Bangladesh J. Sci. Ind. Res. **41**(3-4), 239-244, 2006

Efficacy of Malathion in Controlling *Tribolium Castaneum* Herbst (Coleoptera: Tenebrionidae)

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Abstract

Effect of malathion on treated food medium was studied on adult and 1st, 2nd and 3rd instar larvae of *Tribolium castaneum*. The LD_{50} for the instars was 228.22, 78.13 and 183.01 ppm, respectively. The rate of mortality increased with increasing concentrations. Toxicity probably depended on the ingestion of the treated food medium.

Introduction

The flour beetle *Tribolium castaneum* Herbst is one of the most destructive pests of stored food grains. It is generally found in granaries, mills, warehouses, etc. feeding on rice, wheat, flour, suji (a coarse flour of wheat), barley, etc. It is one of the major pests of stored products. The mentioned food items are significantly damaged by this pest in storage condition throughout the world. Because of the great economic importance of the pest, many studies on this beetle have dealt with its control. Mention may be made of the works of Pinniger, Strong and Tyler *et al.*[1-3] Laboratory studies on the use of malathion as a grain protectant include those of Floyd, Lemon, Hosni *et al.*, Strong *et al.*, Lindgren *et al.*, Gore, Watters, O'Donnell and Husain.[4-12] All of them used malathion on adult *Tribolium*. Malathion gained wide acceptance and approval for use as protectant for stored grain. It has properties with emphasis on its low mammalian toxicity Parkin.[13] Very little published works were available regarding the control of *T. castaneum* larvae with malathion (commercial grade) in the environment of Bangladesh. There is no published data on the control of *Tribolium castaneum* by commercial grade malathion in this country. This led to the present work. Synergistic effect of piperonylbutoxide on malathion is also incorporated here.

Materials and Methods

The experimental insects were collected from the laboratory cultures and placed in petridishes containing treated whole meal flour. All the cultures were kept at a room temperature $20^{O} \pm 2^{O}$ C. Experiments were carried out with 1st, 2nd and 3rd instar

larvae. Combined effect of piperonylbutoxide and malathion on adult was also incorporated. Twenty larvae for each treatment were introduced in each petridish containing treated food media. Each treatment consisted of 5 replicates. A similar treatment with untreated flour was also maintained. Standard concentrations were prepared by adding 2 ml of malathion with 1000 ml of water to prepare 2000 ppm. The lowest concentrations were prepared by mixing water (1:1) with higher concentrations. Mortality counts of the instar larvae and adults were assessed after 20 days. The percentage mortality data were subjected to statistical analysis Busvine[14] and the dose mortality relationship was expressed as a median lethal dose (LD_{50}).

For adults the effectiveness of the insecticides was evaluated by confining 50 test insects on wheat flour which had been treated with insecticide and determining subsequent knockdown and mortality. To determine synergistic effects of piperonylbutoxide on adult *T. castaneum* required quantities of malathion alone and in combination with piperonylbutoxide was individually weighed using an electronic balance and mixed with wheat flour. After thorough mixing, the treated flour (approximately 1g) was then transferred to individual glass vials containing *Tribolium castaneum* adults and secured at the top with cotton wool. Five doses of the insecticides were applied on the insects. Then mortality of the beetle was recorded LD_{50} and co-toxicity coefficients were calculated. The intensity of synergism was determined by co-toxicity coefficient which is measured by the ratios of the LD_{50} values of the toxicant done to the LD_{50} values of the toxicant in mixtures with the synergist x 100. If the co-toxicity coefficient is above 100, then synergism occurs.[15]

Results and Discussion

The results of the dose mortality tests and statistical analysis are shown in Tables I and II and in Fig. 1. Malathion at 50 ppm was unable to give complete kill after 20 days from treatment. The dosage of 200 ppm cause 60, 80 and 56 % mortalities with 1st, 2nd and 3rd instar larvae of *Tribolium castaneum* respectively within 20 days. The dosage of 160 ppm gave 23, 70 and 39 % mortalities with the 1st, 2nd and 3rd instar larvae respectively. Similarly, the dosage of 80 ppm gave 12, 60 and 29 % mortalities with larvae of the mentioned instars. It is observed that the mortality percentage increased with increase of dosage and duration.

