TOXICITY OF SOME PESTICIDES TO DIFFERENT RACES OF HONEYBEES

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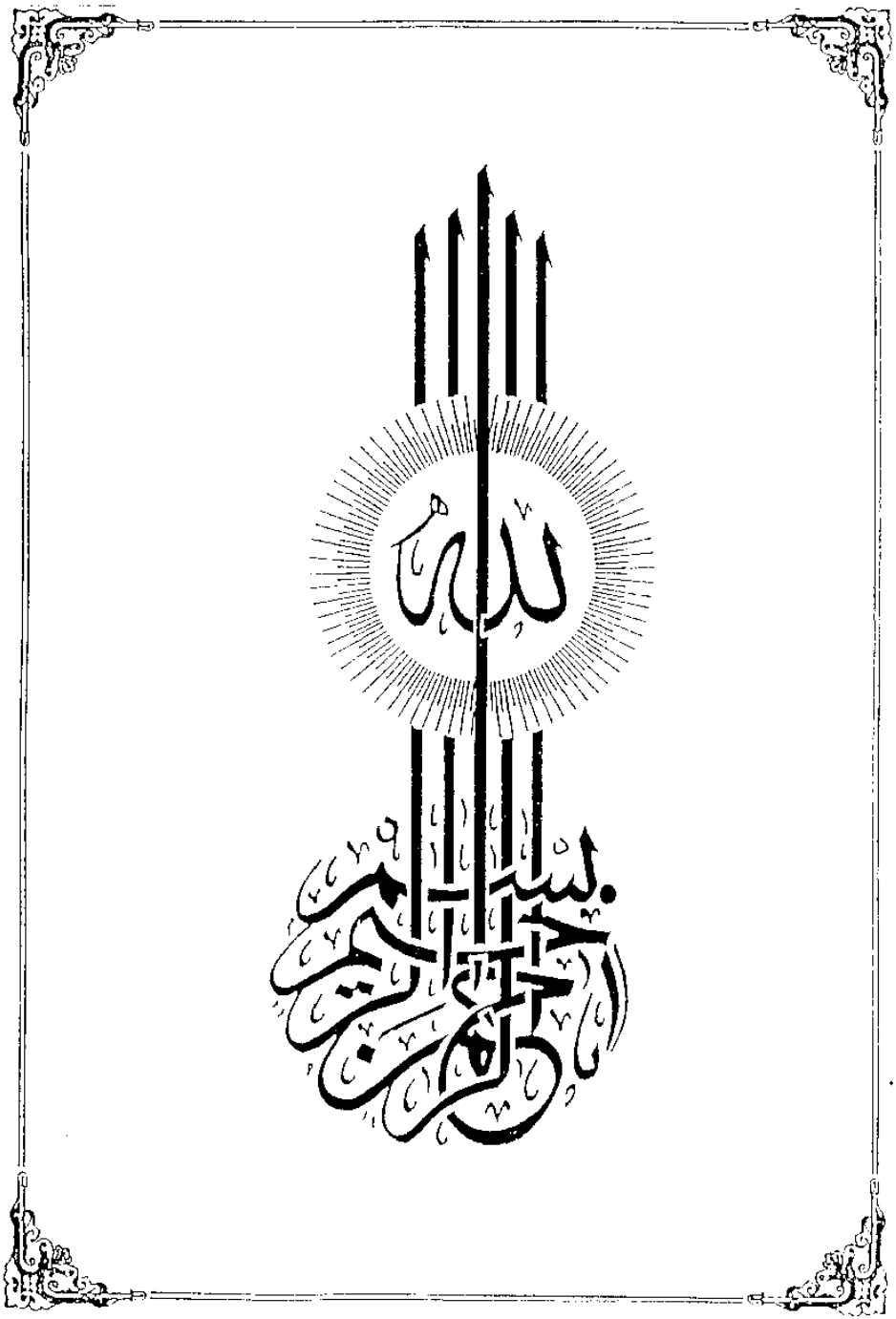

C O N T E N T S

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A C K N O W L E D G E M E N T

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I N T R O D U C T I O N

During the last years of the 20th century several pesticides have been used for controlling pests from which humanity suffers a lot.

Indeed, many insecticides proved to be effective against harmful insects, but their application has not increased the yields of certain crops significantly. This result might be due to the lethal effect of these pesticides to honeybees, which play a great role in the pollination of the flowers of many plant species, and thus in their fruit setting. It is well known that the most ideal pesticide is that which controls pests with least harmful effect om honeybees and other pollinators.

In the present work, it is aimed to investigate the response of three different strains of honeybee workers to insecticides commonly used for pest control in Egypt.

The obtained results may help in planning programmes for pest control with sufficient security to foraging honeybees and thus reaching the maximal seed and fruit production from the plants and the greatest honey yields from bees.

