SUSCEPTIBILITY OF DACUS CUCURBITAE COQ. TO INSECTICIDES

DISSERTATION SUBMITTED FOR THE DEGREE OF MASTER OF PHILOSOPHY IN ZOOLOGY OF THE ALIGARH MUSLIM UNIVERSITY, ALIGARH

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December 1975
I certify that "Susceptibility of *Dacus cucurbitae* Coq. to insecticides" is the original work of Kaushilya Wadhwani and is suitable for submission for the award of the Degree of Master of Philosophy of the Aligarh Muslim University, Aligarh. This work has been done by the candidate under my supervision.

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INTRODUCTION

Fruit flies belonging to the family Tephritidae are cosmopolitan in distribution and attack a wide range of fruits belonging to the families Cucurbitaceae, Myrtaceae, Rosaceae, Palmaceae and Solanaceae. In India the melon fruit fly, Dacus cucurbitae Coq. has been found to attack about 26 different species of useful plants. Bezzi (1916) and Fletcher (1917) reported that it caused serious damage to Luffa aegyptiaca and Momordica charantia in Pusa, and Cucurbita moschata, Citrullus vulgaris and Citrullus melo in Madhya Pradesh. In Uttar Pradesh the species attacks Cucumis sativus also (Chaturvedi, 1941, 1947), while in Delhi it has been found attacking Psidium guava, Prunus persica and Phoenix dactylifera (Batra, 1953).

The larvae are phytophagous and are found in fruits, preferably of the fleshy type. The females visit the host plant for oviposition purposes and cause damage by depositing their eggs inside the fruits and in this way the shipping quality of the fruit is adversely affected. On hatching the maggots feed and tunnel the pulp, devouring the fruit and inviting secondary infections by microorganisms, fungi and even nematodes. Since the flies visit host plants temporarily and it is the larvae which live inside the fruits and cause the real damage, the control of melon fly is a difficult proposition.
Gupta (1958) suggested the use of poison bait spray of malathion and yeast hydrolyzate while Dale and Nair (1966) recommended a coarse spray of liquid bait containing yeast protein and malathion. Pradhan (1963) tried aldrin, BHC, dieldrin, heptachlor and chlordane in the seed beds to kill the maggots entering the soil for pupation but failed to obtain any significant control.

During the present work an attempt has been made to evaluate the sensitivity of *Dacus cucurbitae* to DDT, gamma BHC and aldrin and to find out if the species can develop any tolerance to DDT which is probably the most widely used of all the chlorinated hydrocarbon insecticides.
Though originally described from Hawaii in 1895, the melon fruit fly, *Dacus cucurbitae* Coq. is believed to be a native of the oriental region. It is distributed throughout India and is commonly found throughout the year. The species has also been recorded from Nepal, Pakistan, Ceylon, Burma, Malaysia, Hawaiian Islands, Australia and East Africa.

It attacks a wide variety of plants and is a serious pest of cucurbits. Bezzi (1916) and Fletcher (1917) reported it from Pusa and Nagpur where it was found attacking *Cucumis, Momordica charantia, Luffa aegyptiaca, Eugenia jambolana* and *Cephalandra indica*. Batra (1953) recorded it from Delhi on guava, peach, date palm and citrus fruits while Usman and Puttarudraiah (1955) found it infesting a number of cucurbits like snake gourd, bitter gourd, watermelon and cucumber at Bangalore. All these observations clearly indicate that the species is a pest of considerable economic importance in India where the damage to cucurbits alone has been estimated to be as high as 40.0 to 80.0% of the crop (Pruthi, 1941). Thus in view of all its economic importance, it is not surprising to find that practically all known methods of insect control have been tried against this pest.
Mechanical methods such as covering the fruits with various materials to protect them from melon fly attack have been used for many years (Severin, 1914; Back and Pemberton, 1917; McPhail, 1943). Wrapping of the fruits was done with newspaper, pieces of muslin cloth, metal gauze or even soil, but because of being quite expensive this method has been employed only for those kinds of fruits which are highly priced.

In 1910 Marsh controlled melon flies by aqueous sprays, containing molasses and either Paris green or lead arsenate, but Severin (1914) and Back and Pemberton (1917) failed to obtain any appreciable control through the use of poison bait sprays, containing brown sugar, arsenate of lead or sodium arsenite. Bishop (1934) found that a bait containing 1.0 ounce of sodium fluosilicate, 2.0 pounds white sugar and 4.0 gallons of water was more effective for the control of D. ciliatus, D. vertebbratus and D. pectoralis than the baits containing lead arsenate. Holdaway (1945) failed to get satisfactory control with bait sprays containing tartar emetic. However, Ponec (1937) obtained 100.0% control of the species with 1.5% solution of brown sugar poisoned with 0.2% sodium arsenite or 0.1% white arsenic. Bait sprays containing 0.06% BHC or 0.3% sodium fluosilicate gave 94.0% and 45.0% control of D. ciliatus (Hepbern and Bishop, 1950).

