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ORIGINAL ARTICLE

Effectiveness of different extracts of *Calotropis procera* for the control of shisham defoliator, *Plecoptera reflexa* (Lepidoptera: Noctuidae)

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ABSTRACT

Plecoptera reflexa (Lepidoptera: Noctuidae) is serious defoliator of shisham. Among four extracts (CPPE, CPA, CPM and CPW) of Calotropis procera, two extracts i.e., CPM and CPA were found effective at 1% concentration after 72 hrs for the control of shisham defoliator. Bioassay experiments of effective extracts were carried out using seven concentrations viz., 0.0625, 0.125, 0.25, 0.50, 1.00, 1.50 and 2.00% of extracts against shisham defoliator. It was found that extracts, CPM and CPA caused 66.67 and 63.33% larval mortality of P. reflexa at 2.00% concentration after 72 hrs of exposure respectively.

Key Words: *Plecoptera reflexa, Calotropis procera, Dalbergia sissoo, Lepidoptera, Noctuidae*

INTRODUCTION

The genus *Dalbergia* includes over hundred species, out of these, 27 species are represented in India. The most common species is *Dalbergia sissoo* Roxb. (Shisham). It is extensively cultivated throughout India (Troup, 1921). The heartwood is extremely durable, and is very resistant to termites. Shisham wood makes excellent cabinet, furniture, veneers timbers and charcoal for heating and cooking. The insect species associated with this tree species belonging to various categories include defoliators (64 species), borers of living trees, freshly felled and stored timbers (39 species), sap suckers (24 species), root feeders (11 species), bark feeding insects (07 species), flower, fruit and seed insects (10 species). Out of these, *Plecoptera reflexa* is one of the important defoliator causing severe havoc to the plants (Beeson, 1941). The insect species also appeared in out breaks and caused loss of MAI and CAI, reduced the productivity and also quality of the timber. In northern India, it is controlled by unlimited use of insecticides leading to several health and environmental hazards. With a greater awareness of hazards associated with the use of synthetic organic insecticides, there has been an urgent need to explore suitable alternative products for pest control. Therefore, in present study different extracts of *Calotropis procera* were used against shisham defoliator.

C. procera belongs to family Asclepiadaceae and commonly known as Aak. It is found as a weed throughout India in warm dry places, predominantly in Sub-Himalayan tracts, Bihar, Orissa, West Bengal, Assam, Punjab, Sind, Rajasthan and Deccan to Kanya-Kumari. The whole dried plant is bitter, thermogenic, laxative, anthelmintic, anti-carcinogenic, and good tonic. The root bark is bitter, febrifuge, anthelmintic, depurative, and laxative and is useful in cutaneous diseases, intestinal worms, cough, ascites, anasarca etc. The leaves are used in the treatment of paralysis, arthritis, swellings, pain, leprosy, skin diseases, wounds, ear diseases and cancer. The latex is thermogenic and used as blistering agent.

MATERIAL AND METHOD

Collection of Insect:

Different stages of *P. reflexa* were collected from Barkot, Lachhiwala, Jhajra, Kalsi ranges of Dehradun Forest Division; Chhichrauli and Yamunanagar (Haryana); Bahadrabad, Biharigarh (Haridwar) and FRI campus Dehradun (Fig. 3). Collection of larvae was carried in the morning hours by hand picking in plastic containers, open end covered with muslin cloth tied with rubber

