

Effect of amino acid based micro-nutrient fertilizer on growth and yield of 'Suru' sugarcane

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Abstract:

A field experiment materialized during the year 2016-2017 at Sugarcane Research Unit, Dr. PDKV, Akola, to determine the effect of foliar spraying of Purta Mino Sugarcane Plus on growth and yield of 'suru' sugarcane. The experiment laid out in randomized complete block designs (RCBD) with five treatments were replicated four times. Results indicated superiority of the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60 DAP to 90 DAP) on different ancillary attributes i.e., plant height (cm), number of tillers, average cane diameter (cm), number of nodes/ canes, number of millable canes. The highest cane yield (t/ha) and commercial cane sugar yield (t/ha) was found in the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP (Days After Planting) and 8.75 lit/ha from 60DAP to 90 DAP) followed by the treatment T₄ (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP and 90 DAP).

Keyword: ancillary, Amino Acid, Micro-Nutrient Fertilizer, yield, quality.

Introduction:

Sugarcane (*Saccharum officinarum*) belongs to the genus *Saccharum*, and family Poaceae. It is reported to have originated in New Guinea before spreading throughout the world's tropical and subtropical regions (Daniels and Roach, 1987). Sugarcane cultivated in India belongs to two main groups: (a) *S. barberi* and *S. Sinense* and (b) *S. officinarum*. Sugarcane typically contains 63-73% water, 11-16% fibre, 12-16% soluble sugars, and 2-3% non-sugar carbohydrates. Sugarcane is the primary cash crop, growing in both the tropical and subtropical parts of the country. It is the primary source of sugar, gur, and khandsari, as well as basic materials for alcohol production. It is an efficient substitute for petroleum and other chemical goods. It is a long-duration crop that takes 10 to 15 months or even 18 months to develop, depending on the geographical conditions. India has two main agro-climatic areas for sugarcane cultivation: tropical and subtropical. The tropical region covers around 45% of the country's land area and accounts for 55% of its sugarcane production. Thus, the subtropical region accounts for 55% of the land and 45% of the total production of sugarcane (Shukla et al., 2017). In 2024-2025, the estimated total area and production in India is 53.4 lakh ha and 439 million tonnes (Anon.,2024) .

The Sugarcane Breeding Institute in Coimbatore developed the wonder variety, Co 86032 also called as Narayan, which was suggested for the peninsular zone. It quickly spread and took up a significant amount of Tamil Nadu (80%), as well as about 40% of Andhra Pradesh, Karnataka, Gujarat, and Maharashtra. This midlate cultivar has a high sucrose content, good ratooning ability, and a high yield of 120 t/ha. This can be grown in regions that are impacted by drought and salinity (Shukla *et al.*, 2017).

Amino acids are among possible technique for increasing crop productivity (Shokunbi *et al.*, 2012) and known as more potent plant development bio-regulators (Pessarakli *et al.*, 2015), these organic nitrogen polymers are utilised as building blocks for proteins and enzymes. Amino acids are also important because they are widely used in the production of non-proteinic nitrogenous compounds such purine and pyrimidine bases, pigments, vitamins, and coenzymes (Buchanan *et al.*, 2000). Glutamate, glutamine, and aspartate are the major amino acids produced by plant cells and other amino acids can be composed from them (Buchanan *et al.*, 2000; Taiz and Zeiger, 2013). Different types of soil may contain different forms of amino acids, but their half-lives are short, and only the existence of transporters inside root cells allows plants to absorb them (Jamtgard *et al.*, 2010). In this case, exogenous amino acid therapy via foliar or seed soaking enhanced plant development and yield because molecules can act as indicators of several important plant biochemical processes (Abdel-Mawgoud *et al.*, 2011; Koukounaras *et al.*, 2013; Sadak *et al.*, 2014; El-Awadi *et al.*, 2019). External application of different amino acids as bioregulators can decrease fertiliser use and increase crop output by increasing plant uptake of minerals and optimising nutrient use (Vernieri *et al.*, 2005).