The present result is nearly similar to those of the previous workers (Pinniger, Hosni *et al.*)[1,6] and Tyler *et al.*[3] According to Tyler and Binns,[3] the minimum dosage required to kill *T. castaneum* under low temperature conditions (5^{O} C to 1^{O} C) is 1395 mg/m^2 of malathion. According to Hosni *et al.*,[6] the LD_{50} for *T. castaneum* was 2.25 ppm. The present findings revealed that the LD_{50} for 1st, 2nd and 3rd instar larvae of *T. castaneum* was 228.224, 78.134 and 183.019 ppm

Table I. Dose mortality response of the 1st, 2nd and 3rd instar larvae of *T. castaneum* exposed to different concentrations of Malathion.

Larval instar	Concentration (ppm.)	No of insect used	Corrected % kill	Regression equation Y	LD_{50} (ppm)	95 % Confidence limit	
						Upper (ppm)	Lower (ppm)
1st	200	100	60	2.559 + 2.109x	228.224	425.014	122.552
	160	100	23				
	80	100	12				
	40	100	8				
	20	100	2				
	control	100	0				
2nd	200	100	80	1.131 + 2.043x	78.134	87.690	68.060
	160	100	70				
	80	100	60				
	40	100	25				
	20	100	10				
	control	100	0				
3rd	200	100	56	0.815 + 1.849x	183.019	225.367	148.635
	160	100	39				
	80	100	29				
	40	100	11				
	20	100	3				
	control	100	0				

Table II. Combined effect of malathion and piperonylbutoxide on *Tribolium castaneum* Herbst.

Doses of insecticide (ppm)	Doses of insecticide of synergist (ppm)	Percentage mortality		LD_{50}		Co-toxicity coefficient
Malathion	Malathion + piperonylbutoxide 1:1 ratio	Malathion	Combined	Malathion ppm	Combined ppm	
200	400	60	74			
160	320	44	54			
80	160	34	41	138.25	251.74	109.84
40	80	15	21			
20	40	5	9			

Fig. 1,2 & 3. Mortality response of the 1st, 2nd and 3rd instar larvae of *T. castaneum* exposed to different concentrations of Malathion.

Figure 1 (1st instar)

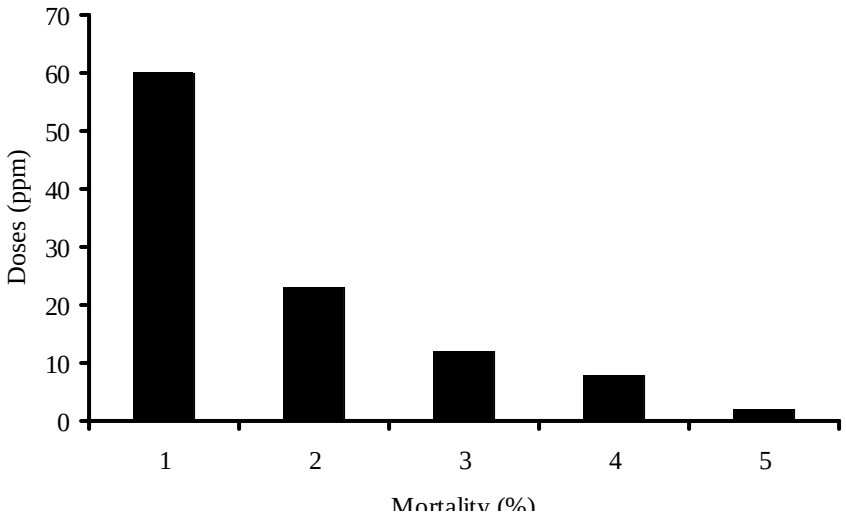


Figure 2 (2nd instar)

