International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2019; 7 (1):71-76
ISSN:2320-7817(p) | 2320-964X(o)

Original Article Open Access

Screening of different plant products for their efficacy against dermestid beetles on bivoltine cocoons (CSR2)

Saranya M*, Umapathy G and Murugesh KA

Department of Sericulture, Forest College and Research Institute,
Tamil Nadu Agricultural University, Mettupalayam- 641 301, Tamil Nadu.
*Email: saranya1153@gmail.com

Manuscript details:

Received : 23.01.2019
Accepted : 15.02.2019
Published : 28.03.2019

Editor: Dr. Arvind Chavhan

Cite this article as:
Saranya M, Umapathy G and Murugesh KA (2019) Screening of different plant products for their efficacy against dermestid beetles on bivoltine cocoons (CSR2), *Int. J. of Life Sciences*, Volume 7(1): 71-76.

Available online on
http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

Eco-friendly management of dermestid beetles was tried with seven different plant products and among these, Notchi (*Vitex nigundo*) has recorded a maximum grub mortality was observed in Notchi (64.67%) at 72 h in 12.5% concentration followed by Pungam (52.67%), Vasambu (41.48%), Neem (35.67%), Tulasi (42.67%), Turmeric (36.22%) and Aswagandha (41.42%) and maximum adult mortality observed in Notchi treatment (62.32%) followed by Neem (41.67%), Pungam (49.37%), Vasambu (40.54%), Tulasi (38.14%), Tumeric (36.22%) and Aswagandha (38.54%). Among the plant extracts, Notchi showed higher adult and grub mortality in CSR2 races at 12.5% concentration whereas Aswagandha showed the minimum mortality.

Key words: Dermestid beetles, botanicals, eco-friendly, pest control

INTRODUCTION

Sericulture is an important labour-intensive agro-based cottage industry which plays an important role in the national economy. The bulk commercial silk is obtained from the mulberry silkworm (*Bombyx mori* L.) and it ranks second in silk production amongst the mulberry silk producing countries in the world. In commercial sericulture, cocoons are produced both for silk and seed and after harvest, the cocoons have to be properly stored till they are stifled for extraction of good quality silk.

In sericulture, among various natural enemies which pose threat to silk production, the dermestid beetles are of particular importance. The dermestids mainly damage stifled and stored cocoons, raw silk and silk fabrics in stores. In grainages, the dermestids damage live cocoons kept for production of new generation of moths, seed (silkworm eggs) and live caterpillars. Exceptionally *Dermestes maculatus* Degeer was reported in Italy as a vector of pebrine disease of silkworm caused by *Nosema bombycis* Nageli (Candura, 1931). Hinton (1945), in his monograph on stored products, recorded 19 species of Dermestidae as pests of silkworm

cocoons and their products in various parts of the world. In India, a loss of about 20% of the silk production was recorded in a Mysore grainage (Thiagarajan and Govindaiah, 1987).

MATERIAL AND METHODS

Lab experiment

A Laboratory study was conducted at the Entomology Laboratory, Forest College and Research Institute, Mettupalayam, to test various plant products for their bioefficacy against dermestid beetles, to screen and identify certain effective plant products.

Culturing of *D. ater*

The test insect species, *D. ater* grubs and adults of uniform age were mass reared on bivoltine cocoons (CSR2) in an insect cage, collected from the laboratory culture for the bioefficacy studies.

Preparation of plant extracts

The plants which are indigenous and locally available were collected from different locations in and around forest college and research institution (Table 1). Leaves and plant parts were washed with water, shade dried for about 10 days, dried in a hot air electric oven at 60ºC to gain constant weight and ground separately with the help of a mixer from which well powdered material were passed through a 25 mm mesh sieve to obtain a fine and uniform powder and preserved in airtight zip-lock polythene bags. Ten grams each of the treatment samples (powder) were taken separately in a 500 ml beaker and mixed with 100 ml acetone and the mixture was stirred for 30 minutes by a magnetic stirrer (at 3000 rpm) and left for 24 hours at room temperature. The mixture was filtered through a fine cloth and it was again filtered through Whatman No.1filter paper. The filtrate was taken into a round bottom flask and condensed by evaporation of the solvent in a water bath at 45°C temperature so as to obtain a volume of 10 ml and then the extracts were preserved in an airtight bottle, labelled and stored in refrigerator.

Preparation of stock solution

Stock solutions of plant extracts were prepared separately by diluting the acetone extracts and diluted to arrive desired concentration *viz.,* 5, 7.5, 10 and 12.5 per cent respectively for *D. ater* grub were prepared by dissolving the stock solutions in acetone.