In this paper, we are highlighting the pivotal role the amino acid based micro-nutrient fertilizer play in competition to others and improvements in the results over the quality and quantity dosage parameters of the fertilizer on the sugarcane subjects. It turns out that the application of the amino-acids produce significantly improved results overall.

Methods and Materials:

A field experiment was carried out at Sugarcane Research Unit, Dr. PDKV, Akola during the period 2016-2017. The experimental field was ploughed two times with disc harrow, irrigated, dried to workable condition, levelled and finally seedbed was prepared by ploughing with cultivation. The plot size was 5.10 x 3.60 m². A sugarcane field experiment was conducted with **Co 86032 (Narayan)** in a randomized block design (RBD) with five treatments and four replications and planted at spacing of 90 x 90 cm (row to row) by wet method. Five treatments were imposed, viz.,

T₁- Control, **T₂**- VS1 Multi-Micronutrient @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60DAP to 90 DAP, **T₃**- (Amino Acid Based Micro-Nutrient Fertilizer) @ 3.75 lit/ha at 60 DAP and 6.25 lit/ha from 60DAP to 90 DAP, **T₄**- (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP and 7.50 lit/ha from 60 DAP to 90 DAP, **T₅**- (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP and 7.50 lit/ha from 60 DAP to 90 DAP.

Observations recorded under the experiments are as follows:

A. Ancillary attributes of sugarcane:

1. Germination (%)

From the net plot area of each plot, one germination counts were taken at 45 days after planting (DAP), and the percent germination was calculated as follows:

$$\text{Germination (\%)} = \frac{\text{number of germinated buds per plot}}{\text{number of buds planted per plot}} \times 100$$

2. Plant height (cm):

Ten plants were tagged randomly in each of the plots, and the height of the tagged plants was taken from ground level to the neck of the plant on 60 and 90 DAP and at harvest using a wooden scale. Height recorded in centimetres was then averaged out.

3. Number of tillers:

Number of tillers (thousand/ha) were recorded at 120 days on per plot basis and the average was worked out and given in table.

4. Average cane diameter (cm):

At harvest, three detashed plants from each plot were chosen at random. A Vernier sliding caliper was used to measure their values at the bottom, middle, and top internodes. The average of the three data points was recorded as the diameter of the cane in centimeters.

5. Number of nodes/canes:

Five detashed and detopped plants selected for recording cane diameter were used for this observation. The total number of nodes in five plants were counted and divided by number of plants to get the average number of nodes per cane.

6. Number of millable canes (Number of canes/ha):

Counting on the number of millable cane (NMC) was done from the net plot area of each plot at the time of crop harvesting and expressed in thousands per hectare.

B. Yield and quality parameters of sugarcane:**1. Cane yield (t/ha)**

The sugarcane harvested from the net plot area has been weighed, recorded, and represented in tonne per hectare (t/ha). Following the removal of the harvested cane's tops, debris, roots, and other unwanted materials, the plot weights were noted.

2. Commercial cane sugar yield (CCS):

The sugarcane yields were calculated as per the following formulae

$$\text{Commercial cane sugar yield (t/ha)} = \frac{\text{CCS per cent cane} \times \text{cane yield (t/ha)}}{100}$$

3. Brix percentage at harvest:

A hand refractometer with a Brix range of 0 to 32° was used to determine the total soluble solids. One or two droplets of pulp were applied to the Refractometer's prism using sanitized glass rods.

4. Sucrose or Pol per cent juice:

The juice samples were filtered through Whatman number 1 filter paper after being clarified using Horne's dry lead subacetate clarity process (Meade-Chen, 1977). A polariscope was used to record the filtrates' pol per cent values. Schmitz's table was used to link the pol readings with the observed degrees of brix in order to determine the values of pol per cent juice, which is a substitute for sucrose per cent juice.

