Effect of Zinc Nutrition on Sugarcane

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ABSTRACT

The experiments were conducted to evaluate the response of sugarcane to zinc nutrition under recommended dose of NPK fertilizers at Hamza Ali Samon Farm, Tandojam, Aslam Kamboh Farm, Shaikh Bhirkio, Mulla Afzal Farm, Garho, Thatta and Ghulam Qadir Palijo Farm, Makli, Thatta. The experiments at each location were conducted under RCBD with three replications. Zinc nutrition @ 0, 2, 4, 6 and 8 kg Zn ha^{-1}as T-1, T-2, T-3, T-4 and T-5 respectively along with recommended dose of NPK fertilizer @ 225-112-168 NPK kg $ha^{-1}$was applied in treatment plots in all experiments. It was observed that zinc nutrition gave encouraging results for cane yield and CCS% as compared to control.

Pooled data of all experiments revealed that maximum cane yield of 108.54 t ha^{-1} and CCS of 12.635 was obtained from T-5 (8 kg Zn ha^{-1}) as compared to cane yield (91.13 t ha^{-1}) and CCS (11.67%) obtained from control treatment. Economics returns of sugarcane due to fertilizer application showed that zinc nutrition @ 8 kg Zn ha^{-1} with recommended dose of NPK fertilizers gave maximum cost benefit ratio (1:5.36).

INTRODUCTION

Sugarcane (*Saccharum officinarum,* L.) is the third major crop of Pakistan. It is not only an important sugar crop but also a source of raw material for various agro-based industries in Pakistan. The national average cane yield (49.00 t ha-1) and sugar recovery (9.46%) is much lower than the other sugarcane growing countries of the world. The average cane yield and sugar recovery in Pakistan however, is much lower than the achievable potential of our existing sugarcane varieties. Sugarcane is annual exhaustive crop and requires large amount of nutrients during its different stages of growth.

There are 17 essential plant nutrients. Carbon and oxygen are absorbed from the air, while other nutrients including water are obtained from the soil. Plants must obtain the following mineral nutrients from the growing media.

The primary macronutrients: nitrogen (N), phosphorus (P), potassium (K), secondary macronutrients such as calcium (Ca), sulphur (S), magnesium (Mg). The macronutrient Silicon (Si) and micronutrients or trace minerals: boron (B), chlorine (Cl), manganese (Mn), iron (Fe), zinc (Zn), copper (Cu), molybdenum (Mo), nickel (Ni), selenium (Se), and sodium (Na).

The macronutrients are consumed in larger quantities and are present in plant tissue in quantities from 0.2% to 4.0% (on a dry matter weight basis). Micro nutrients are consumed in smaller quantities and are present in plant tissue in quantities measured in parts per million, ranging from 5 to 200 ppm, or less than 0.02% dry weight.

Among the micronutrients, zinc plays a vital role in the growth and development of crops particularly in sugarcane it improves yield and quality. Zinc is essential to carry out different functions in plants such as component of certain biological oxidation-reduction systems, metal activator for enzymes, carbohydrate metabolism, RNA synthesis, Auxin and IAA metabolism, integrity of biological membranes, stalk maturation, provides resistance to infection by certain pathogens and ultimately enhances crop yield and quality.

Zinc deficiency is first evident on the younger leaves. Brown spot appears on the leaves, midrib and leaf margin remain green and yellowing of leaf blade. Reduced tillering and shorter internodes. The deficiency symptom can be recognized by the stunted growth and patchy appearance

In Pakistan wide spread deficiency of zinc has been observed due to high pH and $CaCO_3$ content of soils. Besides those, salt affected soils, water logging or flooding, intensive cropping system and low organic amendments have also contributed in low zinc content in soils as well as plants. Deficiency of essential plant nutrients in our soils is as: nitrogen (100%), phosphorus (80-90%), potassium (40%), boron (30-40%), iron (20-30%) and zinc (60-70%).

Keeping in view the importance of zinc, field study was planned to evaluate the effect of zinc nutrition on sugarcane on four different famer's field of Sindh.

MATERIALS AND METHODS

The experiment at each site was conducted under randomized complete block design with three replications. Sugarcane varieties Thatta-10, SPF-234, CPD-01-346 and GT-11 were planted at Hamza Ali Samon Farm, Tandojam, Aslam Kamboh Farm, Shaikh Bhirkio, Mulla Afzal Farm, Garho, Thatta and Ghulam Qadir Palijo Farm, Makli, Thatta, respectively with following treatments.

- T 1= 0 kg Zn ha^{-1} (control)
- T 2= 2 kg Zn ha^{-1}
- T 3= 4 kg Zn ha^{-1}
- T 4= 6 kg Zn ha^{-1}

- T 5= 8 kg Zn ha^{-1}

Recommended dose of NPK fertilizer @ 225-112-168 NPK kg ha^{-1} was applied equally in each trial. Zinc as band application was given at seedling stage (60 DAS) in the form of Zingro. On maturity, the data on cane yield, yield components and quality parameters were taken.

