XV WORLD FORESTRY CONGRESS
Building a Green, Healthy and Resilient Future with Forests
2–6 May 2022 | Coex, Seoul, Republic of Korea

Management of Poplar Defoliator (*Clostera cupreata)* through herbal approach (ID 3485340)

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Abstract

Poplar is a fast growing exotic tree species which has been extensively planted in India under various afforestation/reforestation programmes. Poplar Timber is the backbone of vibrant plywood, board, match, paper and sports goods industries. The cultivation of poplar has generated huge employment in the rural sector in India and has overall improved the rural economy. Poplar is highly prone to insect attack, approximately, 108 insect species are causing damage. Out of these, Poplar defoliator- *Clostera cupreata* (Lepidoptera: Notontidae) is one of the most damaging pest of poplar which defoliate poplar plantation and often appears in outbreaks even causes death of tree.

Therefore, a concept was developed to protect the plant by the plant. Regarding this, a number of plant extracts were screened and tested against the larvicidal efficacy of *C.cuperata.* Out of four plants, leaves of *Calotropis procera* were tested for larvicidal activities against poplar defoliator. The 3rd instar larvae of *C. cupreata* were exposed to a wide range of concentrations (0.0625 to 2.00%). LC50 value of each sample and control was recorded simultaneously. After repeated experiments, a herbal formulation (Biopesticide) was developed and it showed almost 70% efficacies against *Clostera cupreata* (poplar defoliator). Field trials were also carried out in northern part of India at farmer's field.

Novel, environment friendly chemicals for control of plant diseases, crop-damaging pests are needed to replace pesticides that have been withdrawn from the market due to regulatory or economic reasons, or due to development of pest resistance.

Keywords: Poplar, Poplar defoliator, *Clostera cupreata* (Lepidoptera: Notontidae), environment friendly chemicals , larvicidal efficacy

Introduction, scope and main objectives

Forest ecosystem comprising of varied biodiversity and varieties in fauna and flora. Forests are of paramount importance due to their multipurpose utility i.e., for their valuable natural resources which contribute significantly to the local and industrial economy of the country. These natural resources are depleting very fast due to which the regeneration of many tree species is very poor; one reason for poor regeneration is the attack of insect pests. The insects are most dominating groups occupying highest position and constitute biggest number in the whole animal kingdom due to their versality, which play a decisive role in determining the productivity of forest, forest resources, forest products and also affect the growth increment of the tree, at times even leads to the death of the tree. Their demand for the environmental stability has led man to think for proper management of insect pests. Outbreaks of poplar defoliator have been reported from various locations in different states of India *viz.* Haryana, Uttrakhand and Uttar Pradesh. In Tarai Central Forest Division of Uttar Pradesh, India, the insect species was controlled by using a lot of synthetic insecticides.

Populas spp. are deciduous trees commonly known as aspen, poplars. The genus *Populus* is widely distributed throughout the temperate and cold regions of the northern hemisphere between the southern limit of latitude 30ºN and northern limit of latitude 45ºN. In India poplars have a limited distribution in areas lying north of approximately 28 ºN latitude in the states of Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, Himachal Pradesh and Arunachal Pradesh (Mathur and Sharma, 1983). They also occur in some north eastern states of North Bengal, Sikkim and Arunachal Pradesh (Biswas *et al*., 1990). There are six species of poplars viz. *Populus alba, P. ciliata, P. euphratica, P. gamble P. jacquemontiana* var *glauca* and *P. aurifolia,* indigenous to Himalayan region of India. *P. deltoides* is a fast growing exotic tree species which has been extensively planted in India under various afforestation/ reforestation/ agro forestry programmes especially in Tarai region of Uttar Pradesh, farm lands in Punjab and Haryana, as avenue trees in Kashmir and in forest area in Arunachal Pradesh (Lohani, 1979). Poplar found to be susceptible for insect attack. Over 108 insect species of varying nature of damage have so far been recorded causing infestation to the poplar of different dimensions. Poplar constitutes an excellent raw material for a number of wood based industries like matchwood, plywood, fibreboard, paper, pulp, rayon, etc. Thus, Poplar farming offers great scope in agroforestry system, social forestry programmes and in meeting the growing need of wood-based industries besides providing cash benefits to the farmers (Joshi *et al.*1984).