5. Purity coefficient of juice:

In percentage terms, it is the ratio of pol percent juice to the corrected degrees of brix, and the numbers were calculated using the following formulas.

$$\text{Purity coefficient of juice} = \frac{\text{pol per cent juice}}{\text{brix corrected}} \times 100$$

Purity coefficients are relative and do not reflect theoretical juice purities. This is mostly because the small mills have maximum extraction limited to 50%.

6. Commercial cane sugar (CCS) per cent:

The values of commercial cane sugar on per cent cane basis were computed from the following formulae

$$\text{CCS per cent cane} = \{S - (B-S) \times 0.4\} \times 0.73$$

Where, S = sucrose per cent juice B = degrees brix

Result and Discussion:

The data pertaining to the ancillary characters of sugarcane are influenced by different treatments is presented in Table 1.

A. Ancillary attributes of sugarcane**1. Germination:**

The germination (%) as influenced by different treatments showed non-significant results. The mean data regarding to germination (%) recorded was 56.40 %.

2. Plant height:

The results revealed spraying of (Amino Acid Based Micro-Nutrient Fertilizer) had significant variation for plant height of sugarcane (Table 1). Specifically, the Spraying of (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60DAP to 90 DAP (T₅) recorded significantly highest plant height (233.50 cm) followed by the treatment (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60DAP to 90 DAP (T₄) showed plant height of 232.00 cm, while the lowest plant height (212.50 cm) was estimated under the treatment (T₁). It might be as a result of amino acids' ability to facilitate the uptake of ions and nutrients from the soil solution, which improves photosynthesis and encourages foliage growth and development (Baqir and Behadili, 2019).

3. Number of tillers:

For number of tillers in sugarcane, the (Amino Acid Based Micro-Nutrient Fertilizer) concentration demonstrated significant improvement with the amino acid involvement as shown in the Table no. 1. The number of tillers/plants (124.16) in sugarcane was found maximum in the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60DAP to 90 DAP) which were statistically at par with the treatment T₄ (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60DAP to 90 DAP) having the number of tillers/plant (123.24) in subsequent years. The minimum number of tillers/ plants (104.07) was revealed under the treatment (T₁). The results are evident in determining the role that amino acids play in a number of metabolic activities, including the synthesis of proteins and carbohydrates, the production of chlorophyll, the facilitation of photosynthesis, the expansion of enzyme activity, and the stimulation of physiological processes and biological substances. As a result, these amino acids generally improve the growth and development of plants (Khan *et al.*,2019).

4. Average cane diameter:

Table 1 details findings demonstrating the significant effect of average cane diameter of sugarcane. The maximum diameter of cane (3.07 cm) was recorded under the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60 DAP to 90 DAP) which is statistically at par with the treatment T₄ (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP) had a cane diameter of 3.04 cm. However, the treatment T₁ (control) was recorded minimum cane diameter of 2.88 cm. The possible cause is the amino acids, which are necessary for improving growth characteristics by encouraging enzymatic reactions, increasing the crops synthesis of vitamins, and increasing the permeability of cell membranes (Halshoy *et al.*,2023).

5. Number of nodes/ cane:

The outcomes in Table 1 showed a significant effect (Amino Acid Based Micro-Nutrient Fertilizer), as the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60DAP to 90 DAP) gave the highest number of nodes/cane (21.25) followed by the treatment T₄ (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP) recorded 20.50 number of nodes/cane. The control treatment with the lowest number of nodes for the said trait (19.90). Increased photosynthetic activity leads to the intake of more carbohydrates, which in turn promotes cell division and elongation, resulting in a rise in the number of nodes and leaves per plant (Bommesh *et al.*, 2016).

