TOXICITY OF MAKROLIN AGAINST COCKROACHES, HOUSE FLIES AND MOSQUITO LARVAE AS COMPARED WITH OTHER CHLORINATED INSECTICIDES

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Makrolin, Heptachlor, Aldrin, Chlordane and D.D.T. were compared for their insecticidal values, their solutions being prepared in acetone. *Topical Application Method* was followed in the case of cockroach, *Periplaneta americana*, and house fly, *Musca domestica*. For testing toxicity against the mosquito larvae, *Aedes aegypti*, a modification of David's method was used. The results indicated that Makrolin was five times more effective than D.D.T. against cockroach, but markedly less toxic than D.D.T., Heptachlor, Aldrine and Chlordane against house fly. Against mosquito larvae, however, it was found that 13 p.p.m. of Makrolin and 15 p.p.m. of D.D.T. were required to get LC_{95}.

Comparison of its toxicity with that of Heptachlor, Aldrin, Chlordane and D.D.T. shows that Makrolin was proved to be a useful insecticide with pronounced specificity against some of the insects.

Introduction

Makrolin is a new pesticide developed in the Central Laboratories of the Pakistan Council of Scientific and Industrial Research. According to the chemical classification of insecticides, it comes under the category of chlorinated hydrocarbons. A detailed account of the chemical aspects of this development will be published separately. The present investigation deals only with the insecticidal evaluation of Makrolin. The test insects used were cockroach, *Periplaneta americana;* house fly, *Musca domestica;* and the mosquito larvae, *Aedes aegypti*. The toxicity of the various intermediate chlorination products of Makrolin, varying in their specific gravity according to their level of chlorination, was investigated against cockroaches and mosquito larvae. The best results were obtained with Makrolin (chlorination product of 1.415 specific gravity) against cockroaches, house flies and mosquito larvae. These results were also compared with those of the other chlorinated insecticides, e.g., Heptachlor, Aldrin, Chlordane and D.D.T.

Material and Method

The topical application method was used in testing the insecticides against cockroaches and house flies. A gold seal tuberculin syringe manufactured by Clay Adams Inc., New York, operated by an ordinary micrometer[1] was used for applying measured droplets of toxicants to the body of insects. One ml. marked syringe as used by Turner,[2] with a needle of 26 g. was found suitable for this work. Mercury was used for calibrating the syringe in order to determine the exact volume of liquid expelled by a forward movement of micrometer screw. It was found that one complete advance revolution of the micrometer head expelled 11 µl of the liquid from the syringe. In the case of cockroaches 11 µl of each formulation was applied to the mesosternum of each adult. Five cockroaches were released after such treatment in each petri dish of 6-inch diameter.

In the case of the house flies 1.32 µl. of each formulation were applied to the thorax. Twenty treated flies were released in jars of the size $3'' \times 2''$. The wire-screened lid was used to close the mouth of the jar allowing circulation of air.

The criterion for mortality count in the case of cockroaches and house flies was based on the fact that when the dead insect was found lying on the back in the bottom of the test container; and there was no sign of legs or atennae or wing movement after touching the body of insect by a needle. The percent mortality was noted after 24 hours of experiment and each experiment was repeated 20 times.

Solutions of Makrolin, Heptachlor, Chlordane and D.D.T. ranging from 0.1% to 5% were prepared in acetone.

For undertaking toxicity tests against mosquito larvae, *Aedes aegypti*, a modified version of David's[3] method was used. Twenty jena glass dishes, 18.5 cm. in diameter and 8.5 cm. deep were used for the experiments. They were each filled with 1-1/2 litre of tap water. Twenty larvae were introduced into the neck of the glass cylinder (3.5 cm. diameter) placed in the treatment dish 0.31 ml. of each solution was used to make a 10µ thick film over an 18.5 cm. diameter surface, while David[3] used 0.5 ml. to make 10 micron thick film in a bowl of 30 cm. diameter. The

chemical was not spread inside the introducing cylinder so that the surface of water inside may be without any chemical film. After the formation of the toxicant film, the cylinder was raised from the bottom of the treatment dish allowing the larvae to move out from it. Exactly after 30 minutes, the larvae were collected with the help of a pipette through the cylinder and then kept in fresh water for observation. Twenty experiments were run with duplicates. Controls were also kept with each set of experiment.

