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Research Note

Evaluation of larvicidal activity of Panchagavya, against the teak defoliator (*Hyblaea puera* Cramer) and skeletonizer (*Eutectona machaeralis* Walker) in a forest plantation

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ABSTRACT: Panchagavya is an organic formulation, formed by merging five cow derivatives, such as dung, urine, milk, ghee, and curd, which promotes the growth of plants. The present investigation was aimed to determine the larvicidal efficacy of Panchagavya with varied concentrations against major pests of teak, *Tectona grandis,* singly, and combined with leaf extract of members of Meliaceae family, and coupled with extract of seaweed, in experimental research plots. Observations on occurrence of pests was also observed periodically and recorded. Treatments include 5% concentration of panchagavya (T1), which serves as a control and Panchagavya combined with varied dosage of other leaf crude extracts of *Melia dubia* (T2), *Melia azedarach* (T3), *Azadirachta indica* (T4), and a seaweed, *Sargassum wightii* (T5), with a concentration range of 1000-5000 ppm that were used as foliar application. Among the various pests, *Hyblaea puera*, and *Eutectona machaeralis* were found to be dominant, and the III instar larval stage were targeted for the management. Maximum larval mortality was observed with exposure to Panchagavya with crude extract of *S. wightii,* at an appropriate ratio (T5) against teak defoliator, *Hyblaea puera.* The per cent pest reduction was found to be 65% and 73% in 48 h and 72 h time interval. Similarly, higher level of larval mortality was recorded against skeletonizer (*E. machaeralis*) where the reduction per cent was recorded as 62% and 71% at 5000 ppm in (T5) within the interval of 48 h and 72 h. Consequently, a distinct individual lethal effect of Panchagavya (T1, control) against both pests was found to be 8%, 24%, and 46% with similar time frames. However, the efficacy of Panchagavya combined with extract of *M. dubia, M. azedarach* and *A. indica* exhibited statistically significant ability in larvicidal potential against *H. puera*. Whereas, treatments like T2, T3, and T4 showed 59, 67, and 62 % of larval mortality of *E. machaeralis* larva within the period of 72 h. The results of the study affirmed that the synergistic effects of Panchagavya coupled with seaweed extract at appropriate ratio proved to be effective against major pests of teak plantation.

KEYWORDS: *Eutectona machaeralis, Hyblaea puera*, larvicidal activity, *Tectona grandis*

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Forests comprise the world's greatest significant and treasured natural resource and terrestrial biological diversity (Bawa and Dayanandan, 1998). Generally, insects belonging to the class Insecta play a crucial role in a forest ecosystem, they serve as food for wildlife, pollinate plants, and even prey on forest pests. Many forest insect pests have been introduced from other countries and become invasive species, largely, due to the absence of natural predators. They reduce the growth rate of trees, transmit disease, weaken trees, or kill trees. Weakened trees are more susceptible to attack by other insects or diseases subsequently.

Tectona grandis (Linnaeus) is one of the most valuable, ideal timber species of India. A study has underlined that about 187 insect species have been identified, feeding on live teak trees, which includes, 78 species from the order Lepidoptera, 40 species from the order Coleoptera and 18 species of order Orthoptera (Hutacharern and Tubtim,1995). Despite ssubstantial damage of insect pests to the plantation, no well-established management practice is available in our country except the usage of acute toxic synthetic chemicals that cause huge adverse effects, which led to a search for an alternate technique in pest management practices (Isman, 1995). Therefore, it is an eleventh hour to identify simple and environment-friendly alternative methods to accomplish forest pests.

Panchagavya is reportedly used as a bioenhancer, triggering the biological activity of many crop plants to yield quality fruits and vegetables. It displays the properties of both fertilizer and bio-pesticide and augmented the economic yield of crops. In several agricultural practices, another form of Panchagavya, (Amudhakaraisal) usage is a traditional organic crop promoter, employed by the majority of the farmers in Tamil Nadu, which acts as a pest repellent, antifeedant, and growth promoter.

