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Effect of soil application of zinc, iron and manganese on V1 mulberry and total performance of cross breed PM × CSR_2 (*Bombyx mori* L.)

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Abstract
A field experiment was conducted to study the effect of soil application of zinc, iron and manganese on mulberry at Department of Sericulture, UAS, GKVK, Bengaluru-65 during 2018-19. Among the different treatments, T_5 (350:140:140 NPK kg/ha/year + FYM 20 t/ha/year + micronutrient formulation of Zn, Fe and Mn @ 6 kg/acre) recorded significantly higher number of leaves/plant (548.67 and 567.56), leaf area (283.52 and 310.45 cm^2), leaf yield (947.20 and 1040.81 g/plant) and leaf dry matter (359.05 and 552.05 g/plant) on 45th and 75th DAP in V1 mulberry. Significantly higher larval weight (37.59 g/10), shorter fifth instar and total larval duration (198.32 and 510.32 h), ERR (98.83%), single cocoon weight (1.78 g), single pupal weight (1.39 g), single shell weight (0.39 g) and shell ratio (21.69%) were significantly higher in T_5 treatment with PM × CSR_2. Compared to other treatments all the above-mentioned parameters found least in the control.

Keywords: Micronutrient formulation (Zn, Fe and Mn), mulberry yield parameters, silkworm growth and cocoon parameters

Introduction
Sericulture is an ancient agro-based cottage industry which is practiced in China, India and other Asian countries extensively and it is a labour-intensive sector of the Indian economy. It affords to employ approximately 8.60 million persons in rural and semi-urban areas in India. India is the second largest producer and also the largest consumer of silk in the world. In Karnataka about 80.0% of mulberry area is under irrigated condition and high yielding mulberry variety namely V1 is being cultivated.

Mulberry is a robust, perennial deep-rooted high biomass producing foliage crop, being the sole source of nourishment from which the mulberry silkworm (*Bombyx mori* L.) derives nearly 70 per cent of protein for silk synthesis. This plant protein is get converted into silk protein in that silkworm body. The several factors are responsible for successful cocoon crop *viz.*, silkworm egg (3.15%), silkworm race (4.2%), rearing technique (9.3%), local weather (37.0%), mulberry leaf (38.2%), and other factors (6.6%) (Miyashita, 1986) [5]. It is clear that mulberry leaf plays a dominant role in cocoon production as the only source of nutrition to the silkworm. Silkworm larval growth and cocoon yield are mainly influenced by nutritional quality of mulberry leaf (Shankar, 1999) [6].

The mulberry leaf quality mainly depends on variety, soil type, climatic condition, As mulberry is a perennial plant, it remains in the same field for many years, cultivation practices, fertilizer management and irrigation. The soil fertility has a direct bearing on the nutrient status of the leaf and sustained leaf yield.

The intensive cultivation of high yielding mulberry varieties coupled with the unbalanced nutrient management has resulted in soil exhaustion, besides nutrients are lost through leaching and fixation. Depletion of nutrients from the soil reduces the availability of major, secondary and micronutrients which in turn results in reduction of yield and quality of mulberry leaf and in turn cocoon yield + quality. Hence, it is imperative to regularly incorporate secondary and micronutrients to the mulberry soil in required quantities.

Micronutrients play a significant role in plant growth, photosynthesis, chlorophyll formation, cell wall expansion, water absorption and xylem permeability, resistance to plant diseases, enzymatic reactions and are also important for activities of soil microorganisms (Vitti *et al.*, 2014) [11].

Micronutrients are involved in several metabolic activities of mulberry plant that are responsible for quality leaf production and stimulate metabolic activity in silkworm which in turn leads to better rearing performance and silk quality. As mulberry is grown for its foliage and harvested for five to six times a year, requirement of nutrients is high and balanced application of required nutrients is essential. Since available literature on the soil application of micronutrients and its effect on quality and quantity of mulberry leaf and development of silkworm and cocoon quality is scanty, the present investigation was taken up with the effect of soil application of Zn, Fe and Mn in a single formulation on growth and yield of mulberry and cocoon production.

Material and Methods

A field experiment was conducted at Department of Sericulture, UAS, GKVK, Bengaluru-65 during 2018-19 in established mulberry garden with Victory 1 variety planted at a spacing of (90 +150) x 60 cm (paired row system). Physico chemical properties of the experimental site were analysed. The soil was clay loam in texture, having 7.75 pH, EC 0.29 dSm^{-1}, 0.44 percent organic carbon, 220.15 kg ha^{-1} available N, 35.30 kg ha^{-1} available P_2O_5, 175.17 kg ha^{-1} available K_2O. The experiment was laid out in randomized complete block design (RCBD) and replicated thrice with 7 treatments. The treatment details are given below.

