Bangladesh J. Sci. Ind. Res. **42**(2), 157-162, 2007

Effect of Acetonic Extracts of *Calotropis procera* R Br.in (Ait.) on Reproductive Potential of Flat Grain Beetle *Cryptolestes pusillus* (Schon.) (Coleoptera: Cucujidae)

M. M. Rahman[a] and W. Islam[b]

[a]Department of Zoology, Mollah Azad Memorial College, Atrai, Naogaon and [b]Institute of Biological Sciences, Rajshahi University, Rajshahi-6205, Bangladesh

Abstract

Acetonic extracts of Akanda was tested against different parameters of the life cycle of *Cryptolestes pusillus*. The lowest and highest oviposition rate (0.89±0.26 and 2.67±0.33 egg/female/day), hatching rate (14.67±0.53 % and 51.11±0.59 %), adult emergence (16.89 % and 40.89 %), and longevity (male 64.78±1.01day and 105.67±1.09 day) and female (69.56 ± 0.38 day and 113.22±0.57 day) were found in doses (552.413 and 163.678μgcm^{-2}) whereas in control they were 4.89±0.35 egg/female/day, 91.22±1.02 %, 88.44 %, 156.11±1.37 day and 169.67±2.52 day respectively. But highest and lowest incubation period (7.33±0.33 day and 4.89±0.35 day) and developmental period (71.67±0.60 and 39.89±0.26 days) occurred in the same doses and in control these are 4.11±0.26 egg/female/day and 33.44±0.50days.

Introduction

Cryptolestes pusillus (Schon.) is cosmopolitan pest of stored wheat, wheat flour, rice (husked), sorghum, cowpea and other stored commodities (Ahmed and Khatun 1994). It virtually feeds on all kinds of stored grain and milled cereal products and causes immense damage to the tropical and subtropical countries of the world including Bangladesh (Hossain *et al.* 1986, Kirkpatrick and Cagle 1978). The damage is caused both by the larval and adults stages of the pest (Cotton 1963).

Chemical control has been the most efficient and effective means for protection of stored product insect pests, but the over use of the pesticide has led to widespread resistance in insects and other arthropod pests. Moreover, synthetic insecticides are expensive for subsistence farmers and they may pose potential risks owing to the lack of adequate technical knowledge related to their safe use (Keita *et al.* 2001). So, development of economically feasible and socially responsible alternative practices that protect the ecosystem is one of the major objectives of pest management.

Insecticidal plants are now alternative to synthetic insecticides for pest control. Natural compounds of plant origin are biodegradable, often low mammalian toxicity, and pose low danger to the environment and ecosystem if used in small amounts. Recent search has focused on natural product alternatives for pest control in developing countries (Keita *et al.* 2001). *Calotropis procera* R Br. (Ait.) is locally known as Akanda has powerful diuretic and stimulating properties. Mortality and different biological aspect of stored grain pests by plant extract have been conducted (Chander *et al.* 2000, Sharma 1995 and Vardhini *et al.* 1997) and got significant results. So far as know, reproductive potential of *C. pusillus* with Akanda extract has not been conducted. This led to the present findings.

Materials and Methods

C. pusillus was collected from the Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, Rajshahi, Bangladesh and successfully reared in the IPM laboratory, Institute of Biological Sciences, University of Rajshahi. Mass cultures were maintained in petridish (12cm dia.) and sub culture in small petridish (6 cm dia.) containing food medium and kept in the control temperature (CT) room at 30 ± 1^{O} C. A standard mixture of whole-wheat flour with powdered dry yeast in ratio of 19:1 was used as food medium in the experiment.

Akanda leaves and shoots were collected and washed with running water for removing dust and were air dried in a shaded place ensuring sufficient air flow to avoid damping. After drying, the leaves and shoots were chopped finely. Dust were prepared by electric grinder and passed through a 60 mesh sieve. The dust was dissolved in acetone at a ratio of 1:15 W/V in a conical flask and allowed to keep 24 to 72 hours for extraction. The mixture was filtered to separate the extract. The solvent extract then allows to aeration to remove the acetone. Finally the extract was measured and diluted in acetone and different doses were prepared. Each dose was placed in Petri dish (60 mm diam.) Separately, uniformly covering the whole area of the Petri dish. They were then kept open for sometime to allow the solvent to evaporate. Ten paired adult beetles were released on each Petri dish (6cm) containing 5g of food for various doses. They were allowed 24 hours for oviposition. Then the adults were removed from the petridish and eggs were kept in the CT room for development. The incubation period were recorded carefully.

Then the first instar larvae of various doses and also control were counted and kept them in the same doses for adult emergences and the embryo of emerged adults were counted and sexed.

Twenty four hour old eggs were kept in various doses. After hatching their developmental period were noted. Longevity of adult male and female were recorded in each dose separately. Food were changed in 10 days interval of all doses for avoid the interaction of their offspring.

