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Paritosh Nanda
Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

Hasansab A Nadaf
Basic Tasar Silkworm Seed Organisation (BTSSO), Central Silk Board, Bilaspur, Chhattisgarh, India

Vishaka GV
Basic Tasar Silkworm Seed Organisation (BTSSO), Central Silk Board, Bilaspur, Chhattisgarh, India

Rathore MS
Basic Tasar Silkworm Seed Organisation (BTSSO), Central Silk Board, Bilaspur, Chhattisgarh, India

Roma Kaushik
Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

Sritam Mishra
Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

NB Chowdary
(1) Basic Tasar Silkworm Seed Organisation (BTSSO), Central Silk Board, Bilaspur, Chhattisgarh, India
(2) Central Tasar Research and Training Institute (CTRTI), Central Silk Board, Ranchi, Jharkhand, India

RK Singh
Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

A Venugopal
Basic Tasar Silkworm Seed Organisation (BTSSO), Central Silk Board, Bilaspur, Chhattisgarh, India

T Selvakumar
Basic Tasar Silkworm Seed Organisation (BTSSO), Central Silk Board, Bilaspur, Chhattisgarh, India

Corresponding Author:
Paritosh Nanda
Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

Know how on essential chemicals used in Tasar sericulture

Paritosh Nanda, Hasansab A Nadaf, Vishaka GV, Rathore MS, Roma Kaushik, Sritam Mishra, NB Chowdary, RK Singh, A Venugopal and T Selvakumar

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Abstract
Tasar larvae are exposed to the environment, attracting a variety of diseases, pests and predators, resulting in increased larval mortality and a reduction in tasar silk production in India. The most common diseases are virosis, pebrine, muscardine and bacteriosis. Chemicals especially disinfectants play a significant role in tasar sericulture. Chemicals help to control and prevent the spread of diseases, pests and other harmful organisms that can negatively impact tasar silkworm and its host plants. While it is possible to practice tasar sericulture without the use of chemicals, it may be more challenging and less efficient and could result in lower yields and lower quality produce. The use of recommended disinfectants in sericulture ensures clean and hygienic crop production. By implementing proper sanitation and pest management practices, farmers can help to ensure the health and safety of their crops and promote sustainable sericulture practices. Hence for the intended study, the various chemicals and disinfectants used were deliberated in detail. Their importance and usage etc studied were presented .However, it is important to use these chemicals safely and responsibly to minimize any potential negative impacts on the environment and avoid harming the environment wildlife and human health. Hence, understanding and knowing what and how the chemicals used in sericulture and their benefits is important for protecting the environment, human health and the economic viability of tasar sericulture.

Keywords: Tasar, disinfectant, chemical, know how

Introduction
India, the second-largest silk producer in the world, is unique in that it produces all four types of natural silk: tasar, eri, muga and mulberry. Numerous geographically distinct areas, including temperate, subtropical and tropical states, are home to the silk industry. In essence, sericulture is a village-based industry that employs both skilled and unskilled labour (Lakshmanan & Jayram, 1998) [31]. It is a home-based industry because it can benefit from the efforts of every family member, regardless of gender or age. Although sericulture is considered as a subsidiary occupation, technical advancements have made it feasible to cultivate it on a large scale, which makes it profitable in a big way. (Kasi 2013) [29].
A non-mulberry silkworm, *Antheraea mylitta* Drury is used commercially in India to produce tasar silk. *Antheraea mylitta* is wild and polyphagous. It consumes a variety of secondary food plants in addition to *Terminalia tomentosa, Terminalia arjuna* and *Shorea robusta* as its primary food sources. Egg, larva, pupa and adult are the four stages of the *A. mylitta* life cycle. While adults do not eat, larvae are avid eaters where the eating is directly correlated with the weight of the first to fifth instar. The larva's fifth instar spins the cocoon, where it pupates. *A. mylitta*'s cocoon is strong and is constructed from a single silk thread that is between 800 and 1000 metres long. The cocoon has a long peduncle that ends in a ring that fits into the host plant's branch.
Larvae are exposed to the environment, attracting a variety of diseases, pests and predators, resulting in increased larval mortality and a reduction in tasar silk production in India. The most common diseases are virosis, pebrine, muscardine and bacteriosis, which are caused by *Antheraea mylitta* Cytoplasmic Polyhedrosis Virus (AmCPV, a reovirus), *Nosema mylitta* (Microsporidia), *Penicillium citrinum* and *Penicillium variotii* (Fungus) and several types of

bacteria. The magnitude of tasar crop loss in India owing to silkworm diseases is around 40%. The estimated crop loss owing to pebrine, virosis, bacteriosis and muscardine is 20-25%, 25-30%, 10-15% and 2-5% of total crop loss, respectively. As a result, virus and bacteria cause comparatively higher levels of mortality (Singh *et al*., 2021) [62}. Tasar silkworm pests are divided into two groups: predators and parasitoids. Predators damage tasar larvae in their early instars and parasitoids in later stages of silkworm. The major pests of silkworm are the reduviid bug (*Sycanuscollaris* Fabricius), the stink bug (*Eocanthecona furcellata* Wolf), the wasp (*Vespa orientalis* Linnaeus), the ichneumon fly (*Xanthopimpla predator* Fabricius) and the uzi fly (*Blepharipa zebina* Walker). Furthermore, many polyphagous insect pests attack primary tasar food plants, causing damage to various plant parts at various growth and developmental phases (Jolly *et al*., 1974) [28]. The severity of damages produced by these pests varies depending on the nature of damage. Some pests consume the entire leaf, while others suck their sap and feed on the bark of the trees. Some pests bore into the stems and branches of plants, causing significant damage to both young and mature plants. By consuming young seedlings, root feeders cause the most damage. These activities of various pests adversely affect quality and quantity production of leaf and cocoons.

The three most crucial elements for successful sericulture are seed, feed and breed. In the tasar ecosystem, adverse weather conditions, improper disinfecting and poor rearing management cause disease and pest outbreaks and severe crop loss. For managing these diseases and insect pests, the various chemicals are being employed in tasar sericulture. The details of those essential chemicals used in tasar sericulture and their know-how tis discussed hereunder.

Review of Literature

The following review of literature includes chemicals used not only in tasar sericulture but also in the other silkworms rearing and their protection.

Formalin (Ignoffo and Gracia, 1968) [25], sodium hypochlorite (Sahay *et al*. 2008) [48, 51], quarternary ammonium compound and iodine compounds (Venkata Reddy *et al*. 1990) are a few examples of chemical disinfectants. There have been reports of the germicidal effects of lime, phenolic compounds (Henga, 1977) [20], calcium hydroxide, chlorinated lime (Balvenkatasubbaiah *et al*, 1993) and chlorine dioxide (Balvenkatasubbaiah *et al*, 1994, 1996 and 1999) [9, 10, 7] against some or all silkworm pathogens. According to studies (Singh *et al*., 2005, 2006) [66, 61], the virosis and pebrine diseases of the tasar silkworm are effectively treated by a number of disinfectants, such as bleaching powder, slaked lime and formalin. According to Singh *et al*. (2004, 2006) [67, 61], wood ash solution can be used as an effective disinfectant against viruses and bacteria as an alternative of slaked lime. Silkworm body disinfectants are also efficient at lowering diseases incidence in silkworms (Baig *et al*., 1980; Sahay *et al*., 2005) [5, 48, 51]. But among the different disinfectants, many sericulture countries use formalin, bleaching powder, slaked lime and chlorine dioxide.

Application of secondary nutrients combination, SM5, consisting of basal application of slaked lime @ 45 g/plant on onset of monsoon and foliar application of 2% aqueous solution of magnesium sulphate in three equal split doses with an interval of fifteen days after sprouting of leaves, has been found to be very effective for increasing the quantity and quality of leaves of T. arjuna (Das *et al*., 2020) [16].

Dust the ground in and around the tasar host plant bushes with a mixture of bleaching powder and lime (1:9) to maintain hygiene. Before rearing and thereafter on a regular basis every 4 to 5 days throughout rearing, dust the bleaching powder and lime combination onto each bush at a rate of 10 to 15 grammes per bush. Always have two plastic tubs with water and a 2% bleaching powder to 0.5% slaked lime solution (add 20 grammes of bleaching powder and 5 grammes of slaked lime to one litre of water) close to the bushes so that you can wash your hands before and after handling the worms. (Jena et al. 2020) [27]. According to Singh *et al* 2020 [68], dusting slaked lime and bleaching powder (9:1) on the ground under bushes and over the bushes once in each instar and three times in the fifth instar has been found to be useful in preventing the spread of bacterial diseases. Within one week of cocoon harvesting, the entire rearing field must be disinfected using slaked lime and bleaching powder (9:1).

In the rearing of mulberry silkworms, a variety of bed disinfectants are employed, including Ankush, Captan, Dithane M-45, Formalin, Vijetha, Labex, lime, Resham jyothi, RKO (Resham Keet Oushad) and Vijetha green. Among them, lime, hydrated lime and Vijetha are the bed disinfectants that farmers use the most frequently (Rasool *et al*., 2017) [46].

