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EFFECT OF DISINFECTANTS AND ANTIBIOTICS ON DISEASES AND ECONOMIC PARAMETERS OF $CSR_2 \times CSR_4$ *RACE* OF MULBERRY SILKWORM, *BOMBYX MORI* L.

PRACHI RATHOD[1] and SURESH MASRAM[1,2]
[1]P.G.T. Department of Zoology, RTM Nagpur University, Nagpur-440033, India
[2]Centre of Sericulture and Bioresource Management Research (CSBR), RTM Nagpur University, Nagpur-440022, India

ABSTRACT

The present study was undertaken to evaluate the performance of the bivoltine silkworm, dihybrid ($CSR_2 \times CSR_4$) race of silkworm, *Bombyx mori* L, under different climatic conditions of Vidarbha, Nagpur. The rearing was carried out under controlled laboratory conditions by adopting the standard methods. Evaluation of various plant-oriented herbicides such as karanj (*Pongamia pinnata)*, neem (*Azadirachta indica)*, tulsi (*Ocimum tenuiflorum*) as a part of disinfectant and were compared with RKO. Antibiotics such as Ofloxacin and Azithromycin also used as preventive measure of diseases. The efficacy of disinfectants and antibiotics used during larval rearing of $CSR_2 \times CSR_4$ hybrid. The parameters such as survival, cocoon weight, shell weight, shell ratio, filament length, fecundity, and egg hatching were compared. The results suggests that highest mortality was in control during Monsoon and Summer whereas the lowest with Oxfloxicin during all the seasons. Cocoon weight was highest with the treatment with both the antibiotics and lowest with *P. pinnata* during winter and summer whereas shell ratio was highest when treated with Neem and Tulsi powder and lowest with antibiotic. Number of eggs laid by females and hatching were highest during winter compared to other season when Neem Tulsi and *P. Pinnata* were used as disinfectant compared to other treatment and control.

KEY WORDS: *Bombyx mori,* Mulberry silkworm, $CSR_2 \times CSR_4$, disinfectants, antibiotics.

INTRODUCTION

Sericulture is the rearing of silkworms to produce raw silk. The major activities of sericulture comprise of food-plant cultivation to feed the silkworms, and rearing and silkworm to obtain silk cocoons and unwinding the silk filament for value added benefits such weaving to obtain fabric. Among the several commercial species of silkworms, *Bombyx mori* is the most widely used for silk cocoon production. Silk-fibre is a protein produced from the silk-glands of silkworms. Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen, and inherent affinity for dyes, high absorbance, light weight, soft touch, and high durability and known as the "Queen of Textiles" the world over. Sericulture is ideally suited for improving the rural economy of the country, as it is practiced as a subsidiary industry to agriculture. Recent research has also shown that sericulture can be developed as a highly rewarding agro-industry.

The domesticated silkworm, *B. mori*, is a monophagous insect that can be raised on only mulberry leaves (*Morus alba* L.), These silkworms are susceptible to a number of diseases caused by different infectious microorganisms (Doreswamy *et al*., 2004). The cocoon loss due to diseases in India is estimated to be about 15-20 kg per unit of 100 disease free layings which accounts for about 30 per cent of total loss (Selvakumar *et al*., 2002).

Several diseases caused by bacteria, viruses, fungi, and protozoa causing flacherie, grasserie, muscardine and pebrine diseases respectively affect the silkworm. It is best to prevent silkworm diseases than curing them (Swathi *et al*., 2014). This is achieved by adoption of proper and

*Corresponding author email: suresh.masram@gmail.com

effective methods of disinfection and stepwise maintenance of hygiene during rearing. In order to curb the diseases during silkworm rearing, different bed disinfectants and disinfection methods have been evolved in successful cocoon crop production.

An antibiotic is a concoction substance, produced by micro-organism, life forms, which can suppress the development of and even to annihilate different microorganisms. The activity of an antibiotic against micro-organisms is particular in nature, a few life forms being influenced and others somewhat, each antibiotic is thus characterized by a specific antimicrobial spectrum. The antibiotics supplemented mulberry leaves enhance the growth and development of silkworm. Oral supplementation of anti-infection agents along with mulberry leaves to sound silkworm helps in the development, fertility and silk contents and decreases the frequency of diseases (Tayade *et al*., 1988). Antibiotics in silkworm are approved for four different purposes: disease treatment, disease prevention, disease control and for health maintenance or growth promotion (Phillips *et al*., 2004). Hence, the present study has been undertaken to evaluate the efficacy of different bed disinfectants and antibiotics on incidence of diseases and economic parameter of double hybrid race $CSR_2 \times CSR_4$ of mulberry silkworm, *Bombyx mori* L.

