Univ. j. zool. Rajshahi. Univ. Vol. 32, 2013 pp. 21-25
http://journals.sfu.ca/bd/index.php/UJZRU

ISSN 1023-6104

Insecticidal and repellent effect of *Cnesmone javanica* Blume extracts against *Tribolium castaneum* (Hbst.) adults

Meherun Nesa Khan, Abdullah An Naser, Laila Arjuman Banu, Syada Mursheda Afrin, Samama B. Chhabi, M. Saiful Islam and Nurul Islam*
Department of Zoology, Rajshahi University, Rajshahi-6205, Bangladesh

Abstract: Petroleum ether (Pet.E.), chloroform ($CHCl_3$) and methanol (MeOH) extracts of the leaf, stem and roots of *Cnesmone javanica* Blume were screened against adult *Tribolium castaneum* (Hbst.) for insecticidal and repellent activity under laboratory conditions. The Pet.E. extracts of the leaves, stem and roots showed higher toxicity against the beetles in comparison to the MeOH extracts, however $CHCl_3$ extracts offered no mortality at all after 12, 24, 36 and 48h exposure respectively. According to the intensity of activity the extracts could be arranged in a descending order of leaf> root> stem. The $CHCl_3$ extracts of the roots and the Pet.E. extracts of *Cn. javanica* stem offered highest repellent activity at 0.1% ($P<0.001$); while the MeOH extracts of the leaf showed 1% ($P<0.01$) but the Pet.E and MeOH extracts of the roots at 5% ($P<0.05$) level of significance respectively against *T. castaneum* adults.

Key Words: Insecticidal activity, Repellency, *Cnesmone javanica, Tribolium castaneum*

Introduction

Cnesmone javanica Blume of the family Euphoriaceae is found in Assam, Indochina, Myanmer, Malay Peninsula, Borneo, Java and Sumatra. In Bangladesh the common name of this plant is Rakhal Khoskhoshi. The plant is strongly hirsute, covered with stinging hairs. Leaves petiole 1.5-9cm long; blade oblong or ovate, surfaces with patent hairs and scattered bristles. Inflorescence 3 to 9cm in length. Flowers are green. In Panta (India), the seeds of this plant are used in the same way as coriander is used in curry. In North Lakhimpur (India), the juice of the root is used in long-standing fevers. This nettle is used by the East Coast Negritos of Malaya with the fresh juice of the tree for poisoning their darts. In Kelantan (Malaya) it is used as a poison by criminals while the flowers and leaves are mixed in cakes that may cause death. The chemical composition of the test plant is not yet investigated so much, and the information is available only on cellulose properties of the plant. *Cn. javanica* extractives were found highly biocidal in nature when they were tested on the crop plants like mustard and radish (Ghayal *et al.,* 2008). Patrick *et al.* (2012) reported that the neuropharmacological effects of the *Cn. javanica* extract is significant. Reports on insecticidal and repellent efficacy of *Cn. javanica* is scanty, and this lead to the present investigations.

Materials and Methods

Collection and preparation of materials: *Cn. javanica* was collected from the Rajshahi University Campus and identified by Prof. (Rtd.) ATM Naderuzzaman, Department of Botany, University of Rajshahi, and also kept in the herbarium of the Department of Botany, University of Rajshahi. The plants were chopped into small pieces, dried under shade and powdered using a hand grinder, weighed and placed in separate conical flasks to add Pet.E., $CHCl_3$ and MeOH (Merck, Germany) ($100gm \times 300ml \times 2times$) for 48h. Filtration was done by Whatman filter paper at 24h interval in the same flask followed by evaporation until the extract was left. The extracts were then removed to glass vials and preserved in a refrigerator at 4°C with proper labeling.

Collection and culture of insect: Adults of *T. castaneum* were reared in glass beakers (500ml) in a standard mixture of whole-wheat flour (Park, 1962; Park and Frank, 1948) with powdered dry yeast (19:1) in an incubator at 30 ± 0.5°C without light and humidity control for continuous supply of adults throughout study.

