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Research Article

Study of bacterial court (rangi) disease (*streptococcus faecalis*) infection during rearing of mulberry silkworm in different meteorology

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Article Info

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Abstract:

Silkworm Lepidoptera insect is of immense economic importance for the production of silk which is vulnerable to a various microorganisms resulting in crop losses to sericulture industry. It is infected by various disease viz., Pebrine (Fungal disease), Flacherie (Bacterial disease), Grasserie (Viral disease) and Muscardine (fungal disease). Among these, Bacterial court (Rangi) disease caused by Streptococcus faecalis and is commonly observed in all the meteorology but during the summer and winter meteorology, its infection level is more. It is a spore forming obligate intracellular contamination of damaged skin or oral feeding of mulberry leaves that causes the irresistible court rangi disease in silkworm which are transmitted by either horizontal or vertical or transobacterial transmissions. We evaluated the performance of biological and commercial parameters of meteorology in silkworm fed on mulberry leaves. The disease free eggs of Baharaich sericulture grainage Uttar Pradesh were reared in Sericulture Research Laboratory.

The silkworm eggs were incubated at standard conditions for control. Larval rearing was maintained at standard rearing conditions of temperature (26±1°C), Relative Humidity (80±5%), and photoperiod (12hrs light: 12hrs dark). The experiment was laid out in the Completely Randomized Design with six replications. Observation showed significantly greater variations were observed in the mean larval weight (gm) and mean larval length (cm) during all instars i.e. maximum larval weight i.e. 0.076gm, 0.52gm, 3.10gm, 4.10gm, and 6.10gm in 1st, 2nd, 3rd, 4th, and 5th instars, respectively. A similar trend in the mean larval length ($P < 0.05$) was also observed. Significantly greater fecundity (497 no. of eggs), were recorded in the rainy meteorology which were significantly higher as compared to winter and summer meteorology. Similarly, cocoon weight (1.28gm), cocoon shell weight (0.22gm), cocoon

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shell percentage (18.74 %) was recorded found in the rainy meteorology which was significantly greater ($P < 0.05$) than other winter and summer meteorology. We documented that the rainy meteorology is promising and has great potential to perform on mulberry under prevailing meteorological conditions. We also suggest that popularizing sericulture as the allied sector of the agricultural economy needs to exploit the potential of the rainy meteorology for the production of silk yield.

Key words: Streptococcus faecalis, Bacterial court (Rangi) disease multivoltine races, silkworm larvae, cocoon, mulberry leaves, different meteorology rearing

Introduction:

Sericulture is a sustainable, eco friendly and agro-forestry oriented trade comprising cultivation of mulberry plant varieties, rearing of silkworms, and production of silk. It is one of the most labor-intensive sectors and has played a critical role in rural development and economic growth. Most of the marketable silk around the world is being produced from the mulberry silkworm, *Bombyx mori* L. [18]. *B. mori* is an essentially monophagous and host plant-specific insect that feeds solely on mulberry leaves Morus alba, Family: Moracea [14]. Two kinds of silk proteins have been distinguished as major components of silk cocoons, the first being fibroin a fibrous protein secreted in the lumen of the posterior silk gland of Bombyx mori and the second being sericin, a natural macromolecular protein that serves as an adhesive to unite fibroin for making silk cocoons of silkworm, *B. mori* [13]. There are several factors that influence silk production, in which insect is the important component and, among the insects that attack silkworm. Bacterial court (Rangi) disease is soil dwelling and mulberry leaves surface bacterium that naturally produces a toxin that is fatal to herbivorous silkworm insect. The toxic produced by Streptococcus faecalis has been used as spray and is commonly used in mulberry garden. Streptococcus faecalis is also the source of the genes used to genetically modify a number of food crops so that they produce the toxin on their own deter various insect. The toxin is lethal to several orders of insects including Lepidoptera though a number of Streptococcus faecalis strains are available to make its use more targets specific. Susceptible vigorous feeding must ingest toxin crystals in order to be affected the larval life and commercial life. In contrast to poisonous that target the nervous system, haemolymph and skin, in this bacterial disease the affected dead larvae turn flaccid and the colour changes to crimson red. This disease is also commonly known as Rangi due to this formation of crimson red colour. Streptococcus faecalis toxin acts by producing a protein that blocks the digestive system and nervous system of the insect, effecting starving it, toxin is a fast acting insecticides and infected insect will stop feeding within hours of feeding of mulberry leaves and infected insect will die generally from starvation or a rupture of the digestive system within day.

