THE EFFECT OF TEMPERATURE AND HUMIDITY ON THE SUSCEPTIBILITY OF FLOUR BEETLES TO ORGANOPHOSPHORUS INSECTICIDES

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(*Received* 10 *Sept.* 63; *revised* 29 *August* 64)

The effect of temperature and humidity, on the susceptibility of *Tribolium castaneum* Herbst. to malathion and diazinon, has been investigated. It has been found that temperature significantly influences the susceptibility of *T. castaneum* to malathion though not to diazinon. Humidity, however, influences the susceptibility of the insect to both insecticides.

In an earlier paper, Perti *et al*[1]. reported that the susceptibility of *Tribolium castaneum* Herbst. to certain chlorinated hydrocarbon insecticides, such as DDT and dieldrin, was influenced by temperature though not by humidity. In this paper, the effect of temperature and humidity on the susceptibility of *T. castaneum* to certain organophosphorus insecticides, such as malathion and diazinon, has been described.

MATERIALS AND METHODS

Technical grades of diazinon (thiophosphoric acid-2-isopropyl-4-methyl-pyrimidyl-6-diethylester) and malathion (0,0-dimethyl-5-(1,2 dicarboxyethyl) dithiophosphate), were obtained from Geigy Insecticides Ltd., Bombay and Lederle Laboratories (India) Ltd., Bombay respectively. The test insects were adult flour beetles, *Tribolium castaneum* Herbst., three to five weeks old, standardised and bred according to the method described by Haq *et al*[2]., except for temperature and humidity. The insects were reared at 27-29°C and 78-75 per cent R.H.

The susceptibility of *T. castaneum* to diazinon and malathion was investigated on residual films of the insecticides on filter papers. The experimental details were essentially the same as those described by Perti *et al*[1]. The requisite amount of insecticide was dissolved in liquid paraffin and subsequently diluted with petroleum ether (1:2 v/v). Whatman filter papers (No. 1, 11 cm dia.) were laid flat on pin points and one ml of the insecticidal solution was delivered on each filter paper with a hypodermic syringe. The uniformity of the deposits was ascertained. The filter papers were then allowed to dry for three hours in a room temp. 27-29°C and R.H. 70-75 per cent. Fifty insects were used in each assay. The insects were enclosed in a glass ring (7·5 cm dia.) placed on petri dish (11 cm dia.) lined with treated filter paper; the glass rings were covered with wire mesh. The exposure period was 48 hours. After the exposure, the insects were transferred into a clean petri dish (11 cm dia.) lined with untreated filter paper. There were 25 insects in each replicate and two replicates in each assay. The mortality was recorded 24 hours thereafter.

The investigations were conducted at controlled levels of temperature and humidity in incubators at 20, 25, 30 and 35°C and at 30 and 90 per cent R.H. The humidities were maintained at the desired level by introducing, within the incubators, desiccators containing suitable concentration of potassium hydroxide solution.