RESULTS AND DUSCUSSION

It was observed that zinc nutrition in sugarcane improved cane yield and CCS% of sugarcane in all experiments at each location as compared to control where only NPK fertilizer was applied (Fig-1,2,3,4,5,6,7 and 8).

Moreover, the pooled data of all experiments in Fig-9 revealed that maximum cane yield of 108.54 t ha^{-1} was obtained from T-5 (8 kg Zn ha^{-1}) followed by 105.96, 102.2 and 98.18 t ha^{-1} obtained from T-4 (6 kg Zn ha^{-1}), T-3 (4 kg Zn ha^{-1}) and T-2 (2 kg Zn ha^{-1}), respectively as compared to cane yield 91.13 t ha^{-1} achieved from control T-1 (0 kg Zn ha^{-1}). As such zinc application showed 16, 14, 11 and 7% increased cane yield in T-5, T-4, T3 and T2, respectively, over control (T-1).

Almost same trend of encouraging results was observed in case of CCS% in pooled data of all experiments (Fig-10). Maximum CCS of 12.63% was recorded from T-5 (8 kg Zn ha^{-1}) followed by 12.33, 12.1 and 11.68% obtained from T-4 (6 kg Zn ha^{-1}), T-3 (4 kg Zn ha^{-1}) and T-2 (2 kg Zn ha^{-1}), respectively, as compared to CCS 11.67% recorded from control T-1 (0 kg Zn ha^{-1}). As such zinc application showed 0.96, 0.66, 0.43 and 0.21% increased CCS in T-5, T-4, T3 and T2, respectively, over control (T-1).

Economics returns of sugarcane due to fertilizer application were worked out according to prices of fertilizer and sugarcane during 2008-09. It is evident from data in Table-1 that maximum cost benefit ratio (1:5.36) was obtained from T-5 followed by 1:5.25, 1:5.08 and 1:4.88 cost benefit ratio obtained from T-4, T-3 and T-2, respectively, as compared to control treatment.

Table-1. Economic Returns of Sugarcane due to Zinc Fertilizer Application

Fertilizer levels	Gross income in Rs.	Value of increased yield in Rs.	Cost of fertilizer in Rs.	Net return due to fertilizer in Rs.	Cost benefit ratio
0 kg Zn/ha	184538.25	--	33535.0	151003.25	1:4.50
2 kg Zn/ha	198814.50	14276.25	33788.0	165026.50	1:4.88
4 kg Zn/ha	206955.00	22416.75	34042.0	172913.00	1:5.08
6 kg Zn/ha	214569.00	30030.75	34295.0	180274.00	1:5.25
8 kg Zn/ha	219793.50	35255.25	34548.0	185245.50	1:5.36
Price/40 kg sugarcane= Rs. 81/-, Price/50 kg Urea= Rs. 660/-,Price/50 kg DAP=Rs. 3087/-, Price/50 kg SOP= Rs. 2300/-, Price/3kg Zingro Rs. 380/-					

CONCLUSION

Each increment in zinc nutrition to sugarcane enhanced cane yield and yield components in all experiments. Zinc application also increased CCS%. It is suggested that 8 kg/ha zinc with recommended dose of NPK fertilizer is a best economical combination.

