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Impact of bed disinfectants in mulberry silkworm rearing

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Abstract

Sericulture, the rearing of silkworms is a continuous process which requires proper management and skill. The larvae feed solely on host plant leaves and have a possibility to get infected either through contaminated leaves or through other sources of contamination. Silkworms are easily susceptible to diseases and pests which cause crop loss up to great extent. Crop loss occurs mainly due to improper disinfection and unhygienic rearing conditions at farmer's level. Management of silkworm diseases plays a major role in successful silkworm rearing. Therefore, use of bed disinfectants is gaining importance in recent times to reduce the incidence of diseases. Several bed disinfectants have been evolved by sericulture research institutes in India are currently in use and many of them have become quite popular. Various bed disinfectants viz., ankush, sericillin, reshama keet oushad (RKO), vijetha, labex, reshama jyothi, sanjeevini, suraksha, samrakshak, musgard, reshama aishwarya and lime powder are used in silkworm rearing to obtain successful crop.

Keywords: Ankush, disinfectant, labex, sanjeevini, sericillin, vijetha

Introduction

Sericulture is an agro-based cottage industry which deals with raising of host plants, rearing of worms and ultimately production of silk. It helps in upliftment of rural livelihood by generating employment to rural people with minimum investment and maximum output. It not only helps in maintaining sustainable livelihood but also checks migration in rural areas. Diseases in silkworms are the major constraint in achieving high silk productivity. Due to continuous rearing, mulberry silkworm becomes highly susceptible to various diseases caused by different infectious organisms (Doreswamy *et al.*, 2004) ^[16]. During rearing, silkworm larvae have a possibility to get infected either through contaminated mulberry leaf or through other sources of contamination (Baig *et al.*, 1990) ^[10]. The infection by various micro-organisms leads to crop losses is prevalent in all leading silk producing countries and is estimated to be about 15-20 kg per unit of 100 disease free layings which accounts for about 30% total loss (Selvakumar *et al.*, 2002) ^[24]. Nagarajan and Radha (1999) ^[22] stated that control of diseases below the economic threshold level will increase silk production up to 25 per cent without any increase in the area under mulberry sericulture. Proper disinfection of rearing room, its appliances and rearing bed prevent and control the silkworm diseases and help in maintaining hygiene by creating pathogen free environment for healthy cocoon production.

Disinfection and hygiene

Disinfection and hygiene are integral part of silkworm rearing which plays a very important role in elimination of pathogens and thereby reducing pathogen load in the rearing environment. There are no any curative methods for any silkworm diseases, therefore, prevention of the diseases is the best way. Incidence of diseases can be reduced by adoption of proper disinfection and hygienic practices during rearing. Two types of disinfection is practiced in sericulture – disinfection of rearing room, its surroundings area and rearing implements before and after each rearing and the second type of disinfection through application of bed disinfectant during the course of rearing (Anon., 2022a) ^[2]. Disinfection may be carried out by physical, chemical or radiation methods. The substances which are used in disinfection process are known as disinfectant. A suitable disinfectant is the primary need to eliminate the persistent pathogen load from the rearing environment (Balavenkatasubbaiah *et al.*, 2016) ^[13]. Maintenance of hygienic conditions during rearing helps in preventing the entry of disease causing germs from outside and also checks the spread of diseases (Jolly, 1986) ^[18].

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Even after disinfection of the rearing house and its surroundings before the onset of rearing, there is every possibility for silkworm larvae to get infected during the course of rearing either through food or other sources of contamination. It is therefore essential to kill or inactivate these pathogens existing in rearing bed periodically, by applying bed disinfectants (Illahi *et al.*, 2003) [17]. There are many disinfectants reported to be effective against silkworm pathogens. However, only a few of them are in practical use with several limitations associated with their use. Some popular bed disinfectants used during rearing of mulberry silkworm are discussed in this article:

Lime powder

Lime powder is an effective disinfectant widely used in silkworm rearing, especially on the rearing bed. Calcium hydroxide (traditionally called slaked lime) is an inorganic colourless crystal or white powder with the chemical formula Ca(OH)_2 . It is cheap but effective against all the silkworm pathogen disinfectant and locally available (Lakshmanan *et al.*, 2010) [19].

Application of Lime powder

It should be applied on rearing bed when the larvae settle for moult, especially during rainy season when the humidity is very high (Lakshmanan *et al.*, 2010) [19].

Table 1: Application Schedule:

Dusting time	Lime powder required (g/sq. ft bed area)
Settled for 1 st moult	3
Settled for 2 nd moult	3
Settled for 3 rd moult	5
Settled for 4 th moult	5

Lakshmanan *et al.*, 2010 [19].

