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BOTANICALS FOR THE MANAGEMENT OF SILKWORM DISEASES

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Abstract

Silkworms are affected by diseases due to biological, chemical, physical, nutritional and environmental causes. Higher or lower temperature, humidity, ventilation and silkworm feed adversely affects the physiological functions of silkworms and cause susceptible to diseases. The chemicals used for the silkworm disease management having residual effect on silkworm growth and development. Use of plant molecules is an appropriate means of minimizing residual effect and the spread of diseases. Feeding of silkworm with *Psoralea corylifolia* at concentration of 800 ppm once during third instar reduced the grasserie disease by 80 per cent. *In vitro* and *in vivo* studies conducted for the identification of effective botanicals for the management of bacterial flacherie of silkworm, *B.mori* revealed that the botanical, *Thuja orientalis* L. exhibited effectiveness under *in vitro* conditions by inhibiting the growth of *B. thuringiensis* at a dose of 1000 ppm. Application of 50 per cent garlic extract on silkworm recorded 50.17 per cent protection against the muscardine infection. Apart from the disease management, the botanical extracts had significant effect on silkworm growth and development. The economic characters of the silkworm *viz.*, shell weight, cocoon weight and shell ratio were also improved by the topical application of plant extracts.

Keywords: Plant Extracts, Silkworm, Diseases, Control, Growth, Development.

Introduction

Sericulture is an agro based cottage industry contributing more to the small and marginal farmers giving regular income throughout the year. However, due to continuous rearing of mulberry silkworms, become highly susceptible to various diseases accounts about 30-40 per cent loss in the cocoon yield (Chandrasekharan *et al.*, 2006). The losses occur mainly during the final stages of silkworm rearing resulting considerable energy and money loss. Application of toxic chemicals for the management of diseases directly or indirectly influences the rearing of silkworm and cocoon productivity. Management of silkworm diseases is one of the vital components of successful silkworm rearing for obtaining higher

cocoon yield and quality. Use of chemicals for the management of silkworm diseases caused residual toxicity. The biomolecules present in botanicals having both antimicrobial and antiviral properties which can be explored in silkworm rearing and disease management. They also act as growth promoting factors indirectly helps in reducing further spread of diseases. Use of botanicals in silkworm rearing has antimicrobial property, non-toxic, biodegradable and non-pollutant, and serves as an alternate strategy to control silkworm diseases.

Plant extracts contain variety of components, which have 'static' effect if they inhibit the growth of the micro organisms or 'cidal' effect if they kill them (Nigam, 1982). Further, these biocides have an advantage over synthetic chemicals like environment friendly and target specificity, to overcome disease resistance and easy availability (Singh, 1999). Perhaps a good understanding of the disease, its mode of transmission and control of the microbial pathogens causing silkworm diseases using plant extracts could be another possibility of improving silk productivity by reducing the incidence of silkworm diseases. This review paper focuses on the management of silkworm diseases through the use of plant extracts and their impact on silkworm growth and development.

Effect of botanicals against grasserie

Experiments on use of several botanicals for the management of *Bm*NPV revealed its antimicrobial properties on silkworm rearing and disease management (Manimegalai and Chandramohan, 2006). Latha *et al.* (2011) reported that the polyhedral bodies treated with aqueous extracts of different medicinal plants *viz., Adathoda vasica, Bougainvillea spectabilis, Phyllanthus niruri, Terminalia arjuna* and *Pongamia glabra* were administered to silkworm through mulberry leaves once during fourth and fifth instar larvae of PMxCSR2 indicated positive response on economic parameters. Among that, *P. niruri* recorded higher cocoon weight (1.59g in 4^{th} instar and 1.65g in 5^{th} instar), shell weights (0.264g in 4^{th} instar and 0.284g in 5^{th} instar) compared to control (Cocoon wt:1.64g in 4^{th} instar and 1.66g in 5^{th} instar; Shell wt: 0.299g in 4^{th} instar and 0.310g in 5^{th} instar).

