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# STATUS AND STRATEGY FOR MANAGEMENT OF VARIOUS DISEASES OF TROPICAL TASAR SILKWORM *ANTHERAEA MYLITTA*

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**ABSTRACT**

Tasar silkworm eggs, larvae, pupae, and adult often suffer from various diseases which cause around 40% crop loss. The pathogens, environmental factors and silkworm constitution all have a direct impact on the development and dissemination of diseases. Due to outdoor rearing, the disease monitoring in tasar sector is big challenge. Tasar silkworm diseases and their symptoms are very typical and specific. Virosis, pebrine, muscardine, and bacteriosis are the commonly prevalent diseases caused by Cytoplasmic Polyhedrosis Virus (AmCPV, a reovirus), *Nosema mylitta* (Microsporidia), *Penicillium citrinum* and *Penicillium varioti* (Fungus) and different bacterial genera. The estimated crop loss due to pebrine, virosis, bacteriosis, and muscardine is 20-25, 25-30, 10-15, and 2-5% respectively of total crop loss. Several technologies to manage these diseases are in practice at farmers/stakeholders level. Technologies such as Pebrine Visualization Solution (PVS), Jeevan Sudha, Jeevan Suraksha, Depuratex, Leaf Surface Microbe (LSM) etc. are in practice to minimise the decease incidence in field. In addition, integrated disease monitoring and management module has been implemented at the field level to reduce the disease percentage in the field to produce quality seeds. During the 2023-24 discernible variation in disease intensities were observed at BSMTCs, DOS level, BSPUs. The occurrence of pebrine disease was high in DOS grainage of West Bengal followed by Chhattisgarh, Odisha. Lowest level of disease was observed in Jharkhand. Performance of the BSMTCs and BSPUs was found comparatively better than state grainage. It is felt that effective implementation of Disease Monitoring Module at field level will be helpful in reproduction of quality seeds in tasar sector to enhance the production and productivity of tasar silk industry in future. In the present technical article status and strategy for management of various diseases of tropical tasar silkworm *Antheraea mylitta* has been documented. Details about the useful technologies their purpose, process, salient features, schedule of activities, suggested schedule of examination for disease monitoring, schedule of activities to be followed in the field by respective seed producing units has been documented.

***Keywords*:** Eggs production, *Antheraea mylitta,* DMC, module, Tasar Silkworm, disease monitoring.

## Introduction

Tropical tasar silk is produced by the larvae of *Antheraea mylitta* Drury. Generally tasar silkworm reared outdoor on *Terminalia tomentosa* and *T. arjuna.* As tasar silkworms used to get exposed to the natural environment hence precautionary measures are necessary for effective control, occurrence and spread of disease. Continuous disruption of the environment's biotic and abiotic components has a negative qualitative and quantitative impact on cocoon production. Silkworms are susceptible to infection because the infectious organisms are present in their surroundings on a constant basis. Silkworm larvae/pupae and adult often suffer from various diseases causing heavy losses to the economy of the silk industry. Virosis, pebrine, muscardine, and bacteriosis are the commonly prevalent diseases caused respectively by different pathogens. The main causes of diseases in silkworms are pathogens and specific factors that encourage the development of diseases during silkworm desired outcomes. Following the infection of a small number of worms, the infection

spreads throughout the host, releasing pathogens through their excrement or dead worms, which contaminate the surrounding area, including food plants, and the silkworms themselves through direct contact, resulting in secondary infection in the silkworm population. This could eventually result in an epidemic outbreak of the disease if no curative or preventive measures are taken. Given the tasar silkworm's economic significance, protecting it from invasive pathogens is imperative. Disease incidence can be significantly reduced by taking preventive measures during grainage and rearing. The pathogens, environmental factors and silkworm constitution all have a direct impact on the development and dissemination of diseases. The following are given appropriate weightage as preventive measures: identification and rejection of diseased worms to reduce the risk of disease transmission; rigorous disinfection to lower the pathogen load in the environment; and invigoration of silkworms to increase resistance to diseases. Survey reports from various Indian sericulture areas have shown that diseases are frequently the cause of crop loss. According to Sahay *et al*. (2000), the amount of tasar crop loss in India as a result of silkworm diseases is close to 40%. As a result, Central Silk Board, through its various research and development programs, has brought several affordable technologies to manage these diseases in an effort to combat the loss caused by diseases. The farmers and other stakeholders are currently implementing these suggested technologies, which have spread throughout the field.

