Effect of Different Levels of Zinc on the Growth and Yield of Cotton (*Gossypium hirsutum* L) Crop

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Abstract: An experiment was conducted to determine the effect of different levels of zinc on the yield and growth of cotton in the field of Agronomy section ARI, Tandojam during the Kharif Season 2014. Seeds of cotton were sown in rows 75 x 30 cm in row and plant spacing in soil with four replications in Randomized Complete Block Design. Six zinc levels i.e. untreated 0.0, 5.0, 7.5, 10.0, 12.5 and 15.0 kg ha^{-1} were evaluated. The results reveals that plant height, number of sympodia plant^{-1}, number of productive bolls plant^{-1}, fibre length, G.O.T (%) and seed cotton yield kg ha^{-1} affected significantly by the zinc levels, while plant population and number of monopodial branches were not affected. Application of zinc from 5.00 to 15.00 showed similar effect. However, control resulted different in taller plants (130.55 in), while application of 15.00 kg zn ha^{-1} produced maximum sympodia (16.35 plant^{-1}) however productive bolls were more at 10.00 kg zn ha^{-1} (50.30 plant^{-1}). The staple length was maximum (27.00 mm) at 7.5 kg zn ha^{-1}, while G.O.T% was greater (38.28%) at 5.00 kg zn ha^{-1}, whereas maximum seed cotton yield was recorded at 7.5 kg zn ha^{-1} (2556.70 kg ha^{-1}). For the trait of seed cotton yield plant^{1}, there was no any difference between applications of zinc sulphates 5.00 to 7.5kg ha^{-1}.

Keywords: Sowing dates, Effect, Fertilizer, Zinc, Cotton, Yield.

INTRODUCTION

The second most useful product of cotton seed is oilcake, it is almost for feeding to domestic animals. In Pakistan the area under cotton is about 3221 thousand hectares with annual production of 14618 thousand bales, while in Sindh province cotton is cultivated on 635 thousand hectares with total production of 772 thousand bales [1]. Zinc deficiency in cotton has been observed in the Southern United States in a wide range of soil conditions, but it seems to be more frequent on calcareous soils, that are excessively high in phosphorus. Malewar and Dudde (1995) conducted pot experiments which was carried out on Typic Chromusterts of Parbhani, Maharashtra, to study the critical Zn concentrations in soils for predicting responses to Zn application on sorghum and cotton plants. The Zinc deficient plants shows a general bronzing of first true leaves, and intervention choroids. The affected leaves become thick and brittle, with their margins turned upward. Stalk elongation practically ceases and the shortened internodes tend to give the plant a small bushy appearance. Growth and fruiting are delayed and yields are drastically reduced [2, 3].

MATERIALS AND METHODS

An experiment was laid out to determine the effect of different levels of zinc on the yield and growth of cotton crop at ARI, Tandojam during the Kharif Season of 2014.

Sr. No.	Zinc Level
T_1=	Control (untreated) 00
T_2=	5.00 kg Zn ha^{-1}
T_3=	7.50 kg Zn ha^{-1}
T_4=	10.00 kg Zn ha^{-1}
T_5=	12.50 kg Zn ha^{-1}
T_6=	15.00 kg Zn ha^{-1}

Zinc application was used in the form of zinc sulphate. The full dose of zinc along with recommended dose of phosphorus as DAP and 1/3 of nitrogen urea was applied at the time of seed bed preparation. While the remaining dose of N was split and top dressed at the time of various growth stages of crop. plant to plant distance was 30cm

RESULT

The results regarding growth performance and yield parameters of treated cotton plants with various levels of $ZnSO_4$ are presented in the Tables **1-8**. Same work was done by [4] studied in Pakistan by growing cotton cultivars in Zn-deficient soils. Treatments comprised: spraying with 0.1% Zn at early stage (T1), spraying

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ISSN: 1814-8085 / E-ISSN: 1927-5129/17

with 0.05% Zn at early and flowering stages (T2) and spraying with 0.033% Zn at early, flowering and boll formation stages (T3).

Plant Population Plot^{-1}

The data about plant population indicated no any significant difference between six Zinc levels and ranged between 66.67-68.00 plants plot^{-1}. Table **1** shows that there was no heterogeneity in the density of plants.