Materials and Methods:

The experiment was conducted on Bacillus thuringiensis to study the infestation and damage caused by Bacillus thuringiensis for silkworm rearing during two different meteorology i.e., summer and rainy meteorology. The freshly egg laying of experimental race multivoltine mulberry pure Mysore were kept in incubation at 26±1ºC till hatching, after hatching they were brushed with feathers and kept in a rearing tray and fed with tender leaf and chopped mulberry leaves. Silkworm larvae were reared up to third moult in conventional leaf feeding method. After the third moult, the larvae were divided into 2 batches and each batches with three replications. Each replication was maintained with 200 larvae in each rearing tray. One batch

was treated as control whereas experiment was conducted by taking all precautionary measures in the rearing room to prevent the entry of Streptococcus faecalis. Another batch was considered as experimental where rearing was conducted under uncontrolled condition in a rearing room, where no precautionary measure was taken to prevent the entry of Streptococcus faecalis, and rather than there had been the provision for Streptococcus faecalis to oviposit. Oviposition of Streptococcus faecalis on reared silkworm larvae and their subsequent development of court bacterial disease had been studied elaborately and recorded. During the whole experiment the Oviposition behavior of Streptococcus faecalis was marked meticulously. All the rearing data of the experiment as well as relative humidity 80±5%RH and temperature 26±1ºC maintained in the rearing room were recorded during the experiment during different meteorology at control. For better embryonic development and uniform hatching, eggs were spread as a single layer on the sheet and black boxed [9,4,12]. We reared the first three larval instars at 26 ± 1 °C and 80±5% RH while the 1^{st} and 5^{th} instar larval. Incidence of Streptococcus faecalis and also the pattern of oviposition were recorded in every experiment along with control in the respective meteorology. Pattern was recorded on the basis of position of the rearing tray placed in the rearing room serial wise from top to bottom. Study of Bacillus thuringiensis (Bt) [17] infestation during rearing of mulberry silkworm in different meteorology in laboratory was undertaken to overcome the infestation of Streptococcus faecalis in silkworm in context of different meteorology rearing observation as detailed in tables, along with observation of weather parameters and effect of meteorology fluctuation affected by Bacterial court (Rangi) disease caused by Streptococcus faecalis. Data were recorded for the following parameters: Larval weight (gm) which was calculated at the end of each larval stage by weighing five larvae selected randomly by using an electronic balance. Larval length (cm) which was measured by selecting five larvae randomly at the end of each larval instar by using the measuring tape Cocoon weight (gm) was determined by taking ten cocoons (05 female + 05 male cocoons) randomly from each replication on the 7th day of spinning. Other calculation was as:

Cocoon weight (g) = (weight of 05 female cocoons + weight of 05 male cocoons)/10.

Shell Weight (g) = Cocoon weight with pupa (gm) ‧ Cocoon weight without pupa (gm).

Shell percentage (%) =shell weight (gm)/(cocoon weight (gm)×100.

Fecundity (no.): This was determined by counting eggs laid by five females in each replication for each silkworm in different meteorology.

Statistical observation the experiment was laid out in completely randomized design with six replications each containing 200 larvae. Each value was expressed as the Mean ± Standard Deviation (SD) of six observations. Data on various parameters commercial and biological parameters were analyzed by applying ANOVA ($P< 0.05$).

