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Effect of foliar nutrition on nutrient content and uptake by sweet corn (*Zea mays* L. *Saccharata*)

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Abstract

A field experiment was conducted at the Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur during *kharif*, 2024 to study the effect of foliar nutrition on nutrient content and uptake by sweet corn (*Zea mays* L. *saccharata*). The experiment was laid out in a randomized block design comprised of nine foliar nutrition treatments that are replicated four times. Foliar application of 1% 19-19-19 NPK at 45 DAS + 1% KNO₃ at 60 DAS (T₆) recorded higher nutrient content and uptake that favours higher growth and productivity of sweet corn.

Keywords: Sweet corn, foliar nutrition, nutrient content, uptake, productivity

Introduction

Sweet corn, also known as sugar corn, is a hybridized variety of maize cultivated globally for human consumption and as a raw material in the food industry. Sweet corn holds significant market potential due to its unique taste, pleasant flavour and high sugar content. Unlike field corn, sweet corn is harvested at the immature or milk stage, when the sugar content in kernels reaches approximately 13-15% (Bhatt, 2012) ^[1]. This is attributed to one or more recessive alleles in the starch synthesis pathway of the maize endosperm, which prevent sugar from converting into starch, thereby enhancing sweetness (Heryanto *et al.*, 2022) ^[2]. Typically, green cobs of sweet corn are harvested between 75 to 90 days after sowing (DAS). Maize is a heavy feeder of nutrients due to its C₄ character. Intensive cropping and excessive use of chemical fertilizers have led to widespread nutrient deficiencies, posing a challenge to sustainable crop production. According to Dayanand (1998) ^[3], balanced nutrient application contributes 40-60% to crop yield, making optimized fertilization essential for sustainable agriculture. Foliar application of water-soluble fertilizers is increasingly recognized as an efficient technique to enhance nutrient uptake, especially in short-duration crops like sweet corn. Nutrient absorption through leaves is faster and often more effective than through roots, allowing for quick correction of deficiencies and improved crop performance. Foliar feeding with NPK fertilizers has been shown to significantly boost plant biomass and yield (Ling & Silberbush, 2002) ^[4]. Among these, potassium nitrate (KNO₃), which contains 45-46% potassium and 13% nitrogen, is particularly effective compared to conventional nitrogen sources like urea. In addition to chemical fertilizers, organic foliar supplements such as vermiwash and panchagavya are gaining attention. Vermiwash is a liquid bio-fertilizer obtained from water percolated through a column of earthworm-rich compost. It contains earthworm secretions, micro-nutrients and beneficial organic compounds. Panchagavya, a traditional Indian formulation made from cow dung, urine, milk, curd and ghee, is known to promote plant growth and enhance crop productivity when used as a foliar spray. Increasing environmental stress impairing soil health, crop yield and quality. Basal fertilizer application alone is often insufficient to meet the nutrient demands of high-yielding sweet corn crop. Studies such as Ishfaq *et al.* (2022) ^[5] have demonstrated that foliar feeding can improve yield by 15-19% and enhance quality traits by 9-20% under stress conditions like salinity and drought. To realize the full yield potential and quality of sweet corn, especially under stress-prone and nutrient-depleted conditions, evaluating and adopting effective

foliar nutrition strategies are essential.

Materials and Methods

A field experiment was carried out during *kharif*, 2024 at the Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur. The treatments consisted of four replications and nine foliar nutrition treatments viz. T₁ (Control), T₂ (Foliar application of 1% 19-19-19 NPK at 45 and 60 DAS), T₃ (Foliar application of 1% KNO₃ at 45 and 60 DAS), T₄ (Foliar application of 1% Vermiwash at 45 and 60 DAS), T₅ (Foliar application of 3% Panchagavya at 45 and 60 DAS), T₆ (Foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS), T₇ (Foliar application of 1% 19-19-19 NPK at 45 DAS + 1% Vermiwash at 60 DAS), T₈ (Foliar application of 1% 19-19-19 NPK at 45 DAS +3% Panchagavya at 60 DAS) and T₉ (Foliar application of 1% Vermiwash at 45 DAS + 3% Panchagavya at 60 DAS). Of the recommended dose of 90:30:30 NPK kg ha⁻¹, one third of the nitrogen, total dose of phosphorus and potassium was applied at the time of sowing as basal while, the remaining nitrogen was applied as top dressing at knee high stage and tasseling stage uniformly in all treatments. Field operations such as plant protection measures and weeding were taken as per requirement. The data on nutrient content and uptake in cob and fodder were recorded as per standard procedures. Data were analyzed using ANOVA and the significance was tested by F- test (p=0.05).