Aoki (1958) [1] developed a new combination of lime and ceresan (a mercuric substance) for the efficient control of Grasserie while working on the prevention of muscardine disease in silkworms.

Calcium hydroxide can be sprayed on mulberry leaves to reduce the CPV (Cytoplasmic Polyhedrosis Virus) incidence in silkworm *Bombyx mori* L., according to Aruga and Tanada (1971) [2].

As a bed disinfectant against nuclear polyhedrosis, paraformaldehyde, benzoic acid and lime were combined by Baig *et al*. in 1989 [6]. In the treated batches, there was a noticeable decrease in larval mortality and an improvement in cocoon characteristics. A fungicide called "Captan" was added to the composition above by Baig *et al*. (1990a) [3] and a brand-new disinfectant for silkworm beds called "Resham Keet Oushadh" was developed. This product was extensively field-tested and popularised. In their study on the effect of antibiotics on silkworm *Bombyx mori*L. rearing performance and disease-related losses, Baig *et al*. (1990b) [4] found that feeding leaves treated with antibiotics such Gentamycin (0.1%) significantly reduced the spread of the disease.

Slaked lime had been investigated by Balavenkatasubbaiah *et al*. (1994a) [85] as a bed disinfectant to reduce larval mortality during silkwor m rearing.

In a 1999 [7] study, Balavenkatasubbaiah *et al*. evaluated the effectiveness of various treatments against the infections *Nosema bombycis*, *Bacillus thurengiensis*, BmNPV and *Beauveria bassiana* that affect the silkworm, *Bombyx mori* L. The newly developed disinfectant chlorine dioxide @ 500 ppm in slaked lime 0.5 per cent solution was found to be effective against these pathogens both at the laboratory and farmer's level without having any negative effects on silkworm growth, health, or economic characteristics among all the tested combinations. In 2013 [8], Balavenkatasubbaiah *et al*. developed two novel disinfectants: "Asthra," a spray disinfectant for cleaning appliances and rearing houses and

"Ankush," a bed disinfectant that is user-friendly and intended to prevent the spread of all common diseases. At a concentration of 0.005%, it was discovered that Asthra is effective against all typical silkworm diseases. According to laboratory studies, Ankush is effective in reducing the levels of grasserie, flacherie, muscardine and pebrine by 71.14, 80.75, 96.00 and 69.75%, respectively.

Labex, a new disinfectant developed by Bhattacharya *et al*. in 1995 [11], is a 97:3 mixture of slaked lime and commercial bleaching powder that has proven to be particularly efficient in controlling a variety of silkworm diseases, including grasserie and muscardine. Bhattacharya *et al.* (1998) [12] evaluated the effectiveness of three various antibiotics at 0.05 percent concentrations against NPV infection in silkworms. Rifampicin and chloramphenicol were shown to be the most efficient in lowering NPV-infected worm mortality.

The effectiveness of bleaching powder solution as a bed disinfectant against uzi-flies and other microbial infections affecting the silkworm *Bombyx mori* L. was researched by Chakrabotri *et al*. in 1996 [13]. The study's findings showed that the solution's effectiveness in killing uzi-fly eggs ranged between 76 and 96% and the crop benefit in terms of cocoon yield was between 14.7 and 16.4%. The study also showed that this bed disinfectant was very useful disinfectant against gattine, grasserie and flacherie.

Nalidixic acid effectively prevents the development of nuclear polyhedrosis in silkworm, *Bombyx mori* L., according to Choukimath and Savarnamath (1999) [14], who studied the curative aspects of NP disease in silkworms.

A new bed disinfectant called Vijetha was developed by Datta *et al.* in 1998 [17] to combat all the main silkworm diseases and resulted a noticeable decrease in pebrine, grasserie, flacherie and muscardine diseases. In order to manage the bacterial disease that affects muga silkworms, Dutta *et al*. (2010) [18] investigated into the usage of certain botanicals and antibiotics.

Digiloti (*Litsea salicifolia*) and garlic (Allium sativum) proved to be the two botanicals that were most effective at preventing the bacterial disease in Muga Silkworm. Streptomycin sulphate, another antibiotic, was found to be the best antibiotic for preventing the pathogen's growth. Additionally, they studied the combined effects of streptomycin with these two botanicals and discovered that the combination of digloti and streptomycin was superior to that of garlic and streptomycin.