REVIEW OF LITERATURE

a- Laboratory and Semifield Experiments :

When feeding bees with sugar solution mixed with toxicants, Maurizio and Schenker (1957) found that Isolan, Systox and Thiometon were relatively nontoxic and that Diazinon, Dipterex, Malathion, Parathion and Phosphamidon were highly toxic. When spraying flowering borage (Borage officinalis) with 0.1 per cent of the various materials , collecting the nectar and feeding it to bees; they found that Diazinon, Parathion, Isolan and Demeton became nontoxic within 24 hours, while Dipterex, Thiometon and Malathion rendered the nectar toxic for several days. Malathion having the most prolonged effect and Methyldemeton S, rendered it highly toxic.

Shaw (1959), investigated the effect of certain insecticides on honeybees under field conditions. He caged worker bees on the boughs of fruit trees then sprayed them with contact insecticides, transferred the bees to clean cages containing sugar solution as food, kept them in the dark. He found out that 1-2 lb. 50 per cent wettable Sevin per 100 U.S. gl. applied with air-blast machine or hydraulic sprayer, and 0.36 lb. actual Sevin per 100 U.S.gl. in an

emulsion spray applied by air-blast caused more than 50% mortality within 6 hours. In a similar test the residue from a spray of 0.25 lb. Dieldrin per 100 U.S gal., applied by air blast machine, appeared to remain toxic for at least 96 hours and it gave 50% mortality in 36 hours.

In a laboratory test carried out by Leski and Smolarz (1960) at which they applied DDT topically in acetone at 15, 25 and 34°C, they found that its toxicity increased with about 25% with each 10°C rise in temperature, the LD_{50}'s averaging 1.25, 4.6 and 18 ug/bee respectively.

Johansen (1961) found that mortality counts after 72 hours at 72°F showed mean LC_{95}'s as 0.0046 per cent for Parathion, Phosdrin, Dieldrin, Azinophosmethyl and Phosphamidon, 0.039 per cent for Sevin, Phorate, Trithion and DDT and 0.57 per cent for Ethion and phostex. It is pointed out that these results are not necessarily indicative of the danger to bees in the field, where residual action is an important factor. Bioassay of honeybees killed by Dieldrin in the laboratory and field showed the presence of 1.0 and 0.5 ug/bee respectively.

The laboratory investigation carried out by Morse et al. (1963) found out that the decreasing values of the residues of Sevin (p.p.m.) in pollen, corroborate the

earlier findings of Morse (1971a , 1971b), who showed that the daily death rates from colonies exposed to Sevin decreased rapidly. They also mentioned the results of Georgiou and Metcalf (1969) which showed that the LD_{50} of Sevin to honeybees was 0.23 ug/bee when applying 1.0 ul drops of insecticides solution to the notum.

Boran (1963) found that the toxicity of Carbaryl (Sevin) calculated from laboratory data was 70 times that of DDT and three times that of Parathion. The field and glass house experiments confirmed its high toxicity.

Jayox (1964) found that the LD_{50}'s of Dimethoate and Phosphamidon fed to worker bees in 50% sugar syrup were 0.093 and 0.15 ug/bee respectively.

In a laboratory test carried out by Banby and Selim (1965) at which they investigated the contact effect and residues of Dipterex 80%, Sevin 85% and Dimecron 50% on the bees, they found that the three tested pesticides in concentrations as applied for cotton pests control killed all the experimental bees if they were exposed just after application. The three pesticides lost their toxic effect on bees, in open air faster than in the case of room condition. Dipterex was the fastest pesticide to lose its toxicity, Dimecron and Sevin had prolonged effects. Concentrations of Dipterex, slightly lower than that used in

the field, let some bees escape mortality, while trace amount of Dimecron and slightly minute amount of Sevin showed highly toxic action on the bees.

Graves and Mackensen (1965) found out that random sampling of bees taken from hives gave approximately higher LD_{50}'s than selected ages. They also found that, bees caged individually after treatment were less susceptible to DDT than those caged in groups of fifteen. Bees 2 and 8 days old were susceptible than those 4 or 6 days old to the same insecticides.

Tests with Toxaphene, Endrin, Azinphos, Methyl Guthion and Carbaryl (Sevin) indicated that essentially the responses were obtained when insecticides were applied to the dorsum of the abdomen and to the thorax. The LD_{50}'s of DDT and Toxaphene were 9.60 and 73.8 ug/bee respectively after 24 hours.

In a topical application experiment of six insecticides to the thorax of honeybees; Smolarz (1966) indicated that LD_{50}'s of Methyl Parathion (Azofos). BHC (Lindane), Malathion and Terpentol B (chlorinated α-Pinene) were 0.079, 0.18, 0.265 and 55 ug/bee respectively.

