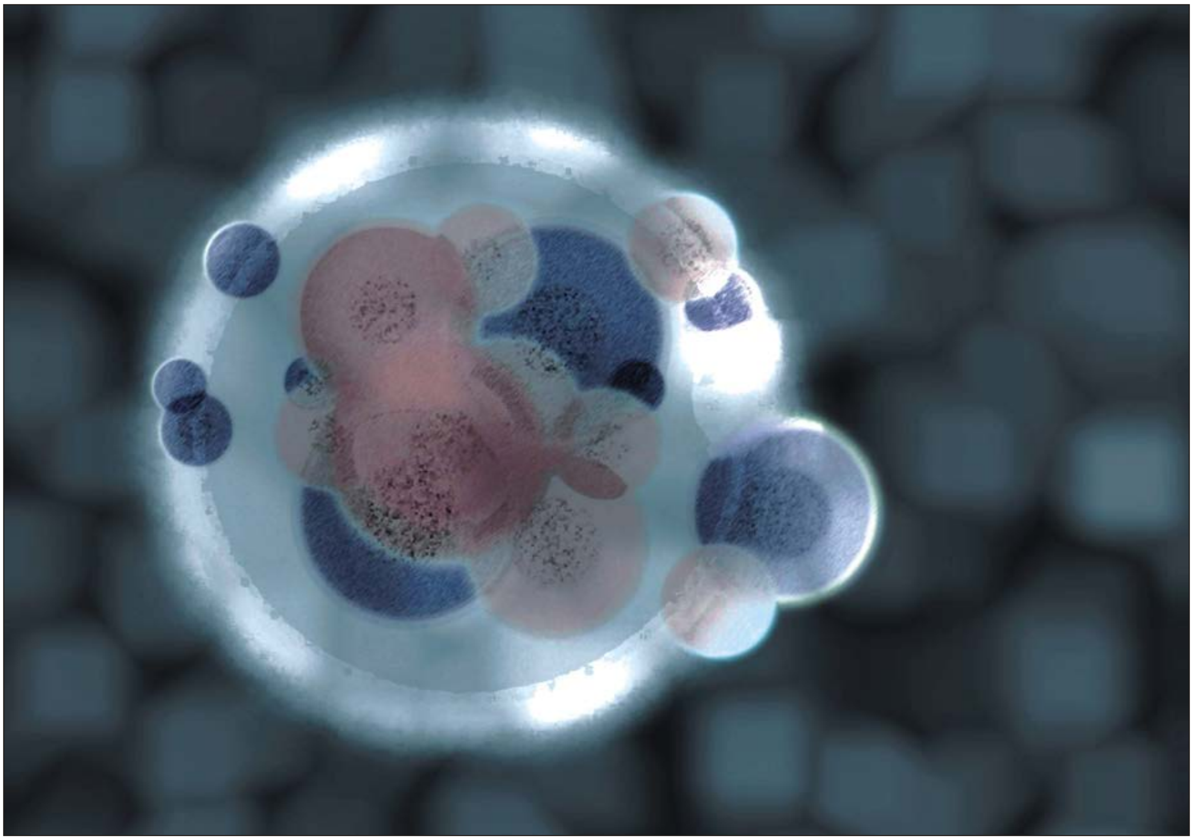

Journal of Biological Sciences

ISSN 1727-3048

science alert

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OnLine Journal of Biological Sciences 1 (7): 580-583, 2001

Effect of Insecticides on Cotton Aphid, *Aphis gossypii* Glover (Homoptera: Aphididae)

K.N. Shahjahan Karim, B.C. Das and M. Khalequzzaman
Department of Zoology, Rajshahi University, Rajshahi-6205, Bangladesh

Abstract: Three insecticides, malathion, sumithion and phorate were tested against *Aphis gossypi* Glover in different concentrations and observations were recorded after twelve and twenty-four hours on aubergine leaf. The result was much better in case of phorate, less with sumithion and much less with malathion. LD_{50} values for phorate, sumithion and malathion were 17.59, 108.07 and 364.05 µg after 12 hours and were 4.493, 45.457 and 178.38 µg after 24 hours respectively.

