IPM APPROACH FOR THE CONTROL OF MAJOR DEFOLIATORS OF PRIMARY TASAR FOOD PLANTS

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Introduction

Defoliators *Anomala blanchardi* Blanch (Coleoptera: Scarabaeidae), *Tricliona picea* Jacoby and *T. variabilis* Jac. (Coleoptera : Chrysomelidae), *Myllocerus viridanus* Fab. (Coleoptera: Curculionidae) and *Notolophus antiqua* Linn (Lepidoptera : Lymantriidae) are the major pests of primary tasar food plants, which cause 15-20% foliage loss (Thangavelu and Singh, 1991). These coleopteran pests occur in all the stages of the plant growth, the adults damage the foliage while grubs damage the secondary and tertiary rootlets of these food plants (Thangavelu, 1984). The lepidopteran larvae cause damage to the foliage.

The indiscriminate and extensive use of insecticides for the control of insect pest lead to "ecological backlash" in the form of environmental pollution as well as development of resistance to insecticides and resurgence (Sundararaj *et al.*, 1995). Further, insecticides cannot be used during rearing, as the tasar silkworm (Lepidoptera : Saturniidae) cannot tolerate even the sub-lethal doses of toxic compounds (Thangavelu and Singh, 1991). This has led to investigations on the possibility of utilizing plant-derived chemicals. It has been well documented that neem (*Azadirachta indica* A. Juss), an extremely potent among all the plants, has pronounced and exemplary, biopesticidal properties (Sundararaj *et al.*, 1995). The potential of neem seed oil and seed extracts against several crop pests have been demonstrated (Schmutterer, 1990, Mordue and Blackwell, 1993). Extensive field and laboratory studies were undertaken for the control of defoliators through neem derivatives and results reveal that these pest populations could be suppressed through neem derivatives. The transformation of adult from the grub of coleopteran beetle could be effectively checked (66.66%) by soil application of neem cake (60 kg/acre) whereas, the lepidopteran larvae were found to suppressed (88%) by foliar application of 6.0 ppm Azadirachtin (Sharma *et al.*, 2002 a, b, c, d; 2003 a, b).

An attempt has been made to work out the efficacies of various control measures such as cultural, mechanical, soil application of neem cake, foliar spray of Azadirachtin aqueous solution and combination of these four methods with an objective to develop eco-friendly Integrated Pest Management (IPM) package for the control of major defoliators of primary tasar food plants.

Material and Methods

Healthy plants of *T. arjuna* (250 nos.) in 5 replications were selected for various control methods such as cultural (deep digging of soil for exposure to the sun during summer for killing of eggs, grubs etc.), mechanical (collection and destruction of eggs, grubs, pupae and adults), soil applications neem cake @ 60 kg/acre, foliar application of 6.0 ppm Azadirachtin and combination of these four methods (IPM). In control only water was sprayed. The schedules of control measures adopted are as follows :

1. *Cultural* : Deep ploughing twice, after silkworm rearing (Nov.-Dec.) and during March-April.

2. *Mechanical* : Collection and destruction of different developmental stages such as eggs, grubs/larvae, pupae and adults of coleopteran and lepidopteran pests during morning and evening twice a week from the month of May to July.

3. *Soil application of neem cake* : Soil application of neem cake (dried and fine meshed @ 60 kg per acre in two split doses at 15 days interval before the onset of monsoon (1st dose – 15th May; 2nd dose – 30th May).

4. *Foliar application of Azadirachtin* : Foliar application of 6.0 ppm Azadirachtin once after 15 days of soil application of neem cake (15th June). Quantity – 18 ml in one litre of water (one litre neem derivative per acre).

5. *IPM* : Combination of above four methods.

6. *Control* : Separate control was maintained for comparisons.

The experiment was designed in randomized block distribution. The averages of leaf yield per plant; leaf damage per cent and number of grubs per cubic feet were recorded for all the treatments. The leaf damage per cent was estimated by the following formula :

$$\text{Leaf damage per cent} = \frac{\text{No. of damaged leaves}}{\text{Total no. of leaves considered}} \times 100$$

The data thus obtained were subjected to statistical analysis (Kempthrone, 1952, Fisher and Yates, 1963). The safe period of Azadirachtin was found to be 5 days for tasar silkworm *Antheraea mylitta* D. (Sharma *et al.*, 2002 a). In order to confirm whether the residual toxicity persisted beyond 5 days of treatment of Azadirachtin, larvae of *A. mylitta* D. (100 worms in 5 replications) was reared on the IPM treated plants. In control only water was sprayed. The newly hatched worms were mounted on the plants after 5 days of treatment. The effective rate of rearing (ERR) percentage, cocoon wt., shell wt. and silk ratio (SR) percentage were considered as the parameters for assessing the residual toxicity.

