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ORIGINAL ARTICLE

Impact of Fungicides on Grainage Parameters of *Bombyx mori* L.

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ABSTRACT
The mulberry silkworm, Bombyx mori exhibits a great deal of sensitivity to a wide range of chemical substances, including fungicides which are regularly used in the field of sericulture for the management of fungal diseases. In the direction of this, an attempt has been made in the current investigation to document the effects of low doses/concentrations, simulating those under field conditions during intervening period, on grainage parameters of Bombyx.mori (PM X CSR$_2$). No morality of the silkworm larvae subjected to the treatments with different concentrations at 0.006%, 0.01%, and 0.02% of Carbendazime and Dithane M-45 were observed during the course period. This clearly indicates that the two fungicides evaluated against PM X CSR$_2$ breed of the silkworm were not toxic at the given dose. Interestingly there was a significant increase in the matured larval weight compare to control batches. In grainage parameters there was a significant and appreciable decline in the number of eggs and hatching percentage laid by the female moths resulted from fungicide treated larvae, Thus the fungicides, Carbendazim and Dithane M-45, were found to have contradictory impact on grainage parameters.
***Key words**: Bombyx mori, fungicides, grainage, parameters*

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INTRODUCTION

In the field of Sericulture too, the occurrence of problems posed by diseases and pests is not uncommon. In fact, both silkworms and their food plants often get attacked by a number of diseases and insect pests, leading both qualitative and quantitative damage [1,2]. To maintain the pest menace, a host of pest management tactics have been evolved and employed. When it comes to the mulberry sericulture too, the two agents occupying the centre stage – the silkworm (*Bombyx mori* L.) and its exclusive food plant, the mulberry (*Morus* Spp.)– have been confronted with pest problems, thereby necessitating the adoption of management strategies to obviate/minimize the loss occurring due to these organisms. Silkworm (*Bombyx mori*) is one of the most important economic insects in the world, while pesticides impact its economic benefits. Carbendazime and Dithane M-45 are the fungicide that has been frequently detected in agriculture systems. There have been a number of instances of insect pest proliferation in various crop systems whenever an insect is exposed to stress caused due to exposure to sub-lethal doses of chemical agents (pesticides). Not only chemical agents bring about this type of effect, even certain levels heat stress, radiation, hormones, antibiotics, wounds and so on would prove to be effective [3]. The phenomenon where the reproductive ability of an organism would significantly increase following exposure to sub-lethal level of stress is called "hormoligosis" or "hormeosis". It is not whether a phenomenon like "hormoligosis" exists in *Bombyx mori.* Taking cue from what is existing elsewhere in many other insects, an attempt has been made in the current investigation whether exposure of this beneficial insect to low (sub-lethal) doses of two fungicides namely Carbendazim and Dithane M-45. It is

appropriate to mention at this juncture that these fungicides are recommended for the management of a number of fungal diseases in mulberry, especially the foliar ones. This apart, some fungicides such as Captan and Dithane M-45 are used along with other chemicals as bed disinfectants to prevent the occurrence of muscardine, grasserie, and flacherie [4]. Further, it is not uncommon to expect that these chemical agents may find their way in to silkworm system whenever one fails to strictly adhere to the recommended safe period. Most pesticides with different modes of action affected insect reproduction even in minute doses. Many studies that have focused on the effect of insecticides on *B. mori* deal with toxicity, retardation of development and growth, fecundity, mortality, food utilization, and economic parameters [5, 6, 7, 8]. Keeping in consideration above literature a study was conducted to initiate the impact of two Fungicides, Carbendazim and Dithane M-45 on grainage parameters of silkworm breed PM X CSR_2.

MATERIAL AND METHODS

Locale of the study: The present study was carried out at the Department of Sericulture and Seribiotechnolgy, University of Mysore, Manasagangotri Mysore, Karnataka in order to know the impact of various concentrations of synthetic fungicides like Carbendazim and Dithane M_{45} on grainage parameters of *Bombyx mori* L.