Nishida (1957) controlled Dacus cucurbitae by using bait sprays containing yeast hydrolysate and either malathion or
parathion on plants favoured by the flies. Steiner (1957) also obtained 93.0 to 100.0% kill of *Dacus dorsalis* when a parathion bait was applied at the rate of 1/5 to 2.0 pounds per acre. Chen (1960) and Gupta (1958) obtained good control by bait sprays of protein hydrolysate and malathion. There was no scorching of young foliage and the adults were attracted from a distance of about 30 feet on either side of the sprayed trees. Dale and Nair (1966) tested emulsion of DDT, BHC, parathion, malathion, trichlorphon and carbaryl with yeast protein and recommended that a coarse spray containing 1.0% yeast protein and 0.1% malathion can be successfully employed for the control of the melon fly.

Plummer and Shaw (1947) obtained 62.0% control of the Mexican fruit fly *Anastrepha ludens* in 1945 through the applications of DDT sprays while Carter (1950) found that aldrin and dieldrin were ten times, and lindane and chlordane five times as effective as DDT for the control of the oriental fruit fly, *D. dorsalis*. 80.0 to 90.0% reduction in the oriental fruit fly infestation was obtained by using sprays of DDT, lindane, aldrin, dieldrin and parathion. Nishida and Bess (1950) succeeded in eliminating *Dacus cucurbitae* through the application of DDT sprays on border vegetation to crop areas. In 1954 the same author could control *D. cucurbitae* by using parathion dust on wild vegetation. Latif (1960) found that higher concentrations of dieldrin and endrin gave appreciable control of *D. cucurbitae*.
and the percentage infestation of *D. cucurbitae* was reduced from 56 to 1.26 and 1.9% when dieldrin was applied at the rate of 0.96 and 0.48 lb per acre at intervals of seven days, with endrin the percentage infestation could be reduced to 4.2 and 5.45% when the chemical was applied at the rate of 0.237 and 0.158 lb per acre.

Bhatia and Kaul (1965) evaluated a number of insecticides for the control of fruit flies by releasing the adults of *D. cucurbitae* in between petridishes treated with a deposit of 0.001287 mg/cm² of the desired pesticide, and found that carbaryl was most toxic and aerosur the least effective. Dale and Nair (1966) studied the effects of insecticides applied to the soil for the control of the larvae of *D. cucurbitae* and concluded that aldrin and heptachlor were highly effective against them.

Ebeling (1953) carried out experiments to determine the effectiveness of 26 insecticides against *D. cucurbitae, D. dorsalis* and *Ceratitis capitata* and found that paraoxon, pyrethrin, parathion and heptachlor were highly toxic insecticides; paraoxon and parathion gave 100.0% kill of all the three species. Keiser (1968) studied effectiveness of foliar sprays of 27 insecticides against three species of fruit flies, *D. dorsalis, D. cucurbitae* and *Ceratitis capitata* and found that fenthion, parathion, dieldrin, dimethoate, azinphosmethyl, malathion, DDT, isodrin and methoxychlor at 2 pounds per U.S. gallon was the most effective insecticide. He also found that *Dacus cucurbitae* was more
susceptible than *Dacus dorsalis* to trichlorophon, carbaryl and endosulfon. In laboratory experiments Keiser (1971) observed locus specific differences in susceptibility to different insecticides shown by the same species and found that DDT and methoxychlor were least effective when applied to the thoracic mesonotum of oriental and melon flies as compared to the mesosternum, abdominal mid-dorsum and mid-venter, and the verto-occipital and oral regions. Malathion however was most effective when applied to the thoracic mesonotum of oriental or melon flies.

Altamirano and Macabasco (1964) carried out control tests of *D. cucurbitae* with foliafume and soap; with foliafume, soap and wettable DDT; with DDT and soap and with foliafume and copper sulphate. They found that the results varied slightly and in most cases, the spray of foliafume and soap afforded economic protection for the fruits.

Carbon bisulphide gave 100.0% kill of the freshly laid eggs of *Dacus cucurbitae* and *Dacus dorsalis* (Misaka, 1936). Uchida (1938) observed the effectiveness of this fumigant against the immature stages of *D. cucurbitae* and found that as the age advanced the eggs became more susceptible to carbon bisulphide.

Development of the larvae and pupae could be inhibited by exposing them to very low or high temperatures. Koidsumi (1934) showed that the larvae and pupae of *D. cucurbitae* dies when exposed to an average temperature of 10.5°C. Koidsumi in 1936
observed that the development of larvae and pupae of *D. cucurbitae* and *D. dorsalis* could also be inhibited by exposing them to a temperature of 40.0°C or more for a period of seven hours.

Experiments in Hawaii carried out by Steiner and Lee (1955) showed that infestations of the oriental fruit fly, *Dacus dorsalis* could be greatly reduced to 60.0 to 100.0% in most of a 6-square mile area, if the male flies were destroyed before they fertilized the females. An experiment in a semi-isolated stand however failed to give significant control because of the migration of the fertile females into the treated area showing thereby that the male-annihilation method may not be suitable for small areas.

Koidsumi (1930) found that *D. cucurbitae* and *D. dorsalis* could be killed by X-ray irradiation in any stage of their life cycle. Their resistance to X-rays became more pronounced as the development proceeded. Balock et al. (1963) suggested the use of comparatively low dosages of gamma radiation in the range of 15,000 to 20,000 roentgens for fruits and vegetables infested with *D. cucurbitae*, *D. dorsalis* and *C. capitata*. