

RESPONSE OF SUGARCANE VARIETY LARKANA-2001 TO SOIL APPLICATION OF CERTAIN MACRO- AND MICRO-NUTRIENTS FOR CANE YIELD AND SUGAR RECOVERY

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ABSTRACT

A field experiment was conducted during the year 2011-12 at the experimental field of Quaid-e-Awam Agriculture Research Institute Larkana to assess the effect macro- and micronutrients at various concentrations on cane yield and recovery of sugarcane variety Larkana-2001. The treatments included: Recommended dose of NPK fertilizers 225-112-168 kg ha^{-1} (control), NPK+Zn @ 5.0 kg ha^{-1} , NPK+Zn @ 7.0 kg ha^{-1} , NPK+B @ 1.5 kg ha^{-1} , NPK+B @ 2.0 kg ha^{-1} , NPK+Zn-B @ 5.0-1.5 kg ha^{-1} , NPK+Zn-B @ 5.0-2.0 kg ha^{-1} , NPK+Zn-B @ 7.0-1.5 kg ha^{-1} and NPK+Zn-B @ 7.0-2.0 kg ha^{-1} . The experiment was conducted in a three replicated Randomized Complete Block Design. The crop receiving recommended dose of NPK + 7.0+2.0 kg ha^{-1} Zn-B produced 75.54 percent germination, 303.00 cm cane length, 3.33 cm cane girth, 6.33 tillers stool $^{-1}$, 17.09 internodes cane $^{-1}$, 16.24 kg weight of 10 canes, 101.06 t ha^{-1} cane yield and 11.05% sugar recovery. Sugarcane fertilized with NPK+Zn-B @ 7.0-1.5 kg ha^{-1} resulted in 75.09 percent germination, 302.00 cm cane length, 3.32 cm cane girth, 6.31 tillers stool $^{-1}$, 17.04 internodes cane $^{-1}$, 16.19 kg weight of 10 canes, 100.37 t ha^{-1} cane yield and 10.92% sugar recovery. The remaining treatments as well as control resulted relatively in lower values for all the cane yield and recovery contributing characters. Hence, it is concluded that Zn-B @ 7.0-1.5 kg ha^{-1} was an optimum level for achieving economically maximum cane yield (100.37 t ha^{-1}) and recovery (10.92%); and the differences were non-significant ($P>0.05$) when boron application was increased to 2.0 kg ha^{-1} with same zinc level (7.0 kg ha^{-1}) in addition to NPK fertilizers.

Key Words: Sugarcane, macronutrients, micronutrients, cane yield, recovery

INTRODUCTION

Sugarcane, *Saccharum officinarum* L. is a major source of raw material for the production of white sugar and a cash crop in Pakistan. Its share in value added to agriculture and GDP is 3.2 and 0.7 percent,

respectively. Sugarcane was cultivated on an area of 1124 thousand hectares, 6.2 percent higher than last year's level of 1058 thousand hectares. Sugarcane production for the year 2012-13 was 62.472 million tons as against the target

production of 59 million tons last year. This indicates a rise of 5.9 percent over the production of last year (58.397 million tons). In case of cane yield ha^{-1} , during 2012-13 the cane yield was 55.580 tons ha^{-1} against 55.196 tons ha^{-1} during last year showing 0.7 percent

increase this year in yield (GoP, 2013). In the country, there are 78 sugar factories in function. In Sindh province the sugarcane cultivation (2012-2013) was 280 thousand hectares with a production of 15350 thousand metric tons (Carroll and Rehman, 2010). This increase in production was mainly associated with increase in area under sugarcane cultivation in the country. However, among the causes for low yield at farmer's field one is the imbalanced application of nutrients required by sugarcane that results in less plant population, lodging, dwarf and thin canes and poor recovery percentage (Hussain *et al.* 2010).