Result and Discussion

The oviposition rate, hatching rate, Incubation period, adult emergence, sex ratio, developmental period and longevity (male and female) were calculated and presented in the Tables I and II. In the control, the oviposition rate (egg/female/day) were 4.89±0.35. The oviposition rate was decreased with the increase of concentration of Akanda extract. Significant difference occurred in different doses (P<0.01) along with control. The lowest oviposition rate (0.89±0.26) was found in 552.413µgcm^{-2} dose. The oviposition rate was significantly reduced in all the treatments compared to control in the present experiment. A few number of eggs were laid at the 552.413µgcm^{-2} dose and egg lying was increasing slowly with the decreasing concentration of Akanda extract.

Akanda inhibited egg-hatching rate of *C. pusillus*. The viability rates decreased significantly with the increase of the concentration of Akanda extract. The lowest viability (14.67±0.53 %) occurred in 552.413µgcm^{-2} dose and in control the rate was 91.22± 1.02 %. Ahmed *et al.* (2002) worked with neem extracts on *T. castaneum* and found the similar result. Mollah and Islam (2002) worked with other botanicals (petroleum spirit extract of *Poligonum hydropiper*) on egg viability of *C. maculatus* and got 40.66 %, 31.66 % and 0 % at 0.05, 0.1 and 0.2 g/100g seeds and in the control the egg viability were 95.33 %.

Table I. Oviposition rate, hatching rate, incubation period and adult emergence of *C. pusillus* treated with Akanda extract

Doses (µgcm^{-2})	Oviposition rate (egg/ female/day)	Hatching rate (viability of egg %)	Incubation period (days) (Mean ± SE)	Adult emergence Number (25) (Mean ± SE)	Adult emergence %
552.413	0.89^{d}±0.26	14.67^{e}±0.53	7.33^{a}±0.33	4.22^{d}±0.28	16.89
368.275	1.00^{d}±0.29	28.44^{d}±0.44	6.44^{ab}±0.29	6.33^{c}±0.37	25.33
245.517	1.56^{c}±0.29	40.56^{c}±0.38	5.22^{b}±0.22	8.11^{bc}±0.35	32.44
163.678	2.67^{b}±0.33	51.11^{b}±0.59	4.89^{b}±0.35	10.22^{b}±0.40	40.89
Control	4.89^{a}±0.35	91.22^{a}±1.02	4.11^{c}±0.26	22.11^{a}±0.26	88.44
F Value	23.93*	2095.44*	18.78*	433.45*	-

* Significant at P<0.01 level. Means in a column followed by different letters are significantly different at P<0.01 by DMRT.

Table II. Longevity (male and female), developmental period and sex ratio of *C. pusillus* treated with Akanda extract

Doses (μgcm^{-2})	Longevity (days) (Mean ± SE)		Developmental period (days) (Mean ± SE)	Sex ratio (%)	
	Male	Female		Male	Female
552.413	$64.78^{e}\pm1.01$	$69.56^{d}\pm0.38$	$71.67^{a}\pm0.60$	47.62	52.38
368.275	$73.11^{d}\pm0.31$	$78.44^{d}\pm0.41$	$59.11^{b}\pm0.48$	46.03	53.97
245.517	$85.67^{c}\pm0.41$	$90.56^{c}\pm0.93$	$42.11^{c}\pm0.48$	48.15	51.85
163.678	$105.67^{b}\pm1.09$	$113.22^{b}\pm0.57$	$39.89^{c}\pm0.26$	48.04	51.96
Control	$156.11^{a}\pm1.37$	$169.67^{a}\pm2.52$	$33.44^{d}\pm0.50$	47.51	52.49
F Value	1524.24*	1023.59*	1072.93*	-	-

* Significant at P<0.01 level. Means in a column followed by different letters are significantly different at P<0.01 by DMRT.

The incubation period *C. pusillus* also significantly effected by Akanda extract and increased with the increase of concentrations. The longest incubation period (7.33±0.33 days) found in 552.413μgcm^{-2} dose followed by 368.275, 245.517 and 163.678 μgcm^{-2} doses.

The Akanda was found to be effective and significantly prohibit adult emergence of *C. pusillus* at all concentrations compared with control.16.89 % adult emergence found at the dose 552.413$\mu gmcm^{2}$ followed by 368.275, 245.517 and 163.678$\mu gmcm^{-2}$ doses, where as control adult emergence was 88.44 %. Mollah and Islam (2005) found that petroleum sprit and acetonic extracts of leaf, shoot and root of *P. hydropiper* were effective and significantly inhibited the adult emergence of *C. maculatus* at all concentrations compared with the control. No adult of *C. maculatus* were emerged at the dose of 0.2g/100g seeds of all plant extracts. The leaf extracts were more effective than stem and root extracts. Rajapakse (2000) recorded the highest reduction of the adult emergence of *C. maculatus* with *Azadirachtin indica* leaf powder. Keita *et al.* (2001) reported that the adult emergence of *C. maculates* were dropped to zero per cent with *Ocimum basilicum* and 4 % with *Ocimum gratissimum*, when the control was 97 %.

