Univ. j. zool. Rajshahi Univ. Vol. 26, 2007. pp. 103-105 ISSN 1023-6104
http://journals.sfu.ca/bd/index.php/UJZRU

Short Communication

Toxicity of malathion and lambda-cyhalothrin with piperonyl butoxide against the lesser grain borer, *Rhizopertha dominica*

A.S. M. Shafiqur Rahman; M.Y. Akter ; Rezwana Ferdousi and Waliullah Talukdar[1]
Department of Zoology, University of Rajshahi, Rajshahi 6205, Bangladesh
[1]Institute of Biological Sciences, University of Rajshahi, Rajshahi, Bangladesh

Key words: Toxicity, malathion, lambda-cyhalothrin,, *R. dominica*

The lesser grain borer, *Rhizopertha dominica* is one of the most notorious and harmful pest of stored grain products. It is commonly known as Australian wheat beetle that directly affects both quantity and quality of stored grain (Willber & Mills, 1985 ; Burkholder & Faustini,1991). Both larvae and adults feed on the same food and followed out until only a thin porous husk remain (Charjan *et al.*,1994). *Rhizopertha* infest a number of other products beside cereals, e.g. seeds of white lotus, pumpkin seeds, tamarind seeds etc. (Kapur, 1994).

The choice of pesticides for the control of storage pests is very limited because of the strict requirements imposed for the safe use of synthetic insecticides on or near food. The continuous use of chemical pesticides for the control of insect pests has resulted in serious problems such as insecticide resistance in pests (Pacheco *et al*., 1990; Sartori *et al.*, 1990).

One method of combating insecticide resistance is to use synergists. Pesticide synergism is only one of the several techniques that can be used to control or study pesticide resistance (Hammock & Soderland,1986; Kemp & Caseley,1991; Busvine,1980).The introduction of synergists in pest control method could be great benefit both economically and ecologically (Metcalf,1992). In the present investigation the synthetic chemicals malathion (organophosphate) and lambda-cyhalothrin (pyrethroid) either alone or in combination with a known synergist, piperonyl butoxide (PBO) was studied on *R. dominica*

The lesser grain borer, *R. dominica* of the present investigation were collected from the storehouse of the flour mills of different local markets under Rajshashi City Corporation. Cultures were maintained in an incubator at 30º ± 0.5º C in jars (1L) and subcultures in beakers (500 ml) containing food medium. A standard mixture of wheat meal, corn meal and yeast (10:10:1.5) was used as the food medium in this experiment.

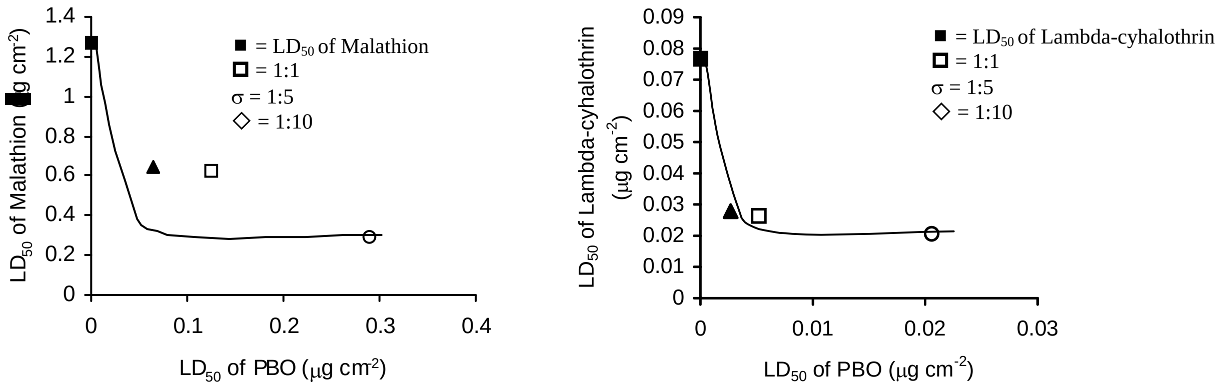
Dose-mortality experiment was done by surface film technique. According to the results obtain from the pilot experiment five concentrations, e.g. 1:1, 1:5 and 1:10 (Insecticide : PBO) were prepared. Petridishes (90 mm) were treated with these chemicals and allowed to dry out through evaporation of the solvent. Adults of five days old were released to each of the treated petridish and the same experiment was repeated five times. The mortality data was recorded after 24 h of exposure. Mortality was corrected by using Abbott's formula (Abbott,1925). The observed data was subjected to probit analysis according to Finney (1947) and Busvine (1971) using a softwere developed in the Department of Agricultural and Environmental Science, University of Newcastle upon Tyne, UK. Isoboles were drawn as per Hewlett (1968).

