RESIDUAL TOXICITY OF BHC AND MALATHION TO THE LARVAL AND PUPAL PARASITES OF *OPISINA ARENOSELLA* WALKER *(NEPHANTIS SERINOPA M.)*

C. P. Ramachandran and K. N. Ponnamma*

ABSTRACT

Recommended residual toxicity tests of BHC and malathion for the control of *Opisina arenosella* Walker against the laboratory-bred parasites were conducted from March to June 1973 at Parakkadu. Both insecticides at recommended doses were found to be highly toxic to all the laboratory bred parasites except BHC to bethylids. Malathion was found to be more toxic to parasites than BHC when mean over periods were analysed. The residual toxicity of insecticides to parasites varied from period to period and parasite to parasite.

INTRODUCTION

Opisina arenosella Walker is a serious pest of coconut palm found mainly within certain localities in the coastal, backwater and interior tracts of India. Severe outbreaks of the pest result in heavy damage to palms, which lead to considerable economic losses.

The pest is controlled by different methods, viz. chemical, biological and/or mechanical. To combat the pest effectively, an integrated adoption of different control measures is more feasible. In nature, many bioagents account for an effective check on the pest population. Meteorological factors play an important role in checking the build-up of pest population.

Nirula (1956) has provided a comprehensive account of the various parasites, predators and pathogens affecting the pest, and reviewed the different programs launched for the control of the pest in the country. Although the natural enemy complex does check the pest population, the pest incidence becomes severe during summer months, when conditions are conducive for its multiplication and population build-up. Laboratory-reared parasites were liberated in pest infested tracts to augment the natural population of parasites in the field. Indigenous parasites were multiplied in the laboratory, e.g., the eulophid, *Trichospilus pupivera* Ferr., the elasmid, *Elasmus nephantidis* Roh., the braconid, *Bracon brevicornis* Mues. In spite of the efforts to check the pest population by liberation of parasites, cyclic outbreaks of the pest occurred during certain years. One such outbreak was reported in the Badagara area of Calicut District, Kerala State in 1970, causing complete defoliation of palms in about 2,000 ha. of coconut gardens.

Nirula (1956) tried different insecticides against the pest in the laboratory and the field, and found out that BHC and DDT at 0.2% concentration were effective in controlling the pest. Sathiamma and Kurian (1970) tried malathion in field trials against the pest, and found it effective in controlling the pest. Chandrika and Nair (1968) bioassayed BHC and malathion at 0.01% concentration and found out that BHC was more toxic to the eulophid than malathion on the basis of LT50 values worked out by them. Saradamma and Nair (1968) in their studies on bioassay of insecticides against *Bracon brevicornis* found that BHC was less toxic than malathion when tried at 0.05% concentration. Prakash Sarup et al. (1971) bioassayed 14 insecticides and, based on LC50 values, found that malathion was less toxic than p,p' DDT to braconids. Nirula et al. (1958) also studied the field weathering of DDT and BHC and their effect on the eulophid. They reported that DDT residues remained toxic up to eight weeks whereas the toxicity of BHC was quite insignificant after six days. BHC and malathion are now being recommended for the control of the pest. The effect of these two insecticides and their residues on the parasites of the pest requires detailed study; the integration of the chemical and biological methods of control is necessary for effective pest management.

The present study was undertaken to find out the residual effect of these insecticides on four species of laboratory-bred indigenous parasites of *O. Arenosella.*

MATERIALS AND METHODS

The experiment was conducted at Parakkadu in the coastal tracts of Alleppey District, Kerala State, India from March to May 1973. BHC, malathion and control were

*Central Plantation Crops Research Institute, Regional Station, Kayangulam, Krishnapuram 690533, Kerala, India.