*Corresponding authors: n_islamm@yahoo.com

Dose-mortality test on *T. castaneum*: The dose-mortality responses of *Cn. javanica* extracts were observed by surface film method. For the Pet.E. extracts of leaf, stem and roots of *Cn. javanica* the doses range from 2.55 to 0.51mg cm^{-2}; 2.04 to 0.25mg cm^{-2} and 2.55 to 0.32mg cm^{-2} respectively; and for the MeOH extracts 0.510 to 0.006mg cm^{-2}; 0.510 to 0.102mg cm^{-2} and 0.510 to 0.102mg cm^{-2} respectively. Each of the doses were diluted in 1ml of solvent, poured into Petri dishes (5cm diam.) and allowed to dry. Ten adult beetles were released in each Petri dish and the experiment replicated three times. The mortality of the beetles was assessed after 1/2, 12, 24, 36 and 48h of exposures.

Statistical analysis: The mortality (%) was observed using Abbott's formula (1925) subjected to probit analysis according to Finney (1947) and Busvine (1971).

Repellent activity test against *T. castaneum*: The repellency test was adopted according to McDonald *et al*. (1970). Half filter paper discs (Whatman No. 40, diam. 9cm) were treated with the selected doses of 0.314, 0.157, 0.079, 0.039 and 0.019mg cm^{-2} of Pet.E. extract and were then attached lengthwise, edge-to-edge, to a control half-disc with adhesive tape and placed in the Petri dishes. The orientation was changed in the two remaining replicates to avoid the effects of any external directional stimulus affecting the distribution of the test insects. Ten adult insects were released in the middle of each of the filter paper circles. The similar process was done for the Pet.E., $CHCl_3$ and MeOH extracts. Insects that settled on each of the non-treated half of the filter paper discs were counted after 1h and then observed repeatedly at hourly intervals up to five hours. The average of the counts was converted to percent repellency (*PR*) using the formula of Talukder and Howse (1993, 1995): $PR = (Nc - 5) \times 20$, where, Nc is the percentage of insects on the untreated half of the disc.

Results and Discussion

Dose mortality effects: The dose-mortality of MeOH extract of root offered highest mortality in comparison to the Pet.E. extract and the $CHCl_3$ extracts of leaf, stem and root didn't offer any mortality of *T. castaneum*. For the Pet.E. extracts of the leaf, stem and roots the LD_{50} values ranged between 1.09 to 0.68mg cm^{-2}; 2.72 to 1.25mg cm^{-2} and 2.48 to 0.68mg cm^{-2} respectively and for the MeOH extracts of the leaf, stem and roots the LD_{50} values ranged between 2.14 to 0.33mg cm^{-2}; 4.59 to 0.34mg cm^{-2} and 31.13 to 0.24mg cm^{-2} against *T. castaneum* (Table 1).

Table 1. LD_{50} values of Pet. Ether and MeOH extracts of the leaf, stem and roots of *Cn. javanica* against *T. castaneum* adults

Solvent		LD_{50} (mg cm^{-2}) at different exposures			
		12	24	36	48
Leaf	Pet.E.	1.09	0.85	0.76	0.68
	MeOH	2.14	0.47	0.41	0.33
Stem	Pet.E.	2.72	1.92	1.61	1.25
	MeOH	4.59	3.82	0.46	0.34
Root	Pet.E.	2.48	1.23	1.03	0.68
	MeOH	31.13	0.31	0.29	0.24

Repellent effects on *T. castaneum* adults: The $CHCl_3$ extracts of the roots and the Pet.E. extracts of *Cn. javanica* stem offered highest repellent activity against *T. castaneum* adults both at 0.1% (P<0.001) level of significance; while, the MeOH extracts of the leaf showed repellency at 1% (P<0.01) and the Pet.E. and MeOH extracts of the roots at 5% (P<0.05) level of significance respectively. The results are presented in Tables 2 and 3.

