

Original Research Article

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Effect of Foliar Nutrition on Yield and Economics of Sweet Corn

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ABSTRACT

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A field experiment was conducted during *rabi*, 2018-19 to study the effect of foliar nutrition on growth and yield of sweet corn on sandy loam soils of Agricultural College Farm, Naira with a pH of 7.3 and EC of 0.072 dSm⁻¹, low in organic carbon (0.42%) and available nitrogen (263.2 kg ha⁻¹), medium in available phosphorus (22.9 kg ha⁻¹) and potassium. The experiment comprised of nine foliar nutrition treatments and laid out in a randomized block design with three replications. The results revealed that foliar application of 19:19: 19 @ 1 % one week before tasseling *fb*1.0 % KNO₃ one week after silking recorded higher cob weight, cob yield without husk, harvest index, gross returns, net returns and B: C ratio in sweet corn.

Introduction

Of late, specialty corns such as sweet corn (*Zea mays* L. var. *saccharata* Sturt) has emerged as an alternative food sources, especially for the affluent sections of the society and has tremendous market potential not only in India but in international market as well. It was introduced to India from USA and has been mostly used for table purpose. Sweet corn is a mutant type with one or more recessive alleles in homozygous condition that enable the endosperm to accumulate twice the sugar content as that of seed corn. This specialty corn due to its high sugar content (14-20 % sugar) and short duration

has gained high popularity, thus making it a profitable crop for the farmers.

It is well known that maize is a heavy feeder of nutrients due to its C₄ nature. The intensive crop rotation and excessive fertilizer use have resulted in a wide range of nutrient deficiencies in field. To realize higher productivity balanced use of plant nutrients is the key as it contributes 40 – 60 % of the crop yield (Dayanand, 1998). Under the current trend of exploitive agriculture in India, the innate soil fertility can no longer be maintained on the sustainable basis. Application of water soluble fertilizers through foliar spray is a well known method

of supplying plant nutrients. Nutrient uptake by leaves is significantly faster than the roots and is extremely effective. Hence, foliar feeding of nutrients is recognized as an important method of fertilization in modern agriculture. This method provides utilization of nutrients more efficiently and straighten out deficiencies quickly, particularly for short duration crops.

Organic fertilizers like animal manures and composted materials, one of the major pillars of sustainable agriculture are important resources as they endow with large amounts of macro and micro nutrients for crop. Vermiwash, the indispensable part of vermicompost is a watery extract of earthworms. It contains N, P, K, Ca and hormones such as auxin, cytokinins and some other secretions. It plays a crucial role in the overall plant growth and development mainly contributing to promotion of growth rate and improvement in crop production. In general, foliar spray of vermiwash would be recommended as a better technique of supplying nutrients to plants at a more rapid rate than methods involving soil application. Hence, there is a need to evaluate the effective best foliar nutrition treatment to realize higher productivity of sweet corn.

Materials and Methods

A field experiment was conducted during *rabi*, 2018-19 at the Agricultural College Farm, Naira, Andhra Pradesh. The soil was sandy loam in texture with a pH of 7.3 and EC of 0.072 dSm⁻¹, low in organic carbon (0.42%) and available nitrogen (263.2 kg ha⁻¹), medium in available phosphorus (22.9 kg ha⁻¹) and potassium (230 kg ha⁻¹). Seed of sweet corn variety 'Sugar-75' were dibbled at a spacing of 60 cm x 20 cm at a seed rate of 20 kg ha⁻¹ on 27th December, 2018. The plot size was 4.8 m x 6.0 m. The experiment was laid out in randomized block design and each

treatment replicated thrice. The treatments comprised of nine foliar nutrition treatments *viz*; T₁ Control (No foliar spray), T₂ (foliar application of 1% 19-19-19 one week before tasseling and one week after silking), T₃ (foliar application of 1% KNO₃ one week before tasseling and one week after silking), T₄ (Foliar application of 0.2% Formula 4 one week before tasseling and one week after silking), T₅ (Foliar application of 1% Vermiwash one week before tasseling and one week after silking), T₆ (Foliar application of 1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking), T₇ (foliar application of 0.2% Formula 4 one week before tasseling *fb* 1% KNO₃ one week after silking), T₈ (foliar application of 1% vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking), T₉ (foliar application of 1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking). Of the recommended dose of 180:75:60 kg N, P₂O₅, K₂O ha⁻¹, one third of the nitrogen, total phosphorus and half potassium was applied at the time of sowing as basal while, the remaining nitrogen and potassium was applied as top dressing at knee high stage and tasseling stage uniformly in all treatments. Standard agronomic practices and plant protection was followed scrupulously for raising the crop.