Fig-1 .Zinc Nutrient Trial at Hamza Ali Samon Farm, TandoJam

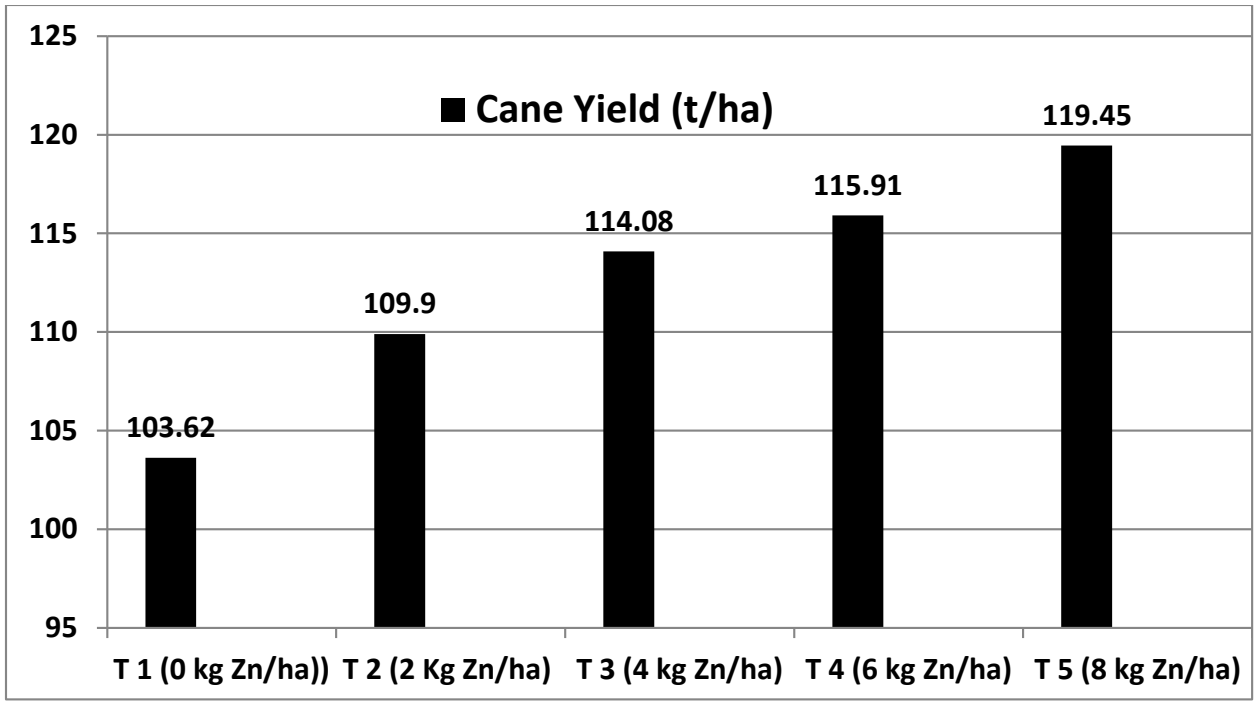


Fig-2 Zinc Nutrient Trial at Hamza Ali Samon Farm, TandoJam

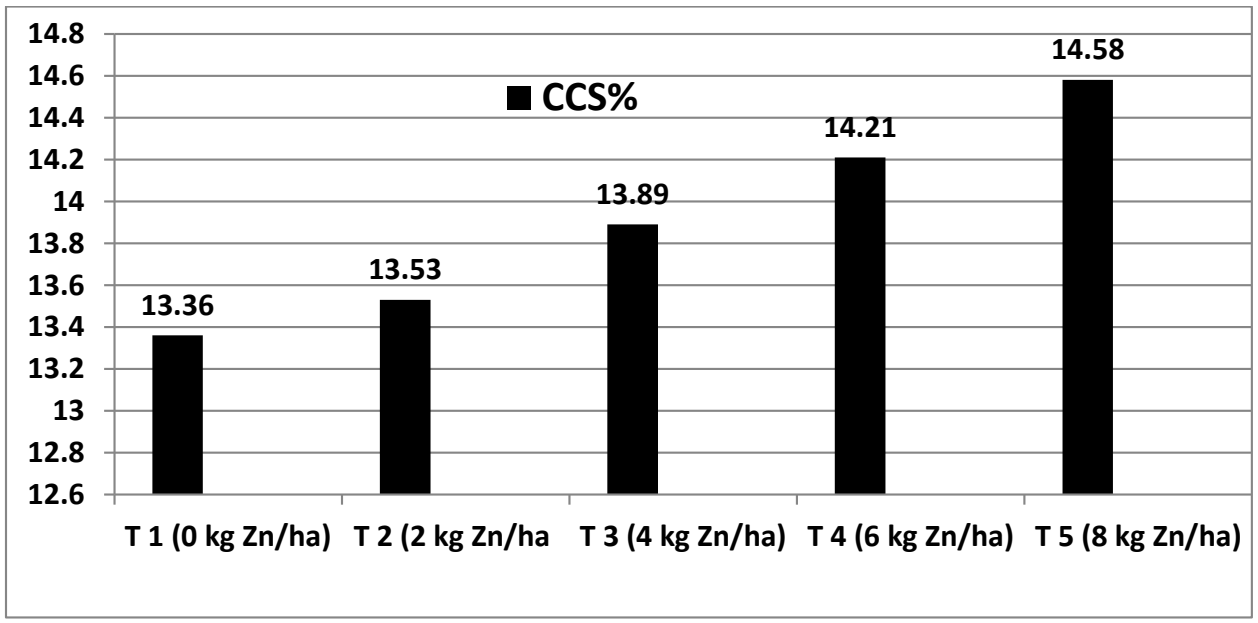