Results and Discussion

The efficacy of various control methods such as cultural, mechanical, soil application of neem cake, foliar application of Azadirachtin and combination of these four methods (IPM) in relation to control are presented in Table 1. Results reveal that the leaf yield per plant was maximum (4.266 kg/plant) in IPM as compared to

Table 1

Efficacies of different control measures in controlling major defoliators of primary tasar food plants.

Treatments	Av. leaf yield/plant (kg)	Av. leaf damage (%)	Av. no. of grubs/cft
Cultural	2.871	33.75 (35.50)	1.250
Mechanical	2.578	35.63 (36.64)	1.250
Neem cake 60 kg/acre	3.704	15.13 (22.86)	0.375
Azadirachtin 6.0 ppm	3.103	24.25 (29.47)	1.000
IPM	4.266	11.25 (19.53)	0.125
Control	2.468	40.00 (39.21)	1.750
CD at 5 %	0.886	3.35	0.435

Figures in parenthesis indicate the mean data after angular transformation.

control (2.468 kg/plant), whereas the leaf damage per cent and number of grubs per cubic feet were found maximum in control (40% and 1.750) as compared to other treatments and minimum in IPM (11.25% and 0.125). The observations on the rearing performance parameters for IPM treatment and control are presented in Table 2. Results indicate that there were no significant variations in different parameters of rearing performance such as ERR%, cocoon wt., shell wt. and SR% in IPM treatment as compared to control.

It is evident from the results that the foliage damage caused by the defoliators could be suppressed significantly in the IPM treatment. In IPM treatment the leaf damage per cent and number of grubs/ cubic foot (cft) were lesser by 28.75% and 1.625 respectively, whereas the gain in the leaf yield/plant was 1.798 kg over control, which indicates the effectiveness of the developed package. The gain in leaf yield/plant, reduction in leaf damage per cent and number of grubs/cft in IPM treatment is mainly attributed to soil applications of 60 kg/acre neem cake (leaf yield/ plant - 3.704 kg, leaf damage - 15.13% and number of grubs/cft - 0.375) and foliar spray of 6.0 ppm Azadirachtin (leaf yield/ plant - 3.103 kg, leaf damage 24.25% and number of grubs/cft - 1.0) as compared to control (leaf yield/plant - 2.468 kg, leaf damage - 40% and number of grubs/cft - 1.750). Neem cake is a potential source of organic manure; rich in many plant nutrients and also contain Azadirachtin as major components (Biswas *et al.*, 1995). Neem cake is generally used as organic manure and also used in the management of insect pests (Sidhu, 1995). The soil application of neem cake and foliar spray of Azadirachtin checked the growth and development of grubs/larvae of these pest, resulted in reduction of adult emergence (Sharma *et al.*, 2002 c). It is also observed that in the Azadirachtin treated lots, adults emerged with distorted crippled wings, however, control did not show any such symptom and led to normal development. This is mainly due to the failure of rupture of longitudinal and transverse moulting sutures to different level. The moulting

Table 2

Bioassay of IPM for the control of major defoliator of primary tasar food plants

Treatments	ERR (%)	Larval wt. (g)		Cocoon wt. (g)		Shell wt. (g)		SR %	
		Male	Female	Male	Female	Male	Female	Male	Female
IPM	31.20 (33.93)	28.05	32.16	8.514	12.054	1.062	1.396	12.602 (20.71)	11.672 (19.91)
Control	29.80 (33.05)	28.20	31.97	8.258	12.280	1.062	1.398	12.984 (21.04)	11.336 (19.62)

All the parameters in IPM are not significant over control.
Figures in parenthesis indicate the mean data after angular transformation.

phenomena are controlled by endocrine system of insect and neem formulations interfere with the normal function of endocrine system of insect (Rembold *et al.*, 1982). Further, lepidopteron larvae were found to suppress (88%) by foliar application of 6.0 ppm Azadirachtin (Sharma *et al.*, 2002 d). It is a systemic insecticide and act in two ways; firstly as a repellent and feeding inhibitor (antifeedant), secondly it upsets the insect hormonal balance so that insects are permanently incapacitated (Biswas *et al.*, 1995). The neem extracts are easily biodegradable and harder for the insect to develop resistance to inherent combination of chemicals derived from plants than to the single synthetic compound (Sidhu, 1995). The seed and leaves of neem tree yield Azadirachtin, a compound that has an immense potential as an insect repellent. Biswas *et al.* (1995) reported that neem has a collection of 20 ingredients, and it is difficult for any insect to develop resistance to all of them. The other control methods such as cultural and mechanical which were also part of IPM treatment, contributed in leaf yield gain and reduction in leaf damage per cent and number of grubs per cubic foot due to killing of eggs, grubs and adults by manual collection or by sun exposure. Thangavelu and Singh (1991) reported that population of these pests can be minimized by mechanical and cultural practices.

Bioassay showed that silkworm rearing could be conducted safely after five days of use of Azadirachtin. Further the moth emergence pattern, coupling percentage, mating behaviour, fecundity and hatching percentage were found normal in IPM treatment and did not vary significantly over control (Sharma *et al.*, 2003 b).