As a result of its potent bactericidal and sporicidal effect, Hoffman (1971) [21] investigated into and recommended the use of formalin in silkworm rearing for the disinfection of rearing rooms and equipment and suggested that using it before brushing would produce better results.

Ibotombi *et al*. (2014) [24] conducted their investigation to examine sodium hypochlorite's role in preventing bacterial and viral infections in Muga silkworms. The study's findings showed that using sodium hypochlorite solutions containing 0.01 percent not only efficiently reduces larval mortality but also increases the production of cocoons.

Using a 2 percent formalin solution to sterilise the egg surface of *Bombyx mori* L. and the rearing room not only helped to get rid of any infection that may have been present, but also acts as a prophylactic measure, according to Krishnaswami *et al*.'s (1973) [30] study on the surface sterilisation of silkworm seed.

The application of turmeric and chalk powder (1:5) and Vijetha green (with *Tribulus terrestris*) results in a similar effect on the control of grasserie infection, in addition to influencing the growth of larvae, according to Manimegalai and Chandramohan's (2005b) [33] experiments testing the effectiveness of botanicals against grasserie disease of silkworm.

The aqueous extracts of *Psoralea coryleifolia* and *Tribulus terrestris* significantly controlled the grasseries disease in the silkworm, *Bombyx mori* L., according to Manoharan (1996) [36], who studied the effects of certain botanicals on the nuclear polyhedrosis disease of silkworms.

The effectiveness of calcium hydroxide in combating the *Bombyx mori* L. silkworm's cytoplasmic polyhedrosis virus (CPV) was examined by Patil in 1991. The findings showed that 0.5% calcium hydroxide is effective in reducing CPV because it increases gut pH, which renders CPV virions inactive.

Lime is used as a bed disinfectant in the management of silkworm diseases, according to Prasad (1999) [43]. He has emphasized the significance of various types of lime as well as approaches to their application in his study.

According to Sahay *et al*. (2005) [48, 51], who studied four treatments, Tassar Keet Oushad (T.K.O) was most effective at preventing Tasar silkworm virosis, bacteriosis and muscardine diseases.

Sahay *et al*. (2008) [49, 50] conducted laboratory studies and field experiments with the use of sodium hypochlorite (NaOCl) and confirmed that it lowers the mortality of the Tasar silkworm owing to virosis and bacteriosis by checking the multiplication and transmission rate of the respective pathogens.

A poly-alkyl monohydric phenolic compound has been reported by Samson *et al.* (1995) [54] as being extremely effective against that affect silkworms. "Disfect- S" was the name given to this chemical. The use of "Resham Jyothi" as a broad-spectrum bed disinfectant against several silkworm diseases was highlighted by Samson *et al*. in 1998 [55].

Reham Keet Oushad (RKO) application after each moult and feeding of mulberry leaves treated with aqueous extract of *Psorallea coryleifolia* @ 800 ppm were recommended by Sivaprakas and Rabindra (1996a) [71] who worked on the integrated disease management methods for grasserie in silkworms. These methods not only reduced grasserie but also improved the larval and cocoon parameters in the summer. The effectiveness of calcium hydroxide in treating *Bombyx mori* L. silkworm Nuclear Polyhedrosis disease was investigated by Sivaprakas and Rabindra in 1996b [72]. The outcomes showed that calcium hydroxide significantly reduces the occurrence of disease.

Iodine is a potent disinfectant because of its sporicidal, fungicidal and virucidal qualities, according to Skyes (1978) [73], who investigated various disinfection and sterilisation procedures.

As a disinfectant and dusting agent, Subba Rao *et al*. (1992) [75] employed bleaching powder and lime. They found that this method not only efficiently inactivated the NPV but also boosted silkworm survival by up to 17% compared to the control.

When Thangavelu and Rajkumar (1993) [78] examined the effectiveness of iodine as a disinfectant in the sericulture, they found that 1% iodine solution was comparable to 2% formaldehyde solution in terms of its ability to disinfect rearing rooms and materials.

In order to combat the Nuclear Polyhedrosis Virus (NPV) in cabbage looper larvae, Vail *et al.* (1968) [79] used sodium hypochlorite and formalin as antiviral agents. They also reported the bactericidal and virucidal effects of active chlorine and sodium hypochlorite.

Asiphor (Alkyl Phenoxypolyglycol-ether-Iodine Complex) was reported by Venkatareddy *et al*. (1990) [82] as a disinfectant against various silkworm diseases.

The effectiveness of wood ash from mulberry and coconut trees as a disinfectant for sericulture was studied by Virendrakumar *et al*. in 2000 [83]. Wood ash appears to be 80–90% effective against *Bombyx mori* L. viruses, such as those that cause nuclear polyhedrosis, infective flacherie and densonuleosis, according to *in vitro* and *in vivo* studies.

While studying the effectiveness of formalin against a viral disease of the silkworm, Golanski (1959) [19] reported that direct spraying of small doses of formalin was a successful way of controlling Grasserie.

When treating NPV in silkworms, Yoshimitsu and Zhou (1988) [84] noticed that the virions become inactive when treated with a saturated calcium hydroxide solution. They also reported that when the solution containing the inactivated virions is given to healthy silkworms, no infection occurs at all.

Material and Methods

The study entitled “Know-how on essential chemicals used in tasar sericulture” was conducted at Basic Tasar Silkworm Seed organization (BTSSO), Central Silk Board, Ministry of Textiles, Govt. of India, Bilaspur, Chhattisgarh (22.09°N 82.15°E, above mean sea level 207m). The materials used and the methods adopted during the study are detailed in this chapter.

The study was carried out during the Months of April-May 2023. During these months the activities carried out in tasar sericulture industry were collection of host plant seeds, preparation of nursery, control measures for insects, FYM application, preparation of bunds and basins, disinfection through flame gun and lime and bleaching powder, application of insecticides etc in the field and daily recording of temperature /humidity, arrangements for control of inside temperature and humidity (use of khus mats /wet gunny bags or installation of coolers, humidifiers etc), control of aeration and ventilation, disinfection of grainage and appliances etc in the grainages.

Chemicals especially disinfectants play a significant role in tasar sericulture. Chemicals help to control and prevent the spread of diseases, pests and other harmful organisms that can negatively impact tasar silkworm and its host plants. While it is possible to practice tasar sericulture without the use of chemicals, it may be more challenging and less efficient and could result in lower yields and lower quality produce. The use of recommended disinfectants in sericulture ensures clean and hygienic crop production. By implementing proper sanitation and pest management practices, farmers can help to ensure the health and safety of their crops and promote sustainable sericulture practices. Hence for the intended study, the various chemicals and disinfectants used were deliberated in detail. Their importance and usage etc studied were presented.

Results and Discussion

Diseased silkworms extrude pathogens into the rearing environment, serving as a source of infection and disease propagation. These pathogens are highly stable and can survive in the environment of tasar silkworm for an extended period of time. The term "disinfection" refers to the destruction of disease-causing pathogens. It can be accomplished through a variety of means, but the most effective is the chemical method, which employs chemicals as disinfectants. The most important actions for a successful harvest of cocoon crop are the disinfection of rearing and grainage sites and appliances besides the practice of hygiene.

Prior to rearing during the months of March–April, the practice of burning or flame gunning the rearing field is carried out in tasar sericulture to ensure successful tasar silkworm rearing by preventing and reducing diseases incidence in silkworms in order to increase cocoon yield. Along with disinfecting the rearing field with a spray of 5% bleaching powder solution at 7-8 days prior to brushing, the ground area in and around the rearing site is also cleared of bushes and weeds. At 2 days prior to brushing, slaked lime and bleaching powder mixture in a ratio of 9:1 is then sprinkled on the ground and bushes with the help of a dusting machine. During rearing, a 9:1 mixture of lime and bleaching powder is sprinkled on the ground beneath bushes every four to five days. Within a week of the cocoon harvest, the rearing field is disinfected by spraying it with a solution of 5% bleaching powder or dusted with a 9:1 mixture of slaked lime and bleaching powder. In addition to disinfecting chemicals, various essential chemicals used in the tasar sericulture are being discussed hereunder.

Slaked Lime

Slaked lime is calcium hydroxide Ca (OH) and is used for managing silkworm diseases. Burnt limestone (calcium oxide) is hydrated with water to produce powdered calcium hydroxide or slaked lime. The alkaline activity of slaked lime kills silkworm pathogens. It comes as white, hygroscopic power (Chowdary and Kumar 2001) [15].

Bleaching Powder

Bleaching powder is chlorinated lime. It is available as a white amorphous powder with characteristic pungent smell of chlorine. It is used as a disinfectant in sericulture. It acts as a strong oxidizing agent. The cell membrane proteins and chlorine in bleaching powder mix to generate chemicals that disrupt cell metabolism and kill pathogens. The cell membrane is also altered, allowing the diffusion of cell content outside. Additionally, it's got an effective germicidal effect and is also a corrosive and bleaching agent. While storing the chlorine in the bleaching powder escapes if the container is kept open, hence use always fresh bleaching powder and keep it closed (Chowdary and Kumar 2001) [15].

How to use

In tasar sericulture, the lime and bleaching powder used in the ratio of 9:1 as disinfectant before, during and after rearing and 2% bleaching powder as ovicide for uzifly while lime is often employed to reduce humidity in the grainages.

Formalin

A formaldehyde and water combination is called formalin. It also serves as a disinfectant. It deoxidizes the pathogen, acts as a reducing agent and kills it (Chowdary and Kumar 2001) [15].

How to use

The formaldehyde content of the commercially available formalin is 36%. The use of formalin as a spray or fumigant is most effective when the pathogen is in direct contact with it. Formalin is effective at 2% concentration. Making one part of 36% formalin with 17 parts of water would provide formalin with a 2% concentration. High humidity (at least 70%) and temperatures above 20°C are necessary for it to work, though. Slaked lime can be added to formalin to increase its potency. To get an additional effect against pathogens, add 5g of slaked lime to a litre of 2% formalin. It is necessary to protect the skin, eyes and nose from the spray because it is carcinogenic. Put on a raincoat and a safety mask to ward off gas. It has the irritating pungent smell. The quantity of water that has to be added can be determined using the following formula if the available formaldehyde content is lower than 36.

$$\text{Parts of water required to be added to one part of formalin} = \frac{\text{Concentration of formalin available-Concentration of formalin required}}{\text{Concentration of formalin required}}$$

Sodium hypochlorite

Chlorine reacts with a sodium hydroxide solution to form sodium hypochlorite (NaOCl). It controls the tasar silkworm's virosis and bacteriosis, which boosts the production of cocoons per disease-free layings (DFLs) reared.

How to use

Once in each instar from the second to the fourth and twice in the fifth instar after an interval of 5 to 7 days, prepare a 0.01% solution of Sodium Hypochlorite by mixing 2.5 ml of NaOcl in 1 litre of water and spray this solution on the bushes during these instars.

Leaf surface microbe (LSM)

The Central Tasar Research and Training Institute (CTRTI), Ranchi, developed Leaf Surface Microbes (LSM) to reduce bacterial infection. LSM has a potent antagonistic effect on the bacterial pathogen that affects tasar silkworms.

How to use

To produce a suspension of water, 10 litres of water well mixed with 4-5 kg of soil from a rearing field that is about 1/2 feet deep and the mixture is allowed to rest for about 12 hours (overnight). Take the clean water from the top of the bucket the following day. Mix the LSM ampoule's contents (5 ml) with 5 litres of freshly prepared soil water. Such LSM suspension is sprayed once on bushes during 2nd instar larvae, 24 hours after moult. One ampoule is sufficient for 100 DFLs rearing (Roy *et al*., 2022) [47].

Jeevan Sudha

A botanical formulation called Jeevan Sudha (JS) was developed by CTRTI, Ranchi from medicinal plants to manage tropical tasar silkworm virosis. Jeevan Sudha is available in 300 gm packets of fine powder. To prevent virosis in tasar silkworm during rearing, it is suggested to apply a 1% aqueous extract of Jeevan Sudha.

How to use

The Total requirement of Jeevan Sudha powder is 300 grams for rearing of 200 DFLs. Instar wise requirement of formulation is as follows:1st instar -50 gram or 8 teaspoonfuls in 5-liter water, 2nd instar-100 gram or 15 teaspoonfuls in 10 liters water and 3rd instar-150 gram or 22 teaspoonfuls in 15 liter water. Soak the formulation in clean water as per required doses for 10-12 hours (overnight) and filter it using muslin cloth and squeeze completely. Once during each of the first, second and third instars of the silkworm larvae's feeding stage, spray filtered solution on the leaves of the bushes being used as food sources (Singh *et al*., 2022b) [64].

Depuratex

Disease transmission through the egg surface is a significant issue in tasar sericulture. In order to clean and surface sterilise tasar silkworm eggs, CTRTI, Ranchi developed Depuratex, an eco-friendly disinfectant. It is cost effective, user friendly and emits rose fragrance. It not only ensures proper cleaning and disinfection but also reduces the risk of egg damage due to scrubbing effect.