Materials used

- Silkworm strain: PM x CSR_2
- Mulberry varieties: S-36 & V-1
- Fungicides: Carbendazim and Dithane M-45 at concentrations of 0.006%, 0.01% and 0.02%.

Methodology Adopted

1. **Silkworm rearing:**The disease-free laying DFLs) of breed PM x CSR_2 were procured from the Germplasm Bank of the Department of Studies in Sericulture Science, Manasagangotri, University of Mysore, Karnataka and incubated at 25±1°C, 80±5%. On 10^{th} day of incubation larvae were brushed and rearing was conducted as per the technology advocated by Krishnaswami (1972). Chawki rearing was carried out by using chopped mulberry leaves of variety S_{-36} and late age worms were reared on mulberry leaves of V_1 variety.
2. **Preparation of different concentrations of fungicide solutions:** Same concentrations of two different fungicides *viz*., Carbendazim and Dithane M_{45} were 0.01%, 0.02% and 0.006 % which were 10, 20 and 30 times lesser than the concentration recommended (0.2%) for mulberry plantation, were made by diluting the commercial formulations in distilled water. The fungicide solutions that were prepared a day before the treatment were stored in glass conical flasks at 10ºC in refrigerator for further use.
3. **Experimental design**: Experiment was designed with 3 treatments and 2 controls of each fungicide (treated with distilled water and absolute). Each treatment comprised of 4 replications each with 40 larvae of 5^{th} instar, which were maintained separately in paper boats.
4. **Imposition of treatment**: The imposition of treatment began with 1-day-old larvae of 5^{th} instar. The larvae were treated once daily with fungicide solutions employing leaf dip method. The treated control batches were fed with mulberry leaves dipped in distilled water, while those of the absolute control batches were fed with normal mulberry leaves without treated with distilled water. The treated and control batches were monitored daily for various observations related grainage parameters (Fecundity (number) and egg hatchability (percentage).
5. **Statistical analysis: T**he data collected with regard to different parameters were subjected to statistical analysis by using OPSTAT statistical software for validating results by employing F-test.

RESULTS AND DISCUSSION

The results of the current investigation involving the evaluation of two fungicides namely Carbendazim and Dithane M-45 at three low (sub-lethal) concentrations (0.01%, 0.02%, and 0.006%) against the silkworm, *B.mori* (PM X CSR_2), considering grainage parameters, are depicted in the tables. The study was conducted on 5th instar larvae as they are more prone to fungal attacks. After investigating the carried-out study significant reduction in the fecundity was observed in most treatments involving Carbendazim with the mean results fluctuating from 350.75 (0.006%) to 446 eggs (0.02%). The values registered in distilled water and absolute control batches stood at 454.25 and 450.75 eggs, respectively. The observations recorded with Dithane M-45 treatment for this parameter showed greater similarity with those involving Carbendazim. The mean results for the treatment varied from 262.8 (0.01%) to 370.0 (0.006%). The hatching percentages were significantly lesser when compared with control. While