Fig-3. Zinc Nutrient Trial at Aslam Kamboh Farm, Shaikh Bhirkio

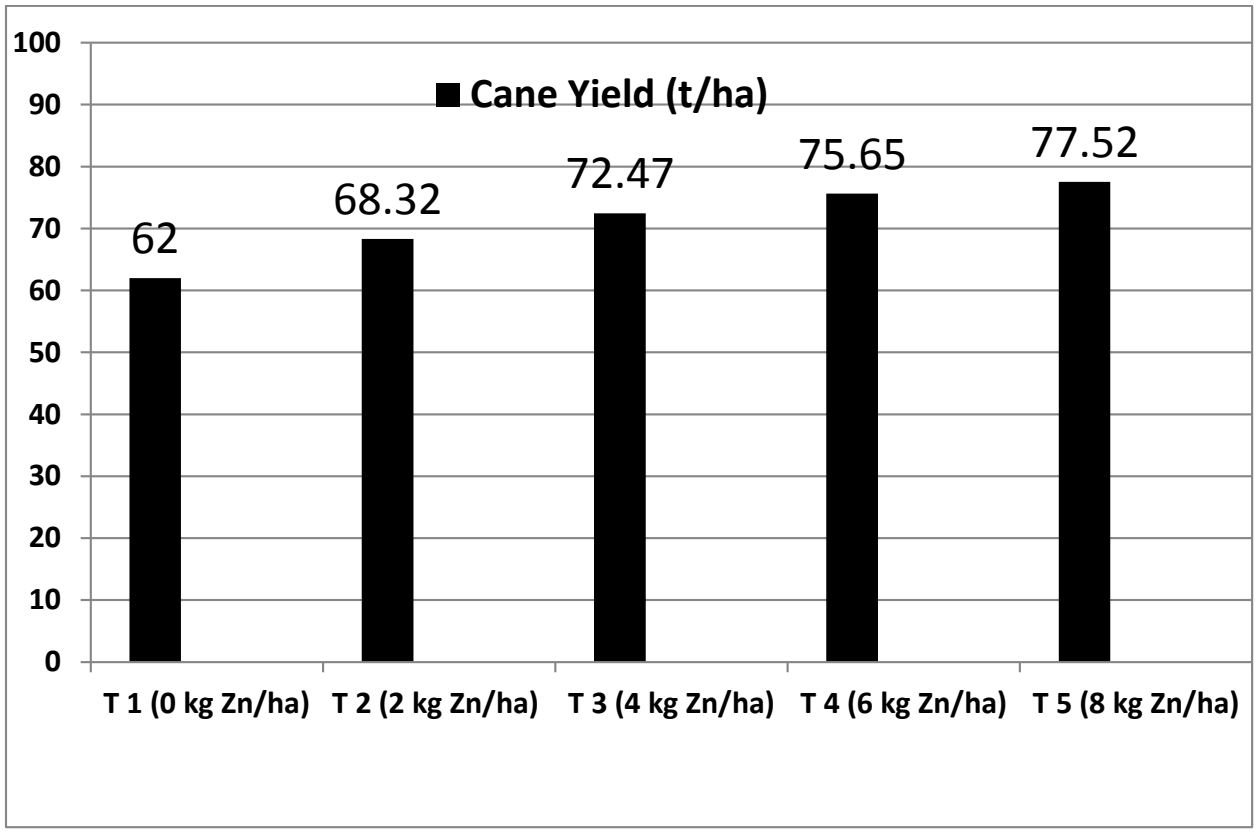


Fig-4. Zinc Nutrient Trial at Aslam Kamboh Farm, Shaikh Bhirkio

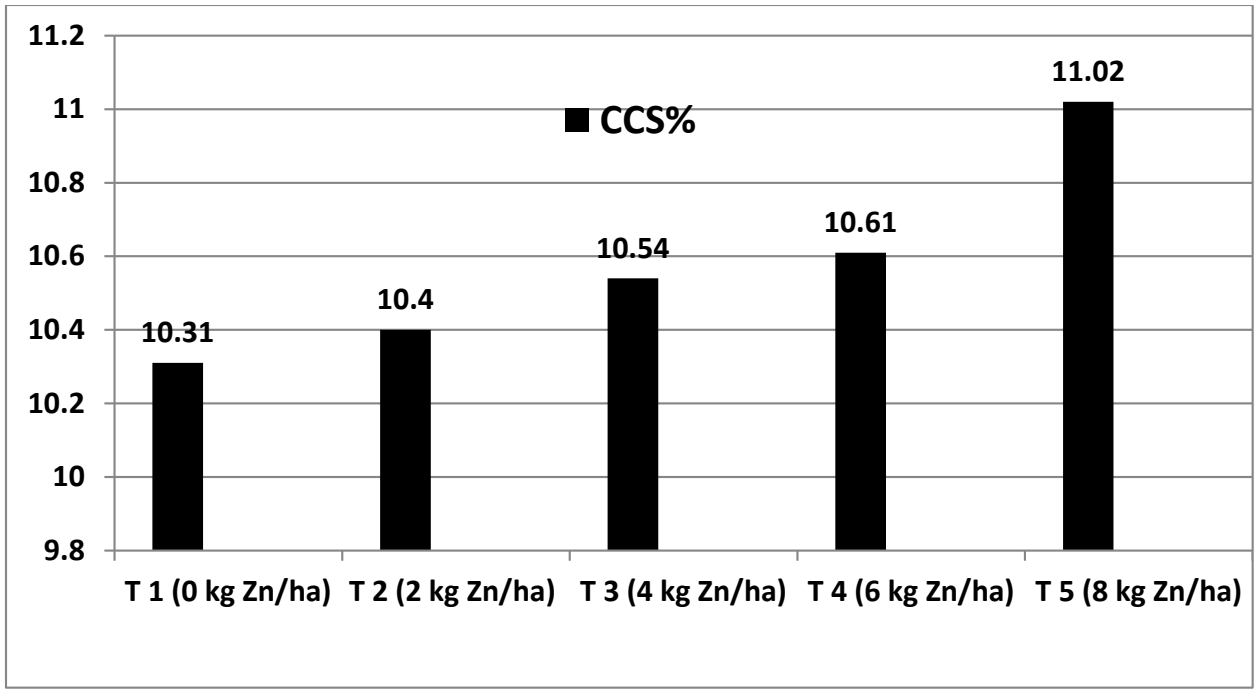


Fig-5. Zinc Nutrient Trial at Mulla Afzal Farm, Garho, Thatta

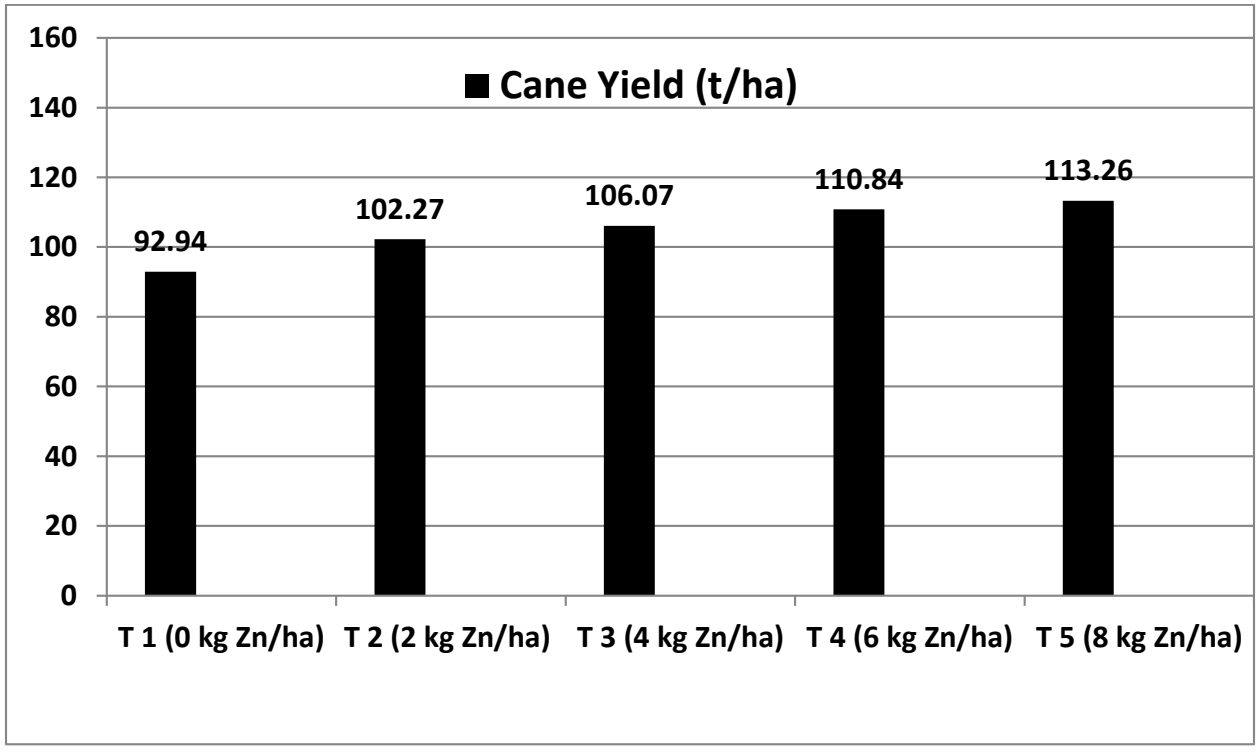


Fig-6. Zinc Nutrient Trial at Mulla Afzal Farm, Garho, Thatta

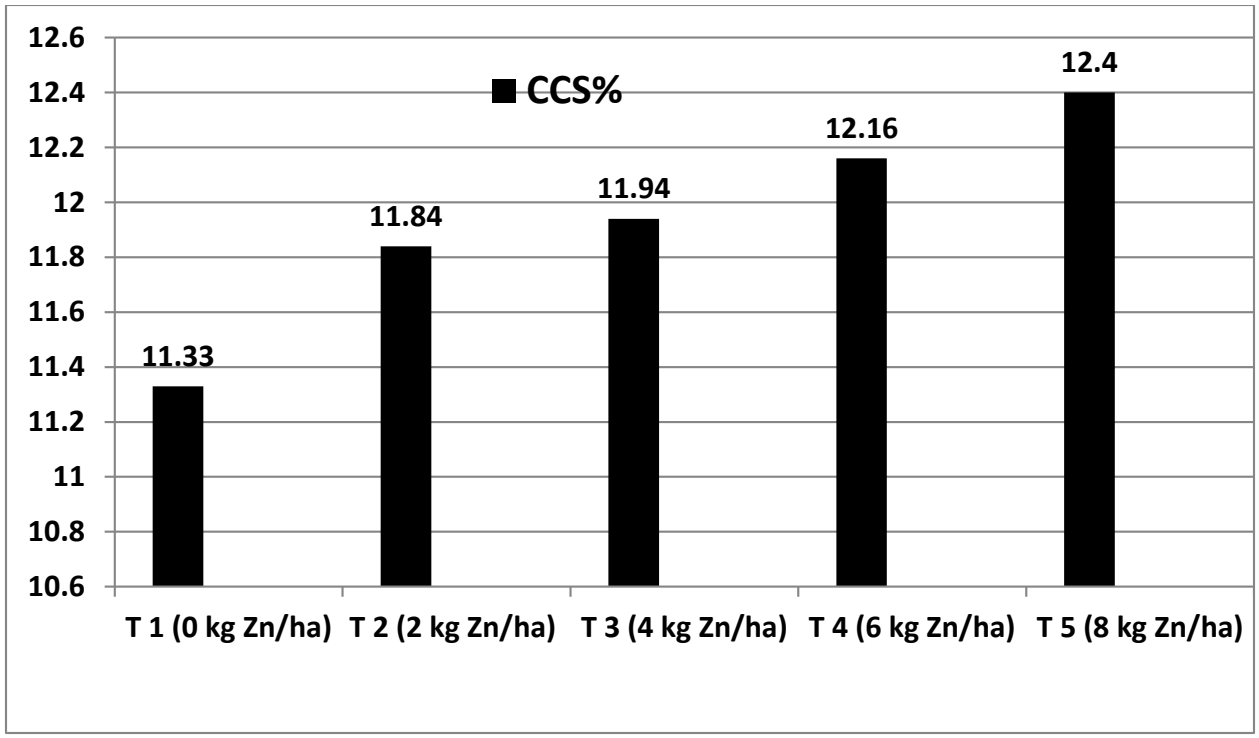