The mortality rate of the insects due to chemical treatment was counted after 24 hours in each case and Abbott's [4] formula was used for correcting the rate of mortality. The probit units of mortality were plotted against the log dosages of the insecticides to find LD_{50}, LC_{50} and LC_{95}.

Results and Discussions

Cockroaches: When the chlorinated products of different specific gravities were tested, it was found that the rate of mortality of cockroaches was on the increase with increase in the specific gravity (Table 1 and Fig. 1) and that the best results were obtained at specific gravities 1. 320, 1.415 and 1.460, the optimum being at 1.460. The toxicity rate was poor at specific gravities 1.0 and 1.15. Results given by Makrolin (specific gravity 1.415) were compared with those given by Heptachlor, Aldrin, Chlordane and D.D.T., as shown in Table 2. In the case of Makrolin the lethal dose to kill 50% population of insects under the test, i.e. LD_{50}, was 46 μg. per cockroach per 24 hours. The LD_{50} values for Heptachlor, Aldrin, Chlordane and D.D.T. were respectively found to be 13,18,25, 220 μg. per cockroach per 24 hours (Table 3 and Fig. 2). This showed that Makrolin was approximately five times more effective than D.D.T. while it was four times less toxic than Heptachlor, two and half times less than Aldrin, one and half times less than Chlordane against cockroaches. A similar sequence of toxic effectiveness of the insecticides for LD_{50} values was reported by Kearns *et. al* [5,6] for Heptachlor, Aldrin and Chlordane, and by Tobias *et. al*[7] for D.D.T. against cockroaches. From the present investigation it was concluded that in the order of toxic effectiveness against cockroaches Heptachlor was the first, Aldrin the second, Chlordane the third, Makrolin the fourth and D.D.T. the fifth.