Results and Discussion

Nutrient content in cob and fodder

Data inferred from Table 1 illustrates that the highest nitrogen content in cob (1.676%) was obtained under foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS (T₆). However, it was statistically at par with foliar application of 1% 19-19-19 NPK at 45 and 60 DAS (1.650%), 1% KNO₃ at 45 and 60 DAS (1.649%) and 1% 19-19-19 NPK at 45 DAS+ 3% panchagavya at 60 DAS (1.643%), respectively. The maximum N in fodder (0.726%) was recorded under T₆ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS), which was statistically at par with foliar application of 1% 19-19-19 NPK at 45 and 60 DAS (0.719%) and foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% vermiwash at 60 DAS (0.712%), respectively. However, T₆ was significantly superior over rest of the treatments. Phosphorus content in cob of sweet corn was significantly affected by the treatment combinations. Higher phosphorus content (0.425%) was recorded under treatment T₆ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS) and it was statistically at par with T₂ (0.419%). The maximum phosphorus content in fodder (0.286%) was recorded under the treatment T₆ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS), which was significantly higher over T₁ (Control), T₃ (foliar application of 1% KNO₃ at 45 and 60DAS), T₄ (Foliar application of 1% vermiwash at 45 and 60 DAS), T₅ (foliar application of 3% panchagavya at 45 and 60 DAS) and T₉ (foliar application of 1% vermiwash at 45 DAS+ 3% panchagavya at 60 DAS). Potassium content in cob of sweet corn was significantly affected by the different treatment combinations. Higher potassium content (0.448%) was obtained under treatment T₆ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS) and it was significantly higher over the rest of the treatments. Data in Table 1 reveals that higher potassium in fodder (1.456%) was obtained with foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS (T₆). It was statistically equivalent to the foliar application of 1% 19-19-19 NPK at 45 and 60 DAS (1.444%) and foliar

application of 1% KNO₃ at 45 and 60 DAS (1.443%), respectively. Further data reveals that it was significantly superior over rest of the treatment combinations. The concentration of nitrogen, phosphorus and potassium in cob and fodder of sweet corn increased significantly due to foliar nutrition over control (Table 1). Foliar feeding of nutrients promotes root absorption of the same or other nutrients thereby improves root growth and nutrient movement from terminal leaves to roots. This results are in line with those reported by Oosterhuis (1993)^[6].

Nutrient uptake by cob and fodder

Data (Table 2) indicates that the foliar application of T₆ (1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS) recorded maximum nitrogen uptake by cob of sweet corn (172.11 kg ha⁻¹), which was statistically at par with treatment T₂ (foliar application of 1% 19-19-19 NPK at 45 and 60 DAS), T₃ (foliar application of 1% KNO₃ at 45 and 60 DAS), T₇ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% vermiwash at 60 DAS) and T₈ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 3% panchagavya at 60 DAS). The maximum nitrogen uptake by fodder (82.20 kg ha⁻¹) was found under treatment T₆ (foliar application 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS) and it was statistically at par with T₂, T₃, T₇ and T₈. Phosphorus uptake by cob of sweet corn was significantly influenced by the foliar nutrition. Data further reveals that the significantly maximum phosphorus uptake (43.65 kg ha⁻¹) was recorded under treatment T₆ (foliar application 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS), which was statistically at par with T₂ and T₈ (42.15 and 39.33 kg ha⁻¹), respectively. Phosphorus uptake by fodder of sweet corn was significantly influenced by the foliar nutrition. Data reveals that maximum phosphorus uptake by fodder (32.34 kg ha⁻¹) was recorded under treatment T₆ (foliar application 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS) followed by foliar application of 1% 19-19-19 NPK at 45 and 60 DAS (31.86 kg ha⁻¹), foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% vermiwash at 60 DAS (30.60 kg ha⁻¹) and foliar application of 1% 19-19-19 NPK at 45 DAS+ 3% panchagavya at 60 DAS (30.96 kg ha⁻¹). The maximum potassium uptake by cob of sweet corn (45.95 kg ha⁻¹) was observed under treatment T₆ (foliar application 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS) which was statistically at par with T₂ (foliar application of 1% 19-19-19 NPK at 45 and 60 DAS), T₃ (Foliar application of 1% KNO₃ at 45 and 60 DAS) and T₈ (foliar application of 1% 19-19-19 NPK at 45 DAS+ 3% panchagavya at 60 DAS). Foliar application of 1% 19-19-19 NPK at 45 DAS+ 1% KNO₃ at 60 DAS recorded maximum potassium uptake by fodder of sweet corn (164.81 kg ha⁻¹). It was statistically at par with T₂, T₃, T₇, T₈ and T₉ (162.82, 157.39, 157.99, 159.31 and 147.65 kg ha⁻¹), respectively. Foliar nutrition enhances nutrient uptake, which in turn improves the effective utilization of supplied nutrients. Increased leaf activity from foliar fertilization stimulates the plants vascular system to uptake more water, which in turn increases the uptake of nutrients from the soil. Foliar fertilization of nutrients helped in timely availability of nutrient in sufficient quantity to the plants. The better absorption, translocation and assimilation of foliar applied nutrients lead to more uptake of nutrients which in turn resulted in higher dry matter production. This could be due cumulative positive effect of foliar fertilization integrated with RDN. These results are in close conformity with those obtained by Naik (2012)^[7] and Chaithanya (2015)^[8].

