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Nutrient uptake of sweet corn (*Zea mays* var. *saccharata*) as influenced by paired row vegetable intercropping

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Abstract

A field experiment was conducted at the College Farm, College of Agriculture, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, Telangana, during *rabi*, 2025-26. The experiment consisted of thirteen treatments replicated thrice in a Randomized Block Design (RBD) comprising sole sweet corn, sweet corn intercropped with cowpea, field bean, spinach and coriander in different row proportions, and their respective sole crops. The results indicated that nitrogen, phosphorus and potassium uptake by sweet corn were significantly influenced by the intercropping systems. The highest N, P and K uptake was recorded with sole sweet corn (142.6, 34.16 and 110.17 kg ha⁻¹, respectively), while among the intercropping systems, sweet corn + coriander (1:1) and sweet corn + cowpea (1:1) recorded comparatively higher nutrient (N,P,K) uptake. The lowest N, P and K uptake by sweet corn was recorded with sweet corn + cowpea (2:2) (121.6, 23.99 and 85.30 kg ha⁻¹, respectively). The findings indicated that sweet corn + coriander (1:1) and sweet corn + cowpea (1:1) were comparatively promising intercropping systems for maintaining higher nutrient uptake by sweet corn under paired row planting.

Keywords: Nutrient uptake, sweet corn, *Zea mays* var. *saccharata*, paired row planting

1. Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops and is widely cultivated for food, feed and various industrial purposes. Besides being an important source of carbohydrates, maize contributes essential nutrients to the human diet and is considered an important component of food and nutritional security (Chaudhari *et al.*, 2018) [3].

Sweet corn (*Zea mays* var. *saccharata*) commonly called as sugar unlike regular field maize, contains a natural mutation at the *sugary* (*su*) gene, which results in higher sugar levels (Srdic *et al.*, 2013) [9]. It is collected earlier, during the milky stage around 80 to 90 days after sowing. Its kernels are tender and eaten as vegetable rather than a grain in many parts of the world. Sweet corn contains 5-6% sugar, 10-11% starch, 3% water soluble polysaccharides and 70% water, besides moderate levels of protein and vitamin (yellow vitamin) and potassium (Oktem *et al.*, 2005) [7]. Its relatively wide spacing provides an opportunity to accommodate short-duration vegetables and legumes between the crop rows while maintaining the desired sweet corn population.

Intercropping can improve the utilization of available land and other growth resources through complementary interactions among component crops (Andrews and Kassam, 1976) [1]. Vegetables like cowpea (*Vigna unguiculata* L.), Spinach (*Spinacia oleracea* L.), Field bean (*Dolichos lablab* L.), Coriander (*Coriandrum sativum* L.) being quick-growing and of short duration are well-suited for intensive and multiple cropping systems in India. Adopting mixed farming with field crops and such vegetables can significantly increase income per unit area compared to sole cropping and also serve as a safeguard against crop failure during unfavourable years.

Nutrient uptake by sweet corn is closely associated with crop growth, dry matter accumulation, root development and nutrient availability in the soil. Intercropping also promotes efficient utilization of available resources and can contribute to maintaining soil fertility as the component crops exploit nutrients from different soil layers (Chaudhari *et al.*, 2025) [4]. Such complementarity in below ground resource use may influence the acquisition of nitrogen, phosphorus and potassium

by sweet corn. Therefore, evaluating nutrient uptake by sweet corn under different intercropping arrangements was essential to determine the extent to which associated crops modify nutrient acquisition by the main crop.

2. Materials and Methods

2.1 Experimental site and soil

The present investigation was conducted during the *rabi* season of 2025–26 at College Farm, College of Agriculture, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, Telangana, India. It is located at approximately 17°32'21" °N latitude and 78°41'04" °E longitude with an elevation of about 559 m above mean sea level. The experimental soil was sandy loam in texture, comprising 63.4 per cent sand, 15.3 per cent silt and 21.3 per cent clay. The soil had a pH of 7.4, electrical conductivity of 0.67 dS m⁻¹. The soil was low in soil organic carbon (0.38%), low in available nitrogen (184.6 kg ha⁻¹), medium in available phosphorus (27.9 kg ha⁻¹) and high in available potassium (310.4 kg ha⁻¹).