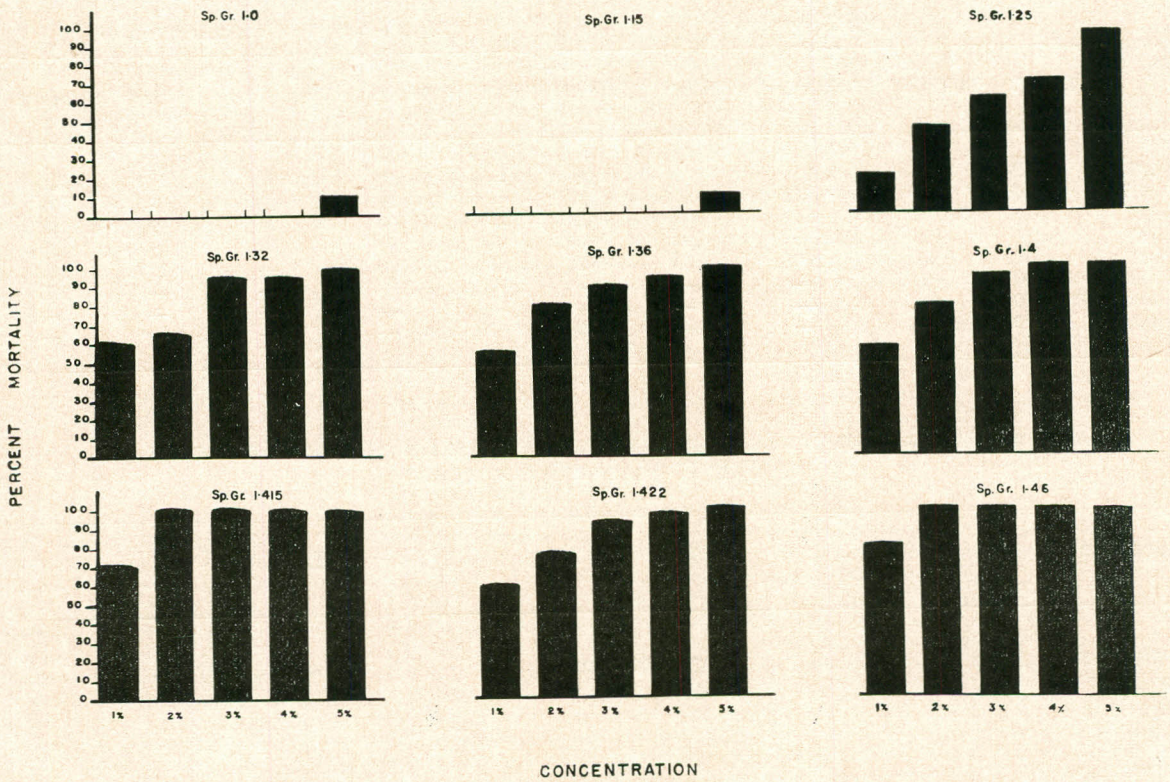

Fig. 1.—Histograms showing the toxicity of Makrolin (specific gravity 1.415) and other intermediate chlorination products of different specific gravities against cockroaches.

TABLE 1.—TOXICITY OF MAKROLIN (SPECIFIC GRAVITY 1.415) AND ITS INTERMEDIATE CHLORINATED PRODUCTS OF DIFFERENT SPECIFIC GRAVITIES AGAINST COCKROACH, *Periplaneta americana*, AFTER 24 HOURS.

Dosage		Percent mortality at different specific gravities								
Concentration (%)	µl/cockroach	1.0	1.15	1.25	1.322	1.36	1.4	1.415	1.422	1.46
1	11	0	0	20	60	55	60	70	60	80
2	11	0	0	40	65	78	80	100	75	100
3	11	0	0	60	92	90	95	100	93	100
4	11	0	0	70	92	97	100	100	97	100
5	11	10	10	93	100	100	100	100	100	100

TABLE 2.—TOXICITY OF VARIOUS CONCENTRATIONS OF MAKROLIN, HEPTACHLOR, ALDRIN, CHLORDANE AND D.D.T. AGAINST COCKROACH, *Periplaneta americana* AFTER 24 HOURS.

Concentration (%)	Dosages (µg./cockroach)					Percent mortality of cockroaches due to				
	D.D.T.	Makrolin	Heptachlor	Aldrin	Chlordane	D.D.T.	Makrolin	Heptachlor	Aldrine	Chlordane
0.1	11	15	11	11	16	—	20	50	43	40
0.25	27.5	39	27.5	27.5	44	—	50	80	70	73
0.5	55	78	55	55	88	—	60	96	90	83
1.0	110	156	110	110	176	40	80	100	97	93
2.0	220	312	220	220	352	50	100	—	100	100
3.0	330	468	—	—	—	60	100	—	—	100
4.0	440	—	—	—	—	60	—	—	—	—
5.0	550	—	—	—	70	70	—	—	—	—

TABLE 3.—MEDIAN LETHAL DOSE OF MAKROLIN, HEPTACHLOR, ALDRIN, CHLORDANE AND D.D.T. AGAINST COCKROACH.

Insecticide	LD_{50}	LD_{50}
Heptachlor	12 µg./Cockroach	10 µg./g. body wt.
Aldrin	18 µg./ ,,	15 µg./g. ,, ,,
Chlordane	25 µg./ ,,	21 µg./g. ,, ,,
Makrolin	46 µg./ ,,	38 µg./g. ,, ,,
D.D.T.	220 µg./ ,,	183 µg./g. ,, ,,

TABLE 4.—TOXICITY OF VARIOUS CONCENTRATIONS OF MAKROLIN, HEPTACHLOR, ALDRIN, CHLORDANE AND D.D.T. AGAINST HOUSE FLY, *Musca domestica* AFTER 24 HOURS.