Reshom Keet Oushadh (RKO)

RKO is the first silkworm body and rearing bed disinfectant, developed by CSRTI, CSB, Mysore in the year 1986. It protects the silkworm from diseases during young and late age silkworms, mainly effective against grasserie and muscardine diseases of silkworm (Anon., 2022b) [3]. It is economical and its usage increases cocoon yield of 7 kg per 100 dfls with a requirement of 3.25 kg RKO for 100 dfls. The shelf life of RKO is six months from the date of manufacture (Anon., 2022c) [4]. The ingredients of RKO are slaked lime powder, benzoic powder, captan/ diathane and formaldehyde. It is very essential to mix homogeneously all components/ ingredients of RKO for its effectiveness (Subbarao *et al.*, 1992) [26].

Application of RKO

The disinfectant must be applied soon after bed cleaning, half an hour before giving the first feed (Swathi *et al.*, 2014) [27].

Cost benefit ratio: Farmers would be profitable with additional income of Rs 1200 by application of RKO (Rs. 35/kg) which increases cocoon yield up to 7kg per 100 dfls. The estimated cost benefit ratio is found to be 1:6 (Anon., 2022c) [4].

Sanjeevini

Sanjeevini is a chemical based disease and season specific bed disinfectant for the control of silkworm diseases. It is recommended for use during summer and rainy seasons

mainly for grasserie and flacherie (Subbarao *et al.*, 1992). It was developed by Karnataka State Sericulture Research and Development Institute (KSSRDI) in 1990. Presently the technology is licensed to M/s Suraksha Bio chem. Pvt. Ltd, Bidar. It is available in powder form with a shelf life of six month. With the use of Sanjeevini, cocoon yield increases up to 6 kg per 100 dfls (Anon., 2022d) [5].

Application of sanjeevini

It should be applied on empty rearing trays before brushing and again on the newly hatched larvae followed by feeding after 30 minutes. Moreover, it is dusted on worms after every moult before feeding and on 3rd and 5th day of fifth instar after bed cleaning. For 100 dfls rearing, about 4 kg and 6 kg sanjeevini is required for tray rearing and shoot rearing respectively (Anon., 2022d) [5].

Cost benefit ratio: The cost benefit ratio is 1:5. It will help in earning extra income of Rs. 1200 from 100 dfls (Anon., 2022d) [5].

Suraksha

Suraksha is a chemical based disease and season specific bed disinfectant for the control of fungal diseases of silkworm. It is recommended for use during winter and rainy seasons highly effective against fungal diseases especially white muscardine. It was developed by KSSRDI in 1990. Presently the technology is licensed to M/s Suraksha Bio chem. Pvt. Ltd, Bidar. It is available in powder form with a shelf life of six month from the date of manufacture. The method of application is simple, easy to adopt and appropriate to the farmers socio economic conditions. Cocoon yield increases up to 8 kg per 100 dfls with application of suraksha (Anon., 2022d) [5].

Application of Suraksha

It should be applied on empty trays before brushing and again on the newly hatched larvae followed by feeding after 30 minutes. It should be dusted after every moult before feeding and during 5th instar on 3rd and 5th day after bed cleaning. For 100 dfls rearing, 4 kg and 6 kg Suraksha is required for tray and shoot rearing respectively (Anon., 2022d) [5].

Cost benefit ratio

The use of Suraksha increases cocoon yield of 8 kg per 100 dfls. Farmers would get an additional income of Rs 1200 per 100 dfls by selling of cocoons which will give a cost benefit ratio of 1:6 (Anon., 2022d) [5].

Resham Jyothi

Resham Jyothi is a wide spectrum silkworm bed disinfectant used for the management of different silkworm diseases. It was developed by Silkworm Seed Technology Laboratory (SSTL), CSB, Kodathi, Bangalore. It is effective against grasserie, bacterial flacherie, muscardine, infectious flacherie and pebrine diseases and available in powdered form (Anon., 2022e) [6].

Application of Resham Jyothi

It should be applied uniformly in the entire tray along with larval bed and once after every moult before resuming food followed by one time application on the 4th day of fifth instar (Anon., 2022e) [6].

Cost benefit ratio: Application of Resham Jyothi costs Rs 60-75 per 100 dfls with increase cocoon yield of 4 kg per 100 dfls would generate an additional income of Rs. 260 per 100 dfls. The cost benefit ratio is found to be 1:4.3 (Anon., 2022e) [6].