## Methodology

CTRTI Ranchi developed various technologies linked to tasar silkworm disease monitoring and management. In the present study strategies with Integrated Disease Monitoring Module, details about the useful technologies their purpose, process, salient features, schedule of activities, suggested schedule of examination for disease monitoring, schedule of activities to be followed in the field by respective seed producing units has been given maximum attention. Activities prior to rearing, during rearing and after rearing, precaution during procurement of cocoons for grainage as well as care during cocoon preservation etc need to be conducted. Pebrine Visualization Solution (PVS), Jeevan Sudha (Singh *et al*., 2008, 2010), Jeevan Suraksha, Depuratex, Leaf Surface Microbe (LSM) (Roy *et al*., 2009), etc., were introduced at field level. The disease monitoring team for the current study travelled to several tasar growing regions of 10 states to observe disease incidences and the application of the suggested disease monitoring and management module in those areas.

**Useful technologies of CTRTI Ranchi:** In tasar sericulture industry, quality DFLs supply is the major bottleneck. Proper implementation of disease management module is needed to control pebrine, virosis, bacteriosis, and muscardine. CTRTI developed various technologies to manage these diseases. Technologies such as pebrine visualization solution (PVS), Jeevan Sudha, Jeevan Suraksha, Depuratex, Leaf surface microbe (LSM) etc. need to be implemented effectively in the form of integrated disease module. These recommended technologies must be percolated effectively at farmers/stakeholders level through REC, RSRS, BSMTC, DOS, NGOs etc. Details of various technologies developed by CTRTI Ranchi are mentioned below:

**Depuratex:**


Depuratex is an eco-friendly disinfectant for egg washing. It is cost effective and user friendly technology to achieve qualitative and quantitative benefits in tasar culture. Depuratex improved hatching of eggs by 2.11% over the existing method of egg washing, besides reducing 5.46 mandages to wash 10,000 Dfls (Disease Free Layings).

**Purpose:**

Cleaning and surface sterilization of tasar silkworm eggs.

**Process:**

- Prepare 5% solution (50ml in 950ml water) of Depuratex
- Collect the silkworm eggs after the mother moth examination in a nylon net bag or cotton bag
- Dip the tasar silkworm eggs in 5% Depuratex solution for 10 minutes with frequent stirring
- Take out the eggs along with nylon net and rub smoothly in the running water for one or two minutes

- Spread the surface disinfected tasar silkworm eggs in thin layer on the newspaper / blotting paper and allow the eggs for drying at room temperature.

**Salient Features:**

- The process is easy, single step and takes only 10-15 minutes to complete egg washing and surface sterilization
- Depuratex is user friendly and emits rose fragrance
- One liter Depuratex is sufficient for washing and sterilizing of 3000- 4000 tasar silkworm DFLs (6000 to 8000gm)
- This technology doesn't require trained personnel for its usage
- Depuratex has long shelf life of 3 years Price - 130/- per 1 litre

**Jeevan Sudha:**


Jeevan Sudha is a botanical formulation from the medicinal plants to manage virosis in tropical tasar silkworm. Jeevan Sudha is available in fine powder form and in 300gm pockets, which is sufficient for 200 dfls tasar silkworm rearing. Application of 1% aqueous extract of Jeevan Sudha during rearing protects the tasar silkworm from virosis.