Concentration (%)	Dosages (µg. house fly)					Percent mortality of house flies due to				
	D.D.T.	Makrolin	Heptachlor	Aldrin	Chlordane	D.D.T.	Makrolin	Heptachlor	Aldrin	Chlordan
0.1	1	—	1	1	1	24	—	45	45	17
0.25	2.5	—	2.5	2.5	—	60	—	55	83	—
0.5	5	5	5	5	5	95	10	77	98	50
1.0	10	10	10	10	10	99	35	95	100	60
1.5	15	15	15	—	15	100	45	97	—	75
2.0	—	20	—	—	—	—	66	—	—	—
3.0	—	30	—	—	—	—	84	—	—	—
4.0	—	40	—	—	—	—	100	—	—	—

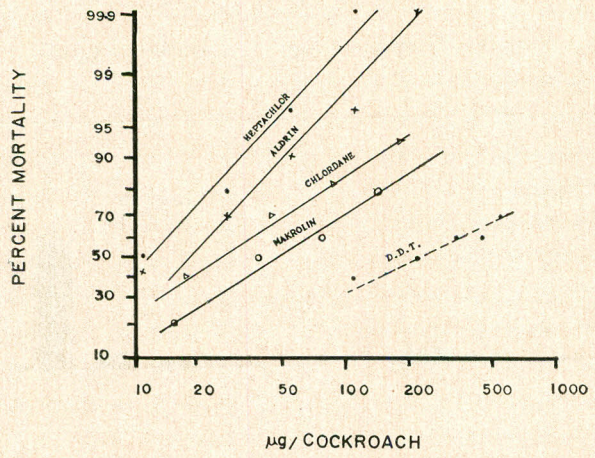

Fig. 2.—Showing the percent mortality of cockroaches due to the toxic effect of Heptachlor, Aldrin, Chlordane, Makrolin and D.D.T.

TABLE 5.—MEDIAN LETHAL DOSE OF MAKROLIN, HEPTACHLOR, ALDRIN, CHLORDANE AND D.D.T. AGAINST HOUSE FLIES.

Insecticide	LD 50
Heptachlor	1.7 µg./ fly
Aldrin	1.15 µg./ ,,
Chlordane	5.6 µg./ ,,
Makrolin	14.0 µg./ ,,
D.D.T.	1.6 µg./ ,,

Toxicity results of various concentrations of Makrolin, Heptachlor Aldrin, Chlordane and D.D.T. against house flies have been shown in Table 4. The LD_{50} values of Aldrin, D.D.T.,

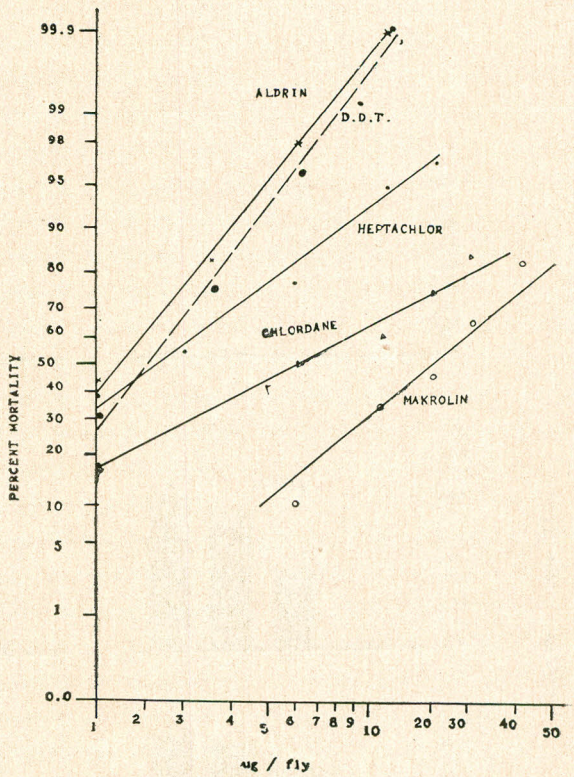

Fig. 3.—Showing the percent mortality of house flies due to the toxic effect of Heptachlor, Aldrin, Chlordane, Makrolin and D.D.T.