Fig-7. Zinc Nutrient Trial at Ghulam Qadir Palijo Farm, Makli, Thatta

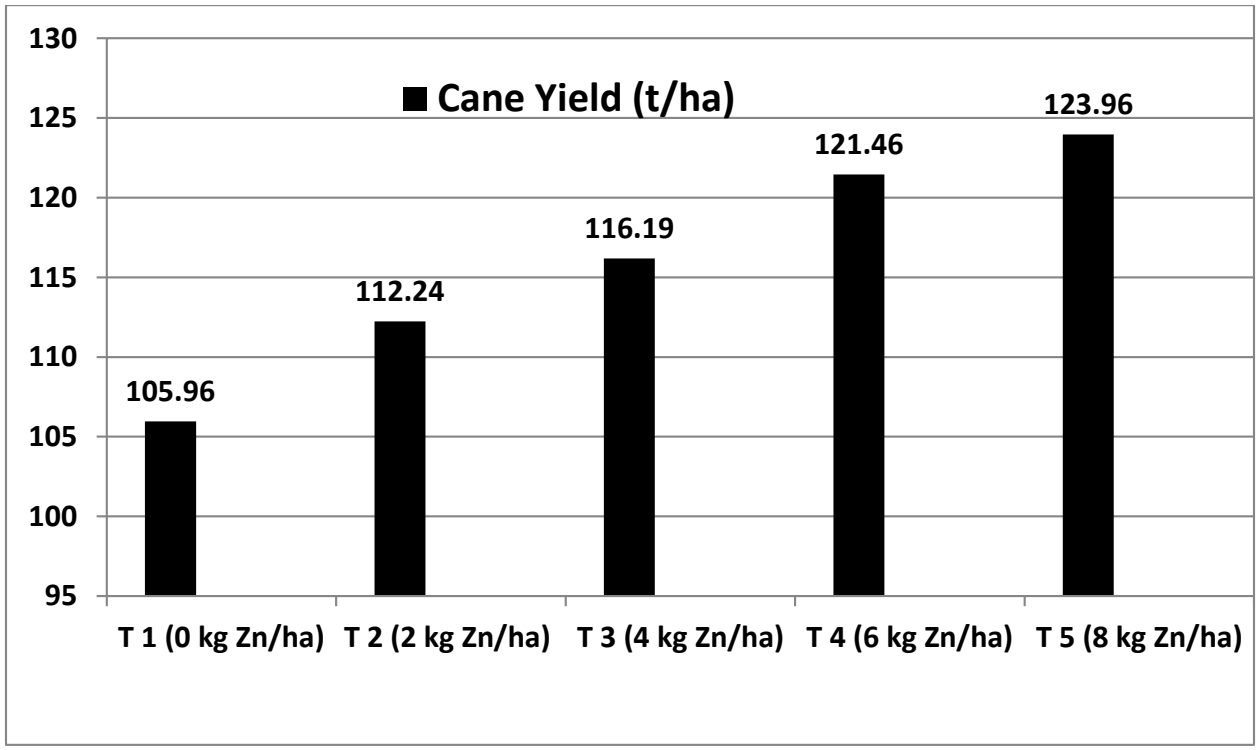


Fig-8. Zinc Nutrient Trial at Ghulam Qadir Palijo Farm, Makli, Thatta

