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Response of Thatta–10 Sugarcane variety to Soil and Foliar Application of Zinc Sulphate ($Zn\ SO_{4}.\ 7\ H_{2}O$) Under Half and Full Doses of NPK Fertilizer

R.N. Panhwar, H.K. Keerio, Y.M. Memon,
S. Junejo, M.Y. Arain, M. Chohan, [1]A.R.Keerio and [2]B.A. Abro
National Sugar Crops Research Institute, PARC, Thatta, Pakistan
[1]Agricultural Training Institute, Sakrand, Pakistan
[2]Coastal Agriculture Research Station, PARC, Karachi, Pakistan

ABSTRACT

Field experiment was conducted to asses the effect of soil and foliar application of zinc under half and full doses of NPK fertilizers on the growth, yield and quality of sugarcane variety Thatta -10 on silty clay soil at NSCRI, farm Thatta during the year 2000-2001. Significant increase over control in respect of sugar recovery%, cane yield and yield contributing traits were observed in plants which were treated with soil and foliar application of zinc under full NPK doses. How ever, the plants treated with soil and foliar application of zinc under half NPK doses responded with lower cane yield and sugar recovery% as compared to control. It was also concluded that the foliar application of zinc had beneficial effect than soil application.

Key words: Sugarcane, zinc sulphate, soil and foliar application, cane yield, sugar recovery%, Thatta, Pakistan

INTRODUCTION

Sugarcane (*Saccharum officinarum,* L.) is one of the most important major crops of Pakistan. It occupies a significant position in the economy of our country on account of its gigantic potential to produce various industrial products and satisfy human and cattle need such as providing shelter, food, feed, sugar, khandsary, gur, alcohol, etc. Pakistan has highest cane average and ranks fifth among the cane growing countries of the world but the average cane yield per hectare is very low (47.6 t ha^{-1}) which is owing to exhausted infertile soils, low input resources consistency in traditional farming system, natural climatically hazards, irrigation constraints. Besides all these factors wide spread deficiency of zinc in soil may be the probable reason for low cane and sugar yield in Pakistan.

Micronutrients are of immense significance, though the plants required them in a smaller quantity and play a vital role in the growth, development and yield of the plants. The deficiency of any nutrient may result in retarded growth and decrease the yield and thus minimizes the usefulness of other agricultural inputs including NPK fertilizers. Particularly zinc is necessary in the synthesis of "Indole acetic acid" (IAA) and Auxin important growth regulating harmones in plants. Zinc also functions as metal activator of several enzymes in plants (Panhwar *et al.*, 2001). Several important compounds contain zinc as essential and tightly bound components such as dehydrogenases, proteinases and peptidases of a variety. A number of these hydrogenases show sensitivity to zinc deficiency (Price, 1970). Tsui (1984) pointed out that importance of zinc element on the growth criteria is mainly due to its distinguished role in plant metabolism through its effect on several enzyme systems. Various scientists have observed the significant role of zinc in cane and sugar yield. Cambria *et al.* (1989) reported that cane yield was significantly increased at 10 kg Zn ha^{-1} as soil application with normal NPK dose. However, cane yield was declined at 20 to 25 kg Zn ha^{-1}, respectively. Nayer *et al.* (1984) reported that yield contributing traits like tillers, plant height, and others were significantly affected by the application of zinc and beyond certain levels of application of this element adversely affected the several traits of the crop. Shinde *et al.* (1986) reported that application of zinc sulphate significantly affected the morphological characters like tillers, height, internodes, leaf area and cane yield. Pannu *et al.* (1986) stated that zinc in combination with N and P increased cane and sugar yield. Similarly Patel *et al.* (1991) also reported that zinc applied to the soil or foliage under current fertilizer practices increased cane and sugar yield.

Zinc deficiency is very common in our soils. Sillanpaa (1982) declared 100% deficiency of the zinc in soils of Sindh. Memon *et al.* (1989) reported that 82% soils in Thatta are deficient in zinc content. There are many factors, which contribute zinc deficiency in our soils such as cultivation of high yielding varieties, intensive cropping system, and injudicious use of phosphoric fertilizers, high pH and calcareousness of our soils as well as the low organic inputs.

Zinc deficiency may be the prime factor in our low productivity, ratoon failure as well as crop malignancy. Keeping in view the significance of zinc for sugarcane production the present study work is undertaken at the experimental farm of National Sugar Crops Research Institute Thatta during 2000-2001.

MATERIALS AND METHODS

The experiment was conducted at National Sugar Crops Research Institute (NSCRI), farm Thatta during the year 2000-2001 to asses the effect of soil and foliar application of zinc sulphate on the yield and quality of sugarcane. Sugarcane variety Thatta-10 was planted with the following treatments.