6. Number of millable canes (Number of canes /ha):

The results from Table 1 detailed a remarkable effect Purta Mino Sugarcane Plus on sugarcane millable canes, as the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60 DAP to 90 DAP) provided the maximum number of millable canes of 89.35. However, it did not differ significantly from the treatment T₄ (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP) which gave an average of 89.07, compared with the control treatment, reaching an average of 75.92.

B. Yield and Quality parameters:**1. Cane yield (t/ha)**

The results in Table 2 showed significant effect of (Amino Acid Based Micro-Nutrient Fertilizer) on sugarcane yield, the treatment T₅ (Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60 DAP to 90 DAP) exhibited maximum cane yield (68.25 t/ha) followed by the treatment T₄ (Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP) had an average of 67.13 t/ha. Meanwhile, the treatment T₁ (control) recorded minimum cane yield of 58.92 t/ha. Amino acids facilitate the various processes of plant metabolism, increase the rate at which carbon is assimilated, and increase the total dry matter that is reflected on the sink and yield by improving the cell's capacity to absorb water and solvent nutrients from growth media (Dreccer *et al.*, 2000; and Sharma-Natu and Ghildiyal, 2005).

2. Commercial cane sugar yield (t/ha)

The outcomes in Table 2 showed a significant effect of Amino Acid Based Micro-Nutrient Fertilizer on commercial cane sugar yield, as the treatment T₅ Amino Acid Based Micro-Nutrient Fertilizer @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60 DAP to 90 DAP) recorded highest CCS average of 10.36 t/ha which was statistically at par with the treatment T₄ Amino Acid Based Micro-Nutrient Fertilizer @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP) exhibited the average of 10.14 t/ha. Furthermore, the lowest CCS (8.92 t/ha) occurred in the treatment T₁ (control). Natural hormones like IAA, GA₃, and ethylene, as well as protein levels, cell division, and plant pigments are thought to be enhanced by amino acids (Ahmed and Abd El-Hameed, 2003; Ahmed *et al.*, 2007 and 2014 and; Madian and Refaai, 2011) which is responsible for potential commercial quality of sugarcane.

The quality parameters *viz.*, brix, sucrose, purity and CCS % were not influenced significantly by Amino Acid Based Micro-Nutrient Fertilizer.

Table 1: Effect of (Amino Acid Based Micro-Nutrient Fertilizer) on ancillary attributes of sugarcane

Notations	Treatments	Germi nation (%)	Height (cm)	Number of internodes	Cane diameter (cm)	Number of tillers/ ha (180 DAP)	Millable canes/ ha
T ₁	Control	57.08	212.50	19.50	2.88	104.07	75.92
T ₂	VSI multi- micronutrient @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP	56.32	231.25	20.45	3.04	122.59	88.47
T ₃	(Amino Acid Based Micro-Nutrient Fertilizer) 3.75 lit/ha at 60 DAP & 6.25 lit/ha from DAP to 90 DAP	55.97	223.50	19.90	2.93	112.96	81.48
T ₄	(Amino Acid Based Micro-Nutrient Fertilizer) 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP	56.32	232.00	20.50	3.04	123.24	89.07
T ₅	(Amino Acid Based Micro- Nutrient Fertilizer) 6.25 lit/ha at 60 DAP & 8.75 lit/ha from 60 DAP to 90 DAP.	56.32	233.50	21.25	3.07	124.16	89.35
	SE(m)±	2.62	4.62	0.36	0.05	44.53	26.16
	CD (0.05)	NS	14.24	1.11	0.14	137.21	80.63

Table 2: Effect of Amino Acid Based Micro-Nutrient Fertilizer on yield and quality parameters of sugarcane