T_1 Control (*RDF+*FYM)
T_2 T_1 + Micronutrient formulation @ 2 kg/acre
T_3 T_1 + Micronutrient formulation @ 4 kg/acre
T_4 T_1 + Micronutrient formulation @ 5kg/acre
T_5 T_1 + Micronutrient formulation @ 6 kg/acre
T_6 T_1 + Micronutrient formulation @ 7 kg/acre
T_7 T_1 + Micronutrient formulation @ 8 kg/acre

- *RDF- Recommended dose of fertilizers (350:140:140 kg NPK/ha/year)
- *FYM- Farm yard manure (20 t/ha/year)
- Micronutrient formulation [Zinc (6%), Iron (0.5%) and Manganese (0.5%)]

Micronutrient formulation (Zn, Fe and Mn) was applied to soil as band placement after middle pruning in August, 2018. The observations on growth and yield parameters of V1 mulberry were recorded on 45th and 75th days after pruning. Leaves were harvested after 45 days of treatment imposition and fed to the multivoltine silkworm (PM × CSR_2) according to the treatment details. Observations on larval weight was recorded during 5th instar stage of larva, cocoon weight and shell weight were recorded on 6th day of cocoon formation (Plate 1 & 2).

Plate 1: Middle pruned V1 mulberry garden established in paired row system.

Plate 2: General view of silkworm rearing

Results and Discussion

The soil application of micronutrient formulation (Zn, Fe and Mn) resulted in better yield parameters of mulberry. Among different treatments, T_5 (350:140:140 NPK kg/ha/year + FYM 20 t/ha/year + micronutrient formulation of Zn, Fe and Mn @ 6 kg/acre) recorded significantly higher number of leaves/plant (548.67 and 567.56), leaf area (283.52 and 310.45 cm^2), leaf yield (947.20 and 1040.81 g/plant) and leaf dry matter (359.05 and 552.05 g/plant) on 45th and 75th DAP in V1 mulberry (Table 1). Compared to other treatments all the above-mentioned parameters found least in the control. The increase in growth and yield parameters of mulberry in T_5 may be due to balanced nutrition, role of micronutrients in various physiological processes. Micronutrients often act as cofactors in enzyme activation and participate in redox reactions, photosynthesis and respiration beside play an essential role in carbohydrate metabolism and sugar translocation (Sinha *et al.*, 2006) [8]. These results are in conformity with those of Bose *et al*. (1994) [2], Bose and Bindroo (2009) [1], Shilphashree and Subbarayappa (2015) [7] and Sowmya and Narayanaswami (2016) [9].

Better quality mulberry leaves produced due to application of micronutrient formulation also reflected in better performance of silkworms. Application of micronutrient formulation (Zn, Fe and Mn) recorded significant variation with respect to growth and yield of silkworm

Table 1: Effect of soil application of micronutrient formulation (Zn, Fe and Mn) on yield parameters of V1 mulberry at 45th and 75th DAP

Treatments	No. of leaves/plant		Leaf area (cm^2)		Leaf yield (g/plant)		Leaf dry matter (g/plant)	
	45 DAP	75 DAP	45 DAP	75 DAP	45 DAP	75 DAP	45 DAP	75 DAP
T_1	426.72	445.56	205.11	242.28	620.45	730.67	216.03	326.61
T_2	445.17	467.22	232.61	242.95	754.99	935.25	246.93	370.35
T_3	465.45	486.72	239.28	262.56	810.67	942.41	260.34	388.23
T_4	487.28	488.89	251.56	263.95	818.67	960.64	274.10	398.56
T_5	548.67	567.56	283.52	310.45	947.20	1040.81	359.05	552.05
T_6	528.95	538.33	263.83	284.45	871.15	994.03	319.16	503.88
T_7	533.83	556.83	268.50	291.97	883.58	1008.17	336.41	538.06
F-test	*	*	*	*	*	*	*	*
S. Em.±	19.39	13.99	10.112	12.396	38.515	46.602	16.517	22.576
CD @ 5%	59.74	43.11	31.158	38.195	118.678	143.595	50.895	69.563