Nutrient requirement of sugarcane can be determined on the basis of respective nutrient in selected index tissues at specific crop stages. Higher growth rate of sugarcane is mainly associated with enhanced uptake of N, P and K (Nasir *et al.*, 2000). N, P and K are essential nutrient elements that contribute to optimum sugarcane yield and uptake (Morris *et al.* 2002). N, P and K application beyond 100 percent of the recommended dose produce only marginal increase in cane and sugar yield (Alexander *et al.*,

2003). The use of nitrogen, phosphorous and potassium fertilizers play key role in development of cane and sugar yields, because sugarcane is known as a heavy feeder crop that depletes the soil of essential nutrients and therefore, adequate nutrient addition is of utmost importance (Korndorfer, 1990). The average yield of the sugarcane varieties is much lower than their potential yield. For instance, through application of balanced NPK fertilizers, the potential yields are obtained upto 165.176 t ha⁻¹ (Khan *et al.*, 2002). Fertilizer use for sugarcane cultivation in Pakistan is imbalance and inappropriate; only 4 percent of the cane growers use NPK and 73 percent of them rely only on NP fertilization (Karstens *et al.*, 1992). Proper fertilization is an important management function in sugarcane production (Khan *et al.*, 2005). Therefore, it is necessary to supply sugarcane crop with the big three (N, P and K) to secure good cane quantity and quality (Elamin *et al.*, 2007).

Micronutrients use in sugarcane crop is a recent practice that is not very widespread. Among the micronutrients, Boron (B) is that which is most

frequently found to be deficient in most soils, with the number of crops that show visual deficiency symptoms growing (Moreira *et al.* 2000). To this micronutrient is attributed a function in metabolism of carbohydrates and transport of sugars through membranes, a fact which is highly important for sugarcane; synthesis of nucleic acids and of phytohormones; and formation of cell walls and cell division (Orlando Filho *et al.* 2001). In addition to B, another micronutrient that is commonly found deficient in soils is zinc (Zn). Zn deficient plants have short internodes and reduced tillering (Orlando Filho *et al.* 2001; Costa Filho and Prado, 2008; Oliveira *et al.* 2009). Ghaffar *et al.* (2011) reported that application of micronutrients like Zn and Fe in addition to NPK fertilizers was necessary to obtain maximum benefits from sugarcane crop. The present study was therefore carried out to investigate the effect of inorganic NPK and soil applied micronutrients (Zn and B) on the cane yield and recovery of sugarcane.

MATERIAL AND METHODS

The study was carried out to investigate the effect of inorganic NPK and soil applied micronutrients (Zn and B) on the sugar recovery and cane yield of sugarcane. The experiment was conducted at the experimental fields of Quaid-e-Awam Agriculture Research Institute, Larkana in a four replicated Randomized Complete Block Design having plot size of 5m x 5m (25m²).

Land preparation:

Sugarcane is a deep-rooted crop and keeping this in mind a well-worked friable fully pulverized seedbed was prepared. The experimental land was prepared well before sowing on off-season. After deep plowing, crosswise goble plough, followed by precise levelling and crosswise ploughing with cultivator were given. Deep plowing was done particularly to break the hard pan of the experimental soil.

Sowing: The planting of sets was done by Dry Method with end to end arrangement. After the proper land preparation, the ridges/furrows were prepared at the distance of 100 cm. The sets were placed in the furrows at 6-8 inches depth of furrow. After covering, the field was irrigated. The sowing was completed upto 2nd October 2011. Forty thousand two-budded sets per acre with end to end arrangement were planted in single row system.

Seed selection and treatment:

The cane seed was obtained from the crop which was not more than eight months in age (nursery seed used), upper 2/3 portion of stalk of the cane of fresh/plant sugarcane crop was used for seed purpose. Seed sets were treated with Vitavax @ 120 g/100 litre water against the attack of seed borne sugarcane diseases like whipsmut.

Irrigation: The irrigation was applied at 8-10 days interval in summer (April- August) and 10-15 days interval in winter (November-March). There was still shortage of canal water; hence mostly tubewell water was applied.

Fertilizer application: The NPK fertilizers were applied in the form of Urea, Single Super Phosphate and Sulphate of Potash, respectively. The zinc will be used in the form of ZnSO₄, while boron was applied in the form Borax as soil application. The soil applied zinc and boron were applied at the time of preparation of ridges for sowing by mixing in the soil. All P, K and Zn or B alongwith 1/3rd of N were applied at the time of sowing and remaining two N splits were applied at first earthing (3-1/2 months after planting) and second earthing (1-1/2 month after first earthing) respectively.