Notations	Treatments	Cane yield (t/ha)	CCS (t/ha)	Brix % at harvest	Sucrose % (at harvest)	Purity % at harvest	CCS % at harvest
T ₁	Control	58.92	8.92	22.15	21.15	95.25	15.15
T ₂	VSI multi-micronutrient @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP	65.76	9.95	21.21	20.83	95.50	15.18
T ₃	(Amino Acid Based Micro-Nutrient Fertilizer) @ 3.75 lit/ha at 60 DAP & 6.25 lit/ha from 60 DAP to 90 DAP	66.75	10.01	22.81	21.21	95.50	14.92
T ₄	(Amino Acid Based Micro-Nutrient Fertilizer) @ 5 lit/ha at 60 DAP & 7.50 lit/ha from 60 DAP to 90 DAP	67.13	10.14	22.15	21.15	95.50	15.15
T ₅	(Amino Acid Based Micro-Nutrient Fertilizer) @ 6.25 lit/ha at 60 DAP & 8.75 lit/ha from 60 DAP to 90 DAP	68.25	10.36	22.28	22.21	95.50	15.19
	SE(m)±	1.31	0.21	0.20	0.22	0.24	0.17
	CD (0.05)	3.93	0.64	NS	NS	NS	NS

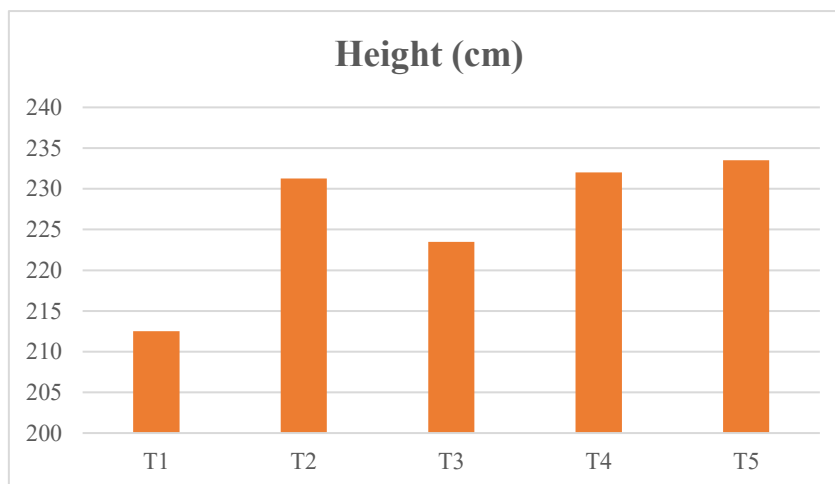


Fig1. Effect of Amino Acid Based Micro-Nutrient Fertilizer on height (cm) of sugarcane

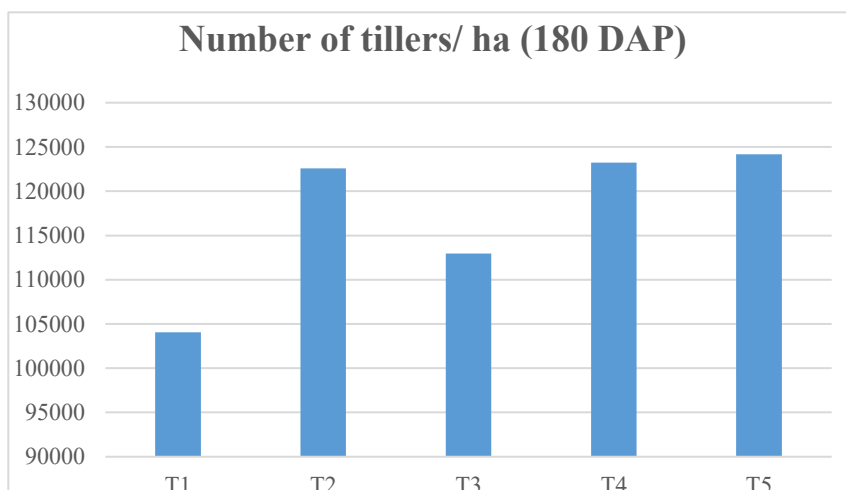


Fig 2. Effect of Amino Acid Based Micro-Nutrient Fertilizer on number of internodes of sugarcane