Key words: Bioassay, *Aphis gossypii*, malathion, sumithion, phorate, LD_{50} value

Introduction

Cotton aphid, *Aphis gossypii* Glover is a polyphagous pest and causes extensive damage to cucurbitaceous crops. Both nymph and adult suck sap from the underside of leaves and shoots resulting in reduced fruit yield. Dozens of chemical insecticides are being used against the cotton insect pests in different parts of the world (Bohlen, 1985). Aphid control may be done by chemical, biological or integrated method. Desirable properties of a good aphidicide are: selective toxicity to aphids, systemic activity, a reasonable residual activity, rapid action and low phytotoxicity (Schepers, 1989).

Fyfanon is a non-systemic broad spectrum organophosphorus insecticide and aphidicide of low mammalian toxicity. It is generally non-phytotoxic. Phorate is also organophosphorus and systemic and contact insecticide and aphidicide. Sumithion is also organophosphorus and contact insecticide (Worthing, 1987). The ultimate bioassay of any pesticide must be its evaluation under field conditions. However, such trials are not possible for all purposes. It is therefore necessary to assess the toxicity of a chemical under a carefully controlled laboratory conditions as a prerequisite to extensive field trials. In this experiment indirect application (leaf-dip method) was used to assay aphid mortality. In direct application, aphids take up insecticide, either by contact with a treated surface by ingestion or inhale as vapour. Some methods can examine these routes in isolation, but in the most widely used technique of placing aphids on treated leaves, all three routes may be involved (Devonshire and Rice, 1988).

Materials and Methods

Chemicals: Malathion ($C_{10}H_{19}O_6PS_2$) obtained as fyfenon (TG 96%) and sumithion ($C_9H_{12}NO_5PS$) obtained as sumithion (TG 98%). Phorate ($C_7H_{17}O_2PS_3$) was obtained as timet (TG 98%). All insecticides were dissolved in acetone.

Toxicity test: Surface film technique (Busvine, 1971) was applied and conducted by bringing leaves of aubergine in the laboratory. Different dilutions of insecticide were applied to the leaves. The insecticides were serially diluted with acetone and 0.2 ml of insecticide solution was placed on 3 cm diameter of ring on the leaf, previously placed on a petridish of 9 cm diameter. Before actual experiment a set of *ad-hoc* experiments were done to find out the dose ranges between 10-90% mortality of the aphids. The doses were calculated by having the actual quantity of insecticide in 0.2 ml of solution divided by the surface area of leaf.

The mortality of the aphid was recorded after 12 hours and 24 hours of treatment and insecticides were tested for four doses. A separate control batch was maintained in which only acetone was dropped on the surface of leaf. The upper part of petridish covers both lower part and ring. Petiole of the leaf was wrapped with wet cotton bud. Adult aphids were used to test the toxicity. Data were analyzed by computer software "Probit Analysis".

Results and Discussion

On the first day of experiment temperature was recorded as 31.1 and 16°C, relative humidity 81% and 51%, dew point 15° and 17° (maximum and minimum respectively) and no rainfall. On the second day the record was 32.5 and 16.5°C, 96% and 45%, 16° and 15° respectively and there was no rainfall again. The LD_{50} values for malathion, sumithion and phorate on *A. gossypii* with 95% confidence limit (lower and upper limit) are presented in Table 1 and 2. After 12 hours of application of malathion LD_{50} value was found as 364.05 µg cm^{-2}. χ^2 shows that there was insignificant difference of mortality rate of the pests among the doses of malathion. The 'r' value and regression equation was found as r = 0.996 ($p<0.01$) and $y = 2.512+0.977x$ (Fig. 1) respectively. After 24 hour the value was found as 178.38 µg. χ^2 value 0.258 shows insignificant variation. The "r" value and regression equation was found as r = 0.982 ($p<0.01$) and $y = 2.581+1.077x$ (Fig. 2). In both cases the slope was positive.