T-1 = N- P- K 275-112-175 Kg ha^{-1} + No zinc (Control)
T-2 = N-P-K 137-56-87 Kg ha^{-1} + Zn SO_4. $7H_2O$. 10 Kg ha^{-1} (As soil application)
T-3 = N-P-K 137-56-87 Kg ha^{-1} + Zn SO_4. $7H_2O$. 1.5 Kg ha^{-1} (As foliar application)
T-4 = N-P-K 275-112-175 Kg ha^{-1} + Zn SO_4. $7H_2O$. 10 Kg ha^{-1} (As soil application)
T-5 = N-P-K 275-112-175 Kg ha^{-1} + Zn SO_4. $7H_2O$. 1.5 Kg ha^{-1} (As foliar application)

The experiment was replicated four times under Randomized Complete Block Design. In each sub plot (Net plot size 18 m^2) three rows of variety Thatta-10 were sown in six meters long furrows, the space between each row was made one meter apart. Recommended full and half doses of NPK fertilizers per plots were applied uniformly in all the treatments. Soil application of zinc was made when the crop attained the height of 50 cm, while the foliar application of zinc was made in two splits, first at 50 cm plant height and second when the crop attained 75 cm height. Zinc Sulphate hepta hydrate ($ZnSO_4.7H_2O$) having 22.745% zinc was used as source zinc. The crop was given normal agronomic and plant protection practices. The composite soil samples were secured before planting and analyzed for nitrogen, phosphorus and zinc content along with some physico-chemical properties of the soil. Soil texture was determined by using Bouyoucos Hydrometer method (As proposed by Kanwar and Chopra, 1959), Electrical Conductivity (Using 1:5 soil water extract) and Soil pH (Using 1:5 soil water suspension). Lime% by acid neutralization method (Kanwar and Chopra, 1959), organic matter by standardized method of Jackson (1958), while analysis for potassium, phosphorus and zinc was done by AB-DTPA method as proposed by Sultan pour and Schwab (1977). The data regarding yield components and sugar recovery% were recorded and subjected to statistical analysis by MSTATC Statistical Programme (MSTAT-C, Manual 1991).

RESULTS AND DISCUSSION

The soil analysis data presented in Table 1 revealed that soil in the trial was silty clay in texture, non saline and alkaline in reaction with pH 7.8. Lime value 12% evidently showed that soil was calcareous in nature. It was low in organic matter, total nitrogen and zinc content but medium in phosphorus and adequate in potassium.

The results of the study presented in Table 2 revealed that there was an increase in cane girth by the foliar and soil application of zinc under full NPK dose over control. The maximum average cane girth 27.4 mm was obtained from foliar feeding of zinc closely followed by soil application (27.0 mm) under full NPK dose, against control (26.0 mm). However, minimum cane girth 25.0 and 25.3 mm was measured in plots, which received soil and foliar application of zinc respectively under decreased NPK dose.

The data presented in Table 2 indicates that there was a significant increase in number of internodes per stalk over control treatment in plots, which received soil and foliar application of zinc under full NPK fertilizer dose. Maximum 28.6 and 28.0 average number of internodes per stalk was observed in plots, which received, foliar and soil application of zinc under full NPK dose respectively against control, which gave 26.5 average number of internodes per stalk. While minimum 23.0 and 23.6 average number of internodes per stalk was exhibited in plots by soil and foliar application of zinc under half NPK dose respectively. Number of internodes per stalk mostly depends upon the nutrients availability and climatic conditions during the growth period (Jamro *et al.*, 2002). Hence the increase in the number of internodes in the present studies may be ascribed to supply of zinc, which was

Table 1: Physico-chemical characters of the soil in the trial at NSCRI farm Thatta

Characters	Results	Remarks
Sand	9.50 %	-
Silt	43.00 %	-
Clay	47.50 %	-
Textural Class	Silty Clay	Soil was well drained
Electrical Conductivity	0.92 dS m^{-1}	Non saline
Soil reaction (pH)	7.8	Alkaline
Lime %	12.0	calcareous
Organic matter	0.43%	Poor
Total Nitrogen %	0.021%	Deficient
AB-DTPA extractable Phosphorus	6.80 mg Kg^{-1}	Medium
AB-DTPA extractable Potassium	265 mg Kg^{-1}	Adequate
AB-DTPA extractable Zinc	0.46 mg Kg^{-1}	Low

Table 2: Effect of soil and foliar application of Zinc on the yield and quality of sugarcane variety Thatta –10 under half and full NPK doses at NSCRI, farm, Thatta during 2000-2001

