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RESEARCH NOTE

Effect of chocolate weed (*Melochia corchorifolia* L.) leachates on the mortality of storage pests, pulse beetle (*Callosobruchus maculatus* F.) and rice weevil (*Sitophilus oryzae* F.)

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ABSTRACT

Insecticidal potential of whole plant leachate of chocolate weed (*Melochia corchorifolia* L.) on storage pests, *viz.* *Callosobruchus maculatus* (F.) and *Sitophilus oryzae* (L.) was assessed under laboratory conditions. Results revealed that whole plant leachate of *M. corchorifolia* had insecticidal action against *C. maculatus* and *S. oryzae*. Mortality rate of storage pests was found to be concentration dependent and the highest leachate concentration (15 %) resulted in significantly higher mortality rate. LC_{50} and LC_{95} values for the mortality of rice weevils and pulse beetles after 48 h of treatment were 11.69, 15.50 mg/L and 32.89 and 43.45 mg/L, respectively. The result clearly indicated the presence of a toxicant or growth inhibitor principle in the whole plant leachate of *M. corchorifolia*. Identification and isolation of active ingredient in the whole plant leachate of *M. corchorifolia* will help to develop an eco-friendly biopesticide against *C. maculatus* and *S. oryzae.*

Keywords: Chocolate weed, Insects mortality, Leachate, Pulse beetle, Rice weevil, Storage pests, Weeds usage

Stored grain pests accounts for 20 to 25% damage in food grains (Rajashekhar *et al*. 2010). Among the various storage insect pests rice weevil (*Sitophilus oryzae*), pulse beetle (*Callosobruchus maculatus)*, lesser grain borer (*Rhyzopertha dominica* F.), Khapra beetle (*Trogoderma granarium* Everts), red flour beetle (*Tribolium castaneum* Herbst.) *etc*. are most detrimental and causes greater damage to the stored grains.

Rice weevil cause heavy losses of stored food grain quantitatively and qualitatively throughout the world (Arannilewa *et al*. 2002). *Callosobruchus* spp. are the major storage pests which cause damage to almost all the pulse crops and adversely affect the seed quality (Park *et al*. 2003). However un-systemic application of synthetic pesticides calls to implement safe alternative options to tackle stored pests. Identifying the insecticidal properties of indigenous plants may be environmentally and socio-economically feasible option to manage these pests.

Chocolate weed (*Melochia corchorifolia* L.) a member of Malvaceae family has become a devastating weed in the sesame growing tracts of *Onattukara*, Kerala. Weed management by their utilization is one of the component of integrated weed management. It is the economic utilization of invasive/noxious species by harnessing their economic potential for meeting the basic human needs and at the same time prevent its spread and eradicating them (Tessema 2012). Plant secondary metabolites acts as signals and provide benefits like defense against herbivores, fungi and bacteria. Leaf/ flower/seed extracts of plants, *viz. Acalypha indica*, *Vitex negundo*, *Nerium oleander* can be effectively utilized for the management of storage pests (Sathyaseelan *et al*. 2008). Beneficial effects of chocolate weed for storage pests management has not been explored thoroughly. This experiment aims to study the insecticidal effect of chocolate weed against storage pests *C. maculatus* and *S. oryzae.*

Chocolate weed samples from infested ûelds (8.93° N and 76.39° E at 3.05 m MSL) of *Onattukara* Regional Agricultural Research Station (ORARS), Kayamkulam, Kerala, India were used for the experiment. Fresh plant samples at active growth stage (30 DAS) were collected carefully from the field without damaging the roots and washed in clean water to remove the dirt and soil adhered to the roots. The study was conducted with leachate of chocolate weed.

Preparation of leachate: Plants were chopped into small pieces of 2 cm length using a fodder cutter. Leachate was prepared by soaking the weighed plant (25, 50, 100 and 150 g) material for 48 h in 1000 mL distilled water to make leachates of 4 different

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concentrations of 2.5, 5, 10 and 15 % , respectively (Ameena and Geethakumari 2016).

Culturing of test insects: The test insects, *viz*. *S. oryzae* (rice weevil) and *C. maculatus* (pulse beetle) adults were obtained from the storage insects' culture from Department of Entomology, College of Agriculture, Vellayani and were mass cultured in 1 kg capacity glass jars of size 20 × 10 cm containing respective food materials (rice and chick pea) as a nutritional source at 60-70 per cent relative humidity and temperature range from 30-35^{0}C. Then glass jars were covered with a fine muslin cloth and secured with a rubber band. Half of the completely infested food materials were replaced with the same quantity of non-infected materials at an interval of two generations. A continuous insect culture was thus maintained throughout the experiment period. The freshly emerged adult beetles were used for the experiments (Kathirvelu and Raja 2015).

Petri dishes of 9 cm diameters were used for the study. Separate experiment was conducted for each insect in completely randomized design (CRD) with five treatments (four different concentrations of whole plant leachates of *M. corchorifolia* and a control) in four replications. Different concentrations of whole plant leachates of *M. corchorifolia* were 2.5, 5, 10 and 15 %. Twenty-five insects (rice weevil/ pulse beetle) were placed in petri dishes. Petri dishes were moistened daily with a fine spray of 1.5 ml leachate using an atomiser. Control treatments were moistened using distilled water. The number of dead insects at 6, 12, 24, 36 and 48 h after spraying (HAT) were recorded. The experiments were repeated thrice for confirmation. Statistical analysis of the data and probit analysis to determine the LC_{50} and LC_{95} values for the mortality of rice weevils and pulse beetles were done using software grapes Agri 1 (Gopinath *et al.* 2021).

Mortality of rice weevil (*S. oryzae*): Mortality of rice weevil occurred due to the leachates of chocolate weed, *M. corchorifolia* (**Table 1**). The highest mortality was observed in 15 % leachate (33.33 %) (**Plate 1**) which was significantly different from all other concentrations of *M. corchorifolia* after 6 h of treatment. Similar trend was observed after 12, 24, 36 and 48 h of treatment.

Mortality of pulse beetle (*C. maculatus*): After 6 h of treatment, the highest mortality of pulse beetle, *C. maculatus* was recorded in 15% leachate (30.67%) (**Plate 2**) followed by 10% leachate (22.67%). Similar trend was observed at 24, 36, 48 h after treatment except at 12 h. The percent mortality was on par with 10 and 15% leachates after 12 h of treatment (**Table 2**)

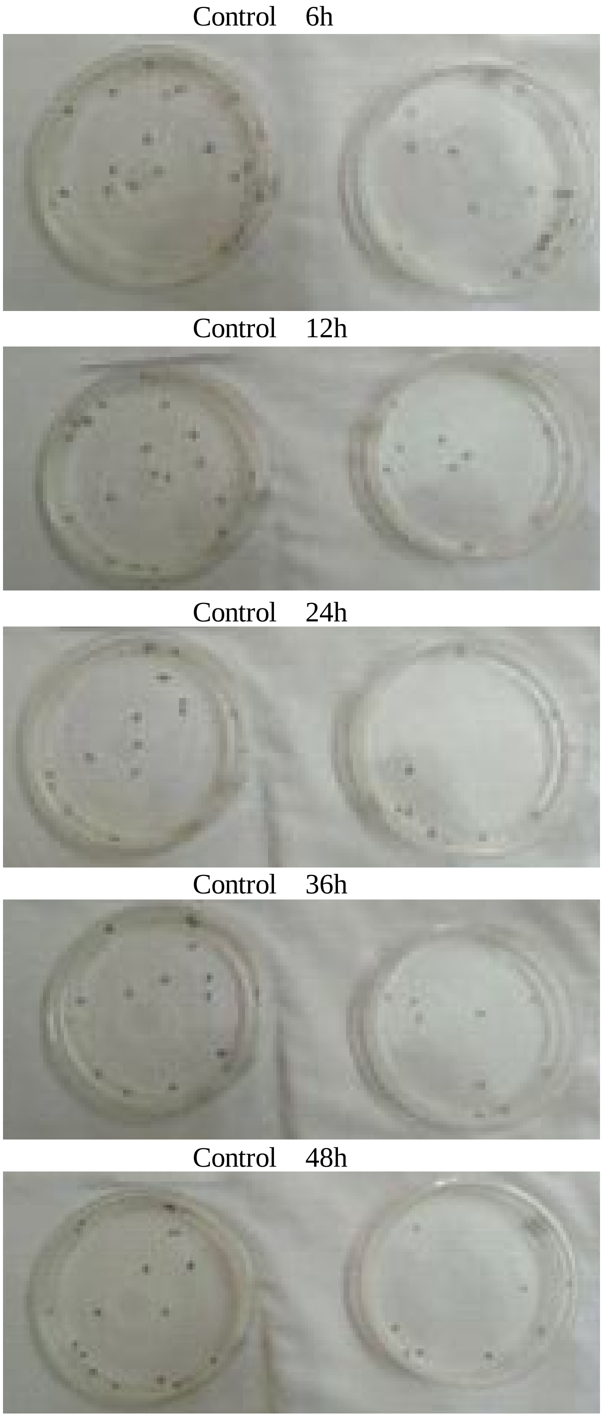

Plate 1. Number of live rice weevils left at different time intervals (15 % leachate concentration)

Toxicity of chocolate weed whole plant extract on the mortality of test insects

Rice weevil (*S. oryzae*): LC_{50} and related parameters of toxicity of whole plant leachate of chocolate weed (*M. corchorifolia*) against rice weevil (**Table 3**) indicated LC_{50} and L95 values for the mortality of *S. oryzae* as 23.32 mg/L and 55.61 mg/L , respectively after 6 h of treatment. After 12 h, LC_{50} and LC_{95} values for the mortality were observed to be 18.07 and 41.84 mg/L, respectively. LC_{50} value of 13.96 mg/L and

Table 1. Mortality of *S. oryzae* L. (rice weevil) after treatment with leachate of chocolate weed (*M. corchorifolia*)

Concentration of leachate (%)	Mortality of rice weevil (%)				
	6 HAT	12 HAT	24 HAT	36 HAT	48 HAT
2.50	10.67	10.67	13.33	14.67	16.00
5.0	17.33	18.67	21.33	29.33	32.00
10.0	25.33	28.00	29.33	38.67	41.33
15.0	33.33	42.68	57.33	60.00	62.67
LSD (p=0.05)	3.799	4.518	5.038	4.234	2.444

HAT: hours after treatment

Table 2. Mortality of *C. maculatus* (pulse beetle) after treatment with leachate of chocolate weed (*M. corchorifolia*)

Concentration of leachate (%)	Mortality of pulse beetle (%)				
	6 HAT	12 HAT	24 HAT	36 HAT	48 HAT
2.50	12.00	13.33	14.67	18.67	20.00
5.0	16.00	21.33	22.67	24.00	26.67
10.0	22.67	26.67	29.33	34.67	37.33
15.0	30.67	40.00	42.67	48.00	49.33
LSD (0.05)	5.09	4.52	3.67	6.03	6.88

HAT: hours after treatment

Table 3. Toxicity of chocolate weed whole plant leachate (*M. corchorifolia*) on the mortality of *Sitophilus oryzae* (rice weevil)

Toxicity of leachate for mortality of pulse beetle (mg/L)			
HAT	LC_{50}	LC_{95}	Chi square
6	25.42	59.17	0.000
12	19.97	49.39	0.002
24	18.61	47.53	0.004
36	15.80	40.85	0.000
48	15.50	43.45	0.000

HAT: hours after treatment

Table 4. Toxicity of leachate of chocolate weed (*Melochia corchorifolia* L.) on the mortality of pulse beetle, *Callosobruchus maculatus* F

Toxicity of leachate for mortality of rice weevil (mg/L)			
HAT	LC_{50}	LC_{95}	Chi square
6	23.32	55.61	0.001
12	18.07	41.84	0.000
24	13.96	30.35	0.022
36	12.42	32.94	0.008
48	11.69	32.89	0.009

HAT: hours after treatment

LC_{95} value of 30.35 mg/L were observed 24 h after treatment and recorded 0.022 as chi square value. After 36 and 48 h, LC_{50} and LC_{95} values recorded were 12.42, 11.69 mg/L and 32.94, 32.89 mg/L, respectively.

Pulse beetle (*C. maculatus*): The leachate showed LC_{50} value of 25.41 mg/L and LC_{95} value of 59.17 mg/L at 6 h after treatment to kill the pulse beetle and at 12 h, LC_{50} and LC_{95} values for the mortality of pulse beetle were 19.97 and 49.39 mg/L, respectively. At 24 h, 18.61 mg/L was the LC_{50} value and 47.53 mg/L was the LC_{95} value. Similarly, after 36 h, the LC_{50} value of pulse beetle was 15.79 mg/L and LC_{95} value was 40.85 mg/L, respectively. After 48 h, the LC_{50} and LC_{95} values of pulse beetle were observed to be 15.50 and 43.45 mg/L, respectively (**Table 4**).