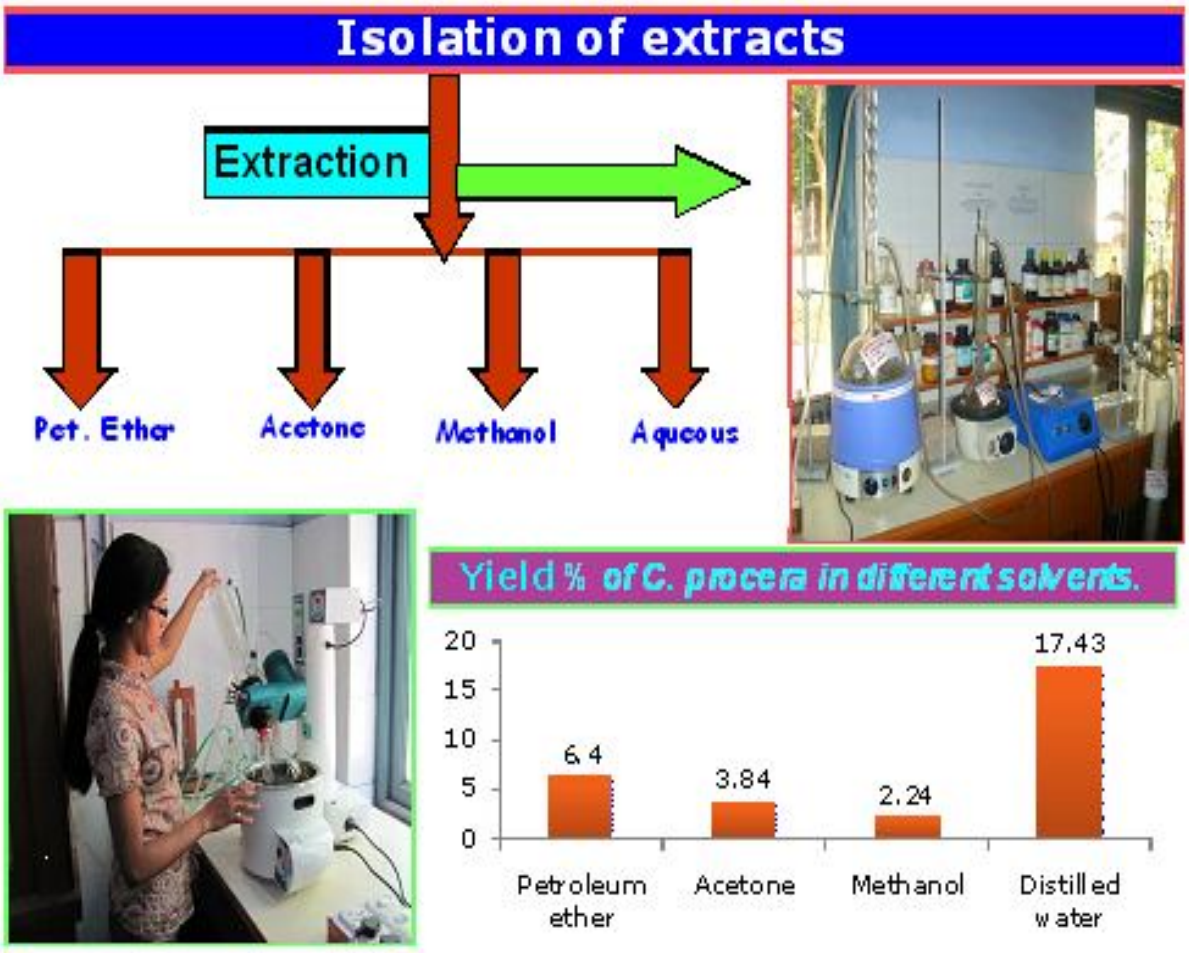
band. The collected immature and mature stages of defoliator were brought from the field to the laboratory for rearing and to maintain the laboratory culture for laying down a series of experiments. (Fig. 4)

Fig. 1-6: 1. Collection of *C. procera* from the field, 2. Shade drying of collected material, 3. Female and male of *P. reflexa,* 4. Mature and immature stages of *P. reflexa,* 5. Rearing of *P. reflexa* in the laboratory, 6. Exposure of different concentrations of extracts on the 3rd instar larvae

Collection of Plant Material:

The leaves of *Calotropis procera* were collected from Thano, Uttarakhand (Fig. 1). The plant material was identified and authenticated from the Head, Botany Division, Forest Research Institute, Dehradun as leaves of *C. procera.* The material was shade dried and powdered (Fig. 2).

Preparation of Extracts:
Shade dried and powdered material of leaves (300 g) of *C. procera* was extracted with the solvents of elutropic series petroleum ether, acetone, methanol, and distilled water. These extracts were concentrated on rotatory evaporator under reduced pressure. The yield of the extracts and procedure is given below:



Rearing of Insect:
Larvae of *P. reflexa* were reared separately in glass chimney and wooden cages with fresh leaves of shisham. The pupae when formed were sorted out and kept separately in glass jars covered with muslin cloth till the emergence occurred. The emerged moths of *P. reflexa* were released separately for egg laying in wooden glass cages (60 x 60 x 90 cm) having fresh foliage of shisham. Cotton soaked in water solution of honey/sugar was supplied as food.