Table 1. LD_{50}, 95% confidence limits and Regression equation of insecticides to adults *Rhizopertha dominica* after 24 h. of treatment

Insecticides	LD_{50} (µg cm^{-2})	95% confidence limits		Regression equation	χ^2 (df)
		Lower	Upper		
Malathion	1.267	0.7629	2.107	Y= 4.09108+0.82396 X	1.6398 (3)
Lambda-cyhalothrin	0.0767	0.0500	0.1178	Y=4.219616+0.88152 X	0.4687 (3)

Table 2. Lethal dose and co-toxicity coefficient of piperonyl butoxide with malathion and lambda-cyhalothrin on *R. dominica* adults after 24 hours of application.

Insecticide	LD_{50} (µg cm^{-2})	Ratio Insecticide:PBO	Combined LD_{50} (µg cm^{-2})	Insecticides LD_{50} (µg cm^{-2})	PBO LD_{50} (µg cm^{-2})	Cotoxicity Coefficient
Malathion	1.267	1:1	0.5791	0.2895	0.2895	437.65
		1:5	0.7453	0.1242	0.6211	1020.13
		1:10	0.7040	0.0640	0.6400	1979.68
Lambda-cyhalothrin	0.0767	1:1	0.0412	0.0206	0.0206	372.33
		1:5	0.0316	0.0052	0.0263	1475.00
		1:10	0.0307	0.0027	0.0279	2840.74



(A) **(B)**

Fig. 2. Isobolograms of LD_{50} of (A) malathion and piperonyl butoxide, (B) lambda-cyhalothrin and piperonyl butoxide applied on *R. dominica* adults.

Results and Discussion

Initial bioassays were carried out to established the effects of single treatment. The LD_{50} values of the adults *R. dominica* were 1.267 and 0.0767μg cm^{-2} for malathion and lambda-cyhalothrin respectively (Table 1). The result indicate that lambda cyhalothrin was highly toxic to the test insect as compared to malathion. Lindgren *et al*(1954) studied the effect of malathion against *R. dominica* and reported that 2 or 4 ppm malathion gave complete mortality of *R. dominica.* Aheer *et al* (1991) also reported that malathion gave 64.0% mortality of *R. dominica* keeping the lowest concentration of the insecticides constant their mixtures with PBO were used in different ratios. The result indicate that PBO has some synergistic effect with both insecticides on *R. dominica*.

The co toxicity coefficient shows that when applied in a mixture PBO synergized both malathion and lambda cyhalothrin at ratio 1:1 and greater. Isoboles were prepared by plotrting the LD_{50} values of both the insecticides with PBO. Isoboles suggests that the synergism increased within the increase of PBO in the mixture. It was suggested by Sun and Johnson (1960) that the synergistic effect of sesamex and related compound was due to the inhibition of biological oxidation. The same mechanism of action may also occur to the combinations tested here. The synergistic action of some pyrethroid synergists were studied by Rai *et al* ,(1956) and Ware & Roan (1958) on malathion. effect of PBO in combination with several insecticides were studied by Bengston *et al* (1983) Hewlett (1968) & Hadaway *et al* (1962). Dyte & Rowlands(1970) studied the effects of insecticide synergist on the potency and metabolism of bromophos and fenitrothion on *Tribolium castaneum.* The effect of PBO on toxicity of insects has been studied by several investigators. It is now generally recognized that PBO produces its synergistic effect by inhabiting the detoxification enzymes within the insect body (Casida 1970; Benke & Wilkinson,1971; Jao & Casida, 1974; Davnport & Wright, 1985)

References

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

Aheer,G.M., Ulfar, M.& Ali, A.1991. Grain protectants performance against insect pests of stored grain *J. Agric. Research Pakistan*. **29(3):**399-403.

Bengston, M.; Davies, R.A.H.; Desmarchelier, J.M.; Henning, R.; Murray, W.; Simpson, B.W.; Snelson, J.T.; Sticka, R. & Wallbank, B. E. 1983. Organophosphorothioates and synergistic synthetic pyrithroids as grain protectants and bulk wheat. *Pestic.Sci*. **14:** 373-384.

Benke, G. M. & Wilkinson,C. F. 1971. In vitro microsomal epoxidase activity and susceptibility to carbaryl, piperonyl butoxide combinations in house crickets of different age and sex. *J. Econ. Entomol.* **64:**1032.