Table 1: Effect of foliar nutrition on nutrient content in cob and fodder of sweet corn

Treatments	Nutrient content (%)					
	Nitrogen		Phosphorus		Potassium	
	Cob	Fodder	Cob	Fodder	Cob	Fodder
T ₁ : Control	1.508	0.540	0.379	0.176	0.360	1.313
T ₂ : 1% 19-19-19 NPK at 45 and 60 days after sowing	1.650	0.719	0.419	0.282	0.429	1.444
T ₃ : 1% KNO ₃ at 45 and 60 days after sowing	1.649	0.692	0.395	0.256	0.428	1.443
T ₄ : 1% Vermiwash at 45 and 60 days after sowing	1.535	0.634	0.384	0.218	0.380	1.357
T ₅ : 3% Panchagavya at 45 and 60 days after sowing	1.553	0.642	0.386	0.217	0.388	1.359
T ₆ : 1% 19-19-19 NPK at 45 days after sowing+ 1% KNO ₃ at 60 days after sowing	1.676	0.726	0.425	0.286	0.448	1.456
T ₇ : 1% 19-19-19 NPK at 45 days after sowing + 1% Vermiwash at 60 days after sowing	1.633	0.712	0.401	0.278	0.422	1.435
T ₈ : 1% 19-19-19 NPK at 45 days after sowing +3% Panchagavya at 60 days after sowing	1.643	0.707	0.405	0.279	0.430	1.437
T ₉ : 1% Vermiwash at 45 days after sowing + 3% Panchagavya at 60 days after sowing	1.567	0.643	0.387	0.249	0.392	1.382
S.Em±	0.012	0.006	0.004	0.004	0.004	0.005
CD (P=0.05)	0.034	0.017	0.013	0.012	0.012	0.015

Table 2: Effect of foliar nutrition on nutrient uptake by cob and fodder of sweet corn

Treatments	Nutrient uptake (kg ha ⁻¹)					
	Nitrogen		Phosphorus		Potassium	
	Cob	Fodder	Cob	Fodder	Cob	Fodder
T ₁ : Control	111.27	44.11	27.94	14.36	26.58	107.24
T ₂ : 1% 19-19-19 NPK at 45 and 60 days after sowing	166.23	81.14	42.15	31.86	43.20	162.82
T ₃ : 1% KNO ₃ at 45 and 60 days after sowing	159.61	75.46	38.17	27.87	41.42	157.39
T ₄ : 1% Vermiwash at 45 and 60 days after sowing	145.88	65.68	36.53	22.53	36.17	140.54
T ₅ : 3% Panchagavya at 45 and 60 days after sowing	147.93	67.59	36.73	22.94	36.93	143.01
T ₆ : 1% 19-19-19 NPK at 45 days after sowing+ 1% KNO ₃ at 60 days after sowing	172.11	82.20	43.65	32.34	45.95	164.81
T ₇ : 1% 19-19-19 NPK at 45 days after sowing + 1% Vermiwash at 60 days after sowing	158.45	78.44	38.88	30.60	40.97	157.99
T ₈ : 1% 19-19-19 NPK at 45 days after sowing +3% Panchagavya at 60 days after sowing	159.49	78.34	39.33	30.96	41.83	159.31
T ₉ : 1% Vermiwash at 45 days after sowing + 3% Panchagavya at 60 days after sowing	150.11	68.79	37.07	26.57	37.56	147.65
S.Em±	5.95	3.34	1.57	1.26	1.69	6.41
CD (P=0.05)	17.37	9.74	4.59	3.69	4.92	18.70

Conclusion

Based on results emanated from the experiment, it is concluded that significantly higher uptake of nitrogen (172.11, 82.20 kg), phosphorus (43.65, 32.34 kg) and potassium (45.95, 164.81 kg) by cob and fodder, respectively over control was recorded with foliar application of NPK at 45 DAS and KNO₃ at 60 DAS. Hence, foliar nutrition with NPK and KNO₃ at critical stages of growth was more pronounced to supplement the plant nutrient need required for its growth and production.

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