Table 2. Percent repulsion values and the arcsin transformed data of the Pet. Ether, $CHCl_3$ and MeOH extracts of *Cn. javanica* against *T. castaneum* adults

Type of extract		Dose mg cm^{-2}	Percent repulsion PR = (Nc – 5) × 20 in hours (Arcsin transformed values for ANOVA)				
			1	2	3	4	5
Leaf	Pet.E	10	33.2(35.18)	13.2(21.30)	26.6(31.05)	40(39.23)	33.2(35.18)
		5	33.2(35.18)	93.2(74.88)	60(50.77)	53.2(46.83)	60(50.77)
		2.5	20(26.57)	20(26.57)	33.2(35.18)	6.6(4.66)	20(26.57)
		1.25	46.6(43.05)	33.2(35.18)	33.2(35.18)	33.2(35.18)	73.2(58.82)
		0.625	46.6(43.05)	40(39.23)	46.6(43.05)	60(58.82)	66.6(54.70)
	$CHCl_3$	10	53.2(46.83)	46.6(43.05)	86.6(68.53)	66.6(50.77)	46.6(43.05)
		5	46.6(43.05)	46.6(43.05)	46.6(43.05)	60(58.82)	86.6(68.53)
		2.5	53.2(46.83)	86.6(68.53)	93.2(74.88)	40(39.23)	66.6(54.70)
		1.25	80(63.43)	40(39.23)	26.6(31.05)	26.6(31.05)	53.2(46.83)
		0.625	26.6(31.05)	40(39.23)	80(63.44)	80(63.44)	66.6(54.70)
	MeOH	10	93.40(75.11)	100(90.00)	93.4(75.11)	93.4(75.11)	100(90.00)
		5	33.4(35.30)	33.4(35.30)	26.6(31.05)	33.4(35.30)	26.6(31.05)
		2.5	33.4(35.30)	20(26.56)	20(26.56)	13.4(21.47)	33.4(35.30)
		1.25	86.6(68.53)	33.4(35.30)	40(39.23)	33.4(35.30)	20(26.56)
		0.625	60(50.77)	80(63.44)	86.6(68.53)	33.4(35.30)	73.4(58.95)
Stem	Pet.E	10	53.2(46.83)	93.2(74.88)	93.2(74.88)	60(50.77)	73.2(58.82)
		5	33.2(35.18)	66.6(54.70)	26.6(31.05)	53.2(48.83)	80(63.43)
		2.5	33.2(35.18)	53.2(46.83)	80(63.43)	53.2(46.83)	46.6(43.05)
		1.25	40(39.23)	46.6(43.05)	46.6(43.05)	33.2(35.18)	80(63.43)
		0.625	-40(-39.2)	20(26.57)	20(26.57)	33.2(35.18)	80(63.43)
	$CHCl_3$	10	66.6(54.70)	66.6(54.70)	86.6(68.53)	93.2(74.88)	100(90)
		5	60(50.77)	80(63.43)	86.6(68.53)	80(63.43)	73.2(58.82)
		2.5	86.6(68.53)	60(50.77)	66.6(54.70)	86.6(68.53)	93.2(74.88)
		1.25	73.2(58.82)	80(63.43)	46.6(43.05)	60(50.77)	80(63.43)
		0.625	46.6(43.05)	40(39.23)	26.6(31.05)	40(39.23)	60(50.77)
	MeOH	10	93.4(75.11)	86.6(68.53)	66.6(54.70)	66.6(54.70)	86.6(68.53)
		5	60(50.77)	26.6(31.05)	33.4(35.30)	26.6(31.05)	46.6(43.05)
		2.5	33.4(35.30)	26.6(31.05)	33.4(35.30)	0(00)	6.6(14.89)
		1.25	33.4(35.30)	-6.6(-14.89)	53.4(46.95)	13.4(21.47)	6.6(14.89)
		0.625	73.4(58.95)	86.6(68.53)	100(90.00)	-20(-26.56)	-20(-26.56)
Root	Pet.E	10	100(90)	100(90)	100(90)	100(90)	93.2(74.88)
		5	73.2(58.82)	100(90)	100(90)	100(90)	100(90)
		2.5	86.66(68.53)	80(63.43)	80(63.43)	73.2(58.82)	73.2(58.82)
		1.25	86.6(68.53)	100(90)	100(90)	100(90)	100(90)
		0.625	86.6(68.53)	73.2(58.82)	73.2(58.82)	66.6(54.70)	53.2(46.83)
	$CHCl_3$	10	100(90)	100(90)	100(90)	100(90)	100(90)
		5	66.6(54.70)	46.6(43.05)	46.6(43.05)	53.2(46.83)	53.2(46.83)
		2.5	-73.4(-58.9)	-93.4(-75)	-93.4(-75)	-93.4(-75)	00
		1.25	40(39.23)	60(50.77)	53.2(46.83)	53.2(46.83)	60(50.77)
		0.625	40(39.23)	46.6(43.05)	60(50.77)	73.2(58.82)	73.2(58.82)
	MeOH	10	-40(-39.23)	6.6(14.89)	-33.4(-35.30)	26.6(31.05)	-26.6(-31.05)
		5	26.6(31.05)	26.6(31.05)	26.6(31.05)	33.4(35.30)	-13.4(-21.47)
		2.5	-53.4(-46.95)	-26.6(-31.05)	-33.4(-35.30)	-6.6(-14.89)	-13.4(-21.47)
		1.25	40(39.23)	60(50.77)	53.4(46.95)	13.4(21.47)	33.4(35.30)
		0.625	40(39.23)	46.6(43.05)	86.6(68.53)	33.4(35.30)	33.4(35.30)