MATERIALS AND METHODS

The present investigation was undertaken during all the three monsoon, winter, and summer seasons. The experiment was undertaken at Centre of Sericulture and Bioresource Management Research (CSBR), RTM Nagpur University, Nagpur. Each treatment consisted of 100 silkworms. Disease free layings (DFLs) of bivoltine double

Table 1: Effect of disinfectants and antibiotics on mortality and cocoon formation during different season by $CSR_2 \times CSR_4$ race of silkworm, *B. mori.*

A. Monsoon							
Treatment	Larvae	Mortality			Cocoons formed		
	used	Flacherie	Grasserie	Total	Healthy	Flimsy	Total
Control	100	14	04	18	54	28	82
P. pinnata	100	10	00	10	80	10	90
Tulsi powder	100	10	06	16	76	08	84
Neem powder	100	08	04	12	82	06	88
Azithromycin	100	06	02	08	76	16	92
Ofloxacin	100	08	00	08	78	14	92
B. Winter							
Treatment	Larvae	Mortality			Cocoons formed		
	used	Flacherie	Grasserie	Total	Healthy	Flimsy	Total
Control	100	06	00	06	90	04	94
P. pinnata	100	05	01	06	91	03	94
Tulsi powder	100	09	01	10	87	03	90
Neem powder	100	07	02	09	89	02	91
Azithromycin	100	05	00	05	95	00	95
Ofloxacin	100	04	01	05	95	00	95
C. Summer							
Treatment	Larvae	Mortality			Cocoons formed		
	used	Flacherie	Grasserie	Total	Healthy	Flimsy	Total
Control	100	07	02	09	88	03	91
P. pinnata	100	08	00	08	92	00	92
Tulsi powder	100	06	02	08	91	01	92
Neem powder	100	05	00	05	94	01	95
Azithromycin	100	04	02	06	94	00	94
Ofloxacin	100	02	02	04	95	01	96

Table 2: Effect of disinfectants and antibiotics on economic characters and silk formation during different season by $CSR_2 \times CSR_4$ race of silkworm, *B. mori.*

A. Monsoon						
Treatment	Cocoon weight (g)	Shell weight (g)	Shell ratio (%)	Silk length (m)	Silk weight (g)	Denier
Control	1.250±0.047	0.255±0.016	20.46±0.34	1004.64±15.15	0.320±0.006	2.869±3.563
P. pinnata	1.320±0.047	0.266±0.011	20.04±0.23	1208.16±21.66	0.341±0.005	2.543±2.077
Tulsi powder	1.349±0.099	0.262±0.012	20.25±0.15	1114.92±29.67	0.327±0.009	2.436±2.729
Neem powder	1.440±0.036	0.297±0.006	20.52±0.17	1088.28±16.57	0.395±0.006	3.274±3.258
Azithromycin	1.493±0.154	0.195±0.014	20.33±0.15	1214.80±22.56	0.349±0.004	3.098±1.176
Ofloxacin	1.465±0.044	0.221±0.009	20.35±0.16	1195.32±28.57	0.338±0.005	2.681±2.331
B. Winter						
Treatment	Cocoon weight (g)	Shell weight (g)	Shell ratio (%)	Silk length (m)	Silk weight (g)	Denier
Control	1.360±0.043	0.284±0.008	20.90±0.19	788.20±88.70	0.218±0.008	2.486±0.811
P. pinnata	1.263±0.063	0.264±0.014	20.88±0.22	802.80±25.63	0.210±0.013	2.489±4.564
Tulsi powder	1.340±0.065	0.285±0.004	21.27±0.62	744.72±11.60	0.230±0.003	2.453±2.327
Neem powder	1.445±0.056	0.309±0.010	21.46±0.18	999.84±26.93	0.317±0.004	2.853±1.336
Azithromycin	1.448±0.059	0.299±0.007	21.27±0.62	1144.72±11.60	0.239±0.009	2.743±4.558
Ofloxacin	1.496±0.041	0.318±0.006	20.53±0.17	1098.90±24.44	0.289±0.004	2.575±4.635
C. Summer						
Treatment	Cocoon weight (g)	Shell weight (g)	Shell ratio (%)	Silk length (m)	Silk weight (g)	Denier
Control	1.402±0.054	0.307±0.006	21.90±0.11	954.84±21.89	0.241±0.001	2.271±0.411
P. pinnata	1.298±0.049	0.275±0.015	21.18±0.61	977.64±92.30	0.324±0.007	2.982±0.617
Tulsi powder	1.482±0.054	0.333±0.004	22.46±0.40	1053.00±49.40	0.267±0.006	2.282±1.092
Neem powder	1.399±0.046	0.297±0.011	21.22±0.91	979.80±24.86	0.267±0.006	2.282±1.092
Azithromycin	1.485±0.044	0.286±0.007	20.14±0.90	1078.88±31.39	0.185±0.003	2.110±0.860
Ofloxacin	1.499±0.058	0.288±0.008	21.60±0.18	1077.40±30.37	0.244±0.006	3.023±1.325

hybrid, *Bombyx mori* ($CSR_2 \times CSR_4$) procured from NSSO, Bengaluru were reared on the leaves of mulberry variety Knva2M5. About 600 newly moulted third instar larvae were distributed in 6 trays, having 100 each. About 10 larvae were weighed individually before applying disinfectants. Trays were coded as T1, T2, T3, T4, T5 and T6. The dosages of different disinfectants were prepared as described below;

T1 - Application of RKO (Resham Keet Oushad powder).

