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EFFECT OF THRIPS (*PSUDODENDROTHRIPS MORI* NIWA) INFESTED MULBERRY LEAVES ON BIOCHEMICAL AND ECONOMIC PARAMETERS OF SILKWORM, *Bombyx mori* L.

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Mulberry, (*Morus alba* L.*)* leaves are the predominant food source for silkworm, *Bombyx mori* L. that has been attacked by number of insect pests and pathogens. Among the sucking pests, thrips, (*Pseudodendrothrips mori Niva)* is a dominant pest causing enormous damages to mulberry leaves. Rearing of silkworm with thrips infected mulberry leaves affects growth, development and causes to reduce silk production. The present study deals with silkworm larvae fed with thrips infested mulberry leaves on biochemical and economic parameters. The biochemical parameters such as protein, lipid, carbohydrate and glycogen content, were studied in tissues of larvae like haemolymph, silkgland and fatbodies. The result showed that there was decreased in protein, lipid, carbohydrate, glycogen contents, when the larvae fed with thrips infested mulberry leaves than control. Maximum decrease (-53.80%) was noticed in the lipid content. There was also decreased in the economic characters such as cocoon weight (-20.26%), shell weight (-43.75%), shell ratio (-7.48%), filament length (-30.19%), reliability (-29.28%) and denier (-25.22%)due to feeding of thrips infested mulberry leaves when compared to control.

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1. INTRODUCTION

"Mulberry (*Morus spp.*) is the sole food plant of monophagous insect, *Bombyx mori.* Silkworm nutrition is of great applied value which involves chemical and physiological activities transforming food into body structure. In insect fed with biochemical substances activate various metabolic processes resulting in growth and development" [1]. "Major biomolecules such as proteins, carbohydrates and lipids play an important role in biochemical process underlying growth and development on insects" [2]. "Although mulberry is a complete diet for silkworm, sometimes it is possible that some deficiencies occur due to different reasons. The production of qualitative and quantitative effects of mulberry leaves is affected by several number of factors such as, diseases (24%), insect pests (18%), weeds (7 %) and others (51%). The major pests of mulberry are Leaf roller, Thrips, Bihar hairy caterpillar, Cut worm (Lepidoptera), Jassid, Spiralling white fly, Mealybug, Scale insect (Homoptera)" [3]. "The thrips *Pseudodendrothrips mori Niwa* was found to be most dominant species in different parts of world and one of the important saps sucking insect pests of mulberry plant" [4,5]. "Among the sap feeders infesting mulberry, incidence of thrips is highest (42.25%), followed by mealy bugs (20.50%), leaf hoppers (20.28%) and scale insects (1.65%)" [6]. "*Psudodendrothrips mori* feed on fully expanded leaves and young tissue in the buds. Infested leaves dry out and have a stippled or silver flecked appearance. Small brownish specks of excrement will usually be noticed on the underside of the leaves" [7]. "Mulberry thrips have caused serious damage to sericulture in the southern states of India" [8]. "Mulberry thrips reduces the moisture by 3.57%, therefore has a negative impact on the quality of the leaves consumed by silkworm" [9]. "The variation in the nutrient contents may be attributed to damage caused by the insect altering the metabolic functions leading to either increase or decrease in protein synthesis and mobilization of proteins for repair of the damaged tissues in order to develop resistances" [10]. "The altered post infestation biochemical composition may be because of disturbed host metabolism due to pest attack" [11]. "The leaves become unfit to feed the silkworms. Incidence of the thrips infested mulberry leaves are used for feeding the silkworms, that leads to poor growth of silkworms and more susceptibility to diseases followed by heavy mortality. Live silkworms that escape mortality spin only flimsy cocoons with poor silk content which leads to economic loss to the farmers"[12,13]. The present study explores to assess the biochemical parameters in tissues (haemolymph, silkgland and fatbodies) and commercial parameters in silkworm larvae fed with thrips infested mulberry leaves and un infested mulberry leaves.

