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Effect of Soil and Foliar Application of Micronutrients on Growth and Yield of Mulberry (*Morus alba* L.) and Silkworm (*Bombyx mori* L.)

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ABSTRACT

A field experiment was conducted during *kabi*, 2015-18 at KVK, Hassan, Karnataka, India to study the effect of soil and foliar application of micronutrients on growth and yield of mulberry and Silkworm. The experiment was carried out by adopting Randomized Complete Block Design (RCBD) with five replications and three different treatments. Results indicated that among the different treatment combinations tested, soil application of zinc sulfate @ 10 kg/ ha/ year and borax @ 1 kg/ ha/ year recorded significantly higher number of shoots/ plant (18.6), shoot length (110 cm), number of leaves per shoot (419) and leaf yield (6,850 kg/ha/crop). This treatment also recorded significantly higher larval weight (4.54 g), cocoon weight (2.01 gm), shell weight (0.45 g), pupal weight (1.29 g), cocoon yield (76.39 kg/100 DFL), effective rate of rearing (95.48 %) and higher B: C ratio (2.09) as compared to other treatment combinations respectively.

Keywords Mulberry, Zinc sulfate, Borax, Silkworm.

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INTRODUCTION

Mulberry is a perennial deep rooted high biomass producing foliage crop cultivated as a sole food for silkworm (*Bombyx mori* L.). In India, mulberry is cultivated in an area of 0.24 million ha with an annual production of 36,152 Mt of raw silk. India ranks second in silk production in the world after China. India also has the unique distinction of producing all the four commercially produced silks in the world namely Mulberry, Eri, Muga and Tassar. From the total production of silk in the country, mulberry alone accounted for about 70.21 % i.e. 25,384 Mt (CSB 2020) [1].

Nutritional quality of leaves plays an important role in determining the larval growth, cocoon quality and yield. It is stated that silk production is dependent on the larval nutrition and nutritive value of mulberry leaves, which plays a very effective role in producing good quality cocoons. In silkworms, silk fibro in is derived mainly from 4 amino acids: Alanine, serine, glycine and tyrosine which come from their dietary source of protein and amino acids. Silkworms obtain 72-86% of their amino acids from mulberry leaves and more than 60% of the absorbed amino acids are used for silk production (Lu and Jiang 1988).

The growth and development of silkworm (*Bombyx mor*i L.) and the economic characters of cocoon were greatly influenced by the nutritional content of mulberry leaves (Shashidhar *et al.* 2009) Micronutrients applied to mulberry helps to increase the foliage productivity with quality leaves. Among the essential micronutrients zinc and boron play a vital role in accelerating economic and reproduction characters of silkworm. Hence, emphasizing the soil application of micronutrients in mulberry, the present investigation was carried out to study the effect of soil and foliar application of micronutrients on growth and yield of mulberry.

MATERIALS AND METHODS

A field experiment was conducted at Krishi Vigyana Kendra, Hassan, during *rabi,* 2015 - 18 in established mulberry garden with Victory-1 variety planted at spacing of 5 × 2 × 3 ft. The soil of the experimental site was clay in texture with pH of 7.10, EC - 0.20 dSm^{-1}, organic carbon – 0.51 %. The soil was medium in available N (302.0 kg ha^{-1}), available P (32.10 kg ha^{-1}), available K (183.40 kg ha^{-1}) and low in micronutrients viz., copper (0.36 mg ha^{-1}), zinc (0.55 mg ha^{-1}), boron (0.27 mg ha^{-1}), high in iron (4.8 mg ha^{-1}) and medium in manganese (2.31 mg ha^{-1}). The experiment was carried out by adopting Randomized Complete Block Design (RCBD) with five replications and three different treatments. The treatment details are given below

T_1: Farmers practice, NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year

T_2: NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Foliar application of micronutrients (2.5 ml/ lt, Seriboost)

T_3: NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Soil application of zinc sulfate @ 10 kg and borax @ 1kg/ha/year

RESULTS AND DISCUSSION

Growth and yield parameters of mulberry

Results obtained from present experiment indicated that the soil application of zinc sulfate @ 10 kg and borax @ 1kg/ha/year (T_3) recorded significantly higher no. of shoots/ plant (18.6), shoot length (110 cm), no. of leaves/ plant (419) and leaf yield (6,850 kg/ha/crop) of mulberry over other treatments. The lower no. of shoots/ plant (16), shoot length (98 cm), no. of leaves/ plant (384) and leaf yield (6,350 kg/ ha/crop) of mulberry in (T_1) farmers practice that received, NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year (Table 1).