Cob weight was recorded by taking the weight of all cobs of tagged plants in each treatment after dehusking and the average weight of cob was expressed in grams. Green cobs harvested from the net plot were weighed and expressed the cob yield without husk in kg ha⁻¹. Harvest index is the ratio of cob yield to the total biological yield (Cob + stover) and expressed in percentage. The total cost of cultivation was calculated for the individual treatments on the basis of inputs used and prevailing market prices. Gross monetary returns were arrived at by multiplying economic yield with the

prevailing market price of green sweet corn cobs and fodder. Net monetary returns were arrived at by deducting the cost of cultivation from gross monetary returns for each treatment. Benefit cost ratio was calculated by using the following formula.

Results and Discussion

Effect of foliar nutrition on yield of sweet corn

Cob weight

Statistically measurable differences were noticed with regard to cob weight of sweet corn due to various foliar nutrition treatments. Cob weight of sweet corn was found to be maximum due to foliar application of 1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking (T₆) which were however, comparable with 1% 19-19-19 one week before tasseling and one week after silking (T₂) and 1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking (T₉). Application of 1% 19-19-19 one week before tasseling and one week after silking (T₂) was in turn found to be on par with T₃ (1% KNO₃ one week before tasseling and one week after silking) and T₈ (1% Vermiwash at one week before tasseling *fb* 1% KNO₃ one week after silking) and T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking). The cob weight was minimum with T₁ (control) and found to be significantly inferior to rest of the foliar nutrition treatments (Table.1).

Cob yield without husk

The perusal of the data indicated that the foliar nutrition treatments were found to show significant influence on the cob yield without husk. Significantly higher cob yield without husk was observed when sweet corn crop was supplemented through foliage with 1% 19-19-19 one week before tasseling *fb* 1% KNO₃

one week after silking (T₆) which was however, found parity with foliar applications T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₃ (1% KNO₃ one week before tasseling and one week after silking) and T₈ (1% Vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking). While, the lowest cob yield was associated with non-supply of foliar nutrition to sweet corn (T₁- control) which was however, comparable with T₄ (0.2% Formula 4 one week before tasseling and one week after silking), T₅ (1% Vermiwash one week before tasseling and one week after silking) and T₇ (0.2% Formula 4 one week before tasseling *fb* 1% KNO₃ one week after silking). There was a huge 24.8% enhancement in the cob yield due to foliar feeding of sweet corn with 1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking (T₆) followed by 23.4% due to application 1% 19-19-19 one week before tasseling and one week after silking (T₂) and 22.2% due to 1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking (T₉), 19.8% due to 1% KNO₃ one week before tasseling and one week after silking (T₃) and 19.1% due to 1% Vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking (T₈).

The highest cob weight and yield associated with T₆ (1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking) could be ascribed to the fact that all the yield attributing characters of sweet corn *viz.* number of cobs plant⁻¹, number of kernel rows cob⁻¹, number of kernels row⁻¹, cob weight and cob girth were found to be the highest with this treatment which was however, comparable with T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₃ (1% KNO₃ one week before

tasseling and one week after silking) and T₈ (1% Vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking) except cob weight which was on par with T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking). Larger growth stature *viz.* higher plant height, more number of leaves plant⁻¹, and maximum dry matter production might have enabled the sweet corn to produce maximum yield structure. Larger photosynthetic surface coupled with higher sink size might have enabled transportation of maximum photosynthates to the sink, thus helped in producing the highest fresh cob yield among the foliar nutrition treatments.