2.2 Experimental details

The experiment was laid out in a Randomized Block Design (RBD) with three replications and thirteen treatments. The treatments comprised T₁: Sole sweet corn (60 cm × 20 cm), T₂: Sweet corn + cowpea (1:1), T₃: Sweet corn + field bean (1:1), T₄: Sweet corn + spinach (1:1), T₅: Sweet corn + coriander (1:1), T₆: Sweet corn + cowpea (2:2), T₇: Sweet corn + field bean (2:2), T₈: Sweet corn + spinach (2:3), T₉: Sweet corn + coriander (2:3), T₁₀: Sole cowpea, T₁₁: Sole field bean, T₁₂: Sole spinach and T₁₃: Sole coriander. Sweet corn was planted in paired rows at 80/ 40 cm × 20 cm that is 40 cm x 20 cm within the pair and 80 cm between paired rows. Cowpea and field bean were planted at 30 cm × 10 cm, while spinach and coriander were planted at 20 cm × 10 cm spacing.

2.3 Crop management

The experimental field was prepared to a fine tilth through repeated ploughing and harrowing. Sweet corn and the respective intercrops were sown according to the treatment-specific spacing and row arrangements. The recommended agronomic practices were followed uniformly throughout the experiment. Recommended doses of 200 kg N, 60 kg P₂O₅, 50 kg K₂O ha⁻¹ (for sweet corn); 25kg N, 50kg P₂O₅, 25kg K₂O ha⁻¹ (for cowpea and field bean); 25kg N, 25kg P₂O₅, 50kg K₂O ha⁻¹ (for spinach); and 46 kg N, 40 kg P₂O₅, 40 50kg K₂O ha⁻¹ (for coriander) were applied through urea, single super phosphate and muriate of potash. Irrigation and other intercultural operations were carried out as required for maintaining satisfactory crop growth, while plant protection measures were adopted whenever necessary. Plant samples were collected and analysed using standard procedures as described under the respective sections.

2.4 Plant sample analysis

Plant samples were collected separately from each treatment at harvest. The nitrogen content of the samples was determined by the Kjeldahl method after digestion with concentrated H₂SO₄ (Piper, 1966) [8].

To determine the uptake of phosphorus vanadomolybdo phosphoric yellow colour method and the absorbance was measured at 430 nm with a spectrophotometer (Piper, 1966) [8]. Potassium content was estimated using a digital flame photometer (Piper, 1966) [8]. The uptake of nitrogen, phosphorus and potassium was computed using the following formula,

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%)} \times \text{Total dry matter (kg ha}^{-1}\text{)}}{100}$$

3. Results and Discussion

3.1 Nitrogen uptake (kg ha⁻¹)

Significant variation in nitrogen uptake by sweet corn was observed among the intercropping treatments. The highest nitrogen uptake was recorded with sole sweet corn (T₁) (142.6 kg ha⁻¹), which was on par with sweet corn + coriander (1:1) (141.8 kg ha⁻¹) and sweet corn + cowpea (1:1) (138.4 kg ha⁻¹), whereas the lowest uptake was registered with sweet corn + cowpea (2:2) (121.6 kg ha⁻¹). Early harvesting of spinach and coriander reduced competition and facilitate nutrient recycling (Chaudhari *et al.*, 2025) [4]. Among the intercrops, Sweet corn + spinach (2:3) recorded the highest nitrogen uptake (29.81 kg ha⁻¹) followed by Sweet corn + cowpea (2:2) (25.64 kg ha⁻¹) and Sweet corn + field bean (2:2) (22.69 kg ha⁻¹), whereas sweet corn + coriander (1:1) recorded the lowest (12.97 kg ha⁻¹).

Higher nitrogen uptake in T₁ was attributed to greater dry matter accumulation and green cob yield. The superior uptake in T₂ and T₅ may be due to better crop growth and biomass production. Among the intercrops, T₈, T₆ and T₇ recorded numerically higher nitrogen uptake, possibly due to greater biomass production. Legumes may enhance nitrogen availability through biological fixation and complementary root systems (Nasar *et al.*, 2024) [6]. The findings were in agreement with Srinivasaraju *et al.* (1997) [10], Yamuna *et al.* (2017) [11], Anushree *et al.* (2024) [2] and Gopala *et al.* (2025) [5].

3.2 Phosphorus uptake (kg ha⁻¹)

Phosphorus accumulation in sweet corn varied significantly across the intercropping treatments. Sole sweet corn registered the maximum phosphorus uptake (34.16 kg ha⁻¹), followed by sweet corn + coriander (1:1) (31.97 kg ha⁻¹) and sweet corn + cowpea (1:1) (31.36 kg ha⁻¹), with these treatments remaining statistically insignificant with each other. The least phosphorus uptake was observed with sweet corn + cowpea (2:2) (23.99 kg ha⁻¹). Among intercrops, T₆ recorded the numerically higher phosphorus uptake (8.59 kg ha⁻¹), followed by T₇ and T₈ (7.56 and 5.16 kg ha⁻¹, respectively), whereas sweet corn + coriander (1:1) (T₅) registered the minimum value (2.49 kg ha⁻¹).