*Significant at 5%

T_1	Control (*RDF+*FYM)
T_2	T_1 + Micronutrient formulation @ 2 kg/acre
T_3	T_1 + Micronutrient formulation @ 4 kg/acre
T_4	T_1 + Micronutrient formulation @ 5kg/acre
T_5	T_1 + Micronutrient formulation @ 6 kg/acre
T_6	T_1 + Micronutrient formulation @ 7 kg/acre
T_7	T_1 + Micronutrient formulation @ 8 kg/acre

- *RDF- Recommended dose of fertilizers (350:140:140 kg NPK/ha/year)
- *FYM- Farm yard manure (20 t/ha/year)
- Micronutrient formulation [Zinc (6%), Iron (0.5%) and Manganese (0.5%)]

Application of 350:140:140 NPK kg/ha/year + FYM 20 t/ha/year + micronutrient formulation of Zn, Fe and Mn @ 6 kg/acre (T_5) resulted in better growth and yield performance of silkworm. Significantly higher larval weight (37.59 g/10), shorter fifth instar and total larval duration (198.32 and 510.32 h), ERR (98.83%), single cocoon weight (1.78 g), single pupal weight (1.39 g), single shell weight (0.39 g) and shell ratio (21.69%) were significantly higher in T_5 treatment with PM × CSR_2 (Table 2; Fig. 1 & 2; Plate 3). Compared to other treatments all the above-mentioned parameters found least in the control.

The increase in weight of silkworms might be due to the fact that micronutrients involved in better utilization and assimilation of nutrients (Bose *et al*., 1994) [2]. The importance of boron and manganese in silkworm nutrition was also observed by Lokanath *et al*. (1986) [3, 4]. Better response could be attributed to better nutritive value of leaves resulting in high cocoon and shell weight (Vishwanath *et al*., 1997 [10] and Sinha *et al*., 2006) [8].

From the present experiment, it can be inferred that application of micronutrient formulation (Zn, Fe and Mn) to soil can potentially influence the growth, quality and yield of mulberry, silkworm growth and cocoon parameters.

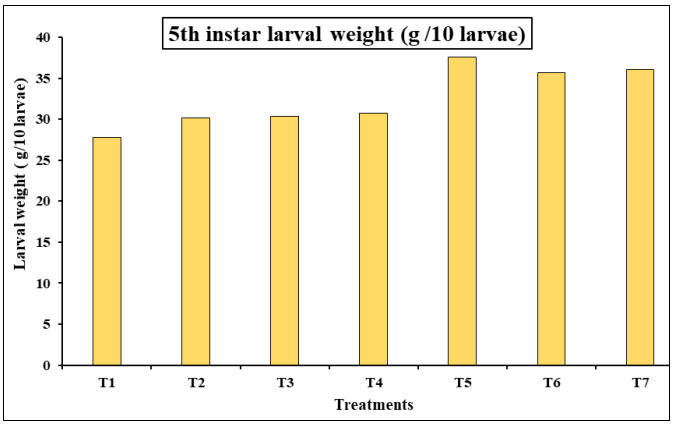

Fig 1: Effect of micronutrient formulation on 5th instar larval weight of mulberry silkworm, PM × CSR_2

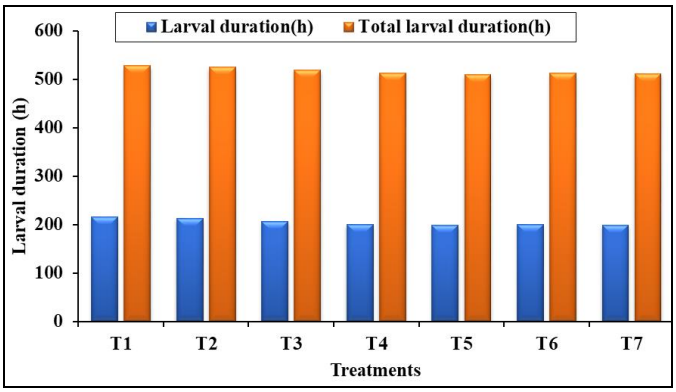

Fig 2: Effect of micronutrient formulation on 5th instar larval duration and total larval duration of PM × CSR_2.