Testing of Extracts:
Experiments were carried out to evaluate the larval mortality effect of extracts of CPPE, CPA, CPM and CPW on the 3rd instar larvae of *P. reflexa* at 1% concentration. Ten 3rd instar larvae of *P. reflexa* were taken from the culture and released in glass jars separately with fresh leaves of shisham treated with 1% each of above extracts. Observations on the mortality status of larvae were recorded after 24, 48 and 72 hrs of exposure. The moribund larvae were considered as dead. The percent mortality of larvae was calculated by using the formula:

$$\text{Percent mortality} = \frac{\text{No. of larvae dead}}{\text{No. of larvae released}} \times 100$$

RESULTS AND DISCUSSION

Observations recorded in table 1 showed that 1% concentration of CPPE (*Calotropis procera* extracted in Petroleum ether) extract caused 20% larval mortality of 3rd instar larvae of *P. reflexa* in each replication after 24 hrs. No larval mortality occurred after 48 and 72 hrs. The average larval mortality was 20%. CPPE extract provided less mortality as compared to LC50, hence taken as not effective. There was no larval mortality in the control.

1% concentration of CPA (*Calotropis procera* extracted in acetone) extract caused 40, 40 and 60% larval mortality of *P. reflexa* in R1, R2 and R3 respectively after 24 hrs and the larval mortality level was the same after 48 and 72 hrs. The average mortality was 46.67% and considered as effective extract. There was no larval mortality in control.

Table 1: Larval mortality of *Plecoptera reflexa* at 1% concentration of *Calotropis procera* extracts

Chemical extract	Replication	No. of larvae	Mortality			% Mortality after 72 hrs	Avg. mortality	Effective or not effective
			After 24 hrs	After 48 hrs	After 72 hrs			
CPPE	R1 R2 R3 Control	10 10 10 10	2/10 2/10 2/10 Nil	2/10 2/10 2/10 Nil	2/10 2/10 2/10 Nil	20.00 20.00 20.00 Nil	20.00%	not effective
CPA	R1 R2 R3 Control	10 10 10 10	4/10 4/10 6/10 Nil	4/10 4/10 6/10 Nil	4/10 4/10 6/10 Nil	40.00 40.00 60.00 Nil	46.67%	effective
CPM	R1 R2 R3 Control	10 10 10 10	6/10 4/10 6/10 Nil	6/10 4/10 6/10 Nil	6/10 4/10 6/10 Nil	60.00 40.00 60.00 Nil	53.33%	effective
CPW	R1 R2 R3 Control	10 10 10 10	Nil Nil 1/10 Nil	Nil Nil 1/10 Nil	Nil Nil 1/10 Nil	Nil Nil 10.00 Nil	3.33%	not effective

CPPE= leaves of *C. procera* extracted in petroleum ether, **CPA**= leaves of *C. procera* extracted in acetone, **CPM**= leaves of *C. procera* extracted in methanol and **CPW**= leaves of *C. procera* extracted in distilled water

Table 2: Bioassay of effective extracts of *Calotropis procera* against larvae of *Plecoptera reflexa* after 72 hrs

			Doses						
Effective extracts	Insect species	Replication	0.0625 %	0.125 %	0.25 %	0.50 %	1.00 %	1.50 %	2.00 %
CPM	*P. reflexa*	R1 R2 R3	nil nil nil	10.00 10.0 10.00	20.00 20.00 10.00	20.00 30.00 20.00	50.00 60.00 60.00	70.00 60.00 60.00	70.00 60.00 70.00
	Average % mortality		nil	10.00	16.67	23.33	56.60	63.33	66.67
	Control		nil	nil	nil	nil	nil	nil	nil
CPA	*P. reflexa*	R1 R2 R3	nil nil nil	10.00 nil 10.00	10.00 10.00 10.00	20.00 20.00 20.00	50.00 50.00 60.00	60.00 60.00 60.00	60.00 60.00 70.00
	Avg.%		nil	6.67	10.00	20.00	53.33	60.00	63.33

1% concentration of CPM (*Calotropis procera* extracted in methanol) extract gave 60, 40 and 60% larval mortality of *P. reflexa* in R1, R2 and R3 respectively after 24 hrs, whereas after 48 and 72 hrs

the larval mortality remained the same. The average mortality after 72 hrs was 53.33% and taken as effective extract. No larval mortality occurred in control.

1% concentration of extract CPW (*Calotropis procera* extracted in water) caused 10% larval mortality of *P. reflexa* in R3 after 24 hrs and no further larval mortality observed after 48 and 72 hrs. In R1 and R2 no mortality occurred. The average larval mortality after 72 hrs was 3.33% and taken as not effective extract. No larval mortality occurred in control.