Table 3. Repellency effect of the Pet. Ether, $CHCl_3$ and MeOH extracts of *Cn. javanica* (leaf, stem and root) against *T. castaneum* adults

Plant part	Solvent	Between doses (df =4)	Between time interval (df=4)
		F-value	F-value
Leaf	Pet. E.	5.333	0.629
	$CHCl_3$	0.701	0.559
	MeOH	20.570** (P<0.01)	1.000
Stem	Pet. E.	115.163*** (P<0.001)	2.113
	$CHCl_3$	6.991	2.131
	MeOH	4.059	1.618
Root	Pet. E.	9.319* (P<0.05)	1.251
	$CHCl_3$	456.980*** (P<0.001)	0.326
	MeOH	13.060* (P<0.05)	1.290

The present result reports that this medicinal plant bears killing and repealing agents. No previous work was found that carried out on biological activity of *Cn. javanica*, however there are some researchers investigated other members of this family that offered promising results. Ukiya *et al.* (2006) found anti-inflammatory, anti-tumor-promoting, and cytotoxic activities of constituents of pot marigold (*Calendula officinalis*) flowers; Liu *et al.* (2010) showed anthelmintic activity; Noor Shahida *et al.* (2009) revealed hypoglycemic potential; Samie *et al.* (2009) proved cytotoxicity and antimicrobial activities; Han *et al.* (2008) found *in vivo* and *in vitro* anti-hepatitis B virus activity of total phenolics from *Oenanthe javanica*; Shen *et al.* (2008) showed antiphytoviral activity of bruceine-D from *Brucea javanica* seeds.

So, more comprehensive works are very much to be solicited for its use in medicine and agriculture

Acknowledgements

The authors are grateful to the Ministry of Science and Information & Communication Technology (MOSICT) of the Peoples Republic of Bangladesh and the University of Rajshahi for providing Research Grants, and to the Chairman of the Department of Zoology, University of Rajshahi for providing laboratory facilities.

References

Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide, *J. Econ. Entomol.* **18**: 265-267.

Busvine, J.R. 1971. *A critical review of the techniques for testing insecticides*. Commonwealth Agricultural Bureau, London, 345 pp.

Finney, D.J. 1947. *Probit analysis: a statistical treatment of the sigmoid response curve.* Cambridge University Press, London. 333 pp.