Weeding: Weeds were removed from young crop, until the crop became in such height to shed the weeds. The weeds were controlled with the use of Gezapex Combi at the rate of 1 to 1½ kg per acre within a period of 3 months

after planting. Weedicide was applied in moist conditions to get good results. First light earthing was done after 3½ months of planting and second after 1½ month of first earthing.

Plant Protection:

A comprehensive approach of I.P.M consisting of cultural, biological and chemical method of control of insect pests and diseases was adopted to maintain the pest population level below the economic injury level. However Furadan 3G was applied against the borers.

Harvesting: The harvesting of sugarcane crop was done when the 1/3rd leaves of the basal portion of the cane became dry and show the tendency of dropping on the ground. Scientifically, the crop becomes mature when the brix is above 20% irrespective of any variety.

The quantitative parameters of the experimental crop were measured at the field, while for the qualitative parameters the cane samples from field were brought to the laboratory.

Methods for recording observations

Germination (%): Germination was recorded on the basis of total setts (2 budded) sown in a plot and number of seedlings germinated in percentage.

Cane length: Cane length was recorded at the field in the labelled sugarcane plants by measuring tape from

bottom of the cane upto the last internode in centimetres and averaged.

Cane girth: Cane girth was measured in each plot on the basis of randomly selected (tagged) plants by means of Vernier Caliper in centimetres and average was worked out.

Tillers stool-1: Tillers stool-1 was observed by counting the stalks sprouted in each plant from the labelled plants in each plot and average was calculated.

Internodes cane-1: Internodes cane-1 were counted from the bottom of the cane upto the last internode for all the tillers in each plant in each labelled plant in each treatment plot and averaged.

Weight of 10 canes (kg): For weighing the samples each comprised of 10 canes, field balance was used and quantity was recorded in kilograms. These canes were also used for crushing and further juice analysis.

Cane yield ha⁻¹(mt): The cane yield ha⁻¹ was calculated on the basis of following formula:

Yield plot-1 of given treatment

Cane yield (m.t ha⁻¹) = X 10000

Plot area (m²)

Brix (%): Brix percentage was determined by means of Brix Hydrometer. For this purpose 200 ml cylinder already cleaned was filled with sample cane juice. The Hydrometer was placed in it and allowed to settle and then reading was recorded. The temperature of juice was

noted and Hydrometer reading was corrected accordingly.

Sugar recovery (%):

Recovery was determined by the procedure and method described in laboratory manual for Queensland sugar mills in order to calculate Pol and sugar recovery.

The data on the above characters was collected and subjected to statistical analysis. Analysis of variance and mean separation tests was applied (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Germination Percentage

The crop receiving NPK (at the recommended dose 225-112-168 kg ha⁻¹) + Zn-B @ 7.0-2.0 kg ha⁻¹ resulted maximum seed germination (75.54%), closely followed by NPK+Zn-B @ 7.0-1.5 kg ha⁻¹ with germination of 75.09 percent. The seed germination reduced to 72.42, 71.02, 70.76, 69.44 and 72.06 percent when the crop received NPK+Zn-B @ 5.0-2.0, 5.0-1.5, 0-2.0, 0-1.5 and 7.0-0 kg ha⁻¹, respectively. However, the differences in germination percentage between these treatments were non-significant ($P>0.05$). The crop treated with NPK+Zn-B levels of 5.0-0 kg ha⁻¹ resulted seed germination of 69.05 percent; while the lowest seed

germination (67.28%) was recorded in control plots, where zinc and boron fertilizers were not applied. The differences in germination percentage between Zn-B levels of 7.0-2.0 and 7.0-1.5 kg ha⁻¹, respectively. This indicates that boron application at the rate of 1.5 kg alongwith 7.0 kg Zn ha⁻¹ and recommended dose of NPK would be an enough level to optimize the germination in sugarcane.