T2 - Application of 5% Karanj (*Pongamia pinnata*) (5g Karanj leaf powder + 95g RKO).

T3 - Application of Tulsi (*Ocimum tenuiflorum*) dry powder in pure form.

T4 - Application of 10% Neem (*Azadirachta indica*) (10g Neem leaf powder + 90g RKO)

T5 - Application antibiotic Ofloxacin (0.5mL mixed with 50mL distilled water).

T6 - Application of antibiotic Azithromycin (2.5mL mixed with 50mL distilled water).

The mixture of different disinfectants using 2g, 4g and 6g dusted daily during third, fourth and fifth instars development in their respective groups (T_2, T_3, and T_4)trays used for treatment. Similarly, antibiotics about 500µl solutions sprinkled on the mulberry leaves, air dried and then fed to the larvae of the respective group (T_5 and T_6) used for the antibiotic treatment. The larvae of control group received normal feeding and dusting using RKO

(T_1). The experiment was repculture was maintained using rearing environment suggested by (Krishnaswami, 1986).

RESULTS

The efficacy of various surface disinfectants and antibiotics to prevent the occurrence of diseases, larval mortality, and economic parameters has been studied using CSR_2 x CSR_4 race during the different seasons. During the monsoon larval mortality was higher as compared to winter and summer. The mortality was highest 18% in control with RKO, during monsoon followed by 16%, 12%, and 10% with Tulsi, Neem and *P. pinnata*, powder respectively while 8% occurred with both antibiotics. During winter mortality was higher in tulsi treated group than with other disinfectant treated groups and the lowest with antibiotics and similar trend were recorded also in summer season. The application antibiotic resulted lowest mortality specially during winter and summer as compared to the disinfectants and control (Table 1).

The average cocoon weight was always highest during summer then followed by winter and least during monsoon season when larvae treated with antibiotics. Among the disinfectants used weight of cocoons were higher with Tulsi powder during summer season and Neem produced cocoons with higher weight during winter and monsoon. *P. Pinnata* produced cocoons weighing even lower than control group as observed during winter and summer. In control when larvae were treated with only RKO produced cocoon of lower weight (Table 2). Shell ratio was highest with the Tulsi treatment during summer season, however no significant difference was noticed in shell ratio of other treated groups and control. Silk length was highest 1214 meters and 1208 with Azithtromycin and *P. pinnata* respectively during monsoon, and as no significant difference in the length was noticed among others, however significantly lower silk length was observed in control, *P. pinnata* and tulsi powder. Silk denier was higher 3.274 and 3.098 during monsoon Tulsi and Azythromycin respectively. No significant difference was recorded in the silk denier amont all the treated and control groups (Table 2).

The female fecundity of double hybrid CSR_2 x CSR_4 has been presented in Table 3. Above 600 eggs laid by the females during winter, when larvae treated with Tulsi, Neem and Azythromycin compared to other groups, whereas, significantly lower number of eggs 472 during monsoon and 496 during summer laid by the females of control groups than the other treated groups during all the three seasons. Egg hatching was higher during summer and winter with Tulsi powder, however no seasonal effect was observed on hatching percent. Among all the treated and control groups no significant variation in egg hatching percentage was recorded (Table 3).

DISCUSSION

Disinfection and maintenance of hygiene are the most important for the successful rearing of silkworm and production of healthy cocoons, silkworm larvae must be protected from the infection of various pathogens. The diseases in silkworm appears in the larvae, therefore, the larvae must be protected by using various disinfectants and antibiotics such as karanj *Pongamia pinnata*, neem *Azadirachta indica*, tulsi *Ocimum tenuiflorum* and antibiotics Ofloxacin and Azithromycin were evaluated by feeding them to the silkworms by topical application on the mulberry leaves during different seasons monsoon, winter, and summer.