In case of sumithion after 12 hours of application LD_{50} value was calculated as 108.07 µg cm^{-2}. χ^2 value 0.001 (NS) shows that there was no variation among doses. The `r` value and regression equation was found as r = 0.998 ($p<0.01$) and $y = 3.048+0.956x$ (Fig. 3). After 24 hours of application LD_{50} value was calculated as 45.457 µg. χ^2 value 0.154 (NS) shows no variation among doses. The `r` value and regression equation was found as r = 0.993 ($p<0.01$) and $y = 2.999+1.213x$ (Fig. 4). In both cases the slope was positive.

In case of phorate after 12 hours of application LD_{50} value was calculated as 17.59 µg cm^{-2}. χ^2 value 0.286 (NS) shows that there was no variation among doses. The `r` value and regression equation was found as r = 0.988 ($p<0.01$) and $y = 3.424+1.265x$ (Fig. 5). After 24 hours of application LD_{50} value was observed as 4.493 µg cm^{-2}. χ^2 value 0.029 (NS) shows no variation among doses. The r-value and regression equation was found as r = 0.996 ($p<0.01$) and $y = 4.430+0.884x$ (Fig. 6). In both cases the slope was positive.

Alam (1969) recorded the control of *A. gossypii* by spraying sumithion at the rate of 6 oz $acre^{-1}$. Al-Dabbas *et al*. (1974)

Table 1: Toxicity of different aphidicides on adult *A. gossypii* after 12 hours

Aphidicide	Dose (µg cm^{-2})	No. of aphid used	No. of aphid died	Mortality (%)	LD_{50} (µg cm^{-2})	95% C.L. lower	95% C.L. upper	χ^2
	455.20	20	11	55.0				
	200.42	20	9	45.0				
Malathion	111.25	20	7	35.0	364.05	135.22	980.13	0.042NS
	55.63	20	5	25.0				
	Control	20	1	5.0				
	187.69	20	12	60.0				
	126.54	20	11	55.0				
Sumithion	48.41	20	8	40.0	108.07	52.21	223.69	0.001NS
	24.20	20	6	30.0				
	Control	20	1	5.0				
	61.15	20	15	75.0				
	20.38	20	12	60.0				
Phorate	11.04	20	8	40.0	17.59	10.46	29.57	0.286NS
	5.52	20	6	30.0				
	Control	20	1	5.0				

NS = Non significant

Table 2: Toxicity of different aphidicides on adult *A. gossypii* after 24 hours

Aphidicide	Dose (µg cm^{-2})	No. of aphid used	No. of aphid died	Mortality (%)	LD_{50} (µg cm^{-2})	95% C.L. lower	95% C.L. upper	χ^2
	455.20	20	14	70.0				
	200.42	20	11	55.0				
Malathion	111.25	20	8	40.0	178.38	96.11	332.93	0.258NS
	55.63	20	5	25.0				
	Control	20	1	5.0				
	187.69	20	16	80.0				
	126.54	20	14	70.0				
Sumithion	48.41	20	11	55.0	45.457	24.33	84.92	0.154NS
	24.20	20	8	40.0				
	Control	20	1	5.0				
	61.15	20	17	85.0				
	20.38	20	15	75.0				
Phorate	11.04	20	13	65.0	4.493	1.184	17.06	0.029NS
	5.52	20	11	55.0				
	Control	20	1	5.0				

NS = Non significant

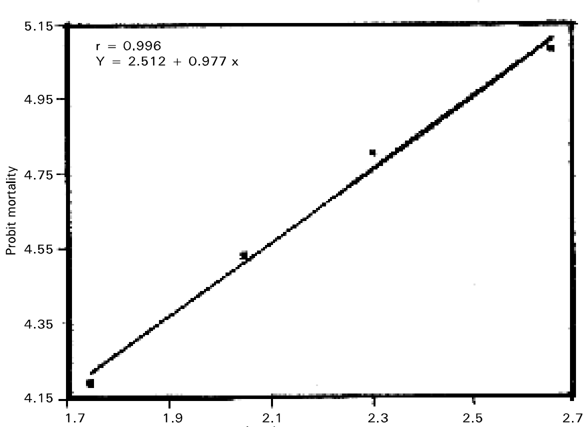

Fig. 1: Relationship between logdose and probit mortality of malathion on *A. gossypii* after 12 hours of application