Table 1: Mean Plant Population Plot^{-1} of Cotton as Affected by Different Levels of Zinc

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean plant population Plot^{-1}
T_1=	Control (untreated)	68.00 a
T_2=	5.0 kg ha^{-1}	67.33 a
T_3=	7.50 kg ha^{-1}	67.33 a
T_4=	10.00 kg ha^{-1}	68.00 a
T_5=	12.50 kg ha^{-1}	67.00 a
T_6=	15.00 kg ha^{-1}	66.67 a

Plant Height (cm)

The data regarding mean performance for plant height of cotton plant are displayed in the Table **2**. The results revealed that cotton received uniform dose of NP without zinc sulphate which resulted different in taller plants (130.55 cm plant^{-1}), followed by high levels of zinc 12.50 kg ha^{-1} (122.44 cm plant^{-1}) and 10.00 kg ha^{-1} (121.48 cm plant^{-1}) respectively. However, lower plant height was observed in increase of low~~er~~ dose of zinc 5.00 kg ha^{-1} (112.26 cm plant^{-1}). These results demonstrated that zinc applied from 7.50 kg ha^{-1} to 15.00 kg ha^{-1} produced equal and greater plant height as compared to lower dose which recorded lowest plant height although no application of zinc produced maximum plant height.

Table 2: Mean Plant Height (cm) of Cotton as Affected by Different Levels of Zinc

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean Plant height (cm)
T_1=	Control (untreated)	130.55 a
T_2=	5.0 kg ha^{-1}	112.26 d
T_3=	7.50 kg ha^{-1}	119.66 c
T_4=	10.00 kg ha^{-1}	121.48 bc
T_5=	12.50 kg ha^{-1}	122.44 b
T_6=	15.00 kg ha^{-1}	120.67 bc

Number of Monopodial Branches Plant^{-1}

Monopodial branches are vegetative branches in the current study (Table **3**). It was observed that application of zinc sulphate at various levels did not have any significant influence on the development of vegetative branches. However, it ranged between 1.85 to 1.98 plant^{-1}. These results showed that no variation in the development of monopodial branches between zinc level.

Table 3: Mean Number of Monopodial Branches Plant Ffected by Zinc

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean number of monopodial branches plant^{-1}
T_1=	Control (untreated)	1.85 a
T_2=	5.0 kg ha^{-1}	1.98 a
T_3=	7.50 kg ha^{-1}	1.94 a
T_4=	10.00 kg ha^{-1}	1.92 a
T_5=	12.50 kg ha^{-1}	1.90 a
T_6=	15.00 kg ha^{-1}	1.93 a

Number of Sympodial Branches Plant^{-1}

Sympodial branches are called fruiting branches arises from the auxiliary buds. The results presented in Table **4**. It reveals that the number of fruiting branches varied significantly among the different zinc levels. Application of zinc sulphate resulted significant increase in number of fruiting branches as compared withouts application zinc. Cotton treated with 15.00 kg Zn ha^{-1} have more fruiting branches (16.35 plant^{-1}), followed by 12.50 kg Zn ha^{-1} (16.28 plant^{-1}) and 10.00 kg Zn ha^{-1} (16.22 plant^{-1}) respectively. However, no application of Zn produced lower number of fruiting branches (9.36 plant^{-1}). It was found that although higher dosages of Zn recorded more number of fruiting branches but was non-significant when compared to lower doses, all the Zn treated plots recorded statistically same number of branches.

Table 4: Mean Number of Sympodial Branches Plant Affected by Zinc

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean number of sympodial branches plant^{-1}
T_1=	Control (untreated)	9.36 b
T_2=	5.0 kg ha^{-1}	15.78 a
T_3=	7.50 kg ha^{-1}	15.80 a
T_4=	10.00 kg ha^{-1}	16.22 a
T_5=	12.50 kg ha^{-1}	16.28 a
T_6=	15.00 kg ha^{-1}	16.35 a

Number of Productive Bolls Plant^{-1}

Number of productive bolls are those bolls which were opened uniformly without any damage to the disease. The number of productive bolls recorded in the current study differed significantly between the treatments (Table **5**). It was observed that lower dose of zinc 10.00 kg ha^{-1} recorded maximum number of productive bolls (50.30 plant^{-1}) followed by 7.5 kg Zn ha^{-1} (49.80 plant^{-1}) and 5.00 kg Zn ha^{-1} (49.66 plant^{-1}) respectively. Whereas no application of zinc resulted in lesser number of productive bolls (34.78 plant^{-1}). The results explains that there was no significant change in the number of bolls between 5.00, 7.5, 10.00 and 12.50 and 15.00 kg Zn ha^{-1} respectively, including that high dose of zinc did found preferable [5] suggested that boll mean weight is an important independent yield component and play a prime role in improving seed cotton yield [6] assessed different *hirsutum* varieties for yield and other useful traits and observed significant variations for boll weight.