In earlier studies, it has been reported that in many rural areas, Panchagavya was used as a prophylactic measure for controlling pests and used as a pest repellent (Sebastian and Lourduraj, 2007). A study conducted by Subramanian and Tennyson (2012) has showed that the use of indigenous cow products in combination with other effective plant extracts could possibly cut down sharply the expenditure on pest management operations.

Hence, an effort has been taken to determine the larvicidal properties of Panchagavya, self-reliantly, and to evaluate synergistic effects with proportionate extracts of selected *Meliaceae* family species, including a seaweed, targeting, two major pests *Hyblaea puera*, and *Eutectona macheralis* associated with *T. grandis*.

Experiment details

This study was conducted in a well-designed research plot located in Kattankulathur, Kanchipuram District Tamil Nadu, during the period of May 2016 to October 2016. The soil type is red laterite with an average pH of 6.5. The study area covers 1.00 ha with a holding of 400 one-year-old seedlings with an espacement of 3m x 3m. A standard sampling method was adopted with three replications for the study. A sum of 118 seedlings, covering 11 rows was selected for the study, and the sample size covers 29.5% of the total study area. Incidence of insects' pests associated with teak was observed in the morning and evening regularly and recorded.

Collection of larvae

A major pest of *T. grandis* was given due consideration for larvicidal activity. Hence, egg batches and different developmental instars of *H. puera* and *E. machaeralis* were collected from infected seedlings of the teak plants and were reared in the laboratory on leaves of *T. grandis* at room temperature (30±3 °C). The third instar larvae were segregated and monitored for the experiment.

Collection of plants

Leaves of *M. dubai, M. azedarach* and *A. indica* were collected from research plots of State Forest Research Institute, Chennai. Whereas, seaweed, *Sargassum wightii* was collected from Gulf of Mannar biosphere Reserve in Tamil Nadu, India. They were shade dried in the laboratory and were individually pulverized to a fine powder. Each powdered plant material was sieved using a strainer. One kilogram of each powdered plant material was sequentially extracted with hexane, diethyl ether, dichloromethane, ethyl acetate, and methanol for a period of 72 h each and then filtered. The filtered content was subjected to a rotary vacuum evaporator until solvents were completely evaporated to get the solidified crude extracts. The crude extracts, thus obtained, were stored in sterilized amber-coloured bottles maintained at 4°C in a refrigerator. Standard one percent stock solution (1000 ppm) was prepared by dissolving 100 mg of crude extract in 100 ml of acetone.

Treatment protocol

Treatments have been designed to validate the bio efficacy of Panchagavya, as single, and with different combinations of leaf extracts as in Table 1, against the third instar larva of *H. puera* and *E. machaeralis.* The larval mortality was observed, after foliar application, using a power sprayer of 10-liter capacity and was sprayed with a concentration range of 1000 to 5000 ppm for seaweed, Panchagavya, and similar doses of leaf extracts were also used. Data were recorded at 24, 48 and 72 h after application. For each treatment, five replicates with one control were maintained to get concurrence values.

The rate of mortality of teak defoliator and skeletonizer by foliar application of Panchagavya individually, and combination of crude extract of *Meliaceae* members and a seaweed, *S. wightii* are presented in Table 2.

Results revealed that (Table 2), mortality of larva was found to be high in treatment (T5), at 5000 ppm concentration, in 48 h and 72 h of interval, against larva of *H. puera.* Percentage of mortality was recorded as 65% and 73% to the respective time duration. However, the effects of Panchagavya (alone) showed a mortality of 24 and 46%, in 48 h and 72h respectively against the same pest.

The maximum Per cent of larval mortality was recorded as 62 and 71% in 48 h and 72 h of interval, at 5000 ppm concentration of (T5) against, *E. macheralis,* whereas, in (T1), mortality was insignificant recording 12, and 39 %, at 48 h and 72 h respectively against teak skeletonizer (Figure 1).

Table 1. Treatment details of Panchagavya and combinations

Treatment details	Composition of Formulation
T1 (Control)	Panchagavya (5% concentration)
T2	Panchagavya + 3%crude extract of *M. dubia*
T3	Panchagavya + 3%crude extract of *M. azedarach*
T4	Panchagavya + 3%crude extract of *A. indica*
T5	Panchagavya+crude extract of seaweed *S. wightii* (at 1000 ppm-5000 ppm concentration)

Table 2. Larval mortality of the teak defoliators at different treatments of Panchagavya

Treatment	Pest	Larval mortality%								
		24 hrs			48 hrs			72 hrs		
		1000 ppm	2500 ppm	5000 Ppm	1000 Ppm	2500 ppm	5000 ppm	1000 Ppm	2500 ppm	5000 Ppm
T1(Control)	*H.puera*	8			24			46 *		
T2		12	23	33	18	29	42	40	52	60
T3		21	34	43	23	32	48	40	59	65*
T4		18	32	40	15	27	39	38	56	63
T5		28	42	53	32	41	**65***	43	50	**73***
T1(Control)	*E.macheralis*	3			12			39		
T2		14	26	39	23	35	45	38	49	59
T3		23	37	47	26	51	59	32	52	67*
T4		20	28	42	31	36	53	47	56	62
T5		24	46	48	30	48	**62***	40	57	**71***

*The values are expressed in % mortality. The results are analyzed by student's t-test (n=6),*indicates statistically significant.*

The effect of Panchagavya with crude extract of *M. dubai* (T2) treatment revealed 12, 23, 33%, 18, 29, 42%, and 40, 52, 60% of mortality to the respective concentrations 1000, 2500, and 5000 ppm at an interval of 24h, 48h, and 72 h respectively against *H. puera larva.* Whereas 14, 26, 39%, 23, 35, 45%, and 38, 49, 59% of larval mortality was observed against larvae of *E. macheralis.*

Synergistic effects of Panchagavya with extract of *M. azedarach* (T3) application have resulted the percentage of mortality found to be 21, 34, 43%, 23, 32, 48%, and 40, 59, 65% to the respective time, 24 h, 48 h, and 72 h targeting larva of *H. puera.* While, the larval mortality showed in *E. macheralis* and the percentage was recorded as 23, 37, 47%, 26, 51, 59%, and 32, 52, 62% respectively within a similar time frame.

In (T4) treatment, the effects of Panchagavya combined with an extract of *A. indica* showed, the percentage of mortality to be 18, 32, 40%, 15, 27, 39%, and 38, 56, 63% against *H. puera* at the respective time frame of 24, 48, and 72 h, whereas, against *E. macheralis,* larva, mortality was observed as 20, 28, 42%, 31, 36, 53%, and 47, 56, 62% respectively.

Application of Panchagavya with crude extract of seaweed, *S. wightii* (T5), on the third instar larvae of *H. puera* has resulted in a significant increase in the mortality rate and recorded as 28, 42, 53%, 32, 41, 65% and 43, 50, 73% at 1000, 2500, and 5000 ppm concentration respectively. Similarly, the mortality per cent was observed as 24, 46, 48% in 24 h, 30, 48, 62% in 48 h and 40, 57, 71% in 72 h respectively against the pest *E. macheralis.*