Result and Discussion:

Investigations from the study revealed that the infection caused by Bacterial court (Rangi) disease caused by Streptococcus faecalis during rearing of mulberry silkworm, Bombyx mori Linn is significantly lower (4.99gm in winter, 5.71gm in summer and 6.10gm in rainy meteorology) in the fifth instar silkworm larvae weight in respect to control rearing as 6.35gm and the larval length in different meteorology significant lower (0.69cm in winter, 0.71cm in summer and 0.72cm in rainy meteorology) in the fifth instar larva in respect to control 0.75cm in length of larvae. All the observation of rearing larval stage of 1^{st} , 2^{nd} , 3^{rd} , 4^{th} instar

larva in different meteorology with Bacterial court (Rangi) disease caused by Streptococcus faecalis the impact of their larval life is lower of larval weight respective larval stages as 0.072gm, 0.48gm, 2.88gm, 3.99gm in winter meteorology, 0.074gm, 0.45gm, 2.95gm, 4.01gm in summer meteorology and higher to 0.076gm, 0.52gm, 3.10gm, 4.10gm at rainy meteorology due respect lower to control stage of larval stages as compare significant impact of Bacterial court (Rangi) disease caused by Streptococcus faecalis as 0.078gm, 0.54gm, 3.15gm, 4.35gm to control parameter. Streptococcus faecalis infection during rearing of mulberry silkworm in different meteorology also affected the cocoon and economic traits of silkworm as cocoon weight, cocoon shell weight and cocoon shell percentage like lowers the weight and percentage are 1.23gm in winter, 1.25gm in summer, 1.28gm in rainy but the lowers from control as 1.35gm as cocoon weight. The data obtained from shell weight in different rearing meteorology is lower in 0.19gm in winter, 0.20gm in summer, 0.22gm rainy meteorology due to respect of control 0.25gm. Similarly the cocoon shell percentile and fecundity rate lower in winter like 15.66%, 16.20% in summer, 17.50% in rainy meteorology respect to control 18.73% and the fecundity rate of egg laying is lower in 410 in winter, 425 in summer, 497 in rainy meteorology but the ideal control parameters the fecundity rate is higher 505 no. of eggs.

Table: It shows that study of bacterial disease Streptococcus faecalis infection during rearing of mulberry silkworm in different meteorology.

Different stages of silkworm Streptococcus faecalis infected stages	CONTROL PARAMETERS OF SILKWORM LARVAE	DIFFERENT METEOROLOGY		
		SUMMER METEOROLOGY	WINTER METEOROLOGY	RAINY METEOROLOGY
Fecundity No. egg lays	505±2.06	425±3.64	410±4.44	497±3.01
1st instar larva (gm)	0.078±0.01	0.074±0.01	0.072±0.01	0.076±0.01
2nd instar larva (gm)	0.54±0.03	0.45±0.02	0.48±0.03	0.52±0.03
3rd instar larva (gm)	3.15±0.05	2.95±0.04	2.88±0.03	3.10±0.02
4th instar larva (gm)	4.35±0.03	4.01±0.05	3.99±0.04	4.10±0.05
5th instar larva (gm)	6.35±0.04	5.71±0.06	4.99±0.04	6.10±0.06
Larval length (cm)	0.75±0.03	0.71±0.01	0.69±0.02	0.72±0.03
Cocoon weight (gm)	1.35±0.001	1.25±0.002	1.23±0.003	1.28±0.002
Shell weight (gm)	0.25±0.003	0.20±0.003	0.19±0.002	0.22±0.004
Cocoon shell%	18.73±0.07	16.20±0.06	15.66±0.004	17.50±0.005

Table1: Different stages of silkworm Streptococcus faecalis infected stages

Fig1: Study of bacterial disease Streptococcus faecalis infection during rearing of different larval weight, larval length, Cocoon weight, Cocoon shell weight of mulberry silkworm in different meteorology