Table 5: Mean Number of Productive Bolls Plant^{-1} of Cotton as Affected by Different Levels of Zinc

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Number of productive bolls plant^{-1}
T_1=	Control (untreated)	34.78 c
T_2=	5.0 kg ha^{-1}	49.66 a
T_3=	7.50 kg ha^{-1}	49.80 a
T_4=	10.00 kg ha^{-1}	50.30 a
T_5=	12.50 kg ha^{-1}	47.44 ab
T_6=	15.00 kg ha^{-1}	45.33 b

Staple Length (mm)

The results pertaining mean value of staple length displayed in the Table **6**. It may be observed from the results that staple length differed significantly between the treatments. Application of zinc sulphate resulted in significant increase in staple length as compared to no application of $ZnSO_4$. Greater staple length was recorded under 7.5 kg Zn ha^{-1} followed by 7.50 kg Zn ha^{-1} (26.95 mm) and 12.50 kg Zn ha^{-1} (26.88 mm) respectively. While no application of Zn resulted in poor staple length (25.50 mm).

Table 6: Mean Value of Staple Length (mm)

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean staple length (mm)
T_1=	Control (untreated)	25.50 b
T_2=	5.0 kg ha^{-1}	26.80 a
T_3=	7.50 kg ha^{-1}	27.00 a
T_4=	10.00 kg ha^{-1}	26.95 a
T_5=	12.50 kg ha^{-1}	26.66 a
T_6=	15.00 kg ha^{-1}	26.88 a

Ginning Outturn (%)

The results regarding ginning outturn (%) of cotton treated with different Zn levels are shown in the Table **7**. The results reveals that the differences in the ginning outturn (%) between the treatments was highly significant cotton receiving 5.00 or 7.5 kg Zn ha^{-1} produced equally maximum G.O.T (38.28 and 37.95%) followed by 10.00 kg Zn ha^{-1} (36.98%) and 15.00 Zn ha^{-1} (36.93%) respectively. However, no application of Zn resulted in poor Ginning outturn (35.15 %). It was found that there was no significant variation in the ginning outturn between 5.00 and 7.5 kg Zn ha^{-1} and 10.00, 12.5 and 15.0 kg Zn ha^{-1}.

Table 7: Mean Value of GOT %

S. No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean ginning outturn (%)
T_1=	Control (untreated)	35.15 c
T_2=	5.0 kg ha^{-1}	38.28 a
T_3=	7.50 kg ha^{-1}	37.95 a
T_4=	10.00 kg ha^{-1}	36.98 b
T_5=	12.50 kg ha^{-1}	36.92 b
T_6=	15.00 kg ha^{-1}	36.93 b

Seed Cotton Yield kg ha^{-1}

The results for mean value of seed cotton yield is given in Table **8**. The results indicated that seed cotton yield affected significantly by the different zinc levels. Application of zinc at 7.5 or 5.00 kg ha^{-1} recorded maximum seed cotton yield (2556.70 kg ha^{-1}) and

Table 8: Mean Seed Cotton Yield kg ha^{-1} of Cotton as Affected by Different Levels of Zinc

S.No.	Treatments $ZnSO_4$ kg ha^{-1}	Mean seed cotton yield kg ha^{-1}
T_1=	Control (untreated)	2020.50 c
T_2=	5.0 kg ha^{-1}	2440.67 b
T_3=	7.50 kg ha^{-1}	2556.70 a
T_4=	10.00 kg ha^{-1}	2270.67 b
T_5=	12.50 kg ha^{-1}	2261.33 b
T_6=	15.00 kg ha^{-1}	2207.33 b

2440.67 kg ha^{-1}), followed by 10.00 kg Zn ha^{-1} (2270.67 kg ha^{-1}) and 12.50 kg Zn ha^{-1} (2261.33 kg ha^{-1}) respectively while no application of Zn recorded lowest seed cotton yield (2020.50 kg ha^{-1}). It was found that there was no significant difference in the seed cotton yield between 5.00 and 7.5 kg Zn ha^{-1} and 10.00, 12.5 and 15.00 kg Zn ha^{-1}.

CONCLUSIONS

It is observed from the results that zinc at 5.00 kg ha^{-1} proved effective level of Zn, while further increase in Zn level did not found beneficial. Maximum plant height was recorded under no application of zinc (130.55 cm) while, Zn applied at 15.00 kg ha^{-1} recorded maximum sympodia (16.35 plant^{-1}), however 10.00 kg Zn ha^{-1} gave more number of bolls (5.30 plant^{-1}), Staple length was maximum at 7.5 kg Zn ha^{-1} (27.00 mm), G.O.T (%) at 5.00 kg Zn ha^{-1} (38.28%) and seed cotton yield at 5.00 or 7.5 kg Zn ha^{-1} (2440.67 and 2556.70 kg ha^{-1}).

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Received on 13-04-2017 Accepted on 18-04-2017 Published on 13-06-2017

https://doi.org/10.6000/1927-5129.2017.13.50