**Purpose:**

Control of virosis in tasar silkworm.

**Process**

- Soak Jeevan Sudha powder in clean water for 8-10 hours (overnight) and filter through muslin cloth.
- Instar-wise requirement of Jeevan Sudha Powder for 200 dfl's rearing
- 1st instar : 50 gram or 8 teaspoonful in 5 litre water
- 2nd instar: 100 gram or 15 teaspoonful in 10 litre water
- 3rd instar: 150 gram in or 22 teaspoonful in 15litre water
- Spray filtered solution on the foliage of bushes and on the tasar silkworm larvae, three times i.e., 24 hours after moult during 2nd, 3rd and 4th instar

**Salient Features**

- Jeevan Sudha reduces the viral disease infection up to 37%
- It improves the cocoon yield up to 12 cocoons per dfl
- Price - 174/- per 300gm packet

**Pebrine Visualisation Solution:**


PVS contributes to easy identification of pebrine spores during microscopic examination of mother moth by cleaning debris and making spores prominent & visible in the slide.

**Purpose**

For easy and quick identification of *Nosema mylitensis* spores.

**Process**

- Crush the abdominal portion of mother moth with 4-5 ml of 0.5% $K_2CO_3$ or 2% KOH solution, in pestle and mortar
- Place a drop of Pebrine Visualization Solution with the help of plastic tooth pick on the glass slide
- Mix a drop of crushed abdominal sample with the help of tooth pick or coconut broom stick and cover with cover slip
- Observe under compound microscope at 600 X magnification

**Salient Features**

- PVS is an easy, quick and cost effective (Rs. 1/- per 200 samples) to identify Nosema spores causing Pebrine disease in mulberry as well as Vanya silkworms
- PVS increases visibility by removing/ dissolving tissue debris, fat globules and other non pebrine artifacts in the smear Price: 150 per 100 ml

**Leaf Surface Microbe:**

Leaf Surface Microbes (LSM) of tasar food plants have strong antagonistic action against bacterial pathogen of tasar silkworm.

**Purpose:**

To minimize the bacterial diseases in tasar silkworm.

**Process:**

- Collect 4-5 kg of soil from 6-8 inches below the soil surface and thoroughly mix with 10 litres of water in a bucket
- Allow the suspension for 12 hours (overnight) to allow the soil particles to settle down.
- Collect the supernatant water in a separate container
- Mix the content of supplied LSM ampule (5 ml) with 5 litres of soil water
- Spray the prepared LSM suspension on the leaves of tasar host plants and on tasar silkworm larvae, 24 hours after 2nd moult
- One ampule LSM is sufficient for 100 dfls rearing

**Salient Features:**

- It reduces the bacterial disease infection levels up to 44 %
- It improves cocoon yield up to 12 cocoons per dfl
- Very low-cost technology, approximately Rs. 200 for rearing of 200 dfls
- Price: 60/- per 5 ml ampule.

**Strategy for management of various diseases of *A. mylitta:***

**A. Management of Pebrine disease:**

- The basic requirement in the management of pebrine disease in silkworms is the disease diagnosis.
- The spores of pebrine disease can be observed in the homogenate of the infected egg, larva, pupa, and moth.
- The individual mother moths should be subjected to intensive microscopic examination to produce pebrine free laying.
- Washing and disinfection of the eggs should be carried properly with the use of depuratex (liquid soap developed by CTRTI for tasar egg washing and surface disinfection) to check the spread of disease from the eggs.
- Dust, unhatched and dead eggs, egg shells and feces may be examined for pebrine spores in the grainages.
- Regular inspection of seed cocoon lots by sample pupae examination by the disease monitoring team during I, II & III crop is recommended.

**B. Management of AmCPV disease**

- Tasar Keet Oushadh (TKO) for dusting on the body of worm is recommended, this may be done once in II, III & IV instar and twice in V instar.
- 1.5 kg/100 dfls TKO is required.
- Foliar application of a fresh solution of 0.01% sodium hypochlorite (2.5 ml/ltr) on the worms.
- once each in II, III, IV instars (24 hrs after molt) and twice during V instar (at an interval of 5 days) is recommended.
- The estimated requirement is 50 ml of sodium hypochlorite for 100 dfls rearing.
- Application of Jeevan Sudha (a botanical formulation developed by CTR&TI, Ranchi) during I, II and III instars is advised by CTRTI Ranchi.

**3. Management of bacterial diseases**

- Feeding silkworm with highly nutritious leaves and rearing them under a congenial and hygienic environment.
- Dusting of slaked lime and bleaching powder (9:1 ratio) once in each instar and thrice in the fifth instar on the ground under bushes and over the bushes.
- Application of TKO
- Application of Leaf Surface Microbe (LSM)

**4. Management of muscardine disease**

- Dusting of T.K.O. may be done once in II, III & IV instar and twice in V instar on the body of the larvae before transfer.

- For every 100 dfls rearing 1.5 kg of T.K.O. is required.
- Spraying of 0.5% NaOH on the worms 24 hours after each molt is a useful prophylactic measure.

**Suggested schedule of examination/ monitoring:**

| Sl. No. | Stage | Tentative schedule of examination/monitoring |
|---|---|---|
| 1 | Before brushing | • 15 days prior to brushing, the ground area in and around should be cleared of bushes and weeds.<br>• 10 days before brushing, disinfection of rearing field, trunk of host plants with spray of 2% bleaching powder solution.<br>• Dusting of slaked lime and bleaching powder mixture, in ratio of 9:1 in rearing field. |
| 2 | Larvae | During III stage/ Moult & 5$^{th}$ stage |
| 3 | Pre-pupae/Pupae | Prior to seed cocoon procurement and before preservation (April-May-June for 1$^{st}$ grainage, 15$^{th}$ August to 10$^{th}$ September for 2$^{nd}$ grainage and during October for 3$^{rd}$ grainage) using pebrine visualization Solution (PVS) |
| 4 | Moth | During erratic emergence & grainage operation |

**Schedule of activities to be followed in the field by respective seed producing units:**

| Sl. No. | Stage | Tentative schedule of activities |
|---|---|---|
| **a.** | **Rearing field preparation** | |
| 1 | Pruning/pollarding of host plants. | Plant should be pollarded every three years and light pruning every year in the month of March. |
| 2 | Field burning for ground disinfection. | This should be conducted in the month of March or April after the leaf shed or before sprouting of leaves. |
| 3 | Foliar spray of insecticides for gall insect | Applied once the sprouting of leaves Commences. |
| 4 | Foliar spray of urea | One month before the brushing of worms. |
| 5 | NPK application | Deep root application of NPK through making holes. |
| **b** | **Prior to brushing** | |
| 1 | 15 days before brushing | The ground area in and around rearing site should be cleared of bushes and weeds. |
| 2 | 10 days prior to brushing | Disinfection of rearing field and trunk of host plants with spray of 2% bleaching powder solution need to be carried out. |
| 3 | 5 days prior to brushing | Dusting of slaked lime and bleaching powder mixture in ratio of 9:1 in the rearing field need to be carried out. |
| **c.** | **During rearing** | |
| 1 | Once each in second day of 1st, 2$^{nd}$ and 3$^{rd}$ instar | Foliar spray of Jeevan Sudha is to be done only on the branches where larvae are feeding |
| 2 | Once during 2$^{nd}$ stage | Foliar spray of Leaf Surface Microbes need to be carried out. |
| 3 | Once each in 2$^{nd}$, 3rd, 4$^{th}$ instar andthrice during 5$^{th}$ instar at an interval of 4 days | Dusting of slaked lime and bleaching powder mixture in ratio of 9:1 need to be carried out. |
| **d.** | **After rearing** | |
| 1 | One week after harvest of cocoons | Disinfection of rearing field with spray of 2% bleaching powder solution to be done. |
| **e** | **Prior to procurement of cocoons in the grainage** | |
| 1 | 10 days before consignment of seed cocoons | The Grainage house and appliances should be washed thoroughly with water next day followed by 3% formalin/ 2% bleaching powder solution. |
| 2 | 8 days before consigning the seed cocoons. | Flame gunning of grainage house and Appliances need to be done. |
| 3 | 6 days before consigning the seed cocoons | Spray 5% bleaching powder solution in grainage house and on appliances need to be done. |
| 4 | 4 days before consigning the seed cocoons | Fumigation of the grainage house by a solution of formalin (2 liters), potassium permanganate (500 g) and 3 liters of water need to be done. |
| 5 | 2 days before consigning the seed cocoons | Doors and windows should be opened to remove the fumes |
| 6 | 1 day before consigning the seed cocoons | Sprinkling of slaked lime and bleaching powder (9:1) in and round the grainage house need to be done. |
| | | |

