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ORIGINAL ARTICLE

Efficacy of extracts of *Adina cordifolia* against *Clostera cupreata* (Lepidoptera: Notodontidae) and *Plecoptera reflexa* (Lepidoptera: Noctuidae)

K.P. Singh, Mohammad Faisal and Arvind Kumar

Forest Protection Division, Forest Research Institute, Dehradun, India

Email: singhkp@icfre.org

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ABSTRACT

Clostera cupreata (Lepidoptera: Notodontidae) and Plecoptera reflexa (Lepidoptera: Noctuidae) are serious defoliators of poplar and shisham. Out of four extracts (ACPE, ACA, ACM and ACW) of Adina cordifolia, ACM was found effective for the control of poplar defoliator – C. cupreata and shisham defoliator P. reflexa. Bioassay experiments of effective extract were carried out using 0.0625, 0.125, 0.25, 0.50, 1.00, 1.50 and 2.00% concentrations. It was found that extract, ACM caused 36.67±3.33% larval mortality of C. cupreata and P. reflexa at 2.00% concentration after 72 hrs of exposure.

Key Words: *Adina cordifolia, Clostera cupreata, Plecoptera reflexa, Lepidoptera, Notodontidae, Noctuidae*

INTRODUCTION

Populas spp. are deciduous trees commonly known as aspen, poplars, green gold and cottonwood. It is distributed in the states of Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, Himachal Pradesh and Arunachal Pradesh (Mathur and Sharma, 1983). There are six species of poplars viz. *Populus alba, P. ciliata, P. euphratica, P. gamblei, P. jacquemontiana var. glauca* and *P. aurifolia,* indigenous to Himalayan region of India. Poplar is attacked by over 108 insect species (Beeson, 1941; Chatterjee and Thapa, 1964; Tiwari 1993). Out of these, *Clostera cupreata* is one of the important defoliator causing severe damage to the poplar. 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 insect species associated with this tree species 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).

C. cupreata and *P. reflexa* appeared in out breaks and caused loss of MAI and is one of the important defoliators causing severe CAI reduced the productivity and also quality of the timber. In Northern India, these defoliators are 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, the present work was initiated to study the efficacy of different extracts of *A. cordifolia for* the control of *C. cupreata* and *P. reflexa*.

MATERIALS, METHODS AND RESULTS

Collection of Insect

Different stages of *C. cupreata* and *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. 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 defoliators were brought from the field to the laboratory for rearing and to maintain the laboratory culture for laying down a series of experiments.

Collection, drying and grinding of plants material

Leaves of *A. cordifolia* were collected from New Forest Campus, Dehradun. The plant material was identified and authenticated from the Head, Botany Division, Forest Research Institute, Dehradun as leaves of *A. cordifolia.* The collected leaves were allowed to air dry under shed at room temperature and powdered.

Preparation of extracts

Shade dried and powder material of leaves (192 g) of *A. cordifolia* was extracted with the solvents of elutropic series in petroleum ether, acetone, methanol and distilled water sequentially. These extracts were concentrated on rotary evaporator under reduced pressure. The extracted extracts were ACPE, ACA, ACM and ACW.

ACPE mean leaves of *A. cordifolia* extracted in petroleum ether, ACA mean leaves of *A. cordifolia* extracted in acetone, ACM mean leaves of *A. cordifolia* extracted in methanol and ACW mean leaves of *A. cordifolia* extracted in water. The moisture free yield percentage of the extracts is given in table 1.

Table 1: Yield percentage of *Adina cordifolia* in different solvents

S.No.	Total Weight	Name of Solvent	Moisture free basis Yield in percentage
1.	192 gms	Petroleum ether	4.06
2.	192 gms	Acetone	4.91
3.	192 gms	Methanol	18.42
4.	192 gms	Water or aqueous	9.21

Rearing of insect

Larvae of *C. cupreata* and *P. reflexa* were reared separately in glass chimney and wooden cages with fresh leaves of poplar and 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 *C. cupreata* and *P. reflexa* were released separately for egg laying in wooden glass cages (60 x 60 x 90 cm) having fresh foliage of poplar and shisham. Cotton soaked in water solution of honey/sugar was supplied as food.

Testing of isolated extracts

Experiments were carried out to evaluate the larval mortality of different extracts - ACPE, ACA, ACM and ACW on the 3rd instar larvae of *C. cupreata* and *P. reflexa* at 1% concentration. Ten number of 3rd instar larvae of *C. cupreata* and *P. reflexa* were taken from the culture and released in glass jars with fresh leaves of poplar and shisham treated with 1% of above extracts. Observations on the mortality 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 in presented in table 2 showed that at 1% concentration of ACPE extract against *C. cupreata*, after 24 hrs showed the larval mortality 10.00±0.00%. No further larval mortality occurred after 48 and 72 hrs and was taken as non effective extract. 1% concentration of ACA extract after 24 hrs showed the larval mortality 16.67±3.33. No further larval mortality happened after 48 hrs. The larval mortality status after 72 hrs was increased to 20.00±2.89% and was taken as non effective. ACM extract at 1% concentration gave 23.33±3.33% larval mortality after 24 hrs. After 48 hrs the larval mortality raised to 26.67±3.33%. After 72 hrs the larval mortality status was

increased to 33.33±3.33 and was taken as effective extract. The experiment with ACW extract, at 1% concentration gave 6.67±3.33% larval mortality after 24 hrs. No further larval mortality happened after 48 and 72 hrs and was taken as non effective. In control experiment, no larval mortality was recorded.