Vijetha

Vijetha is a silkworm body and rearing bed disinfectant against all silkworm diseases. It is the first powder formulation for preventing all silkworm diseases (Anon., 2022f) [7]. The central Silk Board has developed a technology for the manufacture of vijetha and the corporation has licensed the technology to M/s Tetragon chemical Ltd.,

Bangalore who has successfully started commercial production in the year 1996. It is cheap can be used throughout the year in summer, rainy and winter with a shelf life of one year (Anon., 2022g) [8].

Application of vijetha

It should be applied on silkworm body and rearing seat @ 3g/sq. ft. during first and 2nd instar and @ 5g/sq. ft. during 3rd, 4th and 5th instar (Anon., 2022f) [7].

Cost benefit ratio: The price of the vijetha is Rs 55 per kg and the total expenditure is 300 for rearing of 100 dfls with a cost benefit ratio of 1:6 (Anon., 2022f) [7].

Table 2: Application schedule of bed disinfectants for 100 dfls

Stage of application	Resham keet oushadh (g)	Sanjeevini (g)	Suraksha (g)	Resham Jyothi (g)	Vijetha (g)
Newly hatched larvae	NA	NA	NA	3	NA
After 1 st moult	80	50	50	35	50
After 2 nd moult	120	120	120	105	150
After 3 rd moult	560	350	350	300	600
After 4 th moult	960	750	750	850	1200
On 4 th day of fifth instar	1550	1500	1500	2150	2000
Total	3270	2790	2790	3443	4000

Shashi Kanta, 2015 [25].

Ankush

Ankush is an eco and user friendly silkworm body and rearing seat disinfectant formulated with botanical and non-hazardous chemicals. It was developed by CSRTI, Mysore in the year 2000. It is effective against all the major silkworm diseases like grasserie, muscardine, pebrine, flacherie etc. (Sharma *et al.*, 2008) [23]. The product is prepared by mixing indigenously available eco-friendly chemicals and botanicals in definite proportions having antimicrobial property and pulverized into 250 mesh size powder. The shelf life is one year from the date of manufacture (Anon., 2020) [1].

Application of ankush: Dusting of the powder should be done uniformly on the silkworm body and seat once after every moult and on the 3rd and 5th day of final instar @3gm/sq.ft bed area to rear 100 dfls of silkworm (Balavenkatasubbaiah *et al.*, 2014) [11].

Table 3: Application Schedule for 100 dfls

Stage of application	Ankush required (g)
After 1 st moult	72
After 2 nd moult	144
After 3 rd moult	288
After 4 th moult	768
After 5 th moult	1076
3 rd day of fifth instar	1348
5 th day of fifth instar	3689

Anon., 2022f [7]

Cost benefit ratio

The price of per kg ankush is Rs 80 and the total expenditure at Rs 300 per 100 dfls. The cost benefit ratio is found to be 1:7 with 4 kg increase in cocoon production per 100 dfls (Anon., 2022f) [7].

Sericillin

Sericillin is a synergistic composition for disinfecting the silkworm body and bed. It was developed by CSRTI, Berhampore in the year 2013. It is a cost effective mixture of

three chemicals viz., lime, bleaching powder and fungicide. It prevents incidence and spread of silkworm diseases mainly muscardine and aspergillosis diseases of silkworm and also check secondary contamination (Chakrabarty *et al.*, 2013) [15].

Application of sericillin

Dusting may be done on silkworm larvae after each moult, 30-40 minutes before resumption of feed. Moreover, additional one time dusting may be done on the 4th day of 5th instar after bed cleaning. About 3-3.5 kg sericillin is required for conducting 100 dfls rearing (Chakrabarty *et al.*, 2013) [15].

Cost benefit ratio: Application of sericillin costs Rs.108 per dfls @ 27 per kg and the average cocoon yield increases 4 kg/100 dfls and the cost benefit ratio is 1:6.4 (Chakrabarty *et al.*, 2013) [15].

Labex

Labex is a highly effective bed disinfectant against grasserie and muscardine diseases of silkworm. It is a mixture of two locally available chemicals i.e. 97% slaked lime and 3% bleaching powder. It was developed by CSRTI, Berhampore in the year 2005. About 4 kg labex is required to rear 100 dfls. At farmers level in Eastern India, use of labex increases cocoon production of 2.7 to 4.8 kg per 100 dfls while in North-Eastern states, application of labex gained 1.7 to 6.9 kg cocoons per 100 dfls. It ranked first position in all India trial conducted by CSB, Bangalore. The shelf life of this product is six months from the date of manufacture (Anon., 2022h) [9].