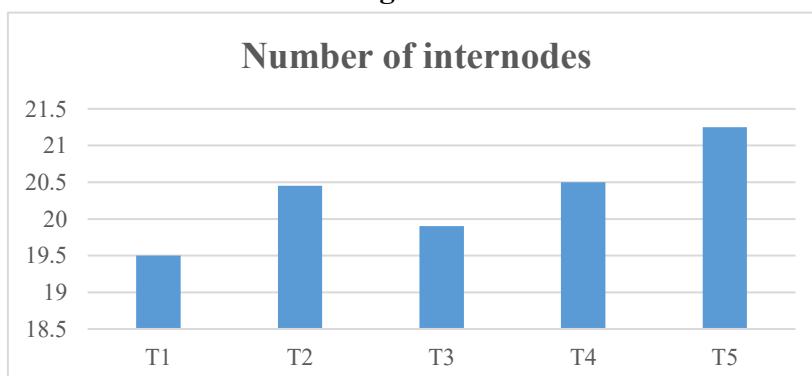


Fig 3. Effect of Amino Acid Based Micro-Nutrient Fertilizer on number of tillers/ ha of sugarcane

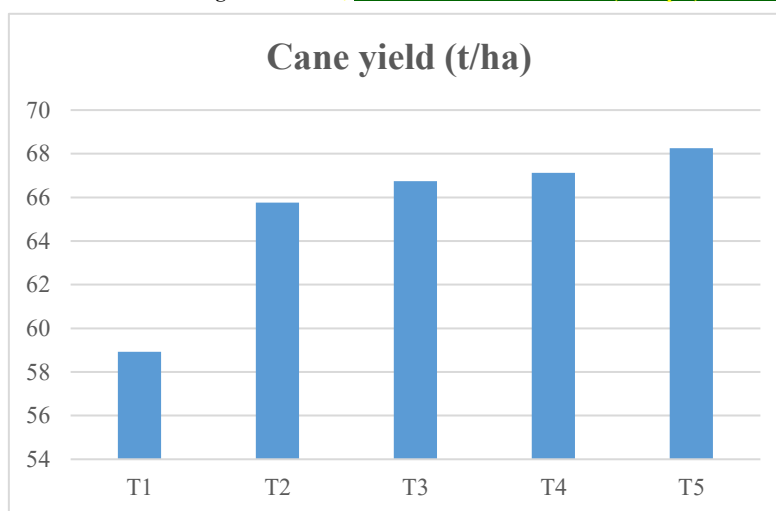


Fig 4. Effect of Amino Acid Based Micro-Nutrient Fertilizer on cane diameter (cm) of sugarcane

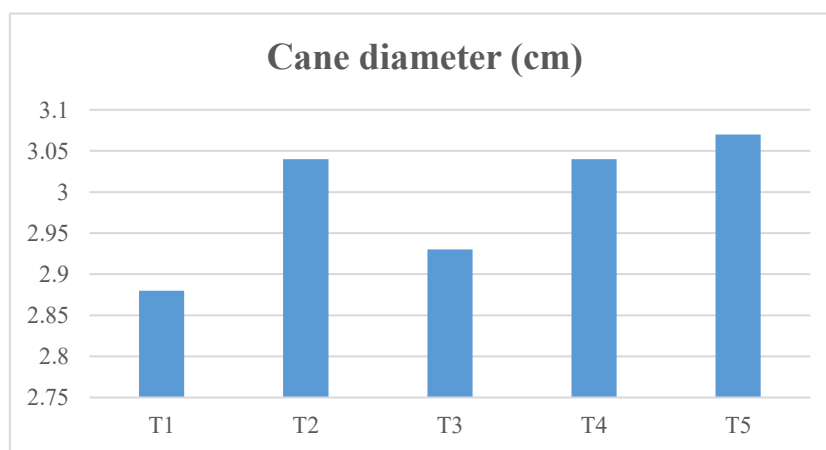


Fig. 5 Effect of Amino Acid Based Micro-Nutrient Fertilizer on millable canes of sugarcane

