 |
| T ₂ | 44826.85 | 5.15 | 12.87 | 82240 | 38610 | 120850 | 76023.15 | 2.70 |
| T ₃ | 45392.09 | 5.32 | 13.44 | 84960 | 40320 | 125280 | 79887.91 | 2.76 |
| T ₄ | 45957.33 | 5.32 | 13.45 | 85120 | 40350 | 125470 | 79512.67 | 2.73 |
| T ₅ | 46522.57 | 5.32 | 13.45 | 85120 | 40350 | 125470 | 78947.43 | 2.70 |
| T ₆ | 44261.61 | 5.04 | 11.85 | 80640 | 35550 | 116190 | 71928.39 | 2.63 |
| T ₇ | 44826.85 | 5.16 | 12.88 | 82560 | 38640 | 121040 | 76213.15 | 2.70 |
| T ₈ | 45392.09 | 5.32 | 13.45 | 85120 | 40500 | 125620 | 80227.91 | 2.77 |
| T ₉ | 45957.33 | 5.33 | 13.46 | 85280 | 40380 | 125470 | 79512.67 | 2.73 |
| T ₁₀ | 46522.57 | 5.33 | 13.46 | 85280 | 40380 | 125660 | 79137.43 | 2.70 |

Selling price of green cob 16000 ₹/t
 Selling price of green fodder 3000 ₹/t

S

The enhanced growth with nitrogen was reported by Massey and Gaur (2006) and Khazaei *et al.*, (2010). Significant improvement in overall growth of the crop by virtue of increased photosynthetic efficiency. Thus greater availability of photosynthates, metabolites and nutrients to develop reproductive structures seems to have resulted in increased productive plants, cob length and cob weight with these fertility levels. The present findings are within the close vicinity of those reported by Massey and Guar (2006) and Khazaei *et al.*, (2010). Further increase in nutrient level though increased green cobs and fodder yields but marginal increase in green cob and fodder yields unable to compensate higher prices of fertilizer (Nath *et al.*, 2009).

Economics

A perusal of the table 4 clearly reveals that treatment T₈ recorded maximum net return of (₹80227.91), followed by treatment T₃ (₹79887.91) giving a B:C ratio of (2.77) and (2.76) respectively.

Based on the findings, of this experiment it can be concluded that 'Sweety' is the best and economically profitable variety as compared to 'Sweet Glory' variety. Application of 60 kg P₂O₅ ha⁻¹ as DAP is economically profitable for farmers.

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