TABLE I

SUSCEPTIBILITY OF *T. Castaneum* TO DIAZINON AND MALATHION AT DIFFERENT TEMPERATURES AND HUMIDITIES

Insecticide	Temp. °C	R.H. %	Heterogeneity	Regression Equation	LC_{50} μ_{gm}/sq cm	S.E. of Log LC_{50}	Fiducial Limits of LC_{50}
Diazinon	20	30	$\chi^2_{(2)} = 0.0492$	$Y = 2.6930\ X + 11.1550$	0.5460	0.3020	0.0013 0.0204
		90	$\chi^2_{(2)} = 0.0471$	$Y = 3.0973\ X + 11.9742$	0.5775	0.2500	0.0018 0.0171
	25	30	$\chi^2_{(3)} = 1.7627$	$Y = 3.5943\ X + 12.8462$	0.6930	0.1700	0.0030 0.0141
		90	$\chi^2_{(3)} = 0.2134$	$Y = 4.5203\ X + 14.8852$	0.6825	0.1440	0.0034 0.0125
	30	30	$\chi^2_{(2)} = 0.0648$	$Y = 1.9815\ X + 10.3459$	0.2100	0.3400	0.0004 0.0093
		90	$\chi^2_{(3)} = 0.1286$	$Y = 2.0804\ X + 10.2251$	0.3255	0.3040	0.0008 0.0121
	35	30	$\chi^2_{(3)} = 0.0558$	$Y = 2.8283\ X + 12.2455$	0.2835	0.2300	0.0010 0.0077
		90	$\chi^2_{(2)} = 0.1502$	$Y = 4.1925\ X + 14.5475$	0.5565	0.1670	0.0025 0.0112
Malathion	20	30	$\chi^2_{(2)} = 0.7237$	$Y = 9.5608\ X + 26.0780$	1.9005	0.0717	0.0131 0.0250
		90	$\chi^2_{(2)} = 0.3355$	$Y = 9.9976\ X + 23.4969$	1.4805	0.0703	0.0103 0.0194
	25	30	$\chi^2_{(3)} = 2.5660$	$Y = 9.2025\ X + 21.7568$	1.5855	0.0667	0.0118 0.0204
		90	$\chi^2_{(3)} = 1.3688$	$Y = 10.2059\ X + 28.8274$	1.4490	0.0713	0.0100 0.0190
	30	30	$\chi^2_{(3)} = 2.2160$	$Y = 2.0924\ X + 9.4293$	0.7980	0.2269	0.0027 0.0213
		90	$\chi^2_{(3)} = 8.1992$	$Y = 3.6712\ X + 13.3592$	0.5565	0.1789	0.0024 0.0119
	35	30	$\chi^2_{(2)} = 2.2753$	$Y = 2.5853\ X + 11.3643$	0.3675	0.2727	0.0010 0.0118
		90	$\chi^2_{(3)} = 0.9859$	$Y = 1.8877\ X + 10.1904$	0.1890	0.3978	0.0003 0.0107

Y = Probit Kill, X = Log concentration,

TABLE 2

ANALYSIS OF VARIANCE OF LC_{50} +

Source of Variation	Diazinon d.f.	S.S.	M.S.	F.	Malathion d.f.	S.S.	M.S.	F.
Between Temperature	3	0·000002	0·000002	3·17	3	0·000247	0·0000820	117·14**
Between R.H.	1	0·000018	0·000006	10·00*	1	0·000011	0·0000110	15·71*
Error	3	0·000002	0·0000006	—	3	0·000002	0·0000007	—
Total	7	0·000022			7	0·000260		

** = Significance at 1% level; * = Significance at 5% level.

DIAZINON:				
Average LC_{50} μ_{gm}/sq. cm.	0·273	0·4200	0·567	0·683
Temperature °C	30	35	20	25
MALATHION:				
Average LC_{50} μ_{gm}/sq. cm.	0·273	0·683	1·512	1·691
Temperature °C	35	30	25	20

+The figures denote the average of two replicates.

RESULTS AND DISCUSSION

The results were subjected to probit analysis[4]; they are summarised in Table 1. The analysis of variance of LC_{50} values is given in Table 2. It will be noted from the results that the susceptibility of *T. castaneum* to malathion is influenced significantly by the ambient temperature and humidity. The LC_{50} values for malathion, at 30 and 90 per cent R.H., show a decrease with rise in temperature, thereby exhibiting a positive temperature coefficient. This indicates that *T. castaneum* is more susceptible to malathion at 30 and 35°C than at 20 and 25°C. Similarly it is more susceptible to malathion at 90 per cent R.H. than at 30 per cent R.H., irrespective of the temperature.

The data presented in Tables 1 and 2 reveal that the susceptibility of *T. castaneum* to diazinon is not significantly influenced by temperature. The LC_{50} values at 30 and 35°C are, in general, lower than those at 20 and 25°C, both at 30 per cent and 90 per cent R.H. Humidity significantly influences the susceptibility of the insect to insecticidal action at higher temperatures (30 and 35°C) though not at the lower temperatures (20 and 25°C). *T. castaneum* is more susceptible to diazinon at 90 per cent R.H. than at the lower humidity.

The differences in the behaviour of malathion and diazinon under identical conditions of temperature and humidity are perhaps due to different volatilities of the two insecticides under the test conditions.

ACKNOWLEDGEMENTS

The authors thank Dr. J. N. Nanda, Director, for encouragement and interest in the work and Shri R. K. Tripathi for statistical analysis of the data.

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