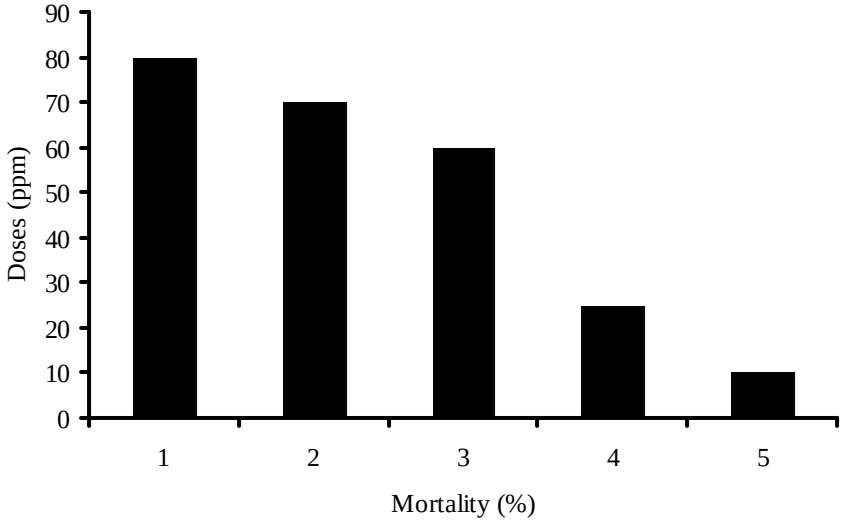
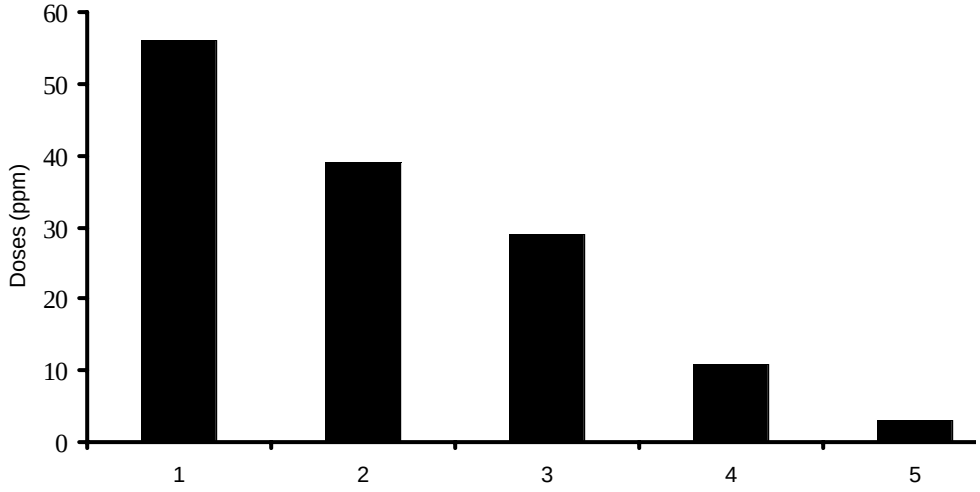


Figure 3 (3rd instar)



respectively. This difference was probably due to the difference in the emulsifiable concentrate formulations. Besides, Hosni *et al*.[6] used adult for the experiments. Husain[12] used premium grade malathion.

It is, thus, inferred that malathion may be used in controlling this pest under pest management programme. To assure best protection against the pest, the highest dose should be applied.

It appeared from the results (Table II) that malathion in combination with the synergist produced synergism to the adults of *T. castaneum*. The results were discussed in relation to the potential use of piperonylbutoxide alone and in combination with malathion as synertgist in the control of adult *Tribolium* population.

Acknowledgement

The author thanks Professor Dr. K. A. M. S. H Mondal, University of Rajshahi, for supervising the experiments. M. M. Husain also wishes to thank Dr. M. O. Faruq (Ex-Director), BCSIR Laboratories, Rajshahi for his suggestions in preparing the manuscript.

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