Colestra cupreata Butler (Lepidoptera: Notodontidae) is reported as major pest of poplar in India. Its outbreak had been quite wide spread, defoliating poplars in the entire region. It has 7-8 generation in a year. Attack of this insect starts in the month of March-April. Use of synthetic pesticides has severely affected both the abiotic and biotic components of the environment. While the former is exemplified by pesticide residues in soil, air, water, food etc. The latter includes phytotoxicity, physiological deformities, diseases, mortality, population changes,genetic disorders, etc. This is where biopesticides come into the picture, which may be considered as one of the components required to protect the environment and render sustainability to the agricultural production. Biopesticides are made from naturally occurring substances that controls pests by non-toxic mechanisms and in eco-friendly manner. Hence biopesticides pose less threat to the environment and human health. They are generally less toxic than chemical pesticides, often target-specific, have little or no residual effects and have acceptability for use in organic farming.

Biopesticides are used globally to control insect pests and diseases. Bioinsecticides, biofungicides and bionematicides are rapidly growing market segments and their demand is expected to boost further in the near future. Globally, there are 175 registered biopesticide active-ingredients and more than 700 products available in the market. The global market for biopesticides has been valued at US $2.3 billion, and it is expected to reach US $5.2 billion by 2020. However, biopesticides represent only 1% of the global market for agrochemicals.

Therefore, a need arises to develop biopesticide for control of pests attack on poplar. Keeping this in mind, the research was carried out to prepare an environment friendly biopesticide from weeds for the management of Poplar defoliator (*C. cupreata)*.

FIGURE 1. POPLAR PLANTATION

Methodology/approach

Plant material: The plant material **(***Calotropis procera)* were collected in and around Dehradun, Uttarakhand, India (herbarium accession no. 162303). The plant parts were cleaned, shade dried and extracted with the solvents of elutropic series viz. petroleum ether, acetone, and methanol and distilled. The yield percentage was determined on moisture free basis and is given in Table1.

TABLE 1. YIELD (%) OF *CALOTROPIS PROCERA* EXTRACTS

Solvents	Yield (%) of extracts
Petroleum ether	6.40
Acetone	3.84
Methanol	2.24
Distilled water	17.93

Preparation of Formulation:

A number of secondary metabolites were isolated and characterized from different parts of the plant by using sophisticated analytical techniques.. A formulation was developed with different combinations of isolated compounds.

Collection of Poplar defoliator (*C. cupreata)*: Mature and immature larvae of poplar defoliator–*C.cupreata* (Lepidoptera: Notodontidae) were collected from the field and brought to the laboratory, Forest Entomology Division, Forest Research Institute, Dehradun India to maintain the laboratory culture.

FIG.2. COLLECTION OF POPLAR DEFOLIATOR

Rearing and maintenance of laboratory culture: Different stages of the defoliator reared in Chimney, wooden and in outdoor cages and maintained the laboratory culture to lay down a series of experiments**.**

FIG. 3 REARING OF POPLAR DEFOLIATOR

FIG. 4. LARVAE AND PUPAE OF *C. CUPREATA*

Testing of formulation under laboratory condition*:* Developed formulation was tested at 1% concentration against the third instar larvae of poplar defoliator with four replications and control in the laboratory. Mortality data was recorded after 24, 48 and 72 hrs. The moribund larvae were also considered as dead.