| | | |
|---|---|---|
| **f** | **During consignment of the cocoons** | |
| 1 | Every Day | The floor and the surroundings need to be cleaned with bleaching powder solution. |
| **g.** | **During grainage operations** | |
| 1 | Every day | Floor and verandah needs to be cleaned with 5%bleaching powder solution after completion of each day's grainage operation.<br>Gunny cloth soaked in 5% formalin, 5 % bleaching solution should be used as foot mat tray at grainage door. |
| 2 | Every day | Slaked lime and bleaching powder (9:1) should be sprinkled all round the grainage house.<br>Eggs need to be washed and surface sterilized using Depuratex. |
| **h** | **Disposal of grainage waste** | |
| 1 | Daily after mother moth examination | Cut moths & rejected egg layings should be disposed in soak pits and bleaching powder should be sprinkled. |

## Result and Discussion

In the present study, various technologies developed by CTRTI Ranchi were used for tasar silkworm disease monitoring and management. Rigorous visit was carried out to observe the role of monitoring and controlling the tasar silkworm disease to produce high quality eggs. Disinfection and hygiene are very important aspects of tasar sericulture industry. The availability and quality of food, abiotic factors, predators, parasites, and diseases that impact cocoon yield all constitute challenges to an insect's physiological potential for life. The care of young and late-stage silkworm larvae against diseases, pests, and predators, as well as tending to the worms during the spinning and cocoon-harvesting process are very much needed. Therefore, the disease monitoring team visited the tasar rearing field situated at 10 different states, at various locations, random samples of diseased and control were collected and microscopic examination carried out to ensure the disease incidence which directly relates to the quality DFLs production. The team conveyed the disease management module in entire tasar growing areas**.** Besides this, environmental data was also recorded at various tasar growing regions. Additionally, the Disease monitoring team demonstrated the use of products launched by CTRTI, Ranchi to control the disease incidences in tasar growing areas **(Fig.1).**