The greater phosphorus uptake in sweet corn with T₁ may be attributed to efficient absorption and utilization of available phosphorus. The better performance of T₂ and T₅ could be linked to favourable rhizosphere conditions and improved phosphorus availability. Root exudates and microbial activity in legume-based systems may enhance phosphorus mobilization (Nasar *et al.*, 2024) [6], while organic acids and extracellular enzymes can facilitate the release of unavailable phosphorus into plant-accessible forms (Yang *et al.*, 2022) [12].

3.3 Potassium uptake (kg ha⁻¹)

Potassium accumulation in sweet corn responded differently to the various intercropping combinations. Sole sweet corn attained the maximum potassium uptake (110.17 kg ha⁻¹), followed by sweet corn + coriander (1:1) (108.22 kg ha⁻¹) and sweet corn + cowpea (1:1) (104.07 kg ha⁻¹), and these treatments remained on par with each other. The lowest potassium uptake (85.30 kg ha⁻¹) occurred under sweet corn + cowpea (2:2), while the other intercropping combinations recorded intermediate values. Among the intercrops, T₇ showed numerically greater potassium uptake (39.46 kg ha⁻¹), followed by T₆ (36.51 kg ha⁻¹) and T₃ (27.65 kg

ha⁻¹), whereas sweet corn + coriander (1:1) accounted for the lowest value (11.48 kg ha⁻¹).

The potassium uptake in T₁ may be attributed to the crop's sustained potassium requirement throughout its growth period. The favourable response of T₂ and T₅ could be associated with efficient root-mediated potassium acquisition. Among the intercrops, the variation in potassium uptake may be attributed to

their differing nutrient demand and capacity to exploit potassium from the soil. The vegetable crops enhance potassium release through root activity and rhizosphere interactions. In spinach and coriander systems, shorter crop duration may reduce prolonged competition, while residue decomposition contributes to potassium recycling. These complementary processes may have influenced potassium uptake by sweet corn.

Table 1: Effect of paired row sweet corn based vegetable intercropping on Nutrient uptake by sweet corn and intercrops

T. No.	Treatments	Nutrient uptake (kg ha ⁻¹) by sweet corn			Nutrient uptake (kg ha ⁻¹) by intercrops		
		Nitrogen	Phosphorous	Potassium	Nitrogen	Phosphorous	Potassium
T ₁	Sole Sweet corn	142.6	34.16	110.17	-	-	-
T ₂	Sweet corn + Cowpea (1:1)	138.4	31.36	104.07	15.79	5.12	24.87
T ₃	Sweet corn + Field bean (1:1)	126.1	27.40	95.52	15.24	4.78	27.65
T ₄	Sweet corn + Spinach (1:1)	125.7	27.18	94.66	20.45	4.47	16.57
T ₅	Sweet corn + Coriander (1:1)	141.8	31.97	108.22	12.97	2.49	11.48
T ₆	Sweet corn + Cowpea (2:2)	121.6	23.99	85.30	25.64	8.59	36.51
T ₇	Sweet corn + Field bean (2:2)	122.8	24.51	87.04	22.69	7.56	39.46
T ₈	Sweet corn + Spinach (2:3)	123.3	25.59	90.32	29.81	5.16	25.72
T ₉	Sweet corn + Coriander (2:3)	124.4	27.06	94.03	19.15	3.86	17.59
T ₁₀	Sole Cowpea	-	-	-	54.27	20.45	79.47
T ₁₁	Sole Field bean	-	-	-	51.46	17.54	85.14
T ₁₂	Sole Spinach	-	-	-	62.57	12.38	54.29
T ₁₃	Sole Coriander	-	-	-	40.87	8.26	38.16
	S Em+	4.96	1.47	4.05	-	-	-
	CD (P=0.05)	14.88	4.41	12.13	-	-	-

4. Conclusion

The study revealed that nutrient uptake by sweet corn was significantly influenced by the different intercropping systems. Sole sweet corn recorded the highest uptake of nitrogen, phosphorus and potassium. Among the intercropping treatments, sweet corn + coriander (1:1) and sweet corn + cowpea (1:1) recorded comparatively higher N,P and K uptake by the sweet corn crop and remained on par with each other indicating the advantage of 1:1 row proportions for N,P and K acquisition. The 2:2 and 2:3 intercropping proportions generally resulted in comparatively lower nutrient uptake by sweet corn. Overall, sweet corn + coriander (1:1) and sweet corn + cowpea (1:1) were promising intercropping systems as far as higher N, P and K uptake by sweet corn under paired row planting are discussed.

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