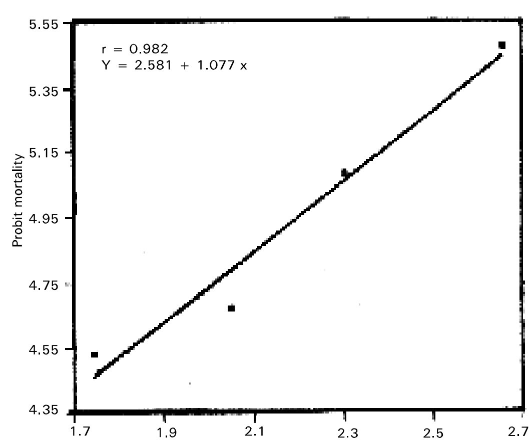

Fig. 2: Relationship between logdose and probit mortality of malathion on *A. gossypii* after 24 hours of application

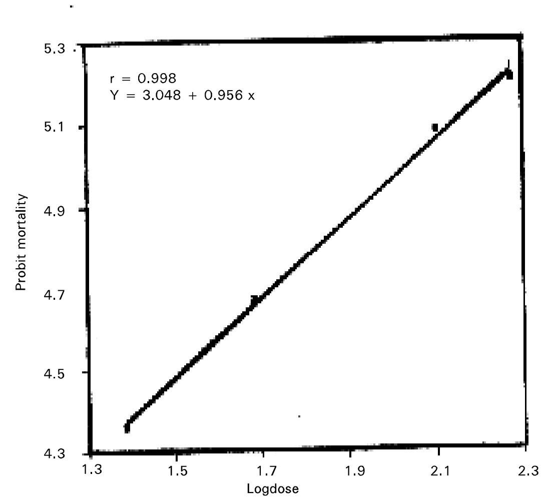

Fig. 3: Relationship between logdose and probit mortality of sumithion on *A. gossypii* after 12 hours of application

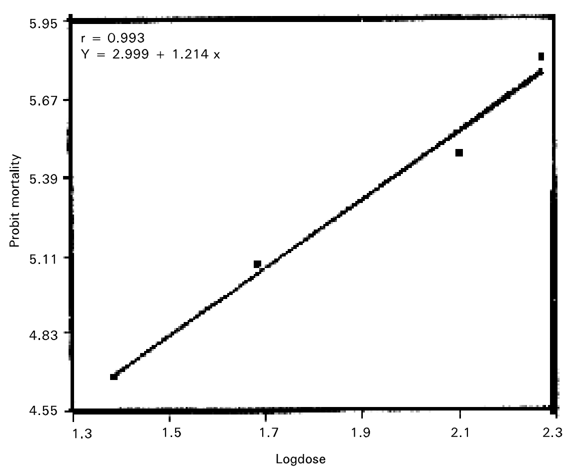

Fig. 4: Relationship between logdose and probit mortality of sumithion on *A. gossypii* after 24 hours of application

tested dichlorvos (Nogos), malathion, fenitrothion (Sumithion)and primiphos-methyl (Actellic) as 50% emulsion concentrates, each applied at 500 ml spray/doum (2500 m^2) on *Aphis fabae* Scop. Primiphos-methyl proved to be most effective of the compounds followed by malathion. Hameed and Dinabandhoo (1978) sprayed 17 insecticide on cotton aphid. The experiment was conducted on ringed leaf disk. LC_{50} with fenitrothion (Sumithion) was 31.62 ppm.