Foliar feeding of major nutrients especially N resulted in development and maintenance of more chlorophyll and photosynthetic area in terms of leaf production which results in higher photosynthesis. In addition, foliar feeding of K helps in higher translocation of photosynthates from leaves to the developing kernels and resulted in higher fresh cob yield. Nitrogen, the major constituents of chlorophyll, amino acids and proteins, phosphates, the energy compound *viz.* ATP, NADP and potassium, the activator/cofactor for various enzymes involved in photosynthesis and CO₂ fixation could have promoted satisfactory plant growth, photosynthetic surface, yield structure and finally cob yield under adequate and balanced supply of nutrients at higher level. These results are in corroboration with findings of Maravalli and Shekh (2019), Prajwal Kumar *et al.*, (2018), Abid *et al.*, (2016), Ullasa *et al.*, (2016), Keerthi *et al.*, (2013) and Al-Betar and Abdou (2010) in sweet corn.

Harvest index

The harvest index worked out was found to be maximum with T₄ (0.2% Formula 4 one week before tasseling and one week after silking)

which was however, comparable with T₃ (1% KNO₃ one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₆ (1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking) and T₂ (1% 19-19-19 one week before tasseling and one week after silking). The lowest harvest index was observed with non-application of foliar nutrition (T₁-control), which was however, comparable with T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₈ (1% Vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking), T₆ (1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking).

Harvest index being the ratio between economic yield to that of total biological yield was found to be the highest with application of with T₄ (0.2% Formula 4 one week before tasseling and one week after silking) which was however found parity with T₃ (1% KNO₃ one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₆ (1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking) and T₂ (1% 19-19-19 one week before tasseling and one week after silking) indicating the physiological ability of sweet corn to convert dry matter into fresh cob yield due to supplementation of foliar nutrition. These results are in corroboration with findings of Ghaffari *et al.*, (2011).

Effect of foliar nutrition on economics of sweet corn

Gross returns

Maximum gross returns (Rs.316427 ha⁻¹) were registered with 1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after

silking (T₆) which was however, comparable with T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₃ (1% KNO₃ one week before tasseling and one week after silking) and T₈ (1% Vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking). While, significantly lower

gross returns (Rs. 262233 ha⁻¹) were observed due to non-application of foliar nutrients to sweet corn (T₁-control) which was however, found parity with T₄ (0.2% Formula 4 one week before tasseling and one week after silking), T₅ (1% Vermiwash one week before tasseling and one week after silking) and T₇ (0.2% Formula 4 one week before tasseling *fb* 1% KNO₃ one week after silking).

Table.1 Cob yield without husk (kg ha⁻¹) and as influenced by foliar nutrition treatments

Treatments	Cob weight (g)	Cob yield without husk(kg ha ⁻¹)	Harvest index (%)
T₁: Control (No foliar Spray)	198	14142	45.7
T₂: Foliar application of 1% 19-19-19 twice *	296	17400	46.8
T₃: Foliar application of 1% KNO₃ twice *	293	16953	47.3
T₄: Foliar application of 0.2% Formula 4 twice *	243	14283	48.3
T₅: Foliar application of 1% Vermiwash twice *	265	14397	45.7
T₆: Foliar application of 1% 19-19-19 one week before tasseling <i>fb</i> 1% KNO₃ one week after silking.	318	17683	46.8
T₇: Foliar application of 0.2% Formula 4 one week before tasseling <i>fb</i> 1% KNO₃ at one week after silking.	245	14507	45.6
T₈: Foliar application of 1% Vermiwash one week before tasseling <i>fb</i> 1% KNO₃ one week after silking.	291	16867	45.0
T₉: Foliar application of 1% 19-19-19 one week before tasseling <i>fb</i> 1% Vermiwash one week after silking.	295	17367	47.0
S.Em±	8.3	782	0.6
CD (P=0.05)	25.0	2344	1.8
CV (%)	5.3	8.49	2.3

(Recommended dose of fertilizer: 180-75-60 kg N, P₂O₅, K₂O ha⁻¹)