the mean data in the treatment batches ranged between 46.808% (0.006) and 86.58% (0.01), those for distilled water and absolute control batches remained at 97.168 and 97.840%, respectively. With regard to Dithane M-45 treatment, the trend observed for Carbendazim was noticed with this fungicide too with mean data ranging from 65.34 (0.02%) to 73.71% (0.01%) in treatments as against 97.17 and 97.84% in distilled water treated and absolute control, respectively. For unfertilized egg percentage, though the mean values among the experimental batches were found to be a maximum of 2.298 in distilled water treated control and 0.749 in treatment with 0.02%, the results recorded with treatment batches were significantly inferior. As far as the treatments with Dithane M-45 go, the results too being significantly inferior with a maximum value scored at 0.01% as against the highest value of 2.298% with distilled water control. The mean percentages of unfertilized (dead) eggs varied between 13.42 (0.01%) and 52.441% (0.006%) as against the control batches with negligible (little in excess of 0.5%). In the Dithane M-45 treated batches of the silkworm, *B. mori,* the percentages for this parameter arranged from 25.70 (0.01%) to 34.084 (0.02 %). On the whole, based results recorded in the current investigation, it can very well be understood that imposition of fungicide treatments to the silkworm *B. mori* (PM X CSR_2) has set in a series of chain reactions that involved larval, pupal (cocoon) and adult stages of the insect in question. It has been recorded by Bizhannia *et al*. [9] that the treatment of silkworm larvae with 1-2% aqueous solutions of Carbendazim resulted in 37% decrease in the treated larval weight. Our findings showing increased larval weight with regard to these aspects are not in agreement with findings by the above workers. Siddaramaiah and Hegde [10] have reported that Carbendazim was not toxic to *B. mori* as its toxicity only lasted for two days. The findings in the current investigation showing growth promoting effect falls in line with the views expressed by the above workers. A decreased, but not significant, in cocoon shell weight has been observed by Bizhannia et al [9] following treatment with 2% Carbendazim. As against, Velide and Bhagavanulu [11] have come out with the observation that the treatment of silkworm larvae with carbendazim led to significant increase in shell weight. Our findings with both Carbendazim are in consonance with those of Velide and Bhagavanulu [11] and differ with those reported by Bizhannia *et al*. [9] and increase in the cocoon weight has been observed by Kuberappa and Jayaramaiah, [12] when the silkworm larvae were treated with Carbendazim or Mancozeb. Bizhannia *et al* [9] too have come out with the observation that hatching percentage did not decrease significantly when silkworm larvae were treated with carbendazim. Our observations are in total disagreement with the findings by these workers. Based on the findings emanated from the above investigations, the following conclusion can be drawn: The fungicides, Carbendazim and Dithane M-45, were found to have contradictory impact on grainage parameters.

Table 1. Effects of Dithane M-45 on Grainage parameters of *Bombyx mori*

S.No.	Treatment	No. of eggs / laying	Hatching %	Unfertilized eggs %	Un-hatched eggs %
1.	0.0100%	262.8 ± 10.03	73.71 ± 1.907	0.591 ± 0.590	25.70 ±2.209
2.	0.0200%	347.8 ± 13.54	65.34 ± 4.764	0.579 ± 0.335	34.084±4.816
3.	0.0060%	370.0 ± 13.11	68.60 ± 1.842	0.195 ± 0.195	31.204±1.774
4.	Distilled water (Control)	454.3 ± 6.562	97.17 ± 0.671	2.298 ± 0.347	0.535 ±0.353
5.	Absolute Control	450.8 ± 7.609	97.84 ± 0.452	1.827 ± 0.353	0.324 ±0.143
F – Test					
SE (m) ±		10.55	2.465	0.386	2.505
SE (d) ±		14.92	3.486	0.546	3.542
CD at 5 %		32.09	7.498	1.174	7.619

Table 2. Effects of Carbendazim on Grainage parameters of *Bombyx mori*

S.No.	Treatment	No. of eggs / laying	Hatching %	Unfertilized eggs %	Un-hatched eggs %
1.	0.0100%	385.75 ± 1.44	86.58 ± 1.25	0 ± 0	13.42 ± 1.25
2.	0.0200%	446 ± 10.79	46.455 ± 1.21	0.26 ± 0.26	53.28 ± 1.37
3.	0.0060%	350.75 ± 13.92	46.81 ± 0.51	0.75 ± 0.44	52.44± 0.59
4.	Distilled water (Control)	454.25 ± 6.56	97.17±0.67	2.30 ± 0.35	0.54 ± 0.35
5.	Absolute Control	450.75 ± 7.61	97.84 ± 0.45	1.827 ± 0.35	0.32 ± 0.14
F – Test					
SE (m) ±		9.089	0.886	0.319	0.887
SE (d) ±		12.854	1.253	0.451	1.254
CD at 5 %		27.648	2.696	0.97	2.698

CONCLUSION

From this study it was concluded that the Carbendazim and Dithane M-45 showed contradictory effects on grainage parameters in the silkworm race PM × CSR_2. It was better to use these two fungicides Carbendazim and Dithane M-45, in recommended concentrations so that better cocoon yield can be obtained.

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