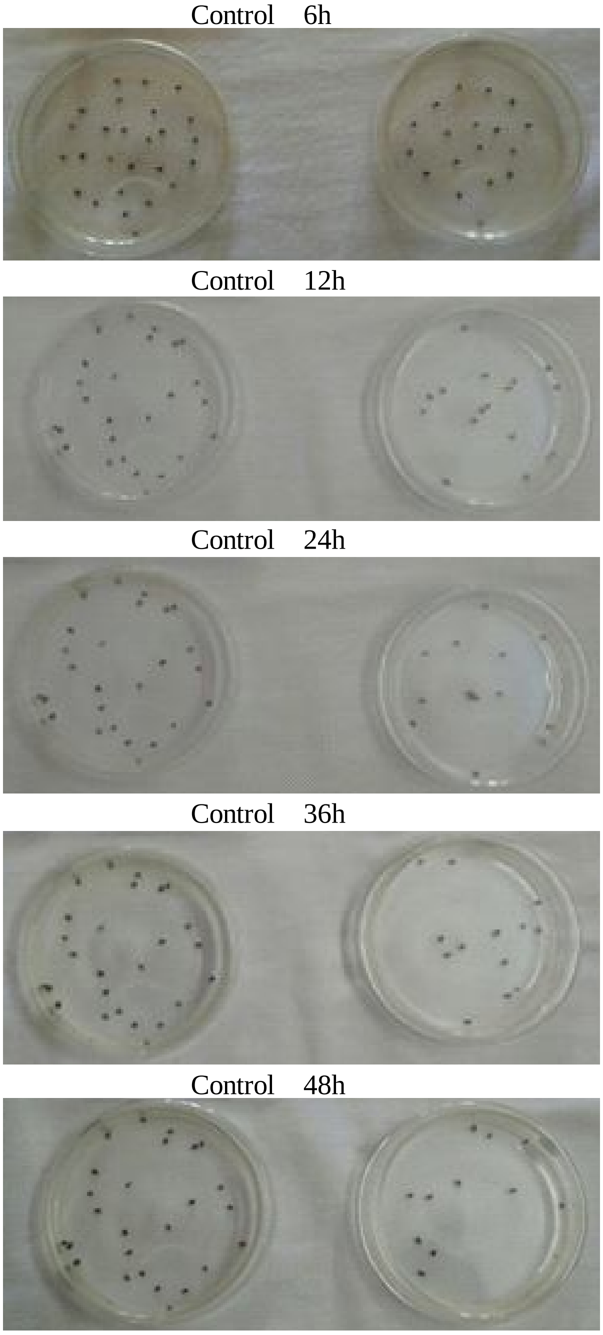

Plate 2. Number of live pulse beetles left at different time intervals (15 % leachate concentration)

Mortality per cent of rice weevil gradually increased with time. The whole plant leachate concentrations (2.5, 5, 10 and 15%) showed the highest mortality percentage at 48 hours after treatment (HAT). Similarly, the mortality percent increased with increase in leachate concentration. Whole plant leachate of 15% concentration resulted in the highest mortality of rice weevil (62.67%).

Jayakumar (2010) opined that plant extracts can effect post embryonic survival of insects, leading to adult emergence with hike in concentration. Kumar *et al*. (2010) observed that higher concentration of ethanolic extracts of *Annona squamosa* leaves had a potent knock down effect on *S. oryzae*. The results are in accordance with the findings of Rani *et al.* (2019) who observed that higher concentrations of *Ocimum sanctum* leaves resulted in higher mortality (66.7%).

Mortality percent of pulse beetle also followed the same pattern and was directly proportional with leachate concentration. The dead pulse beetle per cent also increased as time passed and exhibited the highest values at 48 HAT. The leachate concentration of 15 % recorded the highest mortality (49.33%) at 48 HAT. The mortality per cent values of pulse beetle were lesser than that of rice weevil implying that whole plant leachate of chocolate weed was more effective against rice weevil.

Raja *et al.* (2001) observed that botanicals from *M. corchorifolia* inhibited adult emergence in pulse beetle. They suggested that this may be due to the repellent activity or changes induced by the chemical properties of extracts resulted in reduced egg laying capacity of beetles. Rahman and Talukder (2006) reported that mortality percentage of pulse beetle was directly related to the plant extract concentrations and also with the time after treatment. The plant extract of *Vitex negundo* had the highest toxic effect against pulse beetle. Manju *et al.* (2019) revealed that maximum mortality of pulse beetle was observed at 12, 24 and 48 h when treated with 1 per cent *Piper nigrum* extract.

The present study has revealed the efficacy of *M. corchorifolia* leachate against rice weevil and pulse beetle. Mortality percent values have gradually increased with an increase in whole leachate concentration indicating the presence of a toxicant or growth inhibitor principle in the leachate. Identification and isolation of active ingredient in the leachate is a future thrust area. Advanced studies on the effect of leachate on adult emergence, oviposition and egg viability could pave the way for a new bio pesticide for storage pest control as a component in integrated pest management.

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