Based upon the finding, inference can be drawn that by adopting IPM package, the population build up of defoliators could be suppressed considerably without affecting the natural ecosystem which has direct bearing in natural control of various pests through their natural enemies.

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SUMMARY

Defoliators *Anomala blanchardi* Blanch, *Tricliona picea* Jacoby, *T. variabilis* Jac., *Rhizovrus ruridanus* Fab. and *Notolophus antiqua* Linn. are the major pests of primary tasar food plants, namely, *Terminalia arjuna* Bedd and *T. tomentosa* W&A causing 15-20% foliage unavailable for silkworm feeding. The soil application of neem cake (60 kg/acre) and foliar spray of Azadirachtin (6.0 ppm) were found effective in suppressing growth and development of coleopteran grubs and lepidopteran larvae respectively. Based upon these finding, various control measures such as cultural (deep digging of soil), mechanical (collection and destruction of different developmental stages), soil application of neem cake, foliar application of azadirachtin and combination of these four control measures (IPM) were taken up for evaluation of their efficacy. The averages of leaf yield per plant, leaf damage per cent and number of grubs per cubic feet for each treatment were recorded. Results reveal that IPM was effective leaf yield plant-4.266 kg, leaf damage - 11.25% and number of grubs/cft - 0.125) as compared to control (leaf yield/plant - 2.468 kg, leaf damage - 40% and number of grubs/cft. - 1.250) in controlling the defoliators. The foliage damage could be reduced by 71-87% over control by adopting IPM. The safe period for Azadirachtin was found to be 5 days for tasar silkworm, *Antheraea mylitta* D.

प्रधान टसर कीट भोजन–पादपों के प्रमुख निष्पत्रकों के नियन्त्रण के लिए समेकित नाशिजीव प्रबन्ध दृष्टि .

एस०पी० शर्मा, रामकिशोर, बी०आर०आर०पी० सिंहा व के० थंगवेलु

सारांश

प्रधान टसर कीट भोजन–पादपों अर्थात *टर्मिनेलिया अर्जुना* बेडुोव और *ट० टोमेन्टोसा* वा० व आर्म के प्रमुख पौधोंके ये निष्पत्रक कीडे *एनोमाला ब्लांशार्डी*, ब्लांश, *ट्राइक्लिओना पोलिया* जैकोबी, *ट्र० वेरियाबिलेस* जैकोब. *राइजोट्रस रिडेडानुस* फाब्रि० और *नोटोलोफस एंटिक्वा* लि० आते हैं जो रेशम के कीडों को खाने वाले 15-20% पत्तियों को उनके लिए अनुपयुक्त बना देते हैं। नीम की खली मृदा में मिलाना (60 किग्रा / एकड़) और एजाडिरेक्टिन को पत्तियों पर छिडकना (6.0 भाग प्रति दस लाख भाग पानी मे मिलाकर) कचुकपक्ष भक्षीजातकों की कीटडिंभ जातकों की बढवार और विकास दमित करने के लिए क्रमश : प्रभावकारी पाए गए। इस मालूमात के आधार पर विविध नियन्त्रण उपाय जैसे कि संवर्धनिक (मृदा की गहरी खुदाई करना), यान्त्रिक (कीडों को उनके विभिन्न विकास अवस्थाओं में इकट्ठा करके नष्ट करना), मृदा मे नीम की खली मिलाना एजाडिरेक्टिन का पत्तियों पर छिडकना और रोकथाम के इन चारो उपायों को संयुक्त कर उपयोग करने (समेकित नाशिजीव प्रबन्ध) का उनकी कार्यदक्षता मूल्यांकित करने को लिया गया। प्रति पादप पत्तियों की प्राप्ति का औसत पत्तियों का पहुची हानि का प्रतिशत और प्रतिघनफुट भक्षीजातकों की संख्या प्रत्येक उपचार के लिए आलेखित किए गए। विश्लेषण से प्रकट हुआ कि समेकित नाशिजीव प्रबन्धन नियामक की (पत्तियों की प्राप्ति, पादप 2.468 किग्रा पत्तियों का पहुची हानि–40 % और भक्षीजातकों की संख्या / घनफुट 1.750) की तुलना मे निष्पत्रकों की रोकथाम मे प्रभावकारी (पत्तियों की प्राप्ति / पादप–4.266 किग्रा, पत्तियों को पहुची हानि 11.25 %, भक्षीजातकों की संख्या / घनफुट 0.125) रहा है। समेकित नाशिजीव प्रबन्धन अपनाकर नियामक से पत्तियों को पहुची हानि को 71–87 % तक कम किया जा सकता है। एजाडिरेक्टिन की सुरक्षित अवधि टसर रेशम कीट *एन्थेरिया मायलिट्टा* के लिए 5 दिन पाई गई।

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