Evaluation of antiviral activity was done by using the aqueous extract of *Psoralea corylfolia, Tribulus terrestris, Acacia suma* and *Caesalpinia coriaria* by feeding to silkworm through mulberry leaves. The findings showed that the leaves treated with *Psoralea corylifolia* at concentration of 800 ppm once during third instar reduced grasserie by 80 per cent (Samuel Manohar Raj, 1994).

Mahesha (1999) reported that the mulberry leaves treated with *Tridax procumbens* recorded the lowest grasserie incidence of 7.86 per cent followed by *Lantana camara* (8.02%) and *Parthenium histerophorous* (9.20%).

Application of turmeric powder + chalk powder (1:5) @1 kg per 100 dfl's once during third, fourth and fifth instar immediately after moulting resulted in reduction of grasserie by 63.16 and 62.45 per cent in summer and winter, respectively (Manimegalai and Subramanian, 1999). Spraying of mulberry leaves with *Parthenium* extract at 30 per cent recorded minimum grasserie (6.00%), flacherie (4.33%) and muscardine (1.00%) (Hipparagi, 2000).

Effect of botanicals against flacherie

Bacteria such as *Streptococcus faccalis, Streptococcus liquifacions, Staphylococcus acire, Staphylococcus epidermidis* and *Bacillus* sp. are commonly reported in causing flacherie in silkworm. Karthikairaj *et al.* (2013) studied the antibacterial activity of medicinal plant extracts, Pakarkai (*Momordia charendia*), Thulasi (*Ocimum sanctum*) and Nilavembu (*Andrographis paniculata*) for potential in improving silk production and disease management in both aqueous and alcoholic extracts with the concentration of 50, 100 and 150 µl under *in vitro*. The zone of inhibition was much effective in both aqueous (10.73 mm at 150 µl) and alcoholic (12.13 mm at 150 µl) extracts of *A. paniculata*, when compared to *M. charentia* (aqueous: 8.83 mm; alcoholic: 9.43 mm) and *O. sanctum* (aqueous: 8.3 mm; alcoholic: 8.93 mm) and concluded that it can be used for the control of flacherie disease and thereby improve the silk production.

In vitro and *in vivo* studies were conducted for the identification of effective botanicals for the management of bacterial flacherie of silkworm, *B. mori* by Manimegalai and Chandramohan, 2005. The results revealed that the botanical, *Thuja orientalis* L. exhibited effectiveness under *in vitro* conditions by inhibiting the growth of *B. thuringiensis* at a dose of 1000 ppm. *Curcuma domestica* V. showed partial effectiveness at 40,000 ppm under *in vivo* conditions. *T. orientalis* at 10,000 ppm was the most effective in reducing the mortality caused by 01-TAD-01 and 01-CHI-01 strains of *B. thuringiensis* to 30.03 per cent and 36.00 per cent respectively as against 73.74 and 76.00 per cent mortality in the treated control.

In vivo studies were conducted with botanicals indicated that basil and asparagus were effective against *Staphylococcus* sp. with a mortality percentage of 13.33 and 22.20 per cent

respectively, amla and boerhavia produced mortality of 16.60 and 17.60 per cent against *Bacillus* sp. Respectively. Basil and bael produced mortality of 15.50 and 17.70 per cent and effective against *Klebsiella* sp. The mean mortality was 72.00 per cent in treated control for the pathogenic bacteria (Priyadharshini, 2006).

Rani *et al.* (2016) revealed that the aqueous extracts of five herbs such as *Eclipta prostrata*, *Phyllanthus niruri*, *Punica granatum*, *Acalypha indica* and *Cannamomum zeylenica* are tested against microbes causing flacherie and muscardine disease in silkworm. Among the tested herbs, *Acalypha indica* and *Cannamomum zeylenica* was found to be effective antibacterial nature than the other; *Eclipta prostrata* and *Phyllanthus niruri* was found more effective antifungal property than the other extracts.

