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IMPACT OF BIO-FOLIAR FORMULATIONS ON GROWTH OF SILKWORM *BOMBYX MORI* L. AND ECONOMIC TRAITS OF COCOON

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ABSTRACT

Investigations were undertaken to determine the impact of bio-foliar formulations on growth of silkworm, *Bombyx mori* L. and economic traits of cocoon. Bio-foliar formulations such as panchagavya, vermiwash, Effective Micro-organisms (EM) and seriboost were sprayed on mulberry, *Morus* sp. on 15, 30 and 45 days after pruning (DAP). Leaves harvested on 60 DAP were fed to silkworm and its growth parameters were documented in the fifth instar. Larval weight (3.95 g), silk gland weight (773.12 mg), SGSTI (25.46), ERR (92.05%) and silk productivity (8.34 cg day^{-1}) were statistically higher in the larvae treated with EM. Economic traits viz., cocoon weight (1.60 g), shell weight (0.379 g), shell ratio (23.78%), cocoon yield (9625.90 no.), cocoon yield (21.78 kg), filament length (1330.80 m) and filament weight (354.85 mg) were also maximum in the EM. Larval mortality, denier and renditta were reduced by 55.18, 10.66 and 9.73%, respectively over the control due to application of bio-foliar formulations.

Key words: Mulberry, panchagavya, vermiwash, EM, silkworm, seriboost, *Morus* sp., bio-foliar formulations, *Bombyx mori*, silk cocoon

Organic farming is the rule of nature which is considered as one of the ways of crop production which helps in proficient utilization of micro flora and micro fauna present in the ecosystem. It aims to create environmentally and economically sustainable crop production that utilizes the farm derived renewable resources, ecological and biological interactions, so as to produce nutritious crops (Deep and Reghunath, 2006). Mulberry (*Morus* sp.), the sole food plant for silkworm, is a hardy, deep rooted and perennial deciduous plant. The excessive use of inorganic inputs by the sericulturists to improve the productivity of mulberry causes sustainable damage to the soil health. Usage of organics in mulberry cultivation is essential to improve the cocoon quality which in turn helps in fetching high price for cocoons (Dhiraj and Kumar, 2012**)**. Organic foliar formulations viz.*,* panchagavya, vermiwash and EM (Effective Microorganism) generally are used as spray for increasing the yield and quality of different field crops. Various organic inputs such as *Azospirillum*, *Phosphobacteria*, VAM, green manuring and vermicompost are utilized for increasing the qualitative and quantitative traits of mulberry. But the literature on the effects of bio-foliar formulations are scanty. By keeping this in mind, the present investigation was conducted to determine the effect of spraying bio-foliar formulations on mulberry in the silkworm growth and cocoon economic traits.

MATERIALS AND METHODS

The experiments were conducted in the well-established mulberry garden with V1 variety located in the 'J' block of Forest College and Research Institute, TNAU, Mettupalayam in two seasons/ crops. The bio-foliar formulations viz., panchagavya (3%), vermiwash (2%) and EM (1%) - a commercially available consortium of beneficial microorganisms consisting of *Lactobacillus casei* (lactic acid bacteria), photosynthetic bacteria (*Rhadopseudomona spalustris*) and *Saccharomyces cerevisiae* (yeast) were applied on mulberry thrice at the interval of 15 days i.e*.,* on 15, 30 and 45 days after pruning (DAP) using knapsack sprayer. The seriboost (0.25%), a commercially available multimicro micronutrient mixture, was used as farmers practice and the mulberry plot sprayed with distilled water alone served as control. Mulberry leaves were harvested on 60 DAP and the treated and untreated mulberry leaves were fed to Double Hybrid silkworm from third instar to spinning stage. During the experiment, the silkworms were fed with the foliar formulations treated mulberry leaves thrice a day and it was replicated four times with 50 worms per replication. Different observations on larval, cocoon, yield and reeling related characters were recorded and the data were analyzed statistically and grouped by Duncan Multiple Range Test (DMRT) through SPSS software (Gomez and Gomez, 1983).

RESULTS AND DISCUSSION

The study showed that silkworms fed with different foliar formulations treated mulberry leaves were found to be beneficial in improving the rearing and commercial cocoon characteristics of double hybrid when compared to control. The larval, silk gland, cocoon and reeling characters were studied in the present work and the results are presented hereunder.

Effects on larval traits

The application of different bio-foliar formulations showed improvement in the larval traits such as fifth instar larval weight, ERR and larval mortality of silkworm. As it is shown in Table 1 the treatment with EM registered significantly higher fifth instar larval weight (3.95 g) and ERR (92.05%). This was followed by vermiwash (3.66 g and 90.14%, respectively) and panchagavya (3.60 g and 86.46%, respectively) which were found to be on par with each other. The lowest fifth instar larval weight and ERR of 3.08 g and 82.25%, respectively were recorded in control. The enhancement of fifth instar larval weight and ERR ranged from 12.99% to 28.25 and 2.43 to 7.16%, respectively in the larvae fed with bio-foliar formulations treated mulberry leaves over the control. The present observations are in conformity with the findings of Sudhakar et al. (2000) who recorded the higher larval weight of 3.81 g and ERR of 93.17% in the silkworms fed with nitrogen-fixing bacteria treated mulberry leaves. Several authors reported that there was an increased larval weight and ERR due to mulberry leaves supplementation with *Lactobacillus* sp. (Masthan et al. 2017; Sekar et al. 2016; Moustafa and Soliman, 2019). These findings also fall more or less in line with the present observations.

The lowest larval mortality of 7.95% was recorded in EM followed by vermiwash and panchagavya which registered the larval mortality of 9.85% and 13.54%, respectively. Here, the reduction in larval mortality due to application of EM (1%) was 55.24% over the control. The present results were supported by Saranya et al. (2019) who observed the lowest mortality rate of 3.64% in the *Staphylococcus* sp. treated larval batches over the control. In addition, Amala et al. (2011) and Esaivani et al. (2014) who reported that probiotic yeast, *Saccharomyces cerevisiae* stimulates the silkworm innate defense mechanisms by increasing the enzymatic activity of amylase and invertase. This could have resulted in reduced larval mortality of silkworm. This finding also confirms the present observations

Effects on silk gland traits

The spraying of different bio-foliar formulations on 15, 30 and 45 DAP of mulberry and feeding the silkworm larvae with these leaves had positive effects on the silk gland traits of silkworm (Table 1). The results indicated that EM applied leaves registered increased silk gland weight, SGSTI and silk productivity of 773.12 g, 25.46 and 8.34 cg day^{-1}, respectively which were found to be statistically superior to all other treatments. The lowest silk gland traits of 619.10 g, 20.49 and 5.43 cg day^{-1} respectively were observed in the larvae fed with distillled water treated mulberry leaves (Control). Ganeshkeremane et al. (2004) reported that foliar application of EM increased the photosynthetic efficiency of mulberry leaves which enhances the growth and development of silkworm. Similar phenomenon might have happened in the present experiment, resulting in increased silkgland traits. This finding falls more or less in line with the present results.

Effects on cocoon and yield traits

Significantly higher cocoon weight and shell weight were observed in the larvae fed with bio-foliar formulations treated mulberry leaves compared to

Table 1. Effect of bio-foliar formulations on larval and silk gland traits of silkworm

Treatments	Vth instar larval weight (g)	ERR (%)	Larval mortality (%)	Silkgland weight (mg)	SGSTI	Silk productivity (cg day^{-1})
Panchagavya @ 3%	3.60^{b}	89.16^{b}	13.54^{c}	724.54^{b}	23.45^{b}	7.00^{b}
Vermiwash @ 2%	3.66^{b}	90.14^{b}	9.85^{b}	727.87^{b}	23.76^{b}	7.21^{b}
EM @ 1%	3.95^{a}	92.05^{a}	7.95^{a}	773.12^{a}	25.46^{a}	8.34^{a}
Seriboost @ 0.25%	3.48^{c}	87.99^{c}	15.20^{d}	677.40^{c}	22.00^{c}	6.47^{c}
Control	3.08^{d}	85.90^{d}	17.76^{e}	619.10^{d}	20.49^{d}	5.43^{d}
SEd	0.03	0.55	0.78	10.00	0.61	0.20
CD (P=0.05)	0.07*	1.11*	1.50*	20.00*	1.33*	0.45*

*Significant.

Table 2. Effect of bio-foliar formulations on cocoon and yield traits

Treatments	Cocoon weight (g)	Shell weight (g)	Shell ratio (%)	Cocoon yield/ 10000 larvae by nos.	Cocoon yield/ 10000 larvae by weight (kg)	Filament length (m)	Filament weight (mg)	Denier	Renditta (kg)
Panchagavya @ 3%	1.49^{b}	0.344^{b}	23.08^{a}	9489.70^{c}	19.64^{b}	1338.14^{b}	341.42^{b}	2.30^{b}	6.19^{ab}
Vermiwash @ 2%	1.46^{b}	0.325^{b}	22.26^{ab}	9572.27^{b}	18.91^{bc}	1342.79^{b}	335.56^{c}	2.25^{b}	6.42^{b}
EM @ 1%	1.60^{a}	0.379^{a}	23.68^{a}	9625.90^{a}	21.78^{a}	1350.80^{a}	326.85^{a}	2.18^{a}	6.03^{a}
Seriboost @ 0.25%	1.38^{c}	0.302^{c}	21.88^{b}	9322.37^{d}	17.52^{d}	1301.20^{c}	351.40^{d}	2.43^{c}	6.53^{c}
Control	1.30^{d}	0.278^{d}	21.38^{b}	9297.23^{e}	17.02^{d}	1298.28^{c}	352.60^{d}	2.44^{c}	6.68^{c}
SEd	0.03	0.016	0.80	8.34	0.61	3.10	1.62	0.03	0.12
CD(P=0.05)	0.07*	0.030*	1.58*	18.17**	1.20*	6.77**	3.54**	0.06*	0.25*

*Significant; **highly significant.

control. Here, EM treatment recorded significantly higher cocoon weight of 1.60 g and shell weight of 1.60 g. The next better performing treatments were panchagavya (1.49 g and 0.344 g, respectively) and vermiwash (1.46 g and 0.325 g, respectively) which were found to be on par with each other. Whereas the higher shell ratio of 23.68, 23.08 and 22.26%, respectively were registered in the larval batches fed with EM, panchagavya and vermiwash treated leaves which were found to be on par with each other. Seriboost and control recorded significantly lowest shell ratio of 21.88 and 21.38%, respectively (Table 2). The observations corroborate with Ganeshkeremane et al. (2004) who reported significantly increased cocoon weight (1.34 g), shell weight (0.332 g) and shell ratio (24.77%) due to feeding of silkworm larvae with EM applied mulberry leaves.

The yield traits viz., cocoon yield by nos and cocoon yield by weight were increased over the control by 3.54 and 27.97%, respectively. Significantly highest cocoon yield by numbers and weight of 9625.90 and 21.78 kg, respectively were observed in EM which was followed by vermiwash (9572.27), panchagavya (9489.70) and seriboost (9322.37) in case of cocoon yield by numbers (Nos). While in the cocoon yield by weight, the next better treatments were panchagavya (19.64 kg) and vermiwash (18.91 kg) which in turn were on par with each other. These results are in agreement with the findings of Beevi et al. (2018) who reported that there was significant increase in the cocoon yield by Nos and weight of 9483 and 19.20 kg, respectively when larvae were fed with bio-inoculants treated mulberry leaves. Additionally, the findings of Shashidhar (2009) who reported that the application of organic foliar spray on mulberry plants enhanced the cocoon yield, also can be corroborated with the present observations.

Effects on silk reeling traits

Significantly higher silk filament length (1350.80 m) and weight (326.85 mg) were obtained in the larvae fed with EM sprayed mulberry leaves compared to control (Table 2). This was found to be statistically superior over all other treatments. This result is in coincidence with the finding of Singh et al. (2005) who reported the longest filament length (1143.45 m) and weight (294.38 mg) when the silkworm larvae were supplemented with *L. plantarum*. Beevi et al. (2018) reported increased protein content in EM sprayed mullberry leaves which enhances silk protein synthesis. This might have been the reason for increased maximum filament length and weight in the present experiment.

Denier and renditta have significant differences when the larvae were fed with bio-foliar formulations sprayed mulberry leaves. The lower denier and renditta of 2.18 and 6.03 kg recorded in EM followed by vermiwash (2.25 and 6.42 kg, respectively). The lower renditta was attributed to increased cocoon characters and ultimately better silk reeling related parameters. The present observations were supported by Sudhakar et al. (2000) who reported significantly decreased denier and renditta of 2.17 and 6.85 kg when silkworms were fed with mulberry leaves treated with three nitrogen fixing bacteria.

Thus, this study clearly demonstrated that the

application of EM @ 1% on 15, 30 and 45 DAP on mulberry and feeding the silkworm larvae with bio-formulation treated mulberry leaves significantly enhanced the growth and development of silkworm as well as different economic parameters of cocoon.

REFERENCES

Amala Rani G, Padmalatha C, Ranjith Singh A J A. 2011. Probiotic supplementation to improve commercial characteristics, disease resistance and protein in the silkworm *Bombyx mori* L. World Journal of Biological Research 4(2): 12-26.

Beevi D N, Devamani M, Qadri S M H. 2018. Effect of co-inoculation of microbial consortium on mulberry leaf yield and silkworm cocoon production. International Journal of Science, Environment and Technology 7(6): 1875-1885.

Deep S, Reghunath B R. 2006. Scope of sustainable agriculture. pp: 90-93.

Dhiraj K, Kumar R V. 2012. Application of foliar nutrients to increase productivity in sericulture. Journal of Entomology 34(2): 1-12.

Esaivani C, Vasanthi K, Bharathi R, Chairman K. 2014. Impact of probiotic *Saccharomyces cerevisiae* on the enzymatic profile and the economic parameters of silkworm *Bombyx mori* L. Advances in Biology and BioMedicine 1(1): 1-8.

Ganeshkeremane I, Huga I, Girish B, Asharani C M V. 2004. Use of effective microorganisms in sericulture. Indian Silk 42(10): 9-10.

Gomez K A, Gomez A A. 1983. Statistical procedure for agriculture research 2nd Edn. John Wiley and Sons, New York. pp: 450-480.

Masthan K, Rajkumar T, Narasimha Murthy C V. 2017. Studies on fortification of mulberry leaves with probiotics for improvement of silk quality. International Journal of Biotechnology and Biochemistry 13(1): 73-80.

Moustafa M N, Soliman S A. 2019. Nutritional efficiency and economic traits of silkworm *Bombyx mori* L. reared on mulberry leaves fortified with synbiotics. Journal of Plant Protection and Pathology 10(12): 671-675.

Saranya M, Krishnamoorthy S V, Murugesh K A. 2019. Fortification of mulberry leaves with indigenous probiotic bacteria on larval growth and economic traits of silkworm (*Bombyx mori* L.). Journal of Entomology and Zoology Studies 7(4): 780-784.

Sekar P, Kalpana S, Ganga S, John G, Kannadasan N, Krishnamoorthy R. 2016. Studies on the growth parameters (length & weight) and cocoon production in *Bombyx mori*, fed on mulberry leaves fortified with a putative probiont, *Lactobacillus casei*. International Journal of Current Research 8(4): 29127-29132.

Shashidhar K. 2009. Organic based nutrient management in mulberry (*Morus indica* L.) and its influence on rearing performance of silkworm (*Bombyx mori* L.). University of Agricultural Sciences GKVK, Bengaluru. pp: 131-138.

Singh K K, Chauhan R M, Pande A B, Gokhale S B, Hegde N G. 2005. Effect of Use of *Lactobacillus plantarum* as a probiotics to improve cocoon production of mulberry silkworm, *Bombyx mori* (L.). Journal of Basic Applied Science 1(1):1-8.

Sudhakar P, Chattopadhyay G N, Gangwar S K, Ghosh, J K. 2000. Effect of foliar application of *Azotobacter, Azospirillum* and *Beijerinckia* on leaf yield and quality of mulberry (*Morus alba*). The Journal of Agricultural Science 134(2): 227-234.

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