Ghayal, N.A., Dhumal, K.N., Deshpande, N.R., Shah, S.M. & Ruikar, A.D. 2008. Studies on allelochemicals in *Synedrella nodiflora* and impact of its leaf on germination and seedling growth of Radish (*Raphanus sativus)* and Mustard (*Brassica juncea*). *Asian J. Chem*. **20**(8): 6114 - 6120.

Han, Y.Q., Huang, Z.M., Yang, X.B., Liu, H.Z. & Wu, G.X. 2008. *In vivo* and *in vitro* anti-hepatitis B virus activity of total phenolics from *Oenanthe javanica*. *J. Ethnopharmacol.* **118**(1):148-53.

Samie, A., Obi, C;L., Lal, N. & Meyer, J.J.M. 2009. *In vitro* cytotoxicity and antimicrobial activities, against clinical isolates of *Campylobacter* species and *Entamoeba histolytica*, of local medicinal plants from the Venda region, in South Africa. *Ann. Trop. Med. & Parasitol.,* **103** (2): 159–170

Liu Y.-T**.**, Wan F., Wang, G.-X., Han, J., Wang, Y. & Wang, Y.-H. 2010. *In vivo* anthelmintic activity of crude extracts of *Radix angelicae pubescentis*, *Fructus bruceae*, *Caulis spatholobi*, *Semen aesculi*, and *Semen pharbitidis* against *Dactylogyrus intermedius* (Monogenea) in goldfish (*Carassius auratus*). *Parasitol. Res.* **106**: 1233-1239.

McDonald, L.L., Guy, R.H. & Speirs, R.D. 1970. *Preliminary evaluation of new candidate materials as toxicants, repellents and attractants against stored-product insects.* Marketing Research Report No. 882. Agricultural Research Service, US Department of Agriculture, Washington, DC.

Noor Shahida, A., Wong, T.W. & Choo. C.Y. 2009. Hypoglycemic effect of quassinoids from *Brucea javanica* (L.) Merr. (Simaroubaceae) seeds. *J. Ethnopharmacol*. **124** (3): 586-591.

Park, T. 1962. Beetles, competition and population. *Science* **138:** 1369-1375.

Park, T. & Frank, M.B. 1948. The fecundity and development of the flour beetles, *Tribolium castaneum* and *Tribolium confusum* at three constant temperatures. *Ecology,* **29:** 368-375.

Patrick, A., Eric, W. & Samuel, B.K. 2012. Anticonvulsant and related neuropharmacological effects of the whole plant extract of *Synedrella nodiflora* (L.) Gaertn (Asteraceae). *J. Pharm. & Bio Allied Sci*. **4**: 140-148.

Samie, A., Obi, C.L., Lall, N. & Meyer, J.J.M. 2009.

Shen, J.G., Zhang, Z.K., Wu, Z.J., Ouyang, M.A., Xie, L.H. & Lin, Q.Y. 2008. Antiphytoviral activity of bruceine-D from *Brucea javanica* seeds. *Pest Manag. Sci.* **64**(2): 191-196.

Talukder, F.A. & Howse, P.E. 1993. Deterrent and insecticidal effects of extracts of pithraj, *Aphanamixis polystachya* (Mcliaceae) against *Tribolium castaneum* in storage. *J. Chem. Ecol.* **19**: 2463-2471.

Talukder, F.A. & Howse, P.E. 1995. Evaluation of *Aphanamixis polystachya* as a source of repellents, antifeedants, toxicants and protectants in storage against *Tribolium castaneum* (Herbs). *J. Stored Prod. Res.* **31**: 55-61.

Ukiya, M., Akihisa, T., Yasukawa, K., Tokuda, H., Suzuki, T. & Kimura, Y. 2006. Anti-inflammatory, anti-tumor-promoting, and cytotoxic activities of constituents of pot marigold (*Calendula officinalis*) flowers. *J. Nat. Prod*. **69**: 1692-96.

Walter, V.E. 1990. *Stored product pests*. Franzak and Foster Co., Cleveland, OH. pp. 526-529.

Manuscript received on 07.10.2013, Accepted on 20.12.2013