Cane length (cm)

The sugarcane crop fertilized with NPK (at the recommended dose 225-112-168 kg ha⁻¹) + Zn-B @ 7.0-2.0 kg ha⁻¹ produced highest cane length (303.00 cm), closely followed by NPK+Zn-B @ 7.0-1.5 kg ha⁻¹ with cane length of 302.00 cm. The cane length decreased to 286.67, 286.33, 285.00 and 265.00 cm when the sugarcane received Zn-B @ 5.0-2.0, 7.0-0.0, 5.0-1.5 and 5.0-0 kg ha⁻¹, respectively. The crop fertilized with Zn-B at the rate of 0-2.0 and 0-1.5 kg ha⁻¹ resulted average cane length of 256.67 and 254.00 cm, respectively. However, the lowest cane length of 257.00 cm was recorded in control plots where only recommended dose of NPK fertilizers was applied and no Zn-B were applied. This indicates that there was marked effect of Zn and B on the cane length of sugarcane; but Zn proved to be the most influencing factor and in

absence of Zn fertilizers, the cane length was more adversely affected as compared to absence of boron. The differences in cane length between Zn-B levels of 7.0-2.0 kg ha⁻¹ and 7.0-1.5 kg ha⁻¹ were statistically non-significant ($P>0.05$) indicating that Zn-B application at the rate of 7.0-1.5 kg ha⁻¹ alongwith recommended rate of NPK fertilizers would be an optimum level for achieving economically maximum results in relation to cane length of sugarcane.

Cane girth (cm)

The crop fertilized with NPK (at the recommended dose 225-112-168 kg ha⁻¹) + Zn-B @ 7.0-2.0 kg ha⁻¹ resulted in maximum cane girth of 3.33 cm, closely followed by NPK+Zn-B @ 7.0-1.5 kg ha⁻¹ with cane girth of 3.32 cm. The cane girth reduced to 3.15, 3.15 and 3.13 cm when the sugarcane was fertilized with Zn-B levels of 5.0-2.0, 7.0-0.0 and 5.0-1.5 kg ha⁻¹, respectively. The crop receiving Zn-B at the rate of 0-2.0 and 0-1.5 kg ha⁻¹ resulted average cane girth of 2.82 and 2.80 cm, respectively; while the cane girth of 2.83 cm was observed in control plots where recommended dose of NPK fertilizers was applied without Zn-B. The

results showed that there was marked increase in the cane girth when Zn was added in the nutrient programme. Although, the effect of boron on cane girth was also noticed, but apparently there was little need of boron was seemed.

Number of tillers stool⁻¹

The application of NPK (at the recommended dose 225-112-168 kg ha⁻¹) + Zn-B @ 7.0-2.0 kg ha⁻¹ resulted in maximum number of tillers (6.33) stool⁻¹, closely followed by NPK+Zn-B @ 7.0-1.5 kg ha⁻¹ with 6.31 tillers stool⁻¹. The number of tillers stool⁻¹ decreased to 6.00, 5.98, 5.95 and 5.54 when the crop was fertilized with Zn-B levels of 5.0-2.0, 7.0-0.0, 5.0-1.5 and 5.0-0 kg ha⁻¹, respectively. The crop receiving Zn-B at the rate of 0-2.0 and 0-1.5 kg ha⁻¹ resulted in 5.36 and 5.31 tillers stool⁻¹, respectively; while the number of tillers stool⁻¹ was 5.37 in control plots where recommended dose of NPK fertilizers was applied without Zn-B. It is evident from the results that the number of tillers increased simultaneously with increasing zinc levels, while boron application did not showed apparent effects on the number of tillers stool⁻¹ in sugarcane. Moreover, the termination of zinc application showed a marked decrease in the

number of tillers stool⁻¹, even in addition of boron application.

Number of internodes cane⁻¹

The NPK (at the recommended dose 225-112-168 kg ha⁻¹) + Zn-B @ 7.0-2.0 kg ha⁻¹ produced in maximum internodes (17.09) cane⁻¹, closely followed by NPK+Zn-B @ 7.0-1.5 kg ha⁻¹ with 17.04 internodes cane⁻¹. The number of internodes cane⁻¹ decreased to 16.18, 16.16 and 16.08 when the crop was fertilized with Zn-B levels of 5.0-2.0, 7.0-0.0 and 5.0-1.5 kg ha⁻¹, respectively; but differences between these treatments were non-significant ($P>0.05$). The crop receiving Zn-B at the rate of 5.0-0, control (no Zn-B) and 0-2.0 kg ha⁻¹ resulted in 14.95, 14.51 and 14.49 internodes cane⁻¹, respectively; while the number of internodes cane⁻¹ was lowest (14.33) where B was applied at the rate of 1.5 kg ha⁻¹, but Zn application was discontinued. The differences between these treatments were also non-significant ($P>0.05$). This indicates that application of zinc at higher level of 7 kg ha⁻¹ resulted markedly higher number of internodes, but boron application did not show marked effect on internodes cane⁻¹. Hence, for achieving desired results in case of internodes cane⁻¹, the crop may be given Zn-B at the rates 7.0-1.5 kg