2. MATERIALS AND METHODS

2.1 Experimental Setup

Studies were conducted in the PG and research center of Muslim arts college, Thiruvithancode, Kanyakumari district, Tamil Nadu, India during April-July 2022, when large number of thrips population was observed in the mulberry gardens. Each plot measured 3x1.5m width 10 mulberry plants in a paired row. Mulberry variety, MR2 was used under irrigated condition. Randomized block design was followed with 9 treatments and each replicated thrice.

2.2 Maintenance of Silkworm Rearing

Fresh diseases free layings (DFL_s) (3 numbers) of PM x CSR_2 multivoltine race was purchased from Government sericulture form, Nannagram, Tirunelveli district, Tamilnadu, India. "The silkworm larvae were divided into two lots and each having 100 larvae with 3 replications and reared in the laboratory under 32 ± 2^0C temperature with RH of 65±70% and photoperiod of 16L: 8D. The healthy (control) and thrips infested leaves were fed to silkworm larvae (experimental) separately from third instar onwards, four feedings per day"[14].

2.3 Collection of Haemolymph, Silk Gland and Fatbody from Silkworm Larvae

Haemolymph was collected in glass capillary tube using a pinch of n-phenylthiourea by puncturing at the base of the prolegs separately from a few fifth instar *Bombyx mori* larvae [15] and centrifuged at 3000 rpm for 10 minutes. The supernatant was removed and kept in -20^0C for the determination of protein, lipid, carbohydrate and glycogen.

2.4 Prepration of Silk Gland

Silkglands were collected by dissecting the fifth instar larvae and allowed for 5-7 minutes in the buffer, transferred to a sterilized glass homogenizer and homogenized with 20% (W/V) 50mM Tris-HCl buffer (pH 7). Homogenate was transferred to a clean centrifuge tube and centrifuged at 10000 rpm for 30 minutes in cooling condition. Supernatant was collected in a clean glass test tube for the biochemical analyses.

2.5 Prepration of Fatbody

The fat body was dissected out from fifth instar larvae of *Bombyx mori* on the sixth day in 0.9 percent saline following the method of Yamoka et al.[16].

Protein [17], lipid [18], carbohydrate and glycogen contents [19] were determined in haemolymph (mg/ml), silkgland (mg/g) and fatbody (mg/g).

2.6 Economic Parameters

Economic parameters like cocoon weight(g), shell weight(g), shell ratio(%), filament length(m), reelability(%) and denier [20] were observed and calculated.

3. RESULTS AND DISCUSSION

The biochemical changes in protein, lipid, carbohydrate and glycogen content in tissues like haemolymph, silkgland and fat bodies of silkworm larvae fed with thrips infested mulberry leaves had decrease in protein (19.19± 0.05 mg/ml,11.32± 0.07 mg/g and 8.19±0.07 mg/g), lipid (3.19±0.06 mg/ml, 1.21± 0.06 mg/g and 14.13± 0.04 mg/g), carbohydrate (18.18± 0.06 mg/ml, 12.85± 0.07 mg/g and 7.26± 0.07 mg/g) and glycogen (0.79± 0.06 mg/ml, 1.08± 0.05 mg/g and 6.15±0.07 mg/g) contents respectively. On the other hand, protein (19.50±0.01 mg/ ml, 14.6±0.07 mg/g and 9.14± 0.12 mg/g), lipid (4.15± 0.03 mg/ml, 2.62±0.01mg/g and 14.58±0.09 mg/g), carbohydrate (20.78±0.09mg/ml, 14.28± 0.08 mg/g and 8.26± 0.09 mg/g) and glycogen (1.40± 0.05 mg/ml, 1.29± 0.07 mg/g and 6.73± 0.08 mg/g) contents respectively showed positive effects, when the larvae fed with uninfested mulberry leaves (control).