In India considerable fluctuations occur in the nutritional value and composition of the mulberry leaves depending on factors such as weather, pests, diseases and agricultural practices which have an immense impact on growth and development of silkworm which in turn results in crop loss (Ito, 1978). The bed disinfectant Labex

Table 3: Effect of disinfectants and antibiotics on egg laying and hatching during different seasons by $CSR_2 \times CSR_4$ race of silkworm, *B. mori.*

Treatment	A. Monsoon		B. Winter		C. Summer	
	Eggs Laid (No.)	Eggs Hatched (%)	Eggs Laid (No.)	Eggs Hatched (%)	Eggs Laid (No.)	Eggs Hatched (%)
Control	472± 23.5	97.0	556±41.0	98.0	496±26.4	96.0
P. pinnata	537±18.4	98.9	593±20.3	99.0	593±11.2	98.0
Tulsi powder	564±05.9	91.0	603±16.4	99.0	581±16.5	99.0
Neem powder	504±14.5	95.2	610±14.9	92.0	515±17.7	97.0
Azithromycin	562±24.6	94.0	607±17.6	98.0	570±21.1	98.0
Ofloxacin	544±07.3	92.0	580±9.84	96.0	591±3.52	98.3

was very efficient in almost all the parameters observed under the study in the Bihar region viz. less larval duration and higher larval weight. As the disease management is the major part in the success of the silk rearing the labex seems to have performed very well with higher ERR percentage. So, the same may be recommended for the disease control in mulberry silkworm rearing areas of Bihar as well as eastern India for better yield (Singh, 2023)

Dhirwani *et al*. (2015) while conducting experiment using plant-based disinfectants such as, neem, amla, haldi, ber, Tulsi compared with RKO and other chemical disinfectant and found that larval mortality was nearly 1% and 4% with amla, Tulsi, and Turmeric + RKO, Pure Turmeric and RKO produced 12, 16 and 20 per cent larval mortality respectively as compared to untreated control. The similar results have also been reported by Ayandokan *et al.* (2017).

Mulberry leaves sprayed with antibiotics have influence on development in silkworm. Oral supplementation of antibiotics with mulberry leaves resulted in the increased growth and silk production and it has been reported that the useful activity of the antibiotics can be ascribed to enhance action of anti-infection agents which diminishes fundamentally the occurrence of flacherie and grasserie (Tayade *et al*., 1988).

The antibiotics 0.05% and 0.1% used during rearing of larvae of silkworm *B. mori* larvae reduced the occurrence of diseases (grasserie and flacherie) in contrast to control (Baig *et al*., 1990). Supplementation of ampicillin was more effective than streptomycin which reduced the larval mortality and increased the larval, cocoon and shell weights (Sridar *et al*., 2000)

Antibiotics like Penicillin, Ampicillin and Streptomycin have been found successful in decreasing the mortality of silkworms by 23-25% (Santha *et al*., 2007). In the present study mulberry leaves applied with Oflaxacin and Azithromycin have also reduced the mortality during rearing and increased the larval survival, cocoon formation and shell weight which produced higher denier.

Iqra *et al.* (2021) have reported, mulberry leaves sprayed with antibiotics influenced the development in silkworm by increasing the resistance against pathogens and lowered the mortality in silkworm and played a vital role in the improvement of disease resistance and growth enhancement in farm animals and insects. The highest fecundity (504 eggs) with the application of lime + paraformaldehyde, followed by lime (482 eggs) and formalin (462 eggs) have been reported by Jadhav (1990). In the present study high fecundity and egg hatching was higher during winter and followed by summer and monsoon where as higher egg hatching percent was recorded during summer followed by winter and then monsoon. Both antibiotics and botanicals were effective in producing higher hatching percent than control group.

CONCLUSIONS

In the present study efficacy of different disinfectant and the antibiotics have been evaluated using bivoltine silkworm, dihybrid ($CSR_2 \times CSR_4$) race of silkworm, *Bombyx mori* L, under climatic conditions of Vidarbha. Various plant herbicides such as karanj (*Pongamia pinnata)*, neem (*Azadirachta indica)*, tulsi (*Ocimum tenuiflorum*) and Antibiotics Ofloxacin and Azithromycin. The efficacy of disinfectants and antibiotics used during larval rearing of $CSR_2 \times CSR_4$ hybrid. The results of the present study suggest that highest mortality recorded in control during Monsoon and Summer, whereas the lowest mortality was with Oxfloxicin during all the seasons. Cocoon weight was highest with the treatment with both the antibiotics and lowest with *P. pinnata* during winter and summer, whereas highest shell ratio when treated with Neem and Tulsi powder and lowest with antibiotic. Eggs laid by females and hatching were highest during summer and winter compared to other season when Neem Tulsi and *P. Pinnata* were used as disinfectant compared to other treatment. Thus the from the present study it can be concluded that the antibiotic and herbicid may be used to precvent the larval mortality especially during monsoon and even other seasons to prevent diseases and obtaining high cocon shell percentage and even fecundity.

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