ha⁻¹ in addition to recommended rate of NPK fertilizers. Moreover, it was observed that boron in combination showed positive impact on this parameter, but in absence of zinc application, the boron could not influence this parameter significantly when compared with control.

Weight of 10 canes (kg)

The sugarcane crop receiving recommended dose of NPK (225-112-168 kg ha⁻¹) + Zn-B @ 7.0-2.0 kg ha⁻¹ resulted in highest 10 canes weight of 16.24 kg, closely followed by 16.19 kg weight of 10 canes achieved when Zn-B were applied at the rate of 7.0-1.5 kg ha⁻¹ in addition to recommended dose of NPK. Weight of 10 canes followed an adverse trend and it was 15.36, 15.35 and 15.27 kg under Zn-B levels of 5.0-2.0, 7.0-0.0 and 5.0-1.5 kg ha⁻¹, respectively in addition to recommended NPK; but differences between these treatments were non-significant ($P>0.05$). The crop receiving Zn-B at the rate of 5.0-0, control (no Zn-B) and 0-2.0 kg ha⁻¹ resulted in 14.20, 13.77 and 13.75 kg weight of 10 canes, respectively; while the weight of 10 canes was minimum (13.62 kg) where

B was applied at the rate of 1.5 kg ha⁻¹, and Zn application was terminated. The differences in weight of 10 canes under T₁-T₂-T₄-T₅; T₆-T₇ and T₈-T₉ were statistically non-significant ($P>0.05$).

Cane yield (tons ha⁻¹)

The crop fertilized with Zn-B @ 7.0-2.0 kg ha⁻¹ in addition to recommended NPK (225-112-168 kg ha⁻¹) produced highest cane yield of 101.06 t ha⁻¹, closely followed by 100.37 t ha⁻¹ obtained when Zn-B were applied at the rate of 7.0-1.5 kg ha⁻¹ in addition to recommended dose of NPK. There was considerable reduction in cane yield and it was 95.28, 94.73 and 91.85 t ha⁻¹ under Zn-B levels of 5.0-2.0, 5.0-1.5 and 7.0-0 kg ha⁻¹, respectively in addition to recommended NPK. The crop receiving Zn-B at the rate of 5.0-0, 0-1.5, 0-2.0 kg ha⁻¹ and control (no Zn-B) produced average cane yield of 88.08, 86.81, 85.31 and 85.42 t ha⁻¹, respectively; but the differences between above treatments for cane yield ha⁻¹ were statistically non-significant ($P>0.05$). The results showed that there was marked increase in cane yield ha⁻¹ due to application of Zn-B in addition to recommended dose of NPK fertilizers. However, combined application of boron and zinc proved to be more

beneficial as compared to Zn or B application alone. Hence, the for achieving economically maximum cane yield ha⁻¹ the sugarcane crop needs to be fertilized with 7 kg Zn and 1.5 kg B in addition to recommended dose of NPK fertilizers.