Effect of plant extracts

Bivoltine (CSR2) and Multivoltine (Pure Mysore) silkworm cocoons were obtained from government grainage, Coimbatore for the bioefficacy experiment were conducted to assess the efficacy of plant products on dermestids grub. For each experiment, twenty pairs of grub were released into each vial containing 30 cocoons, the lid of the plastic vials were perforated and secured with a netting material. A different concentration of prepared solution was applied to the dorsal surface of the thorax of each insect (grub) by touching with a camel hair brush. The content of the vials were then thoroughly mixed. Each treatment was replicated four times. The number of dead grub and adults was counted after 24 hours, 48 hours and 72 hours to determine the mortality rate of *D. ater* grub.

Table 1. List of botanicals utilized for bioefficacy test

S. No	Treatments	Family	Common name	Parts used
1.	*Azadirachta indica*	Meliaceae	Neem	Leaves
2.	*Vitex nigundo*	Lamiaceae	Notchi	Leaves
3.	*Pongamia pinnata*	Fabaceae	Pungam	Leaves
4.	*Acorus calamus*	Acoraceae	Vasambu	Rhizome
5.	*Ocimum sanctum*	Lamiaceae	Tulasi	Leaves
6.	*Curcuma longa*	Zingiberaceae	Turmeric	Rhizome
7.	*Withania somnifera*	Solanaceae	Aswagandha	Leaves

RESULT AND DISCUSSION

Evaluation of botanicals against *D. ater*

Neem - *Azadirachta indica*

The highest mortality per cent of grub was recorded at 72 HAT (56.67%) with 12.5 % concentration in CSR2 (Table 2) and least mortality was found to be at 24 HAT (20%), 48 HAT (25.33%) and 72 HAT (33.33%) with 5% concentration. The highest mean mortality (45.28 %) was noticed at 12.5% followed by 10% (39.72 %), 7.5% (31.06 %) and 5% (26.22 %).

It was supported by the finding of Kaethner, (1992) who reported the larvae of the pulse beetles showed highly increased mortality when feeding on neem treated foliage or when treated directly with neem products in the laboratory and several neem products were reported to be highly effective against all larval instars. Neem extracts contain powerful phytochemicals which suppress the chemoreceptors in the mouthparts of the beetle and reduced the feeding in *C. maculatus.* Neem's efficacy to non-target and beneficial organisms has been documented (Schmutterer, 1995; Ascher, 1993; Murugan *et al*., 1999).

Notchi - *Vitex nigundo*

A maximum mortality of 66.67% was observed at 12.5% in 72 HAT followed by 48 HAT (54.33%) and 24 HAT (40%). The least mortality of grub was found at 5% (24.33%), 7.5% (26.67%), 10% (34.83 %) and 12.5% (40%) in 24 HAT in CSR2 (Table 3).

Table 2. Bioefficacy of Neem against dermestid grubs reared on Bivoltine cocoon (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2*			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	20.00	25.33	33.33	**26.22**
7.5	23.33	30.17	39.67	**31.06**
10.0	29.17	40.00	50.00	**39.72**
12.5	33.33	45.83	56.67	**45.28**
SE(d)	1.4084	1.5574	0.6431	
CD at 0.5 %	3.2477	3.5915	1.4831	

Table 3. Bioefficacy of Notchi against dermestid grubs reared on bivoltine cocoons (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2*			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	24.33	31.00	40.00	**31.78**
7.5	26.67	33.33	46.50	**35.50**
10.0	34.83	46.83	57.50	**46.39**
12.5	40.00	54.33	66.67	**53.67**
SE (d)	1.8849	0.9469	1.2050	
CD at 0.5 %	4.3467	2.1836	2.7788	

Table 4. Bioefficacy of Pungam against dermestid grubs reared on Bivoltine cocoons (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2 *			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	15.67	19.17	27.50	**20.78**
7.5	20.33	24.83	33.17	**26.11**
10.0	22.00	31.33	39.33	**30.89**
12.5	25.33	35.67	44.67	**35.22**
SE (d)	0.7137	3.4227	1.8107	
CD at 0.5 %	1.6459	7.8928	4.1755	

The results corroborate with the findings of Tiwari, (1994) who reported that Notchi leaf powder admixed with a commodity to assess contact toxicity of different adult pests or to larval stages (Sosan *et al.* 1989). These trials were conducted mostly with crude leaf powder which showed considerable promise of using Notchi as pest protectant. Similar observations were made by Chowdhury (2009) who reported that the mode of action of notchi extract acted as chitin synthesis inhibitor and found effective against larvae and adults.

Pungam- *Pongamia pinnata*

A highest mortality of 54.33% was found at 72 HAT in 12.5 % concentration (CSR2) and a least mortality of 19.17% of grub was recorded at 5% in 24 HAT followed by 24.17 % and 32.50 % at 48 and 72 HAT (Table 4).