Growth and development of the silkworm depend upon the nutritive status of leaves. If there are no nutrients, the leaf quality severely deteriorated. This could be detrimental to silkworms as reported by Mahadava and Shree [21]. Narayanaswamy et al. [22] reported that the pest infested mulberry leaves are quantitatively and qualitatively very poor. Maratignoni [23] reported that the pest infections induced biochemical and physiological alterations in insect's tissues. The data from the table clearly indicated that the silkworm larvae fed with thrips infested mulberry leaves resulted gradual reduction of protein, lipid, carbohydrate and glycogen in the haemolymph, silk gland and fat bodies. This result was in agreement with Sheelu and Ramani [24] who explained that the haemolymph of *Pseudodendrothrips mori* infested mulberry leaves fed to V^{th} instar *Bombyx mori* were seen decreased in carbohydrate, glycogen and trehalose contents.

The present work reveals that the economic characters such as, cocoon weight (1.18± 0.06 g), shell weight (0.18± 0.04 g), shell ratio (14.34±0.20%), filament length (527.0± 9.53 m), reelability (57.6± 6.10 %) and denier (1.63 ±0.05) got reduced in *Bombyx mori* larvae after being fed with thrips infested left-out mulberry leaf compared to control. "Feeding pest infested leaves to silkworm are known to affect the commercial characters of cocoon" [25]. "Etebari and Bizhannia, [26] observed that there was a significant decrease in total cocoon production, cocoon weight, pupal weight and shell weight due to feeding of thrips infested leaves". Geetha et al. [27] studied "the rearing performance and cocoon production by feeding silkworm with thrips infested mulberry leaves. They observed that significant decrease in larval weight, ERR, total cocoon production, cocoon weight, pupal weight, shell weight and silk filament length. However, shell ratio, denier and rendita were not significant". Paik and Lee [28] reported that "mulberry thrips caused 12% reduction in cocoon weight. The studies have shown that *Psudodendrothrips mori* causes considerable quantitive and qualitative damages to mulberry which inturn affect the productive characters of silkworm"

Table 1. Biochemical parameters of *Bombyx mori* larvae fed on thrips infested mulberry leaves

Biochemical Activity	Treatments	Haemolymph (mg/ml)	Silkgland (mg/g)	Fat body (mg/g)
Protein	Control	19.50 ± 0.21	14.6 ± 0.07	9.41± 0.02
	Infested	19.19 ± 0.05	11.32 ± 0.07	8.19 ± 0.07
		(-1.58)	(-22.43)	(-12.95)
Lipid	Control	4.15 ± 0.03	2.62 ± 0.10	14.58 ± 0.09
	Infested	3.19 ± 0.06	1.21 ± 0.06	14.13 ± 0.04
		(-30.11)	(-53.80)	(-3.08)
Carbohydrate	Control	20.78 ± 0.09	14.28 ± 0.08	8.26 ± 0.09
	Infested	18.18 ± 0.06	12 85 ± 0.07	7.26 ± 0.07
		(-12.50)	(-10.01)	(-12.01)
Glycogen	Control	1.40 ± 0.05	1.29 ± 0.07	6.73 ± 0.08
	Infested	0.79 ± 0.06	1.08 ± 0.05	6.15 ± 0.07
		(-43.56)	(-16.27)	(-8.61)

Note: Percent deviation over control values in parentheses

Table 2. Economic parameters of *Bombyx mori* larvae fed on thrips infested mulberry leaves

Economic traits	Control	Infested
Cocoon weight (g)	1.48 ± 0.06	1.18 ± 0.06 (-20.26)
Shell weight (g)	0.32 ± 0.05	0.18 ± 0.04 (-43.75)
Shell ratio (%)	15.5 ± 0.15	14.34 ± 0.20 (-7.48)
Filament length (m)	778 ± 15.96	527.0 ± 9.53 (-30.19)
Reliability (%)	81.6 ± 8.01	57.6 ± 6.10 (-29.28)
Denier	2.18 ± 0.03	1.63 ± 0.05 (-25.22)

Note: Per cent deviation over control values in parentheses

4. CONCLUSION

The thrips infested mulberry leaves when fed to silkworms will exert an adverse effect on their growth and biochemical parameters, that leads to reduce the commercial characters (40%). Hence, the thrips infested mulberry leaves should not be used for silkworm feed as they are known to affect the commercial characters of cocoon.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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