Table 2: Effect of V1 mulberry leaves on cocoon parameters of PM × CSR_2 as influenced by soil application of micronutrient formulation (Zn, Fe and Mn)

Treatments	Single cocoon weight (g)	Pupal weight (g)	Single shell weight (g)	Cocoon shell ratio (%)	ERR (%)
T_1	1.42	1.20	0.22	15.16	79.67
T_2	1.68	1.37	0.31	18.21	88.33
T_3	1.70	1.37	0.33	19.17	90.00
T_4	1.70	1.37	0.33	19.32	92.17
T_5	1.78	1.39	0.39	21.69	98.83
T_6	1.73	1.37	0.36	20.57	95.67
T_7	1.76	1.38	0.38	21.36	96.83
F-test	*	*	*	*	*
S.Em.±	0.017	0.008	0.008	0.344	1.185
CD @ 5%	0.050	0.025	0.025	1.042	3.595

*Significant at 5%

T_1	Control (*RDF+*FYM)
T_2	T_1 + Micronutrient formulation @ 2 kg/acre
T_3	T_1 + Micronutrient formulation @ 4 kg/acre
T_4	T_1 + Micronutrient formulation @ 5kg/acre
T_5	T_1 + Micronutrient formulation @ 6 kg/acre
T_6	T_1 + Micronutrient formulation @ 7 kg/acre
T_7	T_1 + Micronutrient formulation @ 8 kg/acre

- *RDF- Recommended dose of fertilizers (350:140:140 kg NPK/ha/year)
- *FYM- Farm yard manure (20 t/ha/year)
- Micronutrient formulation [Zinc (6%), Iron (0.5%) and Manganese (0.5%)].

Fig A: T_5 – (RDF + FYM + micronutrient formulation @ 6 kg/acre)

B. T_1– (RDF + FYM)

Plate 3: Effect of soil application of micronutrient formulation on cocoons of PM ×CSR_2

Conclusion

The performance of the commercial formulation (Zn, Fe and Mn) used in current study needs to be compared with other micronutrient formulations and foliar sprays already in use for mulberry cultivation. Since the present study has given very encouraging results with micronutrient formulation (Zn, Fe and Mn) at 6 kg/acre on mulberry yield and quality as well as silkworm rearing and cocoon parameters, there is need to conduct farmers' field trails with (Zn, Fe and Mn) combination and popularize among sericulture farmers.

References

1. Bose PC, Bindroo BB. Effect of micronutrients on yield of mulberry in sub-tropical region. J Crop and Weed. 2009; 5(2):142-143.
2. Bose PC, Singhvi NR, Dutta RK. Effect of micronutrients on yield and yield attributes of mulberry (*Morus alba* L.). Indian J Agron. 1994; 39(1):97-99.
3. Lokanath R, Shivashankar K. Effect of foliar application of micronutrients and magnesium on the growth, yield and quality of mulberry (*Morus alba* L.). Indian J Seric. 1986; 25(1):1-5.
4. Lokanath R, Shivashankar K. Effect of foliar application of micronutrients and magnesium to mulberry on the quality and production of cocoons. Indian J Seric. 1986; 25(1): 40-41.
5. Miyashita Y. A report on mulberry cultivation and training methods suitable to bivoltine rearing in Karnataka, 1986, 1-7.
6. Shankar MA, Anitha Peter, Rangaswamy BT, Rajegowda. Response of mulberry to application of micronutrients and their impact on cocoon production and grainage parameters. XVIII th ISC CON, 1999, 12-16.
7. Shilpa Shree KG, Subbarayappa CT. Effect of Micronutrients on Growth and Yield of Mulberry (*Morus alba* L.) and Silkworm (*Bombyx mori* L.). Mysore J Agric. Sci. 2015; 49(2):167-170.
8. Sinha USP, Sinha AK, Banerjee ND, Prasad J, Chaudhary SK, Surya narayana N. Effect of micronutrients on the growth and leaf yield of Terminalia arjuna. Sericologia. 2006; 46(1):127-132.
9. Sowmya P, Narayanaswamy TK. Influence of micronutrients on yield and yield attributing parameters of mulberry (*Morus* spp.) and silkworm (*Bombyx mori* L.). Mysore J Agric. Sci. 2015; 50(2):453-456.
10. Vishwanath GK, Jayaramaiah M, Shankar MA. Feeding of mulberry leaves supplemented with secondary and micronutrients through foliage on the rearing performance of the silkworm, *Bombyx mori* L. Mysore J Agric. Sci. 1997; 31(2):175-179.
11. Vitti AM, Nuzzaci A, Scopa G, Tataranni I, Sofo A. Hormonal response and root architecture in Arabidopsis thaliana subjected to heavy metals. Int. J Plant Biol. 2014; 5:5226-5232.