Doses of 10 µg Terpentol A and 50 ug/bee Akaricydal E (a mixture of malathion and chlorofenson) did not affect bees' mortality.

In a laboratory test; Tinopal and Johansen ( ) found that, Tomik was the most toxic material to both the house fly and the honeybee as the topical LD values were the least different between the test insects. Tranid was the least toxic material to both insects and showed the greatest difference in LD values. WC. 27609 was moderately toxic to the bee, but less toxic to the fly.

b- Field Experiment :

Coggshall et al. (1957) reported that although DDT is toxic to bees, only a small loss of bees was attributable to DDT, this is therefore considered to be a safe insecticide when used under practical conditions.

A comparative study was carried out by Atkins and Anderson (1954) with 55 pesticides used as dusts diluted with pyrophyllite, using 5% DDT as standard insecticide. They found out that DNOSBP was the most toxic material tested. Chlorobenzilate,is included among the moderately toxic substances, and Ovotran among the relatively safe ones.

In a field experiment carried out by Johansen and Quist (1955), they found out that honeybees were strongly repelled from alfalfa by Dimeton (Systox) during 24 hours after application, and that foraging bees became normal again after 48 hours.

Wolfenbarger and Robinson (1957) in their application of 0.5 lb. Malathion per acre in concentrated bait sprays applied by airoplane to very large areas at ten days intervals, found that, the application of the sprays had no effect on the changes in colony weight.

Palmer et al. (1957), found that Metasystox applied in an emulsion at a rate of 16 fl Oz. per acre in the evning, killed virtually all foraging bees within two days , and nectar in the Kale flowers was shown to be toxic to bees for five days after spraying. All bumble bees visiting the crop were killed.

Anderson and Atkins (1958) carried out field tests at which they found that Parathion proved highly toxic to honeybees, although Malathion was moderately toxic to bees. In similar circumstances Trithion and Dipterex were harmless.

Johansen et al. (1955) found that honeybees were not adversely affected by Dimeton or Sharadan treatments on alfalfa. No greater number of dead bees was collected infront of the hives with these treatments than in the controls.

Palmer et al. (1958) found that there was evidence of bee mortality after Toxaphene applications, but no dead bees were brought out of the hives and brood was unaffected. Strobane causes only negligible losses of bees. These

conclusions are true only when Lannate and Orthene are applied at a time when bees are not flying.

Shaw (1959) observed that 5 % Sevin wettable powder at dosages of 0.5, 1.0 & 1.4 treatments produced more than 50% mortality within 6 hours. The toxicity of Sevin residues (1 lb. actual per 100 gallons) was found to be very depending on how the applications were made. Residues applied with the air blast machine were highly toxic to bees after a period of 96 hours the residual toxicity of Sevin to honeybees was reduced.

Johansen (1960) cleared in his field experiments that, many dead bees were collected at the hives in fields treated with Sevin or Dieldrin. Only approximately normal numbers were collected in the treatments combined with the repellent R-874. Sevin R-874 combination appeared to be slightly more repellent than the Dieldrin R-874 combination.

Way (1961) found that the effect on honeybees of Dimeton and Methyl Dimeton applied to field beans (Aphis fabae) at the best time for controlling the aphid are especially dangerous to bees.

Tests carried out by Morse (1961) when counting dead bees in fixed traps at the entrances of the colonies, indicated that the mean loss in the colonies within and outside the sprayed area were 19,917 and 2,936 bees ,

respectively. Mortality was higher than normal for up to three weeks after treatment.

Madkour (1962) when studied the effect of certain insecticides on the honeybee colonies found that in case of spraying, the percentages of mortality were 100% for Lindane (0.25%), 74% for Endrin (1%), 47.5% for Dusathion (0.10%), 43% for Parathion (0.05%), 34.2% for Chlorthion (0.5%), 20.68% for Meta-iso-systox (0.5%), 1.8% for DDT (3%) and 1.4% for Dieldrin (1%).

Wafa et al. (1963) when exposed bees in cages to bundles of cotton branches picked from sprayed fields at different intervals after spraying with Toxaphene, DDT-Lindane and Dieldrin at rates per acre as recommended for cotton pest control, recorded that, DDT-Lindane was 3 times, and Dieldrin 7 times as toxic as Toxaphene. The treated plants remained toxic to honeybees for 2 days in case of Toxaphene, 4 days in case of DDT-Lindane and 9 days in case of Dieldrin. The activity of honeybees on cotton sprayed with Toxaphene and/or Egyptian clover sprayed with Toxaphene, DDT-Lindane and Dieldrin as usual rates per acre was not affected.

In another laboratory test carried out by the same authors to get the relative sensitivity of the Egyptian, Carniolan and their first cross to DDT, Lindane, Toxaphene,