How to use

For cleaning and sterilising 6000–8000 g of tasar silkworm DFLs (3000-4000), one litre of Depuratex is adequate. The 5% solution is prepared (50 ml in 950 ml water) and collect the silkworm eggs after the mother moth examination in a nylon net bag or cotton bag. Tasar silkworm eggs are dipped into the prepared solution, stirred frequently for 10 minutes, then removed together with nylon net and gently rubbed under running water for one to two minutes. Then, spread a thin layer of the freshly surface-disinfected tasar silkworm eggs on newspaper or blotting paper, allowing them to dry at room temperature (Singh *et al*., 2022c) [65].

Pebrine visualization solution

Pebrine Visualisation Solution (PVS) was developed by CTRTI, Ranchi by combining various chemicals at varying doses to address the issues of tedious microscopic examination. By clearing away debris and making the spores visible and noticeable in the slide, PVS helps to facilitate the identification of *Nosema mylitensis*, pebrine spores during microscopic examination of a mother moth. By removing/dissolving tissue fragments, fat globules and other non-pebrine artefacts from the smear, it improves visibility.

How to use

Using a pestle and mortar, crush the mother moth's abdomen region with 4-5 ml of a 0.5% K_2CO_3 or 2% KOH solution. With the aid of a plastic toothpick, place a drop of PVS on the glass slide and combine a drop of the crushed abdominal sample and then cover it with the cover slip. Observe under compound microscope at 600 X magnification (Singh *et al*., 2022a) [63].

Insecticides

Besides using the above chemicals, the following insecticides are also being used in tasar sericulture depending upon insect pest intensity of infestation. For the purpose of controlling gall fly, dried and powdered Neem Cake is applied at a rate of 150 kg per hectare close to the plant in the final week of May, just before the monsoon

season begins. Neem Cake due to its insecticidal property control gall besides enriching the soil and also the spray of solution of Acetamaprid 20% SP 0.2gm/litre of water is followed thrice at an interval of 15 days after leaf sprouting from 10th to 15th May. One kilogramme of fresh neem leaf is mixed with two litres of buttermilk and thoroughly mixed to treat bark eater infestation in tasar. The mixture is put into an earthen pot, covered with a lid and muslin cloth in a dark place for 15 days. After fifteen days, the solution is mixed thoroughly and filtered through muslin cloth. This solution can be used as a base solution for preparation of active pesticide. The base solution is diluted to 10 times with water (1:10 ratio) and sprayed on bark eater infested parts of the host plant trees (Mittal *et al*., 2022 and Singh *et al*., 2022d) [47, 69]. Further, different other insecticides for stem borers, termites and other insects are also recommended.

The above disinfectants and insecticides are readily available in the market. However, the LSM, Jeevan Sudha, Depuratex and PVS may be procured from CTRTI Ranchi.

Tb Requirement of disinfectant solution

The total requirement of solution for disinfection or insect pest control in the field is round 500 to 600 litres depending on the density of host plants but for disinfection of rearing house, its surroundings and appliances is estimated based on the floor area of the rearing house. The quantity required is 1.5 litres/sq. m floor area or 140 ml/sq. ft. floor area of rearing house + 10% of total quantity (for disinfection of rearing house surroundings).

Table 1: Details of essential chemicals used in tasar sericulture

Chemical	Role	Concentration/Quantity	Availability
Slake lime	Disinfectant	9 parts @ 90 kg/ha/crop	Market
Bleaching powder	Disinfectant	1 part @ 10 kg/ha/crop	Market
Formalin	Disinfectant	2-5%	Market
Sodium hypochlorite	Disinfectant	0.01%	Market
LSM	Bactericide	5 ml/ 100DFLs	CTRTI Ranchi
Jeevan Sudha	Virucide	300 g/200 DFLs	CTRTI Ranchi
Depuratex	Egg surface sterilizer	5% (1 litre/4000 DFLs)	CTRTI Ranchi
PVS	Pebrine visualizer	A drop/slide	CTRTI Ranchi