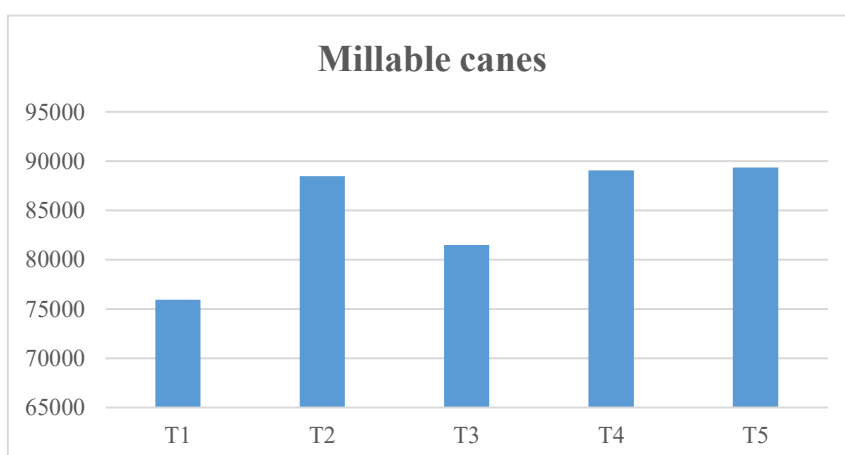


Fig 6. Effect of Amino Acid Based Micro-Nutrient Fertilizer acid on cane yield (t/ha) of sugarcane

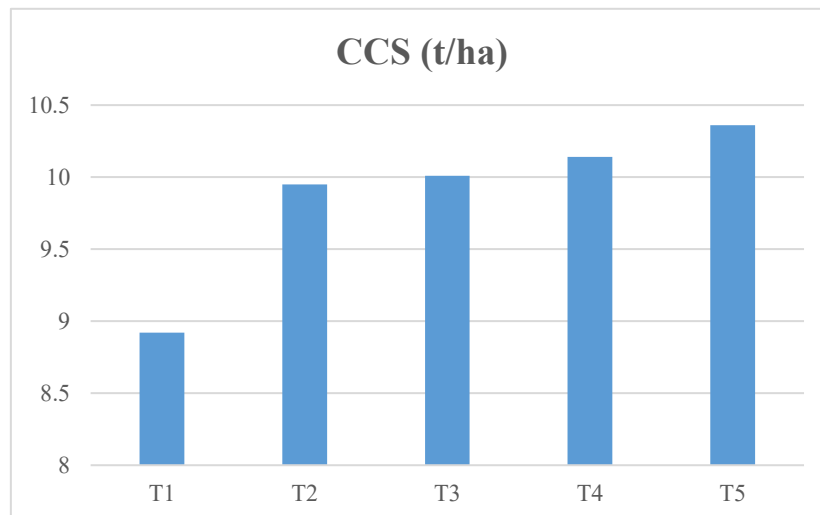


Fig 7. Effect of Amino Acid Based Micro-Nutrient Fertilizer on CCS (t/ha) of sugarcane

Conclusion:

The application Amino Acid Based Micro-Nutrient Fertilizer @ 6.25 lit/ha at 60 DAP and 8.75 lit/ha from 60 DAP to 90 DAP demonstrated a clear and beneficial influence on different ancillary attributes i.e., plant height (cm), number of tillers, average cane diameter (cm), number of nodes/canes, number of millable canes and yield quality parameters. The results clearly show that using Amino Acid Based Micro-Nutrient Fertilizer at this dosage has potential as a useful strategy for farmers to maximize sugarcane crop yield, providing a useful way to enhance agricultural results in sugarcane farming.

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