It is observed from the table 1 that out of the four extracts of *C. procera* two extracts- CPA and CPM were considered as effective extract. Therefore, the bioassay of these extracts was carried out using seven concentrations *viz*: 0.0625, 0.125, 0.25, 0.5, 1.0, 1.5 and 2 per cent.

Bioassay observations in Table 2 showed that CPM and CPA extracts at 0.0625, 0.125, 0.25 and 0.50% in 3-replications caused less larval mortality in *P. reflexa* after 72 hrs as compared to LC50. At 1% concentration CPM extract caused 50.00, 60.00 and 60.00% larval mortality after 72 hrs with an average of 56.60% mortality. At 1.5% concentration 70.00, 60.00 and 60.00% larval mortality with an average of 63.33% were observed after 72 hrs. At 2% concentration the extract caused 70.00, 60.00, and 70.00% larval mortality with an average of 66.67%.

In case of CPA extract, 1% concentration provided 50.00, 50.00 and 60.00% larval mortality with an average of 53.33% after 72 hrs. 1.5% concentration of CPA extract caused 60.00% larval mortality in each replication with an average of 60.00%. 2% concentration of CPA extract caused 60.00, 60.00 and 70.00% larval mortality with an average of 63.33% after 72 hrs. No larval mortality was observed in control. It is observed that extracts of *C. procera* extracted in methanol (CPM) and acetone (CPA) were found effective at 1% concentration for the control of *P. reflexa* under laboratory conditions. The bioassay of effective extract showed that 2% concentration of CPM and CPA extracts caused 66.67% and 60.00% larval mortality after 72 hrs, respectively. It is concluded that the extract of *C. procera* extracted in methanol (CPM) was considered as most effective for the control of larvae of *P. reflexa*.

Similar type of work was carried out by various workers. Singh (2016) tested the different extracts of *Tagetes minuta* for the control of *Clostera cupreata* and it was found that out of the four extracts, the extract (TMM), extracted in methanol caused 50% larval mortality at 2% concentration after 72 hrs whereas the extracts (TMA), extracted in acetone provided 46.66% larval mortality. Singh and Yousuf (2015) also tested the efficacy of different extracts of *T. minuta* against *Plecoptera reflexa*, a major defoliator of shisham. It was observed that the acetone and methanol extracts (TMA and TMM) provided 50 and 60% larval mortality at 2% concentration after 72 hrs under laboratory condition, respectively. Gupta and Joshi (1995) tested seed extracts of neem and *Pongamia pinnata*, leaf extracts of *Aloe vera, Annona squamosa, Calotropis* and *Vitex negundo* for their feeding inhibition properties against the leaf defoliators of Shisham, Bamboo, Teak and *Ailanthus indica.* Extracts of *Aloe vera*, *Azadirachta indica* (neem), seed extracts of *A. indica* and *P. pinnata* were found to be effective against above defoliators. Bhandari et al. (1988) observed that methanol extractives of neem seed found effective against poplar defoliator, *P. cupreata* for their antifeedant activity. Ahmad et al. (1991) recorded that extract of *Acorus calamus*, *Lantana camara* var. *aculeata, Adhatoda vesica* and *Melia azedarach* were effective in killing *Ailanthus* web worm, *Atteva fabriciella.* Meshram (2000) tested crude extracts fresh leaves of 14 plants against larvae of *Dalbergia sissoo* to evaluate their antifeedent and insecticidal activity and it was observed that *Melia azadarach* followed by *Eucalyptus hybrid* and *Pongamia pinnata* were found effective in decreasing order to control the damage due to larvae of *Plecoptera reflexa*.

CONCLUSION

Plecoptera reflexa is one of the important defoliators of shisham causing severe havoc to the shisham plants. The insect also appeared in outbreaks and caused loss of MAI and CAI, reduced the productivity and quality of timber. Four extracts (CPPE, CPA, CPM and CPW) of *Calotropis procera* were tested against the third instar larvae of *P. reflexa* under laboratory conditions. Two extracts namely CPM and CPA were found effective at 1% concentration after 72 hrs. Bioassay experiments of effective extracts were carried out using seven concentrations viz: 0.0625, 0.0125, 0.25, 0.50, 1.00, 1.50 and 2.00% against shisham defoliator. It was found that extracts- CPM and CPA caused

66.67 and 63.33 % larval mortality of *P.relexa* at 2.00% concentration after 72 hrs of exposure respectively.

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