Borle *et al.* (1980) used granular formulation of insecticides, viz., phorate (10%), disulphoton (5%) and dimethoate (5%) at 1.0, 1.5 and 2g on pot respectively against cotton aphid on cotton. It was found that in basal application disulphoton and phorate gave 95.99% and 98.65% mortality respectively after 161 days of treatment. In case of ring application phorate, disulphoton and dimethoate showed 100% mortality up to 75 days, 91 days and 35 days respectively. Bodhade *et al.* (1987) used 9 insecticide to control cotton aphid on cotton seedlings. The concentration and LT_{50} (days) was as follows: endosulfan 0.05% and 4.17, quinalphos 0.05% and 5.27, phenthoate

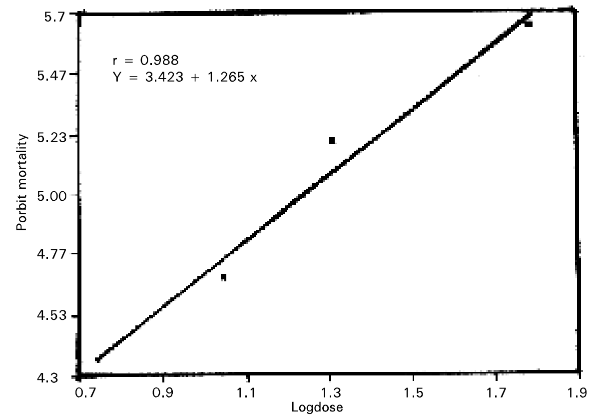

Fig. 5: Relationship between logdose and probit mortality of phorate on *A.gossypii* after 12 hours of application.

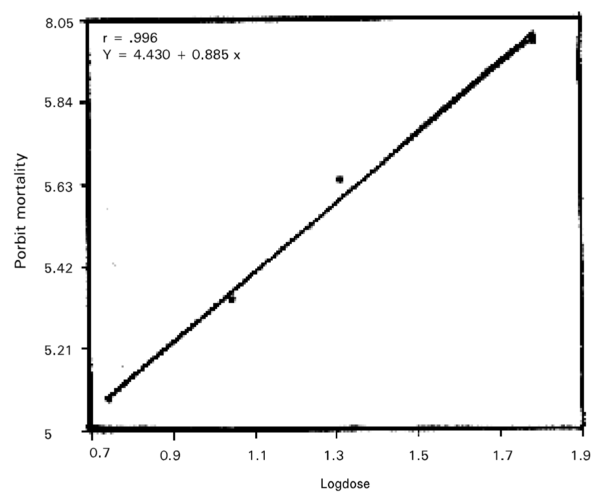

Fig. 6: Relationship between logdose and probit mortality of phorate on *A. gossypii* after 24 hours of application.

0.05% and 5.68, malathion 0.1% and 5.93, phosalone 0.05% and 10.06, phosphamidon 0.04% and 11.49, formothion 0.05% and 16.15, dimethoate 0.05% and 16.59 and monocrotophos 0.05% and 30.89. Ismail *et al.* (1985) observed the effect of three insecticide pirimor 0.3 g/litre, dimerox 0.5 g/litre and diamal (malathion) 1.25 g/litre to control *A. gossypii* on orange.

However, cotton aphids' outbreaks following applications of sulprofos were not entirely due to destruction of natural enemies (Kerns and Gaylor, 1991). Cypermethrin and sulprofos decreased the r_m, but dicrotophos did not. O'Brian and Graves (1992) observed *A. gossypii* on cotton and reported that organophosphorus resistant aphids exhibited significantly higher reproductive potential on day 1 and 2 of adult life compared to susceptible aphids. This observation suggests that indiscriminate use of insecticides to control the cotton aphid and other cotton pests may not only select for stable resistance in the cotton aphid but also for populations of the cotton aphid with increased reproductive capability during early adulthood.

Thus insecticide application must be limited to substances with very low toxicity to man and which can be used with a wide range of safety dosage on the plants. Ideally, it would be better to get away from the use of toxic insecticides and make their use absolutely minimal wherever possible.

Acknowledgment

We thankfully acknowledge the painstaking work of typing and printing the manuscript by Mr. Nafis Imtiaz Karim.

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