Effect of botanicals against fungal diseases

Saratchandra (2001) observed *in-vitro* effect of ten plant extracts of both aqueous and ethanolic extraction of 1, 3, 5, 7 and 10 per cent against entomopathogen *Beauveria bassiana*. Ethanolic extracts of three, seven and nine were found to be effective and inhibition zone was found to be maximum in 5, 7 and 10% concentration of extracts (23.79, 26.15 and 29.43% of inhibition respectively) than other plant extracts.

The antifungal effect of sterilized and raw aloe vera gel against *B. bassiana* was observed on 7^{th} day after inoculation of pathogenic fungus to culture media by following paper disc method. The zone of inhibition using raw gel was significant and was found to be 2.8 mm, 2.4 mm, 2 mm, 1.7 mm and 1.2 mm, respectively in 100%, 75%, 50%, 25%, and 10% and no zone of inhibition was observed for 5%. This showed that raw aloe vera gel possessed antifungal activity against the pathogenic fungi *B. bassiana* which was confirmed by growth inhibition on the culture plates. *In-vivo* studies suggested that the larval mortality was considerably reduced when infected worms were fed with leaves smeared with aloe vera gel as compared to control. The percent reduction was 6.33, 5.33, 4.66, 3.66 and 2.66 when gel smeared leaves were fed to silkworms during fifth instar where as, it was 10.00%, 8.00%, 7.00%, 6.00% and 5.66%, respectively for control. These findings confirmed that the raw aloe vera gel possesses antifungal activity against the pathogenic fungi *B. bassiana in-vivo* (Fatima *et al.*, 2008).

Ray and Majumdar (1974) found that the seeds of ajwain (*Carcum capticum*), roots of lead wort (*Plumbago zeylanica*) and costus (*Saussurea lappa*), stem of long leaf pine (*Pinus longfolia*), rhizome of galangal root (*Alpinia officinarum*), stem of clicorice root (*Glycyrrhika*

glabra) and dried fruit of tamarind (*Tamarindus indica*) exhibited considerable antifungal activity against *Aspergillus niger*. Garlic extract at 1:5 concentration was found most effective against *B. bassiana*, while onion (7.16mm and 12.00mm) and ginger (6.00 and 10.66 mm) at 1:1 concentration had slightly inhibited the fungal growth (Krishnaprasad *et al.*, 1979).

Spraying of phytocide of garlic extract on silkworm reduced white muscardine infection by 78-84 per cent prevented the spore germination (Odikadzae, 1960). Byra Reddy (1986) reported that the disinfection by herb mixture (developed at Sri Jayachamarajendra Institute of Indian Medicine, Bangalore) reduced larval mortality (11.5%) due to *B. bassiana* infection and recorded higher larval weight (32.10g/10 larvae), cocoon weight (1.809 g), pupal weight (1.434 g), shell weight (0.370 g) and shell ratio (20.69%) compared to control.

Raghavaiah and Jayararnaiah (1990) reported that application of 50 per cent garlic extract on silkworm recorded 50.17 per cent protection against the muscardine infection, and higher cocoon weight (1.394 g), shell weight (0.271 g) and shell ratio (19.50%).

Effect of botanicals on growth and development of silkworm

Chowdhry *et al.* (1996) reported the effect of active constituents of *Cassia tora* L. applied topically on the abdominal tergum of the silkworm, *Bombyx mori* L. after fourth ecdysis. Prasad *et al.* (2000) reported that the silkworms fed with mulberry leaves supplemented with potato leaf extract (from crops at the active growth stage) recorded the highest larval weight, cocoon weight, shell ratio (16.37%), and shell weight and lower larval mortality and larval duration.