The Akanda did not deviated sex ratio from the typical 1:1 ratio in both treatment and control. Mollah and Islam (2005) worked with *P. hydropiper* extracts on *C. maculatus* and found that the sex ratio was not deviated from the typical 1:1 ratio in both treatment and control.

The Akanda extract prolongated developmental period from egg to adult emergence significantly in *C. pusillus* at all the doses. The developmental period from egg to adult emergence in the control were 33.44±0.503 days. The developmental period of *C. pusillus* were highest (71.67±0.601) days at 552.413µgmcm^{-2} dose.

The Akanda strongly reduced the longevity of *C. pusillus* in both the sexes. The lowest longevity of male and female (64.78±1.011 and 69.56±0.377 days) were found in 552.413µgcm^{-2}, where as in control the same were 156.11±1.369 and 169.67±2.571 days.

Conclusion

Calotropis procera was found to be toxic to reproductive potential and developmental period of *C. pusillus* and can be used to control the stored pest likely *C. pusillus* safely and effectively.

Acknowledgements

The authors would like to thanks to the Director, Institute of Biological Sciences, University of Rajshahi, Bangladesh for providing laboratory facilities.

References

Ahmed I, Ali R. R. Tabassum, R. Azmi, M. A. Naqvi, S. N. H. and Khan, F. (2001) Toxicity determinations of two pyrethroids Karate (Cyhalothrin) and deltamethrin as compared to neem extract (NA) on *Tribolium castaneum* (PARC strain). *J. Expt. Zool.* **4**(1) : 169-173.

Ahmed, K. N. and Khatun, M. (1994) Effect of temperature and relative humidity on the developmental time and reproductive potential of *Cryptolestes pusillus* (Schon.), a pest of stored grains. *Bangladesh J. Sci. Ind. Res.* **29**(1) : 21-27.

Ahmed, F. Khalequzzaman, K. M. Islam, N. Anam, M. K. and Islam, M. T. (2002) Effect of plant extracts against *Bipolaris oryzae* of rice under in vitro conditions. *Pakistan J. Bio. Sci.* **5**(4) : 442-445.

Chander, H. Ahuja, D. K. Nagender, A. and Berry, S. K. (2000) Repellency of different plants extracts and commercial formulations used as prophylactic sprays to protect bagged grain against *Tribolium castaneum*- a field study. *J Food Sci. Tech.* **37**(6) : 582-585.

Cotton, R. T. (1963) Pests of stored grain and grain products. Burgess Co., pp. 333.

Hossain, M. Verner, P. H. and Rezaur, R. (1986) Taxonomic descriptions of the mature larvae of six species of *Cryptolestes* (Coleoptera: Cucujidae). *Bangladesh J. Zool.* **14** : 139-148.

Keita, S. M. Vincent, C. Schmit, J. P. Amason, J. T. and Belanger, A. (2001) Effect of essential oil of *Ocimum basilium* L and *O. gratissimum* L applied as insecticidal fumigant and powder to control *Callosobruchus maculatus* (Fab.) (Coleoptera : Bruchidae) *J. Stored Prod. Res.* **37** : 339-349.

Kirkpatrick, R. L. and Cagle, A. (1978) Controlling insects in bulk wheat by infrared radiation. *J. Kansas Entomol. Soc.* **51** : 386-393.

Mollah, J. U. and Islam, W. (2002) Effect of *Polygonum hydropiper* L. extracts on the oviposition and egg viability of *Callosobruchus maculatus* F. (Coleoptera: Bruchidae). *J. Bio-Sci.* **10** : 113-116.

Mollah, J. U. and Islam, W. (2005) Effect of *Polygonum hydropiper* L. extracts on the oviposition and egg viability of *Callosobruchus cinensis* F. (Coleoptera: Bruchidae). *J. Bio-Sci.* **12** : 101-109.

Rajapakse, R. (2000) Pesticidal effect of tropical plants-insecticidal activity of some selected botanicals against Callosobruchus macu-*lates* (F.) and *C. chinensis* L. (Coleoptera: Bruchidae) Entomocongress, 5-8 November, Trivandrum, Kerala, India. Pp. 11-12.

Sharma, R. K. (1995) Suppression of insect reproductive potential by neem in stored maize. *Ann. Plant. Proct. Sci.* **3**(2) : 113-114.

Vardhini, D. Mary, A. Raja, S. and Renuka, P. (1997) Influence of azadirachtin on the ecdysome-controlled developmental processes in the stored grain pest, *Tribolium confusum* (Duval). *Nigerian J. Entomol.* **14/15** :90-98.

Received : February 4, 2007;
Accepted : April 4, 2007