Sugar recovery (%)

The highest recovery of 11.05% was noted in juice extracted from the crop receiving Zn-B at the rate of 7.0-2.0 kg ha⁻¹ in addition to recommended NPK (225-112-168 kg ha⁻¹), closely followed by 11.02 and 10.92% recovery noted in plots given Zn-B at the rate of 7.0-0 and 7.0-1.5 kg ha⁻¹, respectively; but the differences between these treatments were non-significant ($P>0.05$). The juice extracted from the crop receiving Zn-B at the rates of 5.0-2.0, 5.0-0 and 0-1.5 kg ha⁻¹ resulted recovery of 10.62, 10.57 and 10.39%, respectively; but differences between these Zn-B levels were non-significant ($P>0.05$). Sugar recovery further reduced to 10.32, 10.24 and 10.250% under Zn-B application at the rate of 5.0-1.5, 0-2.0 kg ha⁻¹ and control (no Zn-B), respectively; & differences between these treatments for sugar recovery were statistically non-significant

($P>0.05$). There was positive impact of higher zinc levels on recovery and application of boron in combination with zinc showed more promising results, while boron alone was less effective to improve the sugar recovery. However, regardless the boron application, higher Zn level showed positive impact on recovery of sugarcane.

DISCUSSION

The present study showed that the crop receiving recommended dose of NPK + 7.0+2.0 kg ha⁻¹ Zn-B produced 101.06 t ha⁻¹ cane yield and 11.05% sugar recovery; while recommended NPK+Zn-B @ 7.0-1.5 kg ha⁻¹ resulted in 100.37 t ha⁻¹ cane yield and 10.92% sugar recovery. The remaining treatments as well as control resulted relatively in lower values for all the cane yield and recovery contributing characters. After going through the results, it was observed that combined application of zinc and boron in addition to recommended dose of NPK showed significantly promising results, but boron when applied alone + NPK did not show beneficial impact on quantitative &

qualitative traits of sugarcane. However, zinc proved to be highly effective, even when applied without boron in addition to NPK. These results are further supported by Bokhtiar *et al.* (2001) who achieved highest sugar yield (11.74 t ha⁻¹) with micronutrient application including zinc with mean cane yield of 87.80 t ha⁻¹. Panhwar *et al.* (2003) reported that foliar application of zinc sulfate had more beneficial effects than soil application when farm yard manure, preferably well rotten sheep or goat manure at the time of land preparation is incorporated. Wang *et al.* (2005) evaluated the optimum rate of Zn application for sugarcane production and indicated that Zn application as ZnSO₄ can significantly benefit sugarcane production. Xiang (2010) studied the effect of zinc, boron, zinc + boron on the yield and quality, and analysed the physiological characters, nourishment characters, photosynthetic characters and agronomic characters of leaves in sugarcane. All treatments improved the actual sugarcane yield; compared with

treatments of zinc, boron & zinc + boron increased the sucrose of sugarcane by 0.68 %. The treatments of zinc, zinc + boron increased juice gravity of sugarcane by 0.54%, but the treatment of boron decreased juice gravity by 0.45%. The treatments of zinc, boron, zinc + boron increased sucrose yield & according to general comparison, treatment of zinc + boron was the best of all at the condition of this experiment. Ghaffar *et al.* (2011) recommended that sugarcane crop should be planted at 120 cm spaced trenches fertilized @ 5+10 kg ha⁻¹ of Zn+Fe for better yield & quality production. Mariano *et al.* (2011) reported that Zn fertilization improved the stalk technological quality, as well as providing a residual effect, increasing the above ground biomass. Ghaffar *et al.* (2012) reported that Zn application significantly affected the quantitative parameters of sugarcane including number of internodes, cane diameter and stripped cane weight and cane yield upto 112.8 t ha⁻¹; while application of Zn @ 5.0 and 10 kg ha⁻¹ gave stripped cane yield of 106.4 and 110.4 t ha⁻¹.

Conclusions

After going through the results, it was observed that combined application of zinc and boron in addition to recommended dose of NPK showed significantly promising results, but boron when applied alone + NPK did not show beneficial

impact on quantitative and qualitative traits of sugarcane. However, zinc proved to be highly effective, even when applied without boron in addition to NPK. Hence, it is concluded that Zn-B @ 7.0-1.5 kg ha⁻¹ was an optimum level for achieving economically

maximum cane yield (100.37 t ha⁻¹) and recovery (10.92%); and the differences were non-significant ($P>0.05$) when boron application was increased to 2.0 kg ha⁻¹ with same zinc level (7.0 kg ha⁻¹) in addition to NPK fertilizers.

Table-1 Germination, cane length and girth of sugarcane variety Larkana-2001 as affected by different levels of macro- and micronutrients

NPK + Zn/B levels	Germination (%)	Cane length (cm)	Cane girth (cm)
N-P-K @ 225-112-168+0 kg ha ⁻¹ (control)	67.28 c	257.00 d	2.83 d
NPK+Zn @ 5 kg ha ⁻¹	69.05 c	265.00 c	2.92 c
NPK+Zn @ 7 kg ha ⁻¹	72.06 b	286.33 b	3.15 b
NPK+B @ 1.5 kg ha ⁻¹	69.44 b	254.00 d	2.80 d
NPK+B @ 2.0 kg ha ⁻¹	70.76 b	256.67 d	2.82 d
NPK+Zn-B @ 5.0-1.5 kg ha ⁻¹	71.02 b	285.00 b	3.13 b
NPK+Zn-B @ 5.0+2.0 kg ha ⁻¹	72.42 b	286.67 b	3.15 b
NPK+Zn-B @ 7.0+1.5 kg ha ⁻¹	75.09 a	302.00 a	3.32 a
NPK+Zn-B @ 7.0+2.0 kg ha ⁻¹	75.54 a	303.00 a	3.33 a
S.E.	1.5151	1.5918	0.0182
LSD 0.05	3.2118	3.3745	0.0387
LSD 0.01	4.4252	4.6494	0.0533

Table-2 Number of tillers stool⁻¹, internodes cane⁻¹ and weight of 10 canes of sugarcane Variety Larkana-2001 as affected by different levels of macro- and micronutrients
Germination, Tillering and cane weight of different cane Varieties

NPK + Zn/B levels	No. of Tillers plant ⁻¹	No. of internodes cane ⁻¹	Weight of 10 canes (kg)
N-P-K @ 225-112-168+0 kg ha ⁻¹ (control)	5.37 d	14.51 c	13.77 c
NPK+Zn @ 5 kg ha ⁻¹	5.54 c	14.95 c	14.20 c
NPK+Zn @ 7 kg ha ⁻¹	5.98 b	16.16 b	15.35 b
NPK+B @ 1.5 kg ha ⁻¹	5.31 d	14.33 c	13.62 c
NPK+B @ 2.0 kg ha ⁻¹	5.36 d	14.49 c	13.75 c
NPK+Zn-B @ 5.0-1.5 kg ha ⁻¹	5.95 b	16.08 b	15.27 b
NPK+Zn-B @ 5.0+2.0 kg ha ⁻¹	6.00 b	16.18 b	15.36 b
NPK+Zn-B @ 7.0+1.5 kg ha ⁻¹	6.31 a	17.04 a	16.19 a
NPK+Zn-B @ 7.0+2.0 kg ha ⁻¹	6.33 a	17.09 a	16.24 a
S.E.	0.0979	0.4200	0.5125
LSD 0.05	0.2076	0.8904	1.0864
LSD 0.01	0.2860	1.2268	1.4968

Table-3 Cane yield ($t\ ha^{-1}$), brix and recovery of sugarcane variety Larkana-2001 as Affected by different levels of macro- and micronutrients

NPK + Zn/B levels	Cane yield ($t\ ha^{-1}$)	Sugar recovery (%)
N-P-K @ 225-112-168+0 $kg\ ha^{-1}$ (control)	85.42 d	10.25 c
NPK+Zn @ 5 $kg\ ha^{-1}$	88.08 d	10.57 b
NPK+Zn @ 7 $kg\ ha^{-1}$	91.85 c	11.02 a
NPK+B @ 1.5 $kg\ ha^{-1}$	86.61 d	10.39 b
NPK+B @ 2.0 $kg\ ha^{-1}$	85.31 d	10.24 c
NPK+Zn-B @ 5.0-1.5 $kg\ ha^{-1}$	94.73 b	10.32 c
NPK+Zn-B @ 5.0+2.0 $kg\ ha^{-1}$	95.28 b	10.62 b
NPK+Zn-B @ 7.0+1.5 $kg\ ha^{-1}$	100.37 a	10.92 a
NPK+Zn-B @ 7.0+2.0 $kg\ ha^{-1}$	101.06 a	11.05 a
S.E.	1.2134	0.1510
LSD 0.05	2.5724	0.3202
LSD 0.01	3.5442	0.4412

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