TABLE 2. LARVAL MORTALITY OF *CLOSTERA CUPREATA* AT 1.0% CONC. OF BIOPESTICIDE

Concentration of Formulation	Replications	No. of Larvae	Larval mortality percentage after		
			24 hrs	48 hrs	72 hrs
1%	R1	20	60.00	60 .00	60.00
	R2	20	60.00	65.00	65.00
	R3	20	55.00	60.00	60.00
	R4	20	55.00	60.00	60.00
	Average	20	**57.50**	**61.25**	**61.25**
	SEM(±)	0.00	0.39	0.32	0.32
	Control	20	Nil	Nil	Nil

Bioassay trial experiments were laid down in field conditions to test the larval mortality using 1.0, 1.5, 2.0 and 2.5% concentration each in 3-replications. Observation recorded after 24, 48 and 72 hrs. of exposure. 20 larvae were taken for testing in each replication. Results of larval mortality are presented in table 3. In case of control experiment, no larval mortality occurred.

TABLE3. LARVAL MORTALITY OF *C. CUPREATA* AT DIFFERENT CONCENTRATION OF FORMULATIONS IN FIELD CONDITION

Concentration of formulation	Replication	No. of larvae	Larval mortality after		
			24 hrs	48 hrs	72 hrs
1.0%	R1	20	60	60	60
	R2	20	60	60	60
	R3	20	60	65	65
		SEM(±)	60.00±0.0	61.67±0.36	61.67±0.36
1.5%	R1	20	65	65	65
	R2	20	65	70	70
	R3	20	65	70	70
		SEM(±)	65.00±0.0	68.33±0.35	68.33±0.35
2.0%	R1	20	70	70	70
	R2	20	70	70	70
	R3	20	65	65	70
		SEM(±)	68.33±0.35	68.33±0.35	70.00±0.0
2.5%	R1	20	75	75	75
	R2	20	70	75	75
	R3	20	70	70	70
		SEM(±)	71.67±0.35	73.33±0.35	73.33±0.35
Control	R1	20	Nil	Nil	Nil
	R2	20	Nil	Nil	Nil
	R3	20	Nil	Nil	Nil

Results and Discussion:

The developed formulation was tested under laboratory condition, field and at farmer's field of Uttarakhand, Haryana and Uttar Pradesh, India to test their efficacy for the management of *C. cupreata* larvae. Results showed that under laboratory conditions, 1% concentration was found effective which provided 61.25±0.32% larval mortality. Further, bioassay was also carried out and it was reported that 1.5% and 2.0% concentration showed 66.50±0.35 and 68.75±0.35% larval mortality. It seems almost similar larval mortality in both the concentrations. Therefore 1.5% formulation concentration is recommended under laboratory conditions. The formulation was also tested in outdoor cages (semi-field condition) and it was observed that 2.0% and 2.5% concentration provided 70.00±0.0 and 73.33±0.35% larval mortality after 72 hrs., which shows almost similar mortality. Therefore, 2.0% concentration is recommended for semi-field condition.

The developed formulation was also tested at the farmer's field of Uttarakhand, Haryana and Uttar Pradesh, India. It was observed that 2.0% concentration provided 63.33±0.36% larval mortality at three different locations as stated above. Whereas, 2.5% concentration yielded 63.33±0.36, 65.00±0.0 and 66.67±0.35% larval mortality in Uttarakhand, Haryana and Uttar Pradesh trials. Therefore, 2.5% concentration is recommended for the farmer's field which yielded maximum larval mortality 66.67±0.35% after 72 hrs. of formulation exposure.

Conclusions/ wider implications of findings

Crop-damaging pests are needed to replace pesticides that have been withdrawn from the market due to regulatory or economic reasons, or due to development of pest resistance. Therefore, novel and environment friendly formulation was developed for the managements of poplar defoliator and for control of plant diseases. Training cum Awareness Programme for the management of poplar defoliator: *C. cupreata* were also organized for poplar growers/ farmers of district Uttarakhand, Haryana, India. This training programme was a lab to land activity for the use of formulation. Experts of the field gave advanced information on the management of poplar and its defoliator.

Acknowledgements

The authors are very much thankful to Department of Science and Technology, New Delhi for providing the financial support for conduction of research work. We are also sincerely thankful to Director, Forest Research Institute, Dehradun, India for support and continuous guidance.

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