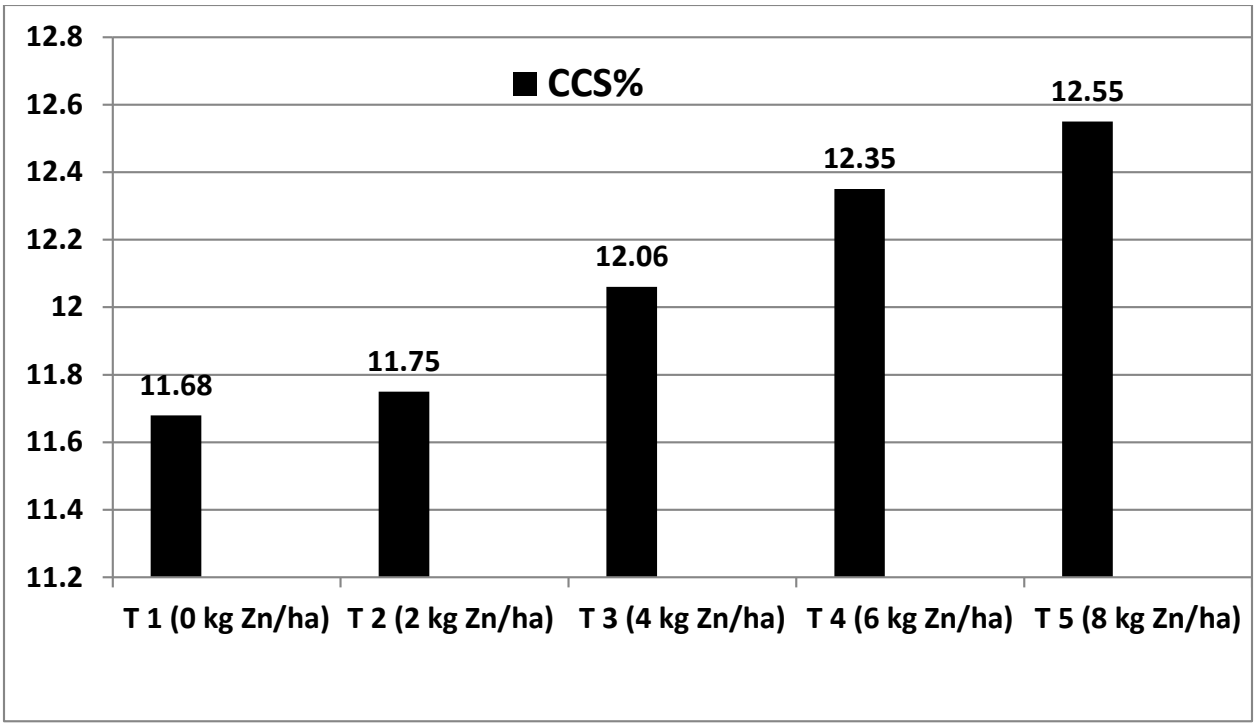


Fig-9. Pool Analysis of Zinc Nutrient Trials

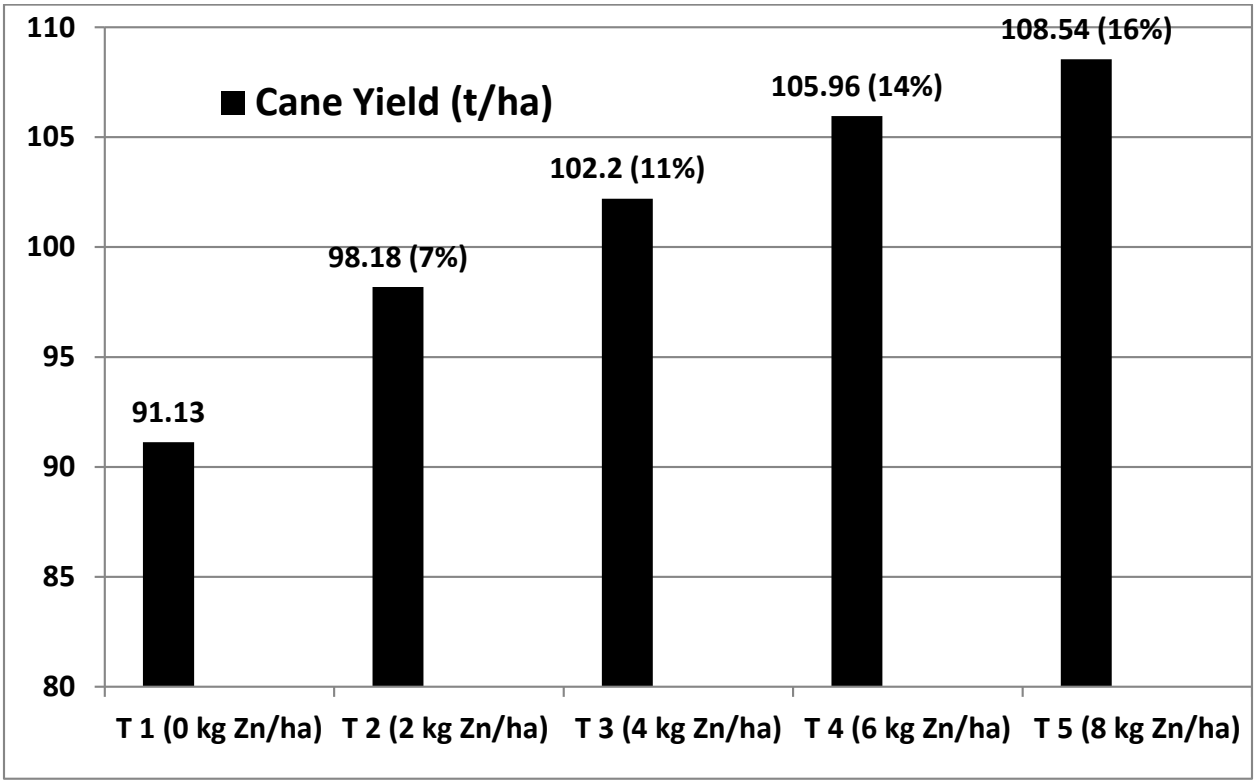
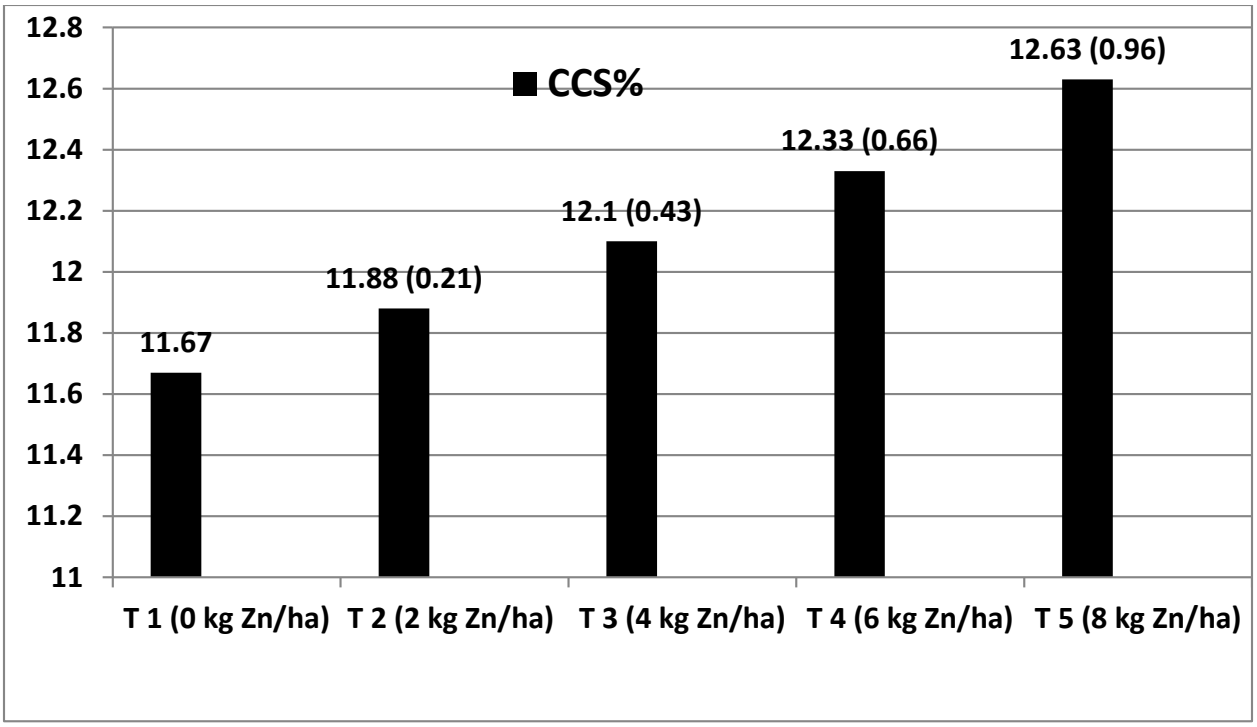


Fig-10. Pool Analysis of Zinc Nutrient Trials


12.8
12.6
12.4
12.2
12
11.8
11.6
11.4
11.2
11
CCS%
11.67
11.88 (0.21)
12.1 (0.43)
12.33 (0.66)
12.63 (0.96)
T 1 (0 kg Zn/ha)
T 2 (2 kg Zn/ha)
T 3 (4 kg Zn/ha)
T 4 (6 kg Zn/ha)
T 5 (8 kg Zn/ha)