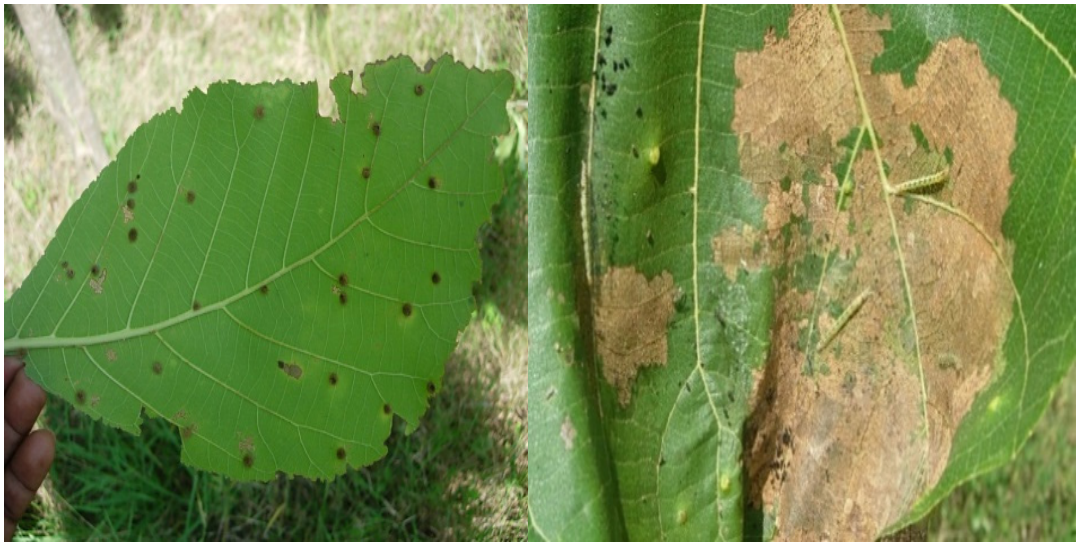

Figure 1. Incidence of defoliators on teak leaves.

DISCUSSION

In India, 1.5 million hectares of teak plantations exist indeed, and around 50,000 ha of teak plantations are raised annually (Subramanian *et al.,* 2000). The increase in plantation area has led to an intensification of insect pests, which resulted in severe outbreaks. The teak-associated pest is a limiting factor in the growth increment of teak in India as well as in other countries. Several investigations have reported that the components like cow dung and cow urine augment the insecticidal activity of Panchagavya (Shailaja *et al.*, 2014).

A notable earlier investigation carried out by the authors such as Meena *et al*. (2016), Shailaja *et al*. (2012), Patel *et al*. (2003), More *et al.* (1989) and Chandrashekharaiah and Sannaveerappanavar (2013) who reported that the least repellence of *P. xylostella*, a voracious feeder, was observed, while in use of Panchagavya in singly, when compared to the synergetic effect with other plant extracts.

Similarly, Pazhanisamy and Archunan (2019) described maximum percent reduction of *Earius vittella* was recorded with a treatment of Panchagavya (3%) + Neem Seed Kernel Extract (NSKE) (5%) treated design, followed by pungam oil (3%) + Panchagavya (3%) and Neem Leaf Extract (NLE) (5%) + Panchagavya (3%). They inferred that Panchagavya combined with NSKE 5% were shown to be effective in the management of *E. vittella* pests. Al Lawati *et al.* (2002) have examined the repellent properties of neem leaf extracts against pulse beetle, *Callosobruchus chinensis,* and reported moderate efficacy was found in neem extract independently.

It is already reported that cow urine and cow dung have larvicidal activity (Kumar *et al.*, 2009; Ngugi 2009) and, Panchagavya has insecticidal and larvicidal activity (Sayi *et al.*, 2018).

Meshram (2010) reported that a reduction of pests was achieved using various plant materials against teak defoliators and skeletonizers in his study. He demonstrated Aloe vera leaf extract 0.5 per cent is proved to be the best and most effective to inhibit the larva of teak skeletonizer, *E. machaeralis*, the larvae feed only 2.70 % treated leaf area in 24 h as compared to 60.90% leaf consumed in the untreated control. Correspondingly, in our study, the reduction of pests was recorded significantly, while the foliar spray of Panchagavya blended with different treatments like T2, T3, T4, and T5. Among them, T5 exhibited the highest response in pest reduction, while Panchagavya mixed with seaweed extract. As demonstrated by Calumpang *et al.* (2017), who argued that the presence of volatile organic compounds emitted by brown seaweed, *Sargassum cinctum,* repels female corn/borer moths.

Among various treatments examined, Panchagavya with seaweed extract (T5) exhibited excellent effects in the reduction of both pests, and it has been presumed that larvicide effects of Panchagavya may trigger the lethal effects on the larva attributed to its bio-enhancing ability while supplemented with *S. wightii* (T5) which displayed a high degree lethal per cent. The low effects on larval mortality were observed with (T1). Our findings suggest that Panchagavya spray is reportedly effective as a larvicide besides growth regulating activity in agriculture (Somasundaram *et al.*, 2007).

CONCLUSION

In the present investigation, it has been affirmed that Panchagavya with *S. wightii* possesses a high degree of larvicidal potential, against the major pests of the teak with appropriate composition. This study, indicates that indigenous Panchagavya and seaweed *S. wightii* composition, can be considered as an alternate effective component for pest management strategy, against the major teak defoliators.

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