Heptachlor, Chlordane and Makrolin against house flies were found to be 1.15, 1.6, 1.7, 5.6 and 14 µg. per fly, respectively (Table 5 and Fig. 3). Similar sequence of effectiveness of the above-mentioned chlorinated insecticides except Makrolin have been reported by Bruce[8] for Aldrin

TABLE 6.—TOXICITY OF MAKROLIN (SPECIFIC GRAVITY 1.415) AND ITS INTERMEDIATE CHLORINATED PRODUCTS OF DIFFERENT SPECIFIC GRAVITIES AGAINST MOSQUITO LARVAE, *Aedes aegypti* AFTER 24 HOURS.

Dosage		Percent mortality at different specific gravities								
Concentration (%)	µl per 1500 ml.	1.0	1.15	1.25	1.322	1.36	1.4	1.415	1.422	1.46
1	310	0	0	0	0	0	0	0	0	0
2	310	0	0	0	1.25	10	12.25	30	31.25	6.66
3	310	0	2.5	2.5	37	33	32	83	30.625	44.16
4	310	2.5	2.5	7.5	65	52.5	68.25	93	61.25	82.5
5	310	5	7.5	62.5	77	75	83.55	97	80.62	94.16

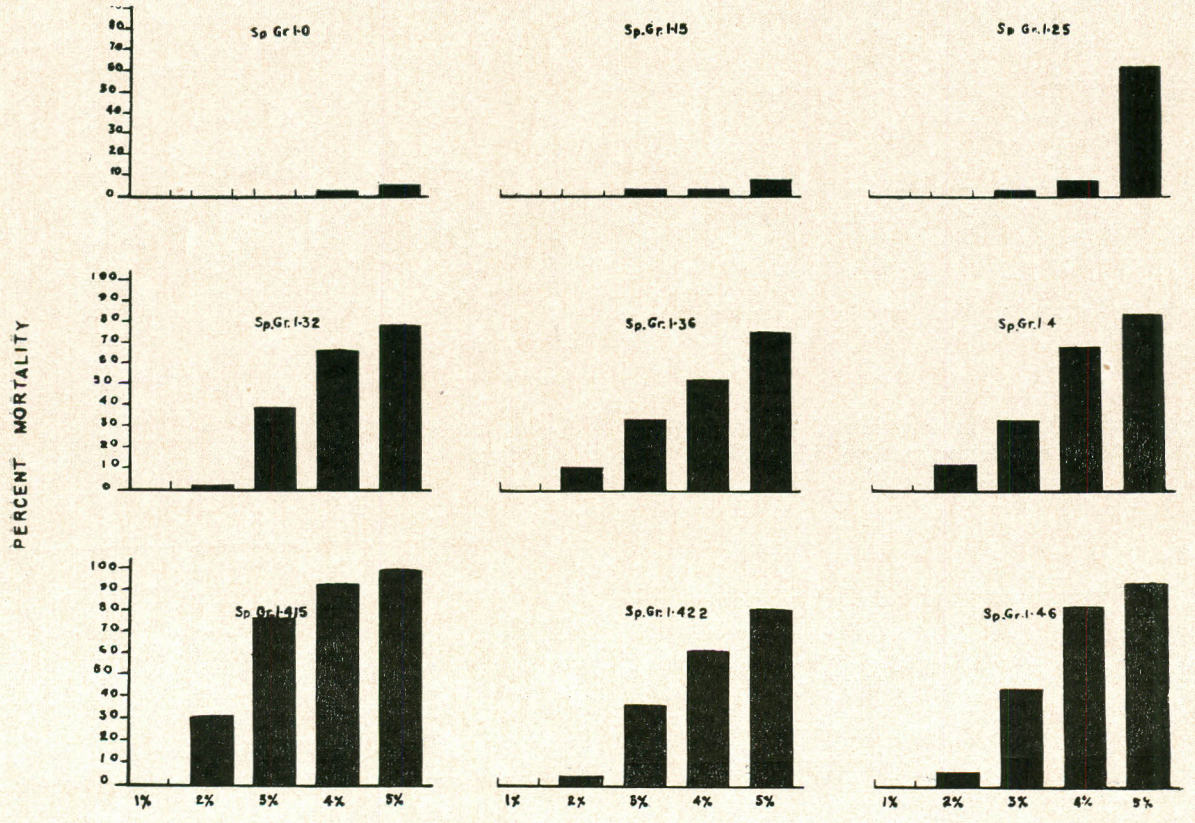

Fig. 4—Histograms showing the toxicity of Makrolin (specific gravity 1.415) and other intermediate chlorination products of different specific gravities against Mosquito larvae.

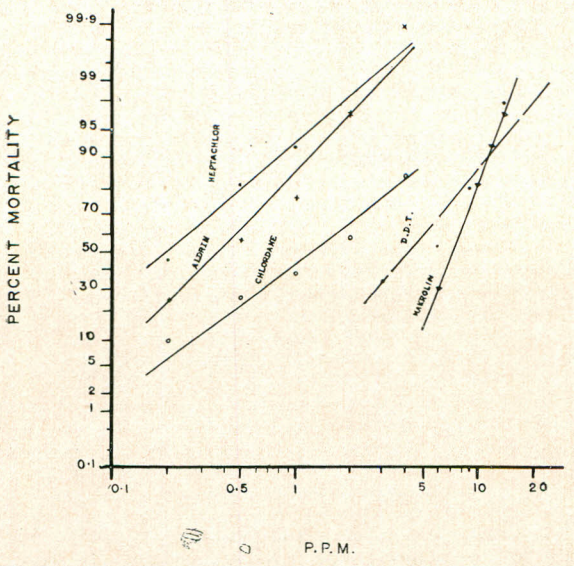

Fig. 5.—Showing the percent mortality of mosquito larvae due to the toxic effect of Heptachlor, Aldrin, Chlordane, Makrolin and D.D.T.

and Chlordane, Metcalf[9] for Heptachlor and D.D.T. The present results show that, in the order of toxicity against house fly, Aldrin holds the first position, D.D.T. the second, Heptachlor the third, Chlordane the fourth, and Makrolin the fifth.