Similar observations have been reported by Lale (1995a) with a high mortality of *D. maculatus* grub on dried fish treated with the *P. Guineense*. Insecticidal property of any plant material could depend on the active constituents of the plant material. It was reported that *P. guineense* contains piperine and chavicine, which are insecticidal including piperidine and alkaloids as the major active components in *P. guineense* seeds.

Vasambu- *Acorus calamus*

The Vasambu treatment resulted in lowest mortality at 24 HAT (15.67%) in CSR2 (Table 5) and a highest mortality was found in 12.5% concentration (25.33%) at 72 HAT. The results are in tune with the findings of Ravi Nandi *et al*. (2008), who stated that the insecticidal property of vasambu formulation with cowdung ash as a carrier against *C. chinensis* in pigeon pea reduced the beetle population.

Tulasi- *Ocimum sanctum*

In CSR2, maximum mortality (49.67%) was recorded at 12.5% concentration in 72 HAT with an overall mean mortality of 38.56% at 12.5% concentration (Table 6). These findings are conformity with Mulungu *et al*. (2007); Fernando and Karunaratne (2012) who reported that insect mortality might be due to blocking of spiracles of the test insects and death might have caused by asphyxia

Table 5.Bioefficacy of Vasambu against dermestid grubs reared on Bivoltine races (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2*			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	19.17	24.17	32.50	**25.28**
7.5	22.00	27.83	36.67	**28.83**
10.0	28.50	37.50	48.67	**38.22**
12.5	32.50	44.67	54.33	**43.83**
SE (d)	0.8062	1.6361	1.3053	
CD at 0.5 %	1.8592	3.7730	3.0100	

Table 6. Bioefficacy of Tulasi against dermestid grubs reared on bivoltine cocoon (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2 *			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	16.67	21.50	30.00	**22.72**
7.5	22.50	28.00	37.33	**29.28**
10.0	24.00	33.33	43.33	**33.55**
12.5	27.33	38.67	49.67	**38.56**
SE (d)	3.4199	3.2259	1.3860	
CD at 0.5 %	7.8864	7.4389	3.1962	

Table 7. Bioefficacy of Turmeric against dermestid grubs reared on bivoltine cocoon (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2 *			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	15.00	17.67	26.67	**19.78**
7.5	19.67	23.50	31.50	**24.89**
10.0	22.00	30.67	39.00	**30.56**
12.5	24.17	33.67	42.33	**33.39**
SE (d)	0.7417	1.1296	1.5030	
CD at 0.5 %	1.7104	2.6048	3.4659	

Table 8. Bioefficacy of Aswagandha against dermestid grubs reared on bivoltine cocoon (CSR2)

Conc. (%)	Mortality percent of grub			
	CSR2 *			
	24 HAT	48 HAT	72 HAT	Mean Mortality (%)
5.0	13.33	16.67	25.17	**18.39**
7.5	19.67	24.00	32.67	**25.45**
10.0	21.67	31.50	40.00	**31.06**
12.5	24.00	35.33	44.00	**34.44**
SE (d)	NS	0.6517	2.8272	
CD at 0.5 %	NS	1.5029	6.5197	

*Mean of four replications; HAT - Hours after treatment
*Treatments comprises of 30 grubs each

Turmeric- *Curcuma longa*

The highest mortality of grub was recorded at 12.5% concentration with 42.33% mortality at 72 HAT in CSR2 while the overall mean mortality of 33.3% was attributed to 12.5% dose (Table 7). Similar to the present results, the rhizome and leaf extracts were reported to offer higher of *T. castaneum* grub (Abida *et al.,* 2010)

Damalas, (2011) reported that the turmeric extract was found effective in controlling certain pests due to the presence of a variety of bioactive constituents that interfere with insect behaviour and growth and its products have been found active as insect 137 repellents and insecticidal agents.

Aswagandha- *Withania somnifera*

The Aswagandha treatment at 12.5 % resulted in a highest mortality of 44% at 72 hours after treatment in CSR2 (Table 8). The results are in compliance with the findings of Yankanchi *et al*., 2009a who reported that extract of *Vitex negundo* and *Withania somnifera* at 0.5% were more effective, caused 100% mortality and progeny suppression.

The aromatic nature of the plant leaf powders suggests that it contains volatile constituents which are highly effective against insects. Insecticidal activity of Solanaceae family plant, *W. somnifera* well documented against a range of insect pests (Kazi *et al.,* 1999; Kim *et al.,* 2003; Shaktivadivel and Daniel, 2008; Gupta and Srivastava, 2009).

The toxic effect of plant extract against dermestid grubs, in decreasing order of efficacy are: *Vitex nigundo* > *Azadirachta indica* > *Pongamia pinnata* > *Acorus calamus* > *Ocimum sanctum* > *Withania somnifera* > *Curcuma longa* in bivoltine Cocoons (CSR2).