Table.2 Economics of sweet corn as influenced by foliar nutrition treatments

Treatments	Gross returns (Rs. ha ⁻¹)	Net returns (Rs. ha ⁻¹)	B: C ratio
T₁: Control (No foliar spray)	262233	186462	2.46
T₂: Foliar application of 1% 19-19-19 twice *	311730	234919	3.06
T₃: Foliar application of 1% KNO₃ twice *	305767	228956	2.98
T₄: Foliar application of 0.2% Formula 4 twice *	263023	186212	2.42
T₅: Foliar application of 1% Vermiwash twice *	264503	188392	2.48
T₆: Foliar application of 1% 19-19-19 one week before tasseling <i>fb</i> 1% KNO₃ one week after silking.	316427	239616	3.12
T₇: Foliar application of 0.2% Formula 4 one week before tasseling <i>fb</i> 1% KNO₃ one week after silking.	268767	191956	2.50
T₈: Foliar application of 1% Vermiwash one week before tasseling <i>fb</i> 1% KNO₃ one week after silking.	298140	221679	2.89
T₉: Foliar application of 1% 19-19-19 one week before tasseling <i>fb</i> 1% Vermiwash one week after silking.	307467	231006	3.02
S.Em_±	10578	10578	0.14
CD (P=0.05)	31712	31712	0.41
CV (%)	6.35	8.64	8.65

Net returns

As regards net returns, significantly higher net returns (Rs. 239616 ha⁻¹) were realized with application of 1% 19-19-19 one week before tasseling *fb* 1% KNO₃ one week after silking (T₆) which was however, comparable with T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling *fb* 1% Vermiwash one week after silking), T₃ (1% KNO₃ one week before tasseling and one week after silking) and T₈ (1% Vermiwash one week before tasseling *fb* 1% KNO₃ one week after silking). While, the net returns were found to be minimum (Rs. 186462 ha⁻¹) when sweet corn

was not supplied with foliar nutrition (T₁) which was however, found parity with T₄ (0.2% Formula 4 one week before tasseling and one week after silking), T₅ (1% Vermiwash one week before tasseling and one week after silking) and T₇ (0.2% Formula 4 one week before tasseling *fb* 1% KNO₃ one week after silking).

Benefit- cost ratio

The B: C ratio of sweet corn was found to alter to a statistically detectable magnitude due to foliar nutrition treatments (Table.2). Significantly higher B: C ratio (3.12) was registered with 1% 19-19-19 one week before

tasseling fb 1% KNO₃ one week after silking (T₆) which was however, comparable with T₂ (1% 19-19-19 one week before tasseling and one week after silking), T₉ (1% 19-19-19 one week before tasseling fb 1% Vermiwash one week after silking), T₃ (1% KNO₃ one week before tasseling and one week after silking) and T₈ (1% Vermiwash one week before tasseling fb 1% KNO₃ one week after silking). The B: C ratio was minimum (2.46) when sweet corn did not receive foliar nutrition (T₁) which was however, found parity with T₄ (0.2% Formula 4 one week before tasseling and one week after silking), T₅ (1% Vermiwash one week before tasseling and one week after silking) and T₇ (0.2% Formula 4 one week before tasseling fb 1% KNO₃ one week after silking).

Significantly higher gross returns, net returns and B: C ratio associated with 1% 19-19-19 one week before tasseling fb 1% KNO₃ one week after silking (T₆), 1% 19-19-19 one week before tasseling and one week after silking (T₂), 1% 19-19-19 one week before tasseling fb 1% Vermiwash one week after silking (T₉), 1% KNO₃ one week before tasseling and one week after silking (T₃) and 1% Vermiwash one week before tasseling fb 1% KNO₃ one week after silking (T₈) over rest of the foliar nutrition might be due to highest economic yield (fresh cobs and stover) without proportionate increase in the cost of cultivation. Supplementing major nutrients in proper balance at peak physiological demand might have enabled to meet the nutrient demand in tune with the physiological needs to ultimately translate to large yield structure, resulted in inflated B: C ratio compared to other foliar nutrition treatments. These results were in agreement with the findings of Maravalli and Shekh (2019), Ullasa *et al.*, (2016), Asghar *et al.*, (2011), Manja Naik (2012).

It can be concluded that foliar application of 19:19: 19 @ 1 % one week before tasseling

fb1.0 % KNO₃ one week after silking recorded higher cob weight, cob yield, harvest index, gross returns, net returns and B: C ratio in sweet corn.

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