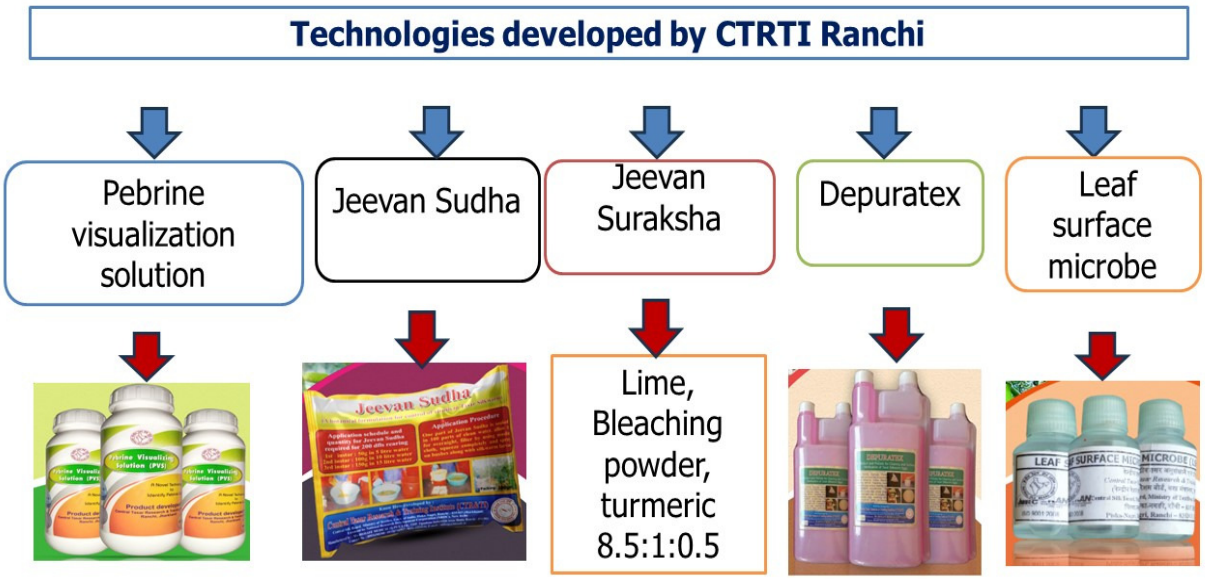


**Fig. 1 :** Integrated disease monitoring and management modules implemented at field level to reduce the disease percentage in field to produce quality seed

The disease incidence data was collected from RSRS, RECs, BSMTCs and BSPUs. Maximum disease was observed in DOS grainage of West Bengal followed by Chhattisgarh, Odisha. Lowest level of disease was observed in Jharkhand (**Table 1**).

**Table 1:** Disease incidence observed in grainages of various states

| Sl.No | State | Cocoon Preserved in grainages | Cocoon recommended for stifling |
|---|---|---|---|
| 1. | Jharkhand | 58,99,005 | 0 |
| 2. | Uttar Pradesh | 1,50,000 | 19000 |
| 3. | West Bengal | 4,51,629 | 114950 |
| 4. | Bihar | 4,52,000 | 0 |
| 5. | Telangana | 6,83,275 | 0 |
| 6. | Chhattisgarh | 52,70,958 | 528300 |
| 7. | Odisha | 30,77,310 | 92930 |
| 8. | Madhya Pradesh | 5,28,500 | 0 |
| 9. | Maharashtra | 7,78,610 | 0 |
| | Total | 1,72,91,287 | 7,35,350 |


This observation signifies the stern implementation of disease monitoring module has carried out in the states having less cocoon rejection due to the disease incidence which depicts a effective impact of following the disease monitoring module which was observed in Jharkhand and other states which showed less disease infection. Positive impact was observed among the rearers after harvesting quality disease free cocoons **Fig.2a-2b.**


**Fig. 2 :** Disease free quality cocoons production after stringent implementation of disease monitoring module **(a)** Harvesting of cocoons **(b)** Counting of cocoons

Additionally, it was noted that the recommended procedures for proper disinfection were followed. After a break of 5-7 days, a solution of sodium hypochloride (NaOCl) (0.01%) (Sahay *et al*., 2008) was sprayed twice on the bushes in the V instar and once in each of the instars II through IV. The incidence of bacterial infection in the tasar silkworm growing area was reduced by the timely application of Leaf Surface Microbe (LSM). Ideally 24 hours after the larvae's moult, the LSM suspension was sprayed onto the leaves of the food plants being used to raise the second instar larvae. Furthermore, during the feeding stage, bushes were sprayed with a botanical formulation called Jeevan Sudha once per instar, twice per second, and three times per instar of the silkworm larvae. In order to identify the pebrine spores during microscopic examination in silkworms, a rigorous three-tier mother moth examination was conducted in tasar grainages using the Pebrine Visualization Solution (PVS). In addition, garlands made of Seed cocoons were kept in the grainage hall. Using jute thread at the tips of the peduncles, garlands made from both male and female cocoons (60:40) were prepared (Fig. 3). To make cleaning the floor easier, the garlands were hung two feet above the floor.