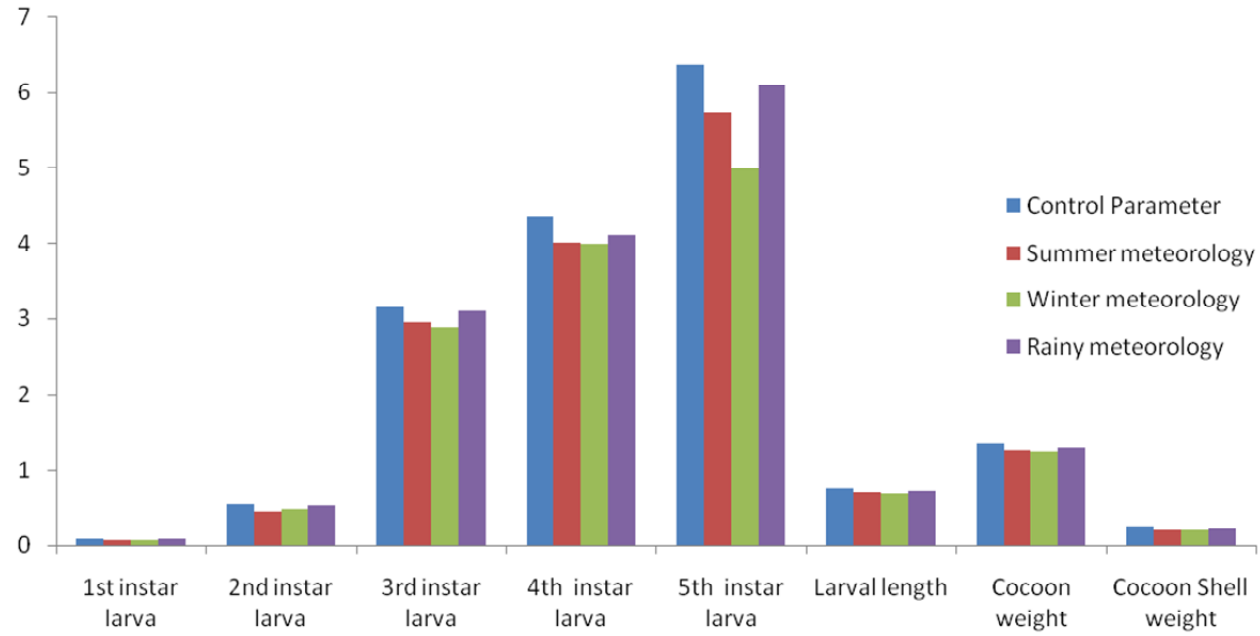
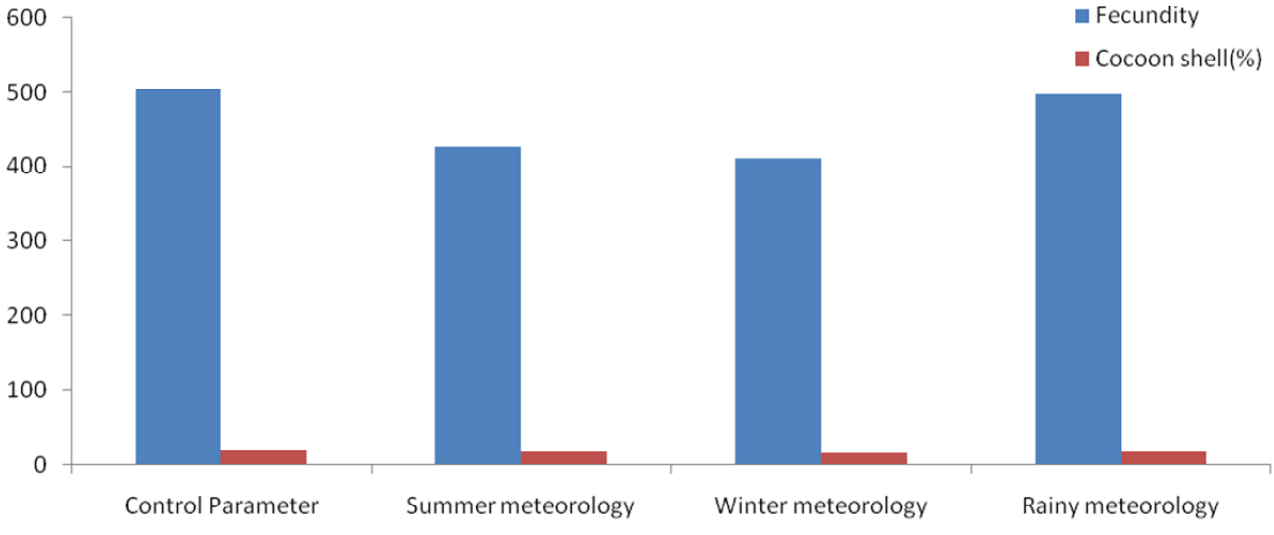


