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Effect of soil and foliar application of Zinc and Boron on growth and yield parameters of mulberry leaf

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Abstract
A study on "Effect of soil and foliar application of Zinc and Boron on growth and yield of mulberry leaf was carried at KVK, Chamarajanagar during 2016-17. Significantly higher shoot height of 194.67cm was recorded in T_3 (RDF+FYM + Soil application of 20 kg zinc sulphate/ha), Number of shoots/ plant did not differ significantly among the treatments. However higher number of shoots/ plant (16.33) was recorded in T_{10} (RDF + FYM + Soil application of Borax @ 0.5 kg/ ha + foliar application of 1 % Zinc sulphate). More number of leaves/shoot (35.00) was recorded in T_3 (RDF+FYM + Soil application of 20 kg zinc sulphate/ha). Higher shoot height of (194.67cm) was recorded in T_3 (RDF + FYM + Soil application of $ZnSO_4$ @ 20 kg /ha). Highest number of shoots per plant (16.33) was recorded in T_{10} (RDF+FYM+ Soil application of Borax @ 0.5kg/ha + 1 % zinc sulphate as foliar spray) Highest number of leaves per shoot (35.00) was recorded in T_3 (RDF + FYM + Soil application of $ZnSO_4$ @ 20 kg /ha). Significantly higher (43.40 t/ha) leaf yield was noticed in T_3 (RDF + FYM + Soil application of $ZnSO_4$ @ 20 kg /ha).

Keywords: Foliar spray, growth and yield, mulberry leaf

Introduction
Sericulture is an agro based Cottage industry which is practiced in China, India and other Asian countries extensively. In recent days, sericulture has gained prime importance in Indian agriculture as it provides gainful occupation to around 7.25 million people in rural and semi-urban areas (Dandin *et al*., 2003) [2]. Although it is considered as a subsidiary occupation, technological innovations have made possible to achieve an intensive scale capable of generating adequate and also continuous income to farmers. Zinc is an essential trace element required for plants. It is an essential component of various enzyme systems involved in energy production, protein synthesis and growth regulation and plays catalytic and structural roles in many cell physiological processes. Zinc is involved in many physiological functions and its inadequate supply will reduce crop yields. The presence of boron is essential to maintain the structural integrity of plant membranes and many symptoms of boron deficiency in plants are secondary effects caused by changes in membrane permeability. Boron deficiencies are most likely on acidic, sandy soils with low organic matter content but not in soils with high organic matter content. Boron nutrition is influenced by many factors. The most important are soil texture, organic matter content and pH (Heckman, 2000) [3]. Higher crop yields require more B than average yields. The need for B fertilization increases as the level of N, P, K and lime application to soil (Heckman, 2000) [3]. Both of these nutrients (Zn and B) have an influential role in the crude protein, crude fibre contents and quality of mulberry leaves. Mulberry being a perennial crop requires continuous and adequate supply of nutrients to get sustained yield as the soil nutrients gets depleted due to continuous cultivation of mulberry. To overcome this, application of balanced nutrients is essential to achieve good growth and yield of mulberry (Ray *et al*., 1973) [7].

Materials and methods
The present study was undertaken to find out the **"**Effect of soil and foliar application of Zinc and Boron on growth, yield and quality of mulberry leaf and silkworm rearing**."** The study was carried during 2016-17 at KVK, Chamarajanagar. The experimental design was randomized complete block design with twelve treatments and three replication in each treatment. Furrows were opened according to the row spacing in each treatment plot and fertilizers were incorporated as per the treatments in the form of band in the furrows 10 cm away from the mulberry plants. The first crop was applied with 70 kg N, 70 kg P_2O_5 and 70 kg K_2O for all the treatments in the form of urea, single super phosphate and murate of potash and 20 tonnes of

FYM. The required doses of Zinc and Boron for respective treatments were calculated and applied to soil and foliar application. After 20-25days of bottom pruning foliar spray was given.

T_1 Recommended dose of fertilizer +FYM.
T_2 T_1+Soil application of zinc sulphate @ 10 kg/ha
T_3 T_1+Soil application of zinc sulphate @ 20 kg/ha
T_4 T_1+Soil application of borax @ 1 kg/ha
T_5 T_1+Soil application of borax @ 2 kg/ha
T_6 T_1+Foliar application of 1 % zinc sulphate
T_7 T_1+Foliar application of 0.5 % boric acid.
T_8 T_1+Soil application of zinc sulphate 5 kg/ha + 1 % foliar spray of zinc sulphate
T_9 T_1+Soil application of zinc sulphate @ 5 kg/ha + 0.5 % foliar spray of boric acid.
T_{10} T_1+Soil application of borax @ 0.5 kg/ha +1 % foliar spray of zinc sulphate
T_{11} T_1+Soil application of borax @ 1 kg/ha +0.5 % foliar spray of boric acid
T_{12} T_1+ Water spray