the three treatments made, each one on a plot size of five palms per treatment and replicated thrice, making a total of 45 palms. BHC and malathion at 0.2% and 0.05% concentrations respectively, were sprayed on the under surface of leaves. Control palms were sprayed with an equal quantity of water. After the spray fluid had dried up, four sample leaflets were taken at random from each palm. The samples collected immediately after spraying were bioassayed the next day, 24 hours after spraying. Subsequent samples were taken one, two, three, four, six and eight weeks after spraying, and bioassayed in the laboratory. The tip portions of leaflets were removed and the remaining portions inserted into specimen glass tubes 7.5 cm x 2.5 cm, which were closed with cotton plugs to avoid contamination of samples and to prevent losses of insecticide/residues while transporting. Five each of the laboratory-reared parasites eulophid, elasmid, braconid and bethylid were then introduced into the tubes for the samples for each series of trials; a total of twenty-five test insects of each species were exposed for bioassay. Mortality was recorded after 24 hours of exposure of the parasites to the sample leaflets.

RESULTS AND DISCUSSION

The results are presented in Tables 1 and 2. Effects of treatments on each species of parasite are discussed separately.

1. ***Trichospilus pupivora*** Ferr. The differences between treatments, periods and their interactions were significant. Both BHC and malathion were toxic to the parasites. Mortality was highest when the parasites were exposed to samples 24 hours after treatment. There was significant difference between treatments at 24 hrs, two weeks, four weeks and six weeks after treatments. Mortality was higher in malathion-treated leaves than in BHC, especially from one to three weeks after treatment. A higher residual toxicity of BHC was recorded after eight weeks of spraying. The overall deleterious effect of malathion was more than that of BHC, when the means over period for these two insecticides were compared.

2. ***Elasmus nephantidis*** Roh. The effects of treatments, timings and their interactions were significant. The effects of timings of application were consistent, whereas the effects of treatments were not as much. Both BHC and malathion were significantly harmful to elasmid. Mortality was highest when elasmids were exposed to samples 24 hours after treatment.

3. ***Bracon brevicornis*** Wesm. The differences between treatments, periods, timings and their interactions were highly significant. However, the differences between insecticides were not consistent over periods, whereas those between timings were consistent. Malathion was significantly more harmful to braconids than BHC. Maximum mortality of parasites was observed in both insecticides when braconids were exposed to samples 24 hours after spraying. The deleterious effect of malathion on braconids was minimum at eight weeks after spraying while samples drawn one, two and six weeks after spraying affected the parasites more.

4. ***Perisierola nephantidis*** Mues. The differences between treatments, periods and their interactions were highly significant. The differences between periods were consistent over treatments, whereas the differences between treatments over periods were inconsistent. Malathion was found to be more significantly harmful to bethylids as compared to BHC. Bethylids showed a higher degree of tolerance to BHC as compared to other species of parasites tried. Samples of both insecticides taken 24 hours after spraying effected highest mortality of parasites. Other periods effected less percentage mortality of parasites and no significant difference.

BHC and malathion were found to affect the parasites within 24 hours of spraying except bethylids, which appeared to be more tolerant to BHC. Residues of BHC had apparently no effect on bethylids even in the first week of treatment and during the subsequent periods. Exposure of parasites to samples of BHC-treated leaves 24 hr after spraying indicated that elasmids were highly susceptible to BHC, followed by braconid, eulophid and bethylid in ascending order of tolerance. Elasmids were the worst affected by malathion, while bethylids, braconids and eulophids showed progressive tolerance to this insecticide in that order.

Table 1 lists the residual effect of BHC and malathion on the laboratory-bred parasites of *Opisina arenosella* Walker while Table 2 gives its Analysis of Variance (ANOVA). When the overall effect of immediate and residual toxicity over a period of eight weeks was taken, malathion was found to be more harmful than BHC to all the four species of parasites tested. The residual toxicity of malathion against eulophid was less in the second week, more in the third week, and declined from the fourth week onwards (Fig. 1). Residual toxicity of BHC to eulophids was less in the first and second weeks of treatment, and increased in the third week. More or less this trend continued up to the eighth week.