Treatments	Cane girth (mm)	Number of Internedes/stalk	Cane height (cm)	Millable canes m^{-2}	Cane yield (t ha^{-1})	Sugar Recovery%
T-1 = N-P-K 275-112-175 Kg ha^{-1} + No Zinc (Control)	26.0	26.5	200	17.4	100	10.0
T-2 = N-P-K 137-56-87 Kg ha^{-1} + Zinc Sulphate 10 Kg ha^{-1} (As soil application)	25.0	23.0	163.3	15.4	75	8.70
T-3 = N-P-K 137-56-87 Kg ha^{-1} + Zinc Sulphate 1.5 Kg ha^{-1} (As foliar application)	25.3	23.6	167.0	15.7	78	8.90
T-4 = N-P-K 275-112-175 Kg ha^{-1} + Zinc Sulphate 10 Kg ha^{-1} (As soil application)	27.0	28.0	210	18.5	110	10.90
T-5 = N-P-K 275-112-175 Kg ha^{-1} + Zinc Sulphate1.5 Kg ha^{-1} (As foliar application)	27.4	28.6	213.3	20.2	114.2	11.0
SE	0.227	0.446	5.023	-	3.886	0.28
CV%	1.87	2.40	2.47	-	5.78	8.86
Cd-1	0.3361	0.4230	3.244	-	3.806	0.6054
Cd-2	0.4712	0.5931	4.548	-	5.336	0.8487

deficient in the soil, which helped in the efficient utilization of NPK fertilizers. The results are in agreement with the findings of Ahmed (1977) and Cambria *et al.* (1989).

The results of the study in Table 2 further revealed that foliar and soil application of zinc under full NPK fertilizer dose produced the plants with better cane height of 213.3 and 210 cm respectively against control (200 cm). While minimum cane height 163.3 and 167 cm was observed in plots, which received soil and foliar application of zinc under half NPK dose respectively against the control. The increase in cane length may be attributed to more uptake of nitrogen with zinc application (Jamro *et al.,* 2002). Khan (1994) reported that cane height was increased significantly with 1.5 kg zinc ha^{-1} as foliar application.

The data depicted in Table 2 showed that maximum 20.2 and 18.5 average mill able canes m^{-2} were recorded in plots, which were treated with foliar and soil application of zinc under full NPK dose against the control, which gave 17.4 average mill able canes m^{-2}. While minimum 15.4 and 15.7 average millable canes were exhibited in plots, which were treated with soil and foliar application of zinc under half NPK dose respectively. Khan (1994) reported that foliar application of zinc @ 1.5 Kg ha^{-1} increased the millable canes m^{-2}. Similarly Jamro *et al.* (2002) stated that foliar application of 1.5 Kg ha^{-1} zinc significantly increased the mill able canes per plant.

The cane yield t ha^{-1} was greatly influenced by foliar and soil application of zinc under full NPK fertilizer dose. Highest cane yield 114.2 t ha^{-1} was exhibited by foliar feeding of zinc followed by soil application (110 t ha^{-1}) under full NPK dose against control (100 t ha^{-1}). How ever, the cane yield tends to decline as 75 and 78 t ha^{-1} in plots by soil and foliar application of zinc under half NPK dose respectively (Table 2). The results show that the plants efficiently utilized NPK fertilizers due to zinc application, therefore increase in the cane yield over control was observed in T-4 and T-5 treatments. Yaduvashi *et al.* (1988) stated that it was not possible to obtain the maximum benefit from the applied NPK fertilizers, without the application of zinc and other micronutrients. Khan (1994) reported that 1.5 Kg ha^{-1} zinc as foliar application increased the cane yield t ha^{-1}. Ahmed (1977) reported that 10 Kg ha^{-1} zinc as soil application produced maximum cane yield than 5.0 Kg zinc.

The data manifested that sugar recovery% was also influenced by foliar and soil application of zinc under full dose of NPK fertilizer. However, the sugarcane was more responsive to foliar application of zinc than soil. Maximum average sugar recovery 11% was recorded in plants by foliar application of zinc with no more difference by soil application (10.9%) under full NPK dose against control (10.0%). How ever, drastic decrease in average sugar recovery 8.7 and 8.9% was exhibited by soil and foliar application of zinc respectively under half NPK fertilizer dose against the control (Table 2). The results are in conformity with Pannu *et al.* (1986) and Patel *et al.* (1991).

It was concluded that zinc as soil and foliar application in combination with normal NPK dose, increased the sugar recovery% and cane yield t ha^{-1} on account of its significant role in efficient utilization of NPK fertilizers. However, the foliar application of zinc had beneficial effect over soil application. It may be due to the soil condition. Under soil application the alkaline and calcareousness of the soil might have impeded the zinc availability to the plants. Whereas under foliar application the large and broader leaves of Thatta -10 variety facilitated the rapid absorption of zinc through leaf stomata and cuticle and thus prove beneficial as compared to soil application.

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