REFERENCES

Abida Y, Tabassum, Zaman S, Chhabi SB and Islam N (2010) Biological screening of *Curcuma longa* L. for insecticidal and repellent potentials against *Tribolium castaneum* (Herbst) adults. *University Journal of Zooogy Rajshahi*, 28: 69-71.

Ascher, KRS (1993) Non-conventional insecticidal effects of pesticides available from the neem tree, *Azadirachta indica*. *Archives of Insect Biochemistry and Physiology,* 22: 433-449.

Candura GS (1931) Prima serie di ricerche sperimentali per conoscere gli ospiti del *Nosema bombyx* Nag., che produce latrofia parassiaria o perbrina del baco do seta. Bollentino della R.Stazone sperimentale di gelsicoltura e bachi coltura di Ascoli piceno, 10:124-135

Chowdary SK, Munshi NA, Ghani MY and Mathur S (1985) Control of *Dermestes cadverinus* Fabricus on infested cocoons of *Bombyx mori* L. on a large scale. Department of Sericulture, S.K. University of Agricultural Sciences and Technology, Mirgund, Kashmir, India.

Damalas (2011) Potential uses of turmeric (*Curcuma longa*) products as alternative means of pest management in crop production. *Plant Omics Journal*, 4(3):136-141

Fernando HSD and Karunaratne MMSC (2012) Ethnobotanicals for storage insect pest management: Effect of powdered leaves of Olaxzeylanica in suppressing infestations of rice weevil *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). *Journal of Tropical Forest. Environment*, 2(1): 20-25.

Gupta L and Srivastava M (2008) Effect of *Withania somnifera* extracts on the mortality of *Callosobruchus chinensis* L. *Journal of Biopesticide,* 1(2): 190-192.

Hinton HE (1945) A monograph of the beetles associated with stored products. *British museum notes London,* 1:234-442.

Kaethner M (1992) Fitness reduction and mortality effects of neem based pesticides on the Colorado potato beetle, *Lephotarsa decemlineata* Say (Coleoptera : Chrysomelidae). *Journal of Applied Entomology,* 113: 456-465.

Kazi SA, Takao I and Toshihide I (1999) Effects of plant oils on oviposition preference and larval survivorship of *Callosobruchus chinensis* (Coleoptera: Bruchidae) on azuki bean. *Journal of Applied Entomology and Zoology,* 34(4): 547-550.

Kim SI, Roh JY, Kim DH, Lee HS and Ahn YJ (2003) Insecticidal activities of aromatic plant extracts and essential oils against *Sitophilus oryzae* and *Callosobruchus chinensis. Journal of Stored Product and. Research*, 39: 293-303.

Lale NES (1995a) An Overview of the use of Plant Products in the Management of stored Product-Coleoptera in the tropics. *Post Harvest News Information,* 6:69-75.

Mulungu LS, Lupenza G, Reuben SOWM and Misangu RN (2007) Evaluation of botanical products as stored grain protectant against Maize weevil, *Sitophilus zeamais*, *Journal of Entomology,* 4(3): 258-262.

Murugan K, Senthil Kumar V, Jeyabalan D, Babu R, Senthil Nathan S and Sivaramakrishnan S (1999) Interactive effect of neem products on the control of pulse beetle, *Callosobruchus maculatus* (F). *Neem News letter*, 15: 41-44.

Ravi Nandi, Naganagoud and Patil (2008) Effect of sweet flag rhizome, *Acorus calamus* L. Formulations with cow dung ash as a carrier against *Callasobruchus chinensis* Linn in pigeonpea. *Karnataka Journal of Agricultural Science,* 21(1): 45-48.

Sakthivadivel M and Daniel T (2008) Evaluation of certain insecticidal plants for the control of vector mosquitoes *viz., Culex quinquefasciatus*, *Anopheles stephensi* and *Aedes aegypti*. *Journal of Applied Entomology and Zoology*, 43(1): 57-63.

Schmutterer H and Singh RP (1995) List of insect pests susceptible to neem products. The Neem Tree *Azadirachta indica* A. Juss and other Meliaceous. Plants: 43.

Sosan MB, Adewoyin FB and Adewunmi CO (2001) Lavicidal properties of 3 indigenous plant oils on the mosquito *Aedes aegypti*. *Nigeria Journal of Natural Product Medicine,* 5: 30-33.

Thiagarajan V and Govindaiah (1987) Menace of dermestid beetles in grainages. *Indian silk*, 26(3): 26-27.

Tiwari SN, Rajamma AJ, Dubey S, Sateesha SB and Ghosh SK (1994) Comparative larvicidal activity of different species of Ocimum against *Culex quinquefasciatus*. *Natural Product Res*earch, 25(20): 1916-1922.

Yankanchi SR and GS Lendi (2009) Bioefficacy of certain plant leaf powders against pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae). *Biocontrol Journal,* 1(2): 48-51.