Results and discussion

Effect of soil and foliar application of zinc and boron on growth and yield of mulberry

Shoot height

Significantly higher shoot height of 194.67cm was recorded in T_3 (RDF+FYM + Soil application of 20 kg zinc sulphate/ha) followed by T_2 (178.33 cm/plant) and lower shoot height of 142.67cm was recorded in the treatment of T_1 (RDF + FYM). The higher shoot height was obtained may be due to zinc involved actively in synthesis of tryptophan which is a precursor of indole acetic acid synthesis consequently it increased tissue growth and development (Swietlik, 1999) [13]. These findings are closely related to research findings of Shivakumar *et al*. (2000) [12] and Sabitha *et al*. (2011) [8]. Further, zinc deficiency can affect plant by stunting its growth, decreasing number of tillers, chlorosis and smaller leaves and spikelet sterility (Mortvedt, 2011) [6].

Number of shoots /plant

Number of shoots/ plant did not differ significantly among the treatments. However higher number of shoots/ plant (16.33) was recorded in T_{10} (RDF + FYM + Soil application of Borax @ 0.5 kg/ ha + foliar application of 1 % Zinc sulphate) and lower number of shoots/ plant (9.67) was recorded in T_1 treatment respectively. These findings are in close conformation with the findings of Shilpashree and Subbarayappa (2015) [11] reported that application of micronutrients along with recommended dose of FYM and fertilizers supplies required plant nutrients to mulberry which in turn resulted on meristematic activity, cell division and differentiation leading to higher shoot height, number of shoots per plant and number of leaves per plant.

Number of leaves /shoot

Significantly more number of leaves/shoot (35.00) was recorded in T_3 (RDF+FYM + Soil application of 20 kg zinc sulphate/ha) and less number of leaves /shoot (26.00) was recorded in the treatment of T_1 (RDF + FYM). These findings are in close conformation with the findings of (Dutta, 2004 and Chathurvedi *et al*., 2005) they were reported that more number of leaves, branches and higher plant height were recorded may be due to zinc works as a stimulant for amino acid synthesis and helps in the process of photosynthesis. The results are also in close conformity with the findings of Pain (1961), Lokanath and Shivashankar (1986) [5] and Basavarajeshwari *et al*. (2008) [1].

Leaf yield of mulberry

Significantly higher leaf yield of 43.40 ton/ha was recorded in T_3 (RDF+FYM + Soil application of 20 kg zinc sulphate/ha) and lower leaf yield of (19.00 ton/ha) was recorded in the treatment of T_1 (RDF + FYM).Increase in leaf yield might be due to increase in yield contributing parameters like number of leaves per branch, plant height and number of branches per plant. These findings are in close conformation with the findings of Yokoyama (1975) [15] reported that mulberry leaf yield depends on the number and length of shoots, internodal distance and number and weight of leaves per plant. Results of the current study are in conformity with the earlier findings of Vishwanath (1979) [14], Kasiviswanathan and Iyengar (1968) [4]. Further, Shankar (1997) reported that the interaction of zinc, iron and boron deficiency causes reduction in leaf yield. Zinc is an essential trace element required for plants. It is an essential component of various enzymes involved in production, protein synthesis and growth regulation and plays catalytic and structural roles in many cell physiological processes. Zinc is involved in many physiological reactions and its inadequate supply reduce crop yield.

Growth components

The data on growth and yield parameters of V1 mulberry variety as influenced by soil and foliar application of zinc and boron under irrigated condition are presented in Table -1

Shoot height (cm)

The soil and foliar application of zinc and boron to V1mulberry had a significant influence on shoot height. The significantly higher shoot height (194.67cm) was recorded with T_3 (RDF + FYM + Soil application of $ZnSO_4$ @ 20 kg /ha) which was on par with T_2 (178.33), T_9 (176.67) and T_8 (173.67). Whereas, lowest shoot height (142.67) was recorded in T_1 (RDF+FYM) followed by T_4 (155.33cm) and T_{12} (155.33cm) (Table 1).

Number of Shoots per plant

Number of Shoots per plant was found non significant among different treatments. Highest number of shoots per plant (16.33) was recorded in T_{10} (RDF+FYM+ Soil application of Borax @ 0.5kg/ha + 1 % zinc sulphate as foliar spray) followed by T_7 (15.00), respectively. Though these two treatments are on par with each other statistically. They are significantly superior to other treatments. Whereas lowest number of shoots (10.33) was recorded in T_6 (Foliar application of 1 % zinc sulphate) followed by T_4 (10.33) where in RDF+ FYM+ Soil application of borax @ 1kg/ha followed by T_2 (11.00), T_1 (9.67), T_3 (10.67), T_4 (10.33), T_5 (12.00), T_6 (10.33), T_8 (12.33), T_9 (13.33), T_{11} (11.00) and these are statistically on par with each other (Table 1).