Application of Labex

Labex is to be dusted with the help of a muslin cloth on the silkworm body @ 3 g/sq. ft. of total bed area one time after each moult i.e. 30-40 minutes before resumption of the next feeding followed by one time application on the 4th day of fifth instar worms after bed cleaning (Anon., 2022h) [9].

Cost benefit ratio: Application of labex costs Rs. 81 per 100 dfls @ Rs 25 per kg which increase cocoon yield up to 4 kg

per 100 dfls and farmers would be benefitted with an additional income of Rs 239 per 100 dfls. The cost benefit ratio is found to be 1:2.95 (Anon., 2022h) ^[9].

Samrakshak

Samrakshak is a chemical based highly effective bed disinfectant formulation for the prevention and control of all silkworm diseases. It was developed by Karnataka State Sericultural Research and Development Institute (KSSRDI) and the year of recommendation 2011. In 2012 Samrakshak was licensed on royalty basis for commercial production to M/s S.S. Associates, Bangalore. It is effective against flacherie, grasserie, pebrine, muscardine and aspergillosis and recommended to use throughout the year (Anon., 2022d) ^[5].

Application of samrakshak

It should be applied on empty rearing trays before brushing and on the newly hatched larvae before feeding. Dusting should be carried out after each moult before feeding and on 3rd and 4th day of fifth instar after bed cleaning. About 4 kg and 6 kg of samrakshak per 100 dfls is recommended for tray and shoot rearing respectively (Anon., 2022d) ^[5].

Cost benefit ratio: Regular application of samrakshak increases cocoon yield to an extent of 8 kg/100 dfls by creating additional income of Rs 1200, with cost benefit ratio of 1:6 (Anon., 2022d) ^[5].

Reshme Aishwarya

Reshme Aishwarya is a chemical based new bed disinfectant for the control of silkworm diseases. During 2006 it was released as a collaborative technology product of KSSRDI and M/S Santhosh enterprises Pvt Ltd. Bangalore, and licensed for mass production and marketing on royalty basis. It was initially evaluated in laboratory both by *in vitro* and *in vivo* methods against all diseases with a significant increases in ERR %. It is economical, easy to adopt and appropriate to the farmers socio economic conditions (Anon., 2022d) ^[5].

Application of Reshme Aishwarya

Reshme aishwarya bed disinfectant was dusted on the newly hatched larvae followed by feeding after 30 minutes. Further dusting has to be done after every moult before feeding and during 5th instar, on 3rd and 5th day after bed cleaning. For 100 dfls rearing, about 4 kg and 6 kg reshme aishwarya is required in tray and shoot rearing method respectively (Anon., 2022d) ^[5].

Cost- benefit ratio: Application of reshme aishwarya (Rs. 60/kg) increase cocoon production up to 5 kg per 100 dfls by creating an extra income of Rs. 1000 per 100 dfls. The cost and benefit ratio is calculated to be 1:4 (Anon., 2022d) ^[5].

Musgard

Musgard is a new, disease and season specific bed disinfectant for the control of fungal diseases of silkworm. It was developed by KSSRDI in 2006. It is recommended for use during winter and rainy season and available in powdered form with a shelf life of six month from the date of manufacture (Anon., 2022d) ^[5].

Application of musgard

It should be applied on newly hatched larvae followed by feeding after 30 minutes. Further dusting has to be done after

every moult before feeding and during 5th instar, on 3rd and 5th day after bed cleaning. For 100dfls rearing, requirement of musgard is 4 kg and 6 kg in case of tray and shoot rearing, respectively (Anon., 2022d) ^[5].

Cost -benefit ratio:

Application of musgard, increases cocoon yield by 8 kg per 100dfls at the rate of Rs 60 per kg and farmers would be benefitted with extra Rs 1600 per 100dfls with a cost-benefit ratio of 1:7 (Anon., 2022d) ^[5].

Conclusion

High return is the ultimate goal of the sericulture industry. This can be achieved by enhancing the quality and quantity of cocoons from a successful rearing. Maintenance of proper disinfection and hygiene of rearing bed and room and its appliances should be conducted to obtain a successful rearing along with other factors. Adoption and intervention of new and improved technologies will be helpful to enhance production and total output. Rearers are not aware of the disinfection process and proper hygiene. Moreover, rearers are not willing to adopt new scientific technologies which is a major drawback. Spreading of awareness among the rearers and adoption of proper technologies are the initial factors to achieve success. The farmers must be encouraged to adopt new technologies by deviating them from their traditional practices through easy availability of the inputs and making them cost effective. Initially these approaches would link the development of techniques with the improvisations and help in attaining a prospective of higher returns.

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