Burkholder, W. E. & Faustini, D. K. 1991. Biological methods of survey and control. In*: Ecology and management of food industry pests* (J. R. Gorhan, Ed.), pp. 361-372. AOAC press.

Busvine, J.R. 1971. *A Critical Review of the Techniques for Testing Insecticides* (2nd Ed.) Commonwealth Agricultural Bureaux, Slough. p. 345.

Busvine, J.R. 1980. Insects and Hygiene. Chapman and Hall. London, England.

Casida, J.E. 1970. Mixed function oxidases involvement in the biochemistry of insecticides synergism. *J. Chem. Agric. Food.* **18:** 753.

Charjan, S.K.U.; Tarar, Rant. Pu. 1994. Studies on the quality of wheat grain influenced by the infestation of stored grain best during storage. *J. of phyto. Research.* **7:**195-198.

Davenport, A.P. & Wright, D.E.J. 1985. Toxicity of Chlorodeiform and Amitraj to the Egyptian leafworm (*Spodoptera littoralis*). *Pestic. Sci.* **16:** 81-87.

Dyte, C.E. & Rowlands, D.G. 1970. The effect of some insecticide synergism the potency and metabolism of Bromophos and Fenitrothion in *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) *J. Stored prod. Res*. **6:**1-18.

Finney, D.J. 1947. Probit analysis: A statistical treatment of the sigmoid response curve. Campridge University Press. London.

Hadaway, A.B.; Barlow, F. & Duncan, J.1962. Effects of piperonyl butoxide on some insecticidal potency. *Bull. Ent. Res*. **53:** 769-778.

Hammock, B.D. & Soderland, D.M. 1986. In: *Pesticide resistance : Strategies and tactics for management*; National Academy Press Washington, DC, III : p.1219.

Hewlett, P.S. 1968. Synergism and potentiation in insecticides. *Chem. Ind.* **1:** 701-706.

Jao, L. & Casida, J.E. 1974. Insect pyrethroid hydrolysing esterases. *Pestic. Biochem. Physiol.* **4:** 465-472.

Kapur, S. 1994. Nutritional studies on *Rhizopertha dominica* (F.) (Bostrichidae: Coleoptera). *Indian J. Ent*. **26:**289-295.

Kemp, M.S. & Caseley, J.C. 1991. In:H*erbicide resistance in weeds and crops* (Caseley, J.C.; Cussans, G.W.; Atkin, R.K.; Eds), Long Ashton International Symposium, Butterworth - Heinemann, Ltd. : Oxford. pp. 240-279.

Lindgren, A.S.; Furiatti, R.S. & Lazzasi, J.S. 1954. Efficacy of insecticides to control *Rhizopertha dominica* in stored wheat. *J. Econ. Entomol.* **91(1):**320-323.

Metcalf, R.L. 1992. *The synergistic activity of various selected chemicals on the insecticides carbofuran and malathion against brine shrimp larvae.* B.Sc. (Hons.) Theses, Department of Agricultural and Environmental Sciences, University of Newcastle-upon-Tyne, p. 53.

Pacheco, I.A., Sartori, M.R. & Taylor, R.W.D. 1990. Levantamento de resiste ncia de insetos-pragas de graos armazenados a fosna no Estado de Sao Paulo, *Coletanea de Institute de Tecnologia de Alimentos*. **20:** 144-154.

Rai, L.; Afifi, S.E.D.; Fryer, H.C. & Roan, C.C. 1956. The effects of different temperatures and piperonyl butoxide on the action of malathion on susceptible and DDT –resistant strains of houseflies. *J. Econ. Entomol.*. **49:** 307-310.

Sartori, M.R., Pacheco, I.A., Iaderosa, M. & Taylor, R.W.D. 1990. Ocorre ncia especicidade de resiste ncia ao insecticida malathion em insetos- pragas de graos armazenados, no Estado de ao paulo. *Coletanea de Institute de Tecnologia de Alimentos*. **20:** 194-209.

Sun, Y.P. & Johnson, E.R. 1960. Analysis of joint action of insecticides against houseflies. *J. Econ. Entomol*. **53**: 887-892.

Ware, G.W. & Roan, C.C. 1958. The interaction of piperonyl butoxide with malathion and five analogs applied to male houseflies. *J. Econ. Entomol.* **51:** 825-827.

Willber, D.A. & Mills, R.B. 1985. Stored grain insects. In: *Fundamental of Applied Entomology.* (R.F. Pfadfct.) 3rd edn.. Mac Millan Publ Co. Inc. New York pp. 73-81.

Manuscript received on 08.10.07, accepted on 14.01.08