**Fig. 3 :** The garlands prepared for nucleus seed cocoon preservation.

The rearing field's pathogen load was decreased after harvesting by thoroughly disinfecting it with lime and bleaching (9:1). The Standard Operating Procedures from seed cocoon generation, grainage operation, and seed production activities ensure disease-free larvae, pupae, moth, and egg stages in the silkworm disease management module developed by CTRTI Ranchi. Through the use of chemical and physical disinfectants, the pathogen was removed from the silkworm rearing environment. The term "hygiene" describes circumstances and behaviors that support preserving health and halting the spread of illness, particularly through cleanliness. Therefore, the most important factors in determining the future of the tasar silk industry are cleanliness and hygiene. Seasonal variations are affecting the disease incidence/forewarning models that were developed earlier. Even so, a number of precursory indicators, such as the disease percentage at the pupal stage before grainage activities, help formulate strategies to lower the incidence of disease and guide policy decisions. In the present study, the maximum disease incidence was observed in DOS grainage of West Bengal followed by Chhattisgarh, Odisha and Lowest level of disease was observed in Jharkhand state. Weather conditions during the rearing period was recorded at various places. Although correlation among of disease incidence, specific centres and environmental conduction could not be established. It was observed that the disease incidence was more in the state having the average temperate range of 33-37ºC and average humidity ranging from 58-86% during the rearing year. However, Jharkhand, West Bengal, Chhattisgarh and Orissa lies in the Eastern Plateau and Hills Region of the Indian agroclimatic zone. The surge variations in the disease incidences within the same agroclimatic zone can be because of the other environmental factors such as inefficient rearing practice in the area, lack of disinfection of field before and after rearing season. Previous contamination of rearing field with the infection causing pathogenic agent.

## Conclusion

Implementation Disease Monitoring Module at field level is very much necessary to produce quality DFLs in order to enhance the production and productivity of tasar silk industry. This module is

desirable to control pebrine, virosis, bacteriosis, and muscardine. Technologies such as pebrine visualization solution (PVS), Jeevan Sudha, Jeevan Suraksha, Depuratex, Leaf surface microbe (LSM) etc. need to be implemented effectively in the form of integrated disease module. These recommended technologies must be percolated effectively at farmers/stakeholders level through REC, RSRS, BSMTC, DOS, NGOs. The present study revealed that the stern execution of disease monitoring module at field level controlled the spread and infection of tasar silkworm diseases which lead to quality egg production. Therefore, it is suggested to take time to time update of cocoon stock, to have a separate/confined zone for tasar seed, use of virgin tasar food plants for seed crop rearing, use forest patches for seed cocoon production. Additionally, proper maintenance of stock seed cocoon need to done, precaution should be taken to minimize in breeding depression. Outdoor cocoon should be preserved in green shed net. Further adoption of Kurjuli-CKP Model is highly recommended. The disinfection during and before rearing should be carried out using quality bleaching powder and Chuna. Thus, the effective implementation of disease monitoring module in field will be accommodating in reproduction of quality seed in tasar sector to enhance the production and productivity of tasar silk industry in future. Therefore, for accurate prediction of disease incidences and its management disease forewarning models, standard procedure of survey and surveillance need to be developed. Additionally, GPS based monitoring, and environmental factors responsible for enhancement of disease incidences need to be ascertained this is combat the intensity of disease occurrence and hereby pave the way to produce quality seed in tasar silk industry which will intern increase the productivity of seed cocoons.

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