This might be due to zinc and boron involved actively in synthesis of tryptophan which is a precursor

Table 1. Effect of methods of application of micronutrients on growth and yield performance of mulberry.

Treatments	No. of shoots/ plant	Shoot length (cm)	No. of leaves/ shoot	Leaf yield (kg/ha/crop)
T_1- Farmers practice, NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year	16	98	384	6350
T_2- NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Foliar application of micronutrients (2.5 ml/lt, Seriboost)	17	95	406	6610
T_3- NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Soil application of zinc sulfate @ 10 kg and borax @ 1kg/ha/year	18.6	110	419	6850
SEm ±	0.370	0.292	0.289	4.552
CD @ 5%	1.206	0.951	0.941	14.843

Table 2. Effect of rearing of silkworm on mulberry leaf obtained by application of micronutrients on silkworm growth and cocoon yield.

Treatments	Larval weight (g)	Cocoon weight (g)	Shell weight (g)	Pupal weight (g)	Cocoon yield (kg/100 DFL)	Effective rate of rearing (%)
T_1- Farmers practice, NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year	4.51	1.80	0.40	1.28	64.80	81.00
T_2- NPK @ 350: 140:140 kg + 20 t FYM /ha/year + Foliar application of micronutrients (2.5 ml/lt, Seriboost)	4.52	1.95	0.43	1.3	72.15	90.18
T_3- NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Soil application of Zinc sulphate @ 10 kg and borax @ 1kg/ha/year	4.54	2.01	0.45	1.29	76.39	95.48
SEm ±	0.007	0.009	0.003	0.005	0.110	0.140
CD @ 5%	0.024	0.029	0.009	0.016	0.358	0.457

of IAA synthesis, works as a stimulant for amino acid synthesis and helps in the process of photosynthesis which in turn resulted in tissue growth, meristematic activity, cell division and differentiation leading to highest no. of shoots/plant, shoot length, no. of leaves/ shoot and leaf yield of mulberry (Swietlik1999).

Silkworm growth and cocoon yield parameters

Soil application of zinc sulfate @ 10 kg and borax @ 1kg/ha/year (T_3) recorded significantly higher larval weight (4.54 g), cocoon weight (2.01 gm), shell weight (0.45 g), pupal weight (1.29 gm), cocoon yield (76.39 kg/100 DFL) and effective rate of rearing (95.48 %) and farmers practice that received, NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year recorded the lower larval weight (4.51 g), cocoon weight (1.80 gm), shell weight (0.40 g), pupal weight (1.28 g), cocoon yield (64.80 kg/100 DFL) and effective rate of rearing (81 %) (Table 2). This may be due to micronutrients involved in better utilization and assimilation of nutrients (Bose *et al* 1994) that increased silk gland weight by dietary supplementation of nutrient rich mulberry leaves. The stimulatory effect of nutrient increases the synthesis of silk protein, DNA and enzymes in midgut region of silk gland, thus enhanced the growth of silkworm (Hisham *et al.* 2001).

Economics

Significantly higher gross returns (26144 Rs), net returns (13644 Rs) and B: C ratio (2.09) was observed with the application of zinc sulfate @ 10 kg and borax @ 1kg/ha/year (T_3). The lowest gross returns (23085 Rs.), net returns (8960 Rs) and B:C ratio (1.63) was recorded in the treatment that received NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year only (Table 3).

CONCLUSION

From the present study it could be concluded that the soil application of NPK @ 350: 140:140 kg + 20 t FYM / ha/ year and zinc sulfate @ 10 kg and borax @ 1kg/ha/year will potentially influence the growth, yield and economics of mulberry and silkworm.

Table 3. Economics of methods of application of micronutrients on mulberry and cocoon production.

Treatments	Gross returns (Rs)	Gross cost (Rs)	Net returns (Rs)	B : C ratio
T_1- Farmers practice, NPK @ 400: 140:120 kg + 12 t FYM/ ha/ year	23085	14125	8960	1.63
T_2- NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Foliar application of micronutrients (2.5 ml/lt, Seriboost)	24042.6	14000	10042.6	1.71
T_3- NPK @ 350: 140:140 kg + 20 t FYM / ha/ year + Soil application of zinc sulfate @ 10 kg and borax @ 1kg/ha/year	26144	12500	13644	2.09
SEm ±	28.39	32.63	24.10	0.005
CD @ 5%	92.60	106.41	78.61	0.015

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