Residual toxicity of both insecticides against elasmids (Fig. 2) showed a decline in the first week, followed by increased toxicity during the second and third weeks. In the case of braconid, the residual toxicity of BHC (Fig. 3) was very low after one week of application, while residual effect of malathion gradually decreased to a negligible level by the fourth week followed by a slight increase in the sixth week. The immediate toxicity of malathion on bethylid (Fig. 4) was very high as compared to that of BHC. The residues of BHC had no apparent ill effect on the bethylids even after seven days spraying, while slight residual effect

...was noticed in the first week after application.

Again, both BHC and malathion at concentrations recommended for the control of the pest were toxic to all the four species of ...

Again, both BHC and malathion at concentrations recommended for the control of the pest were toxic to all the four species of indigenous parasites 24 hours after spraying except BHC to bethylids.

Comparing the two insecticides, malathion and its residues put together were more toxic to all the four species of parasites than BHC. Residual effects of these insecticides on all parasites except for eulophids were negligible four weeks after treatment. In the case of eulophids, residual toxicity of malathion remained for more than four weeks and that of BHC even up to eight weeks after treatment.

CONCLUSION

In an integrated approach to control pest outbreak of *O. arenosella*, BHC should be preferred over malathion. Bethylids and braconids may be liberated after two weeks, elasmids after four weeks, and eulophids after eight we... of insecticidal application. The time of ...

of insecticidal application, The time of release of the... different parasites are synchronised with the resurgent developmental stages, of the pest from the effects of insecticides, and seem to be best suited in an integrated approach of chemical and biological control.

Hence, during periodic outbreaks of *O. arenosella*, BHC is preferred over malathion in an integrated pest control approach.

ACKNOWLEDGMENT

The authors are highly indebted to Dr. Chandy Kurian, Entomologist for his unfailing guidance and help to plan and complete the work, Shri. G.B. Pillai, Entomologist for giving the necessary suggestions in the preparation of the manuscript, and Shri. Narasimhayya for the statistical analysis of the data.

Table 1.

Residual effect of BHC and malathion on the laboratory-bred parasites of *Opisina arenosella* Walker.

PARASITE	TREATMENT	MORTALITY* AT: 24 HR	ONE WEEK	TWO WEEKS	THREE WEEKS	FOUR WEEKS	SIX WEEKS	EIGHT WEEKS	MEAN OVER PERIOD
Eulophid	BHC	.859	.095	.084	.149	.199	.387	.403	.295
	Malathion	.826	.566	.004	.603	.455	.093	.032	.315
	Control	.827	.009	.005	.100	.229	.190	.090	.148
	Grand Mean	.839	.166	.020	.260	.289	.181	.146	.249
Elasmid	BHC	.971	.129	.176	.167	.044	.036	.044	.203
	Malathion	1.00	.119	.132	.034	.039	.028	.175	.204
	Control	.158	.163	.056	.088	.085	.036	.005	.073
	Grand Mean	.811	.138	.116	.088	.046	.034	.055	.151
Braconid	BHC	.881	.028	.009	.000	.000	.010	.126	.076
	Malathion	.977	.167	.167	.127	.005	.120	.000	.178
	Control	.016	.024	.014	.014	.005	.027	.137	.026
	Grand Mean	.635	.060	.044	.026	.002	.042	.063	.114
Bethylid	BHC	.168	.000	.004	.000	.000	.000	.000	.005
	Malathion	.982	.054	.000	.000	.000	.054	.000	.056
	Control	.000	.000	.000	.000	.000	.000	.000	.000
	Grand	.315	.006	.005	.000	.000	.005	.000	.011

*Dead / Total

Table 2.

Analysis of Variance (ANOVA) of the residual effects of BHC and Malathion on Laboratory-bred parasites of *Opisina arenosella* Wlk.