Fig2: Study of bacterial disease Streptococcus faecalis infection during rearing fecundity and Cocoon shell of mulberry silkworm in different meteorology



These results indicated that a bacterial disease Streptococcus faecalis infection during rearing of mulberry silkworm in different meteorology got higher in the rainy meteorology as compared to the summer and winter meteorology. We recorded significant differences in the larval length and larval weight in all instars among mulberry silkworm Bombyx mori Linn. Larval length varies in different races and depends mainly on the mulberry varieties and rearing conditions [7]. Larval weight showed significant variations ($P < 0.05$) of mulberry Bombyx mori races when reared on mulberry varieties [2]. Earlier studies reported a significant interaction between mulberry varieties and Bombyx mori races for larval length, larval weight, and cocoon shell ratio [10,3,16,4,11,8,19]. The studies have revealed that mature larval weight, single cocoon weight, shell weight, and shell percentage were greatly influenced by the nutritive value of different nutritional requirement of mulberry leaves [15].

However, the silkworm race contributes 4.20 % [16] to silkworm productivity. Different species of mulberry may have compositional differences and might lead to varying effects on Bombyx mori growth and silk productions [5,6,7]. In another study, the results showed the significant variations of silkworms when reared on different mulberry species [1]. Our study showed that the multivoltine mulberry Pure Mysore race has the potential to perform well when fed on tender fresh mulberry at rainy meteorology. The seed of this race may be provided to the silkworm rearers having sufficient naturally growing fresh disinfected mulberry plantations. However, the rainy meteorology showed better results as compared to the other two meteorology (summer and winter), for cocoon production and biological parameters. We suggest popularizing sericulture in India depends on the utilization of mulberry resources and improving silk seed by conducting trials for developing hybrid silk seed for better yield production of silk by rearers. Moreover, silkworm rearing is continuous throughout the year alternated with seed crop and commercial crop. It can be concluded from the experiment that rainy meteorology rearing is more beneficial than other rearing meteorology where no precautionary measures are indicated to prevent Streptococcus faecalis. Best silk yield can be obtained in the rainy meteorology following to the other rearing practices.

Conclusion:

Sericulture industry can develop the rural economy of any state as it is a part of the tradition and culture of the local populace and hence is an eco friendly production process with skilled households. It is one of the most promising income resources without spending much for its cultivation and better utilization with the knowledge of the mulberry plant nutrient sources and meteorology suitability. The optimal levels of macronutrients in the host plants are sufficient for silkworm larval growth, larval length, cocoon productivity whereas high levels of micronutrients are very much essential for better silk quality. The findings of the present study can form a platform for further research on silkworm pathology especially under the agro meteorological conditions. Such mulberry varieties and silkworm strains can be recommended for more field trials by rearers and can be used for sustainable growth and development of the sericulture industry.

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