The toxic effect of Makrolin and the intermediate chlorination products with varying specific gravities against mosquito larvae has been shown in Table 6 and Fig. 4. It was found that with increasing specific gravity the rate of mortality also increased. This rate of mortality attained three peaks: first at specific gravity 1.32, second at 1.415 and third at 1.46. Similar results were also obtained against cockroaches, the optimum being recorded for Makrolin (specific gravity 1.415). The results of Makrolin were also compared with Heptachlor, Aldrin, Chlordane and D.D.T. (Table 7, Fig. 5). The LC_{50} for Heptachlor was found to be 0.2 p.p.m., Aldrin 0.38 p.p.m., Chlordane 1.2 p.p.m., D.D.T. 4 p.p.m. and Makrolin 7 p.p.m. The LC_{95} for Heptachlor was calculated to be 1.2 p.p.m., Aldrin 1.6 p.p.m., Chlordane 8 p.p.m., D.D.T. 15 p.p.m. and Makrolin 13 p.p.m. These results indicate that in respect of LC_{95} Makrolin is more toxic than D.D.T. against mosquito larvae.

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TABLE 7.—MEDIAN LETHAL CONCENTRATION OF MAKROLIN, HEPTACHLOR ALDRIN, CHLORDANE AND D.D.T. AGAINST MOSQUITO LARVAE.

Insecticide	LC 50	LC 95
Heptachlor	0.2 p.p.m.	1.2 p.p.m.
Aldrin	0.38 p.p.m.	1.6 p.p.m.
Chlordane	1.2 p.p.m.	8.0 p.p.m.
Makrolin	7.0 p.p.m.	13.0 p.p.m.
D.D.T.	4.0 p.p.m.	15.0 p.p.m

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