Number of leaves/ shoot

Number of leaves per shoot was found significant among the different treatments. Highest number of leaves per shoot (35.00) was recorded in T_3 (RDF + FYM + Soil application of $ZnSO_4$ @ 20 kg /ha) which found on par with T_2 (34.00), T_8 (32.33), T9 (31.33) and T_{10} (31.00), respectively. But, these treatments are performed significantly superior to (26.00) was recorded in T_1 (RDF+FYM), T_{12} (28.67), T_7 (29.33), T_5:T_6

(30.00), T_4 (29.00) and T_{11} (30.00) and these treatments are significantly lowest and statistically on par with each other (Table 1).

Leaf yield (t/ha)

The leaf yield of V1 mulberry was significantly influenced by the soil and foliar application of zinc and boron in V1mulberry. Among the treatments, significantly higher (43.40 t/ha) leaf yield was noticed in T_3 (RDF + FYM + Soil application of $ZnSO_4$ @ 20 kg /ha) which found on par with T_2 (41.21 t/ha) and T_9 (39.34 t/ha). However, the treatment T_{10} (34.81 t/ha) and T_8 (36.04 t/ha) were found on par and T_{11} (30.61 t/ha) and T_6 (33.08 t/ha) were found on par with each other. But there is no significant difference between T_5 (30.12 t/ha) and T_{11} (30.61 t/ha) While significantly lowest leaf yield per hectare (19.00 t/ha) was recorded in T_1 (RDF+FYM) followed by T_{12} (22.75 t/ha) and T_4 (24.93 t/ha) (Table 2).

Table 1: Effect of soil and foliar application of zinc and boron on growth parameters of V1 Mulberry at 60 DAP.

Treatments	Shoot height (cm)	Number of shoots/plant	Number of leaves/shoot
T_1 (RDF+FYM)	142.67	9.67	26.00
T_2 (T_1+soil application of $ZnSO_4$ @ 10kg/ha)	178.33	11.00	34.00
T_3 (T_1+ soil application of $ZnSO_4$ @ 20kg/ha)	194.67	10.67	35.00
T_4 (T_1+ soil application of Borax @ 1kg/ha)	155.33	10.33	29.00
T_5 (T_1+ soil application of Borax @ 2kg/ha)	165.33	12.00	30.00
T_6 (T_1+ foliar application of 1 % $ZnSO_4$)	170.33	10.33	30.00
T_7 (T_1+ foliar application of 0.5 % Boric acid)	162.00	15.00	29.33
T_8 (T_1+ soil application of $ZnSO_4$ @ 5kg/ha+ foliar application of 1 % ZnSO4)	173.67	12.33	32.33
T_9 (T_1+ soil application of $ZnSO_{4+}$ @ 5kg/ha+ foliar application of 0.5 % Boric acid)	176.67	13.33	31.33
T_{10} (T_1+ soil application of Borax @ 0.5kg/ha + foliar application of 1 % ZnSO4)	164.67	16.33	31.00
T_{11} (T_1+ soil application of Borax @ 1kg/ha + foliar application of 0.5 % Boric acid)	167.33	11.00	30.00
T_{12} (T_1+water spray)	155.33	12.00	28.67
Mean	167.19	12.00	30.56
S.Em.±	8.15	1.43	1.55
CD @ 5 %	23.89	4.19	4.53
F-test	*	NS	*

*Significant
NS- Non significant

Table 2: Effect of soil and foliar application of zinc and boron on yield of V1 Mulberry

Treatments	Leaf yield (ton/ha)
T_1 (RDF+FYM)	19.00
T_2 (T_1+soil application of $ZnSO_4$ @ 10kg/ha)	41.21
T_3 (T_1+ soil application of $ZnSO_4$ @ 20kg/ha)	43.40
T_4 (T_1+ soil application of Borax @ 1kg/ha)	24.93
T_5 (T_1+ soil application of Borax @ 2kg/ha)	30.12
T_6 (T_1+ foliar application of 1 % $ZnSO_4$)	33.08
T_7 (T_1+ foliar application of 0.5 % Boric acid)	29.13
T_8 (T_1+ soil application of $ZnSO_4$ @ 5kg/ha+ foliar application of 1 % ZnSO4)	36.04
T_9 (T_1+ soil application of $ZnSO_4$ @ 5kg/ha+ foliar application of 0.5 % Boric acid)	39.34
T_{10} (T_1+ soil application of Borax @ 0.5kg/ha + foliar application of 1 % ZnSO4)	34.81
T_{11} (T_1+ soil application of Borax @ 1kg/ha + foliar application of 0.5 % Boric acid)	30.61
T_{12} (T_1+water spray)	22.75
Mean	32.03
S.Em.±	1.42
CD@5 %	4.15
F-test	*

*Significant

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