Murugesh (2002) reported that the spraying of aqueous extract of *Tridax procumbens*, *Tribulus terrestries* and *Parthenium hysterophorous* resulted in maximum larval weight (33.75, 33.74 and 30.25 g) compared to control (30.70 g). Jayapaul *et al.* (2003) studied the food consumption by silkworm larvae fed on mulberry leaves treated with 1:100, 1:50 and 1:25 concentrations of leaves of *Coffea Arabica*, *Alternathera sessilis*, *Eichhornia crassipes* and deliberated on food consumption and utilization to understand the efficacy of food conversion into larval body, cocoon and cocoon shell during fifth instar. Food assimilated assimilation rate, assimilation efficiency, food converted, conversion rate and conversion efficiencies were significantly higher in silkworm fed on mulberry leaves treated with plant extracts over control.

Administration of mulberry leaves fortified with extracts of *Withania somnifera*, *Tinospora cordifolia* and *Terminalia arjuna* to silkworms, resulted in higher larval mature weight (26.25g), effective rate of rearing (96.30%) than control (25.42g and 94.0%) (Sridevi, 2003). Application of aqueous leaf extracts of *T. terrestris* on silkworm during third, fourth and fifth instars at 0.4 per cent recorded higher cocoon weight (18.00g/10), pupal (15.10g/10) and shell weights (3.28g/10), silk productivity (4.10 cg/day) and filament length (818.00m) (Murugesh and Mahalingam, 2005).

Conclusion

The mulberry silkworm, *Bombyx mori* L., known for the production of silk cocoons is generally affected by viral, fungal, bacterial and protozoan pathogens. Management of silkworm diseases is one of the vital components of successful silkworm rearing for obtaining higher cocoon yield and quality. Use of chemicals for the management of silkworm diseases leaving residual toxicity in silkworm and also harmful to human and environment. Instead of chemicals, the use botanical for disease control alters the silkworm physiology to minimize the residual effect by producing some bioactive compounds against disease causing pathogens. Many botanicals were identified as best in controlling the various silkworm diseases. After making a suitable formulation and evolving farmer friendly strategy of applications, these plant products could be utilized successfully in the management of silkworm diseases in silkworm.

References

1. Byra Reddy MS. 1986. Efficacy of some disinfectants in the control of white muscardine disease of silkworm, *Bombyx mori* Linn. M. Sc. (Agri.) Thesis, UAS, Bangalore, 92.
2. Chandrasekharan K, Nataraju B, Balavenkatasubbaiah M, Sharma SD, Selvakumar T, and Dandin, SB. 2006, Grasserie and post cocoon mortality in silkworm. *Indian Silk*, 45(4): 12-13.
3. Chowdhry SK, Khauria RK, Kulsrasta RK, Ogra and Jain SM. 1996. Silk enhancer from *Cassia tora* for *Bombyx mori* L. *Sericologia*, 36(2): 259-266.
4. Fatima S, Shivashankar R, Chinnaswamy KP, Rashmi K and Sarithakumari S. 2008. *In-vitro* and *In-vivo* efficacy of Aloe vera barbadensis gel against the fungus *Beauveria bassiana* infecting silkworm *Bombyx mori* L. International Conference on Trends in Seribiotechnology, (Abstract), Sri Krishnadevaraya University, Anantapur, Andhra Pradesh, Mar. 26-28, P.63.
5. Gupta DMR. 1950. Diseases of silkworm. Monograph on cottage industries. No. 1, Govt. India Press, Calcutta, pp: 25.
6. Hipparagi GD, RAYAR SG, and Karabhatanal SS. 2001. Field spray of extract of botanicals on mulberry and its effect on silkworm, *Bombyx mori* L. growth and development. Natl. Sem. Mulb. Seri. Res., India, KSSRDI (Abstracts), p. 127.