Table 2: Larval mortality of *C. cupreata* at 1% concentration of *A. cordifolia* extracts

Chemical extract		Mortality after			Effective or not effective
		24 hrs	48 hrs	72 hrs	
ACPE	Avg.	10.00	10.00	10.00	Not effective
	SEM±	0.00	0.00	0.00	
	Control	0.00	0.00	0.00	
ACA	Avg.	16.67	16.67	20.00	Not effective
	SEM±	3.33	3.33	2.89	
	Control	0.00	0.00	0.00	
ACM	Avg.	23.33	26.67	33.33	Effective
	SEM±	3.33	3.33	3.33	
	Control	0.00	0.00	0.00	
ACW	Avg.	6.67	6.67	6.67	Not effective
	SEM±	3.33	3.33	3.33	
	Control	0.00	0.00	0.00	

Table 3: Larval mortality of *P. reflexa* at 1% concentration of *A. cordifolia* extracts

Chemical extract		Mortality after			Effective or not effective
		24 hrs	48 hrs	72 hrs	
ACPE	Avg.	13.33	13.33	13.33	Not effective
	SEM±	3.33	3.33	3.33	
	Control	0.00	0.00	0.00	
ACA	Avg.	26.67	26.67	26.67	Not effective
	SEM±	3.33	3.33	3.33	
	Control	0.00	0.00	0.00	
ACM	Avg.	26.67	26.67	36.67	Effective
	SEM±	3.33	3.33	3.33	
	Control	0.00	0.00	0.00	
ACW	Avg.	10.00	10.00	10.00	Not effective
	SEM±	0.00	0.00	0.00	
	Control	0.00	0.00	0.00	

Table 4: Bioassay of extract of *A. cordifolia* against larvae of *C. cupreata* and *P. reflexa*

Effective extract		Concentration						
		0.0625	0.125	0.25	0.50	1.00	1.50	2.00
ACM (against *C. cupreta)*	Avg.	0.00	0.00	6.67	16.67	30.00	36.67	36.67
	SEM±	0.00	0.00	3.33	3.33	0.00	3.33	3.33
	Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ACM (against *P. reflexa)*	Avg.	0.00	3.33	10.00	20.00	33.33	36.67	36.67
	SEM±	0.00	3.33	0.00	0.00	3.33	3.33	3.33
	Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Fig. 1. Showing different activities in laboratory and experimental field

A. Collected leaves of *A. cordifolia*
B. Collection of mature and immature defoliator
C. Rearing of *C. cupreata* in the lab
D. Exposure of extracts on 3rd instar larvae
E. Collection of defoliators from shisham
F. Rearing of *P. reflexa*
G. Pre pupa and pupa of *P. reflexa*
H. Spraying of extracts on 3rd instar larvae

Observations of table 3 showed that at 1% concentration of ACPE extract against *P. reflexa*, after 24 hrs showed the larval mortality 13.33±3.33%. There was no enhanced in the larval mortality after 42 and 72 hrs. the average larval mortality after 72 hrs was recorded as 13.33±3.33 and was taken

as non effective. ACA extract at 1% concentration gave 26.67±3.33 larval mortality after 24 hrs. There was no increase in the larval mortality after 48 and 72 hrs. The average larval mortality after 72 hrs was recorded as 26.67±3.33% and was taken as non effective. 1% concentration of ACM extract gave 26.67±3.33% larval mortality after 24 and 48 hrs. The larval mortality increased to 36.67±3.33% after 72 hrs and was taken as effective extract. ACW extract, at 1% concentration showed 6.67±3.33% larval mortality after 24 hrs. No further larval mortality happened after 48 and 72 hrs and was taken as non effective. In control experiment, no larval mortality was recorded.

Bioassay experiments of effective extract (ACM) of *A. cordifolia* in methanol were carried out to test the mortality status of poplar defoliator - *C. cupreata* and shisham defoliator- *P. reflexa.* In the first step ACM extract was tested by using 0.0625, 0.125, 0.25, 0.50, 1.00, 1.50 and 2.00% concentration against the larvae of *C. cupreata*. After 72 hrs of exposure the average larval mortality was found 0.0, 0.0, 6.67±3.33, 16.67±3.33, 30.00±0.0, 36.67±3.33 and 36.67±3.33% respectively. In control experiment, no larval mortality was recorded (Table-4). Similarly ACM extract was also tested with the same concentrations against the larvae of *P. reflexa.* The respective larval mortality was observed 0.00, 3.33±3.33, 10.00±0.00, 20.00±0.00, 33.33±3.33, 36.67±3.33 and 36.67±3.33 respectively after 72 hrs. In control experiment, no larval mortality was recorded (Table 4).

Gupta and Joshi (1995) tested the 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, C. *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 of 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 *P. reflexa*.

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