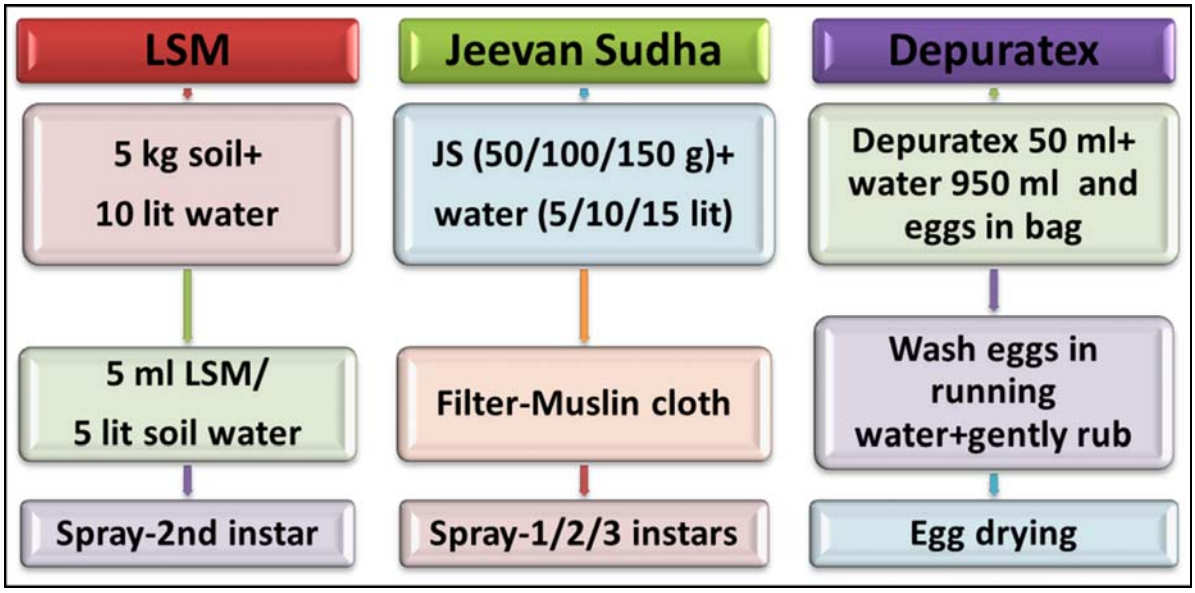

Fig 1: Flow chart of preparation of disinfectants

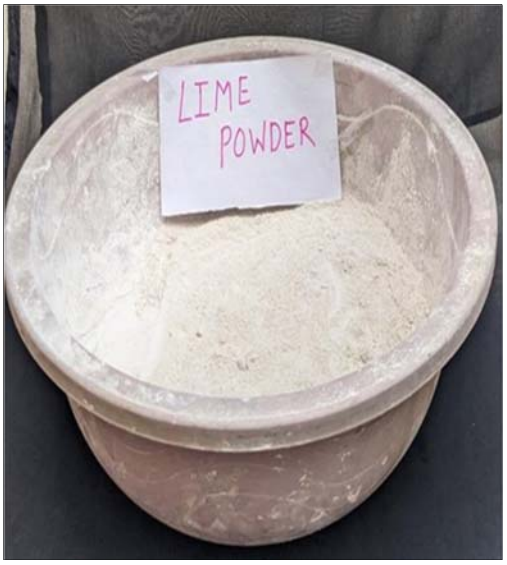

Fig 2: Lime powder

Fig 5: Sodium hypochlorite

Fig 3: Jeevan Sudha

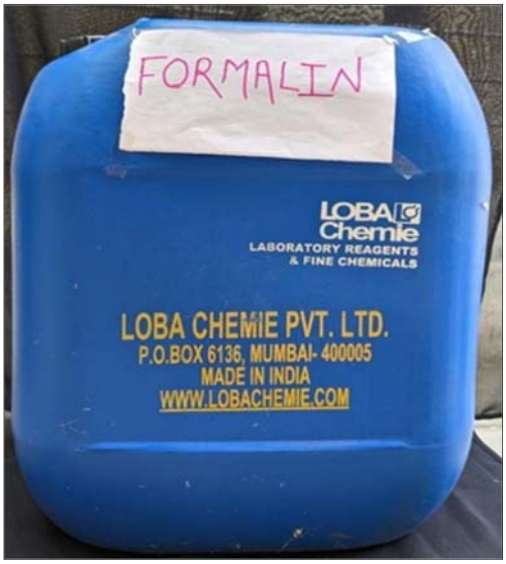

Fig 6: Formalin

Fig 4: Depuratex

Fig 7: Neem leaves

Conclusion

Chemicals are often used in sericulture to increase productivity by controlling pests and diseases that can damage crops and reduce yields. The use of chemicals such as disinfectants and insecticides can help prevent the spread of disease among silkworms, which can significantly reduce the quality and quantity of silk produced. Additionally, insecticides can be used to control pests that can damage silk cocoons and reduce yields. However, it is important to use these chemicals safely and responsibly to minimize any potential negative impacts on the environment and avoid harming the environment wildlife and human health. Hence, understanding and knowing what and how the chemicals used in sericulture and their benefits is important for protecting the environment, human health and the economic viability of tasar sericulture.

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