SOURCE	D.F.	SUM OF SQUARES	MEAN SUM OF SQUARES
A. Eulophid			
Between treatments (Tr)	2	1671.258	835.629*
Between timings (T)	6	17270.624	2878.437**
Tr x T	12	6184.357	515.3631*
Error	42	8825.325	210.127
Total	62	33951.56469	
B. Elasmid			
Between treatments (Tr)	2	2863.832	1431.916**
Between timings (T)	6	18639.787	3156.631**
Tr X T	12	6096.743	506.062*
Error	42	272.674	196.968
Total	62	36173.036	
C. Braconid			
Between treatments (Tr)	2	2591.902	1295.951**
Between timings (T)	6	14507.602	2417.934**
Tr X T	12	10051.806	837.650**
Error	42	5515.330	131.320
Total	62	32666.635	
D. Bethylid			
Treatment (Tr)	2	2096.475	1048.238**
Timings (T)	6	8630.580	1438.430**
Tr X T	12	7565.418	630.451**
Error	42	2388.553	56.870
Total	62	20681.027	

*Significant to the 0.05 level.
**Significant to the 0.01 level.

LITERATURE CITED

CHANDRIKA, S. and NAIR, M.R.G.K. 1968. Relative toxicity of insecticides to adults of *Trichospilus pupivora* Forriere. Agri. Res. J. Kerala. 6 (1):33-36.

NIRULA, K.K. 1956. Investigations on the pests of coconut palm. Part III. *Nephantis serinopa* Meyrick. Indian Cocon. J. 9 (1): 74-90.

NIRULA, K.K. 1958. Relative toxicity of the field weathered insecticide to the eulophid parasite, *Trichospilus pupivora* Ferr. associated with *Nephantis serinopa* Meyrick. Ind. cocon. J. 11 (4): 125-132.

SARADAMMA, K. and NAIR, M.R.G.K. 1968. Relative toxicity of insecticides to adults of *Microbracon brevicornis* (Wosmael), Braconid. Agri. Res. J. Kerala. 6 (2): 98-100.

SARUP, PRAKASH, SINGH, D.S., SRIVASTAVA, M.L., and SINGH, R.N. 1971. Laboratory evaluation of pesticides against the adults of an important parasite, *Bracon brevicornis* Wesmael (Braconidae: Hymenoptera) of some crop pests. Indian J. Ent. 23.

SATHIAMMA, B. and KURIAN, C. 1970. Malathion effectively controls the Cocon. Bull. 1 (7): 12-13.

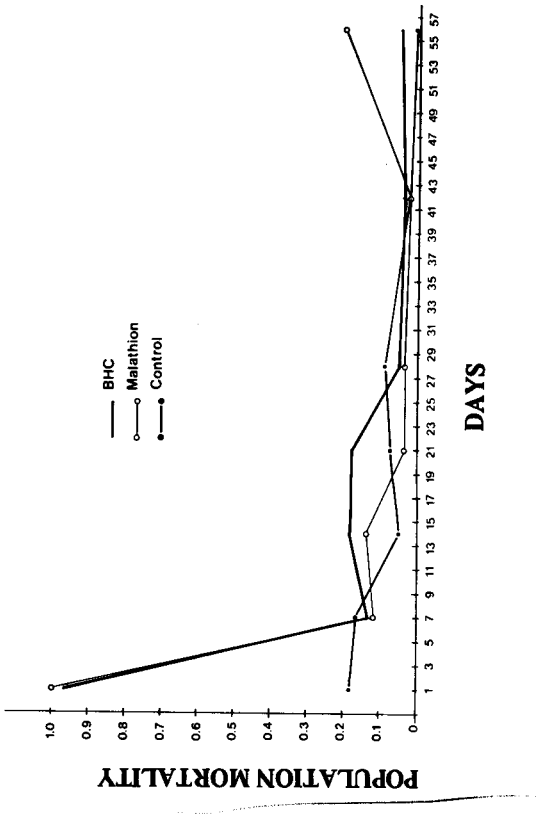

Fig. 2. Residual effect of BHC and Malathion on Elasmid

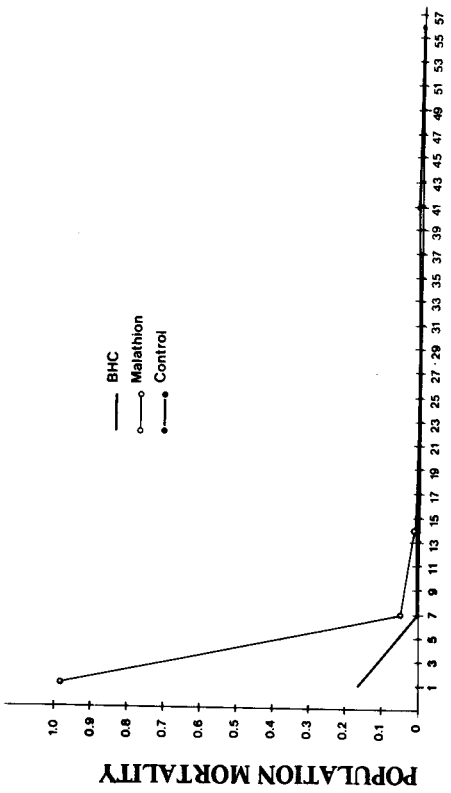

Fig. 4. Residual effect of BHC and Malathion on Bethylid

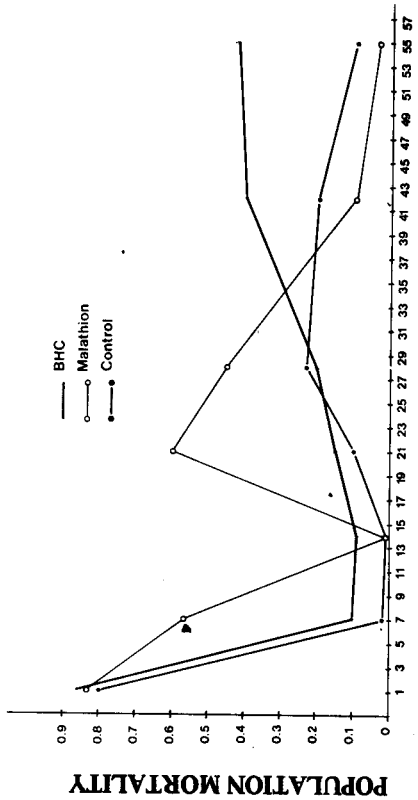

Fig. 1. Residual effect of BHC and Malathion on Eulophid

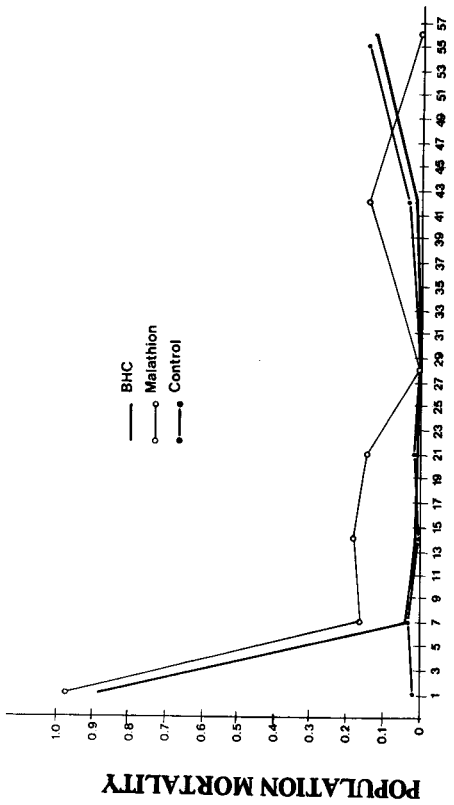

Fig. 3. Residual effect of BHC and Malathion on Braconid