7. Jayapaul C, Padmalatha C, Ranjit Singh A, Murgesan JA, and Dhasarathan P. 2003. Effect of plant extracts on nutritional efficiency in mulberry silkworm *Bombyx mori* L. *Indian J. Seric.*, 42(2):128-131.
8. Karthikairaj K, Prasannakumar K, and Isaiarasu L. 2013. Use of plant extracts for the control of flacherie disease in silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae). *Int. J. Microbiol. Res.*, 4(2): 158-161.
9. Krishnaprasad KS, SIDDARAMAIH AL, and LINGARAJU S. 1979. Possible control of muscardine disease of silkworms by using a few extracts. *Curr. Res.*, 8(5): 79-80.
10. Latha S, Bhaskar RN, Pallavi and Chikkalingaiah. 2011. Effect of botanical treatment to BmNPV polyhedral bodies on cocoon parameters of silkworm *Bombyx mori*. *Int. J. Advanc. Biol. Res.*,1(1): 45-51.
11. Mahesha HM. 1999. Extrafoliation of aqueous extract of botanicals on silkworm, *Bombyx mori* L. M.Sc.(Seri.) Thesis, UAS, Dharwad, p. 82.
12. Manimegalai S. and Chandramohan N. 2005. Botanicals for the management bacterial flacherie of mulberry silkworm, *Bombyx mori* L. *Sericoligia*, 45(1): 55-58.
13. Manimegalai S. and Chandramohan N. 2006. Efficacy of botanicals against grasserie disease of silkworm, *Bombyx mori* L. *Sericologia*, 46(1): 15-23.
14. Manimegalai S. and Subramanian S. 1999. Efficacy of bed disinfectant and botanicals against diseases of silkworm, *Bombyx mori* L. Proc. Of Natl. Sem. Trop. Seri., Bangalore, pp. 338-340.
15. Murgesh KA. 2002. Efficacy of some botanicals in the management of uzifly, *Exorista bombycis* (Louis). M.Sc. (Seri.) Thesis, UAS, Bangalore, p.92.
16. Murugesh K and Mahalingam I. 2005. Influence of *Tribulous terrestris* L. on growth of silkworm, *Bombyx mori* L. and its impact on economic traits. In: Progress of research in organic sericulture and eri-byproducts utilization, University of Madras, Vellore, pp.151-155.
17. Nigam SS. 1982. Antimicrobial activity of essential oils. *Indian Perfumer*, 26(2-4): 249-254.
18. Odikandzae VV. 1960. Cited by Drobt'ko, V.G., In phytoncides in medicine, agriculture and food industry. P.200.
19. Prasad NKK, Sannappa B, Jayashree MK, and Sundar Raj S. 2000. Influence of solanaceous leaf extracts on consumption indices of late age silkworm, *Bombyx mori* L. *Karnataka J. Agric. Sci.*, 13(2): 462-464.
20. Priyadharshini P. 2006. Charcterization and management of bacterial pathogens of silkworm, *Bombyx mori* L. with botanicals and bioinformatics. M.Sc. (seri.) Thesis, Tamil Nadu Agricultural University, Coimbatore, p 93.
21. Raghavaiah G and Jayaramaiah M. 1990. Efficacy of selected plant extracts in reducing the white muscardine disease of silkworm, *Bombyx mori* Linn. *Mysore J. Agri. Sci.*, 24: 89-92.
22. Rani JC, Venkadesh B and Kumaran T. 2016. Impact of certain herbal extracts against bacterial diseases of silkworm *Bombyx mori* L. *Int. J. Res. Pharl. Sci.*, 1(1): 08-10.
23. Ray PG and Majumdar SK. 1974. Antimicrobial activity of some Indian plants. Economic Botany, 30: 317-320.
24. Samuel Manohar Raj, K. 1994. Effect of certain botanicals on the nuclear polyhedrosis virus disease of silkworm, *Bombyx mori* L. M. Sc. (Seri.) Dissertation, Tamil Nadu Agricultural University, Coimbatore, India, p. 62.
25. Saratchandra B. 2001. Studies on the prevention and control of some major silkworm diseases using botanicals. Annual report, CST&TI, Berhampore, p. 48.
26. Singh G. 1999, Studies on the biocidal activities of certain essential oils. *J. Med. Arom. Pl. Sci.*, 21: 1119-1130.
27. Sridevi G. 2003. Effect of mulberry leaves fortified with medicinal botanicals on the performance of mulberry silkworm, *Bombyx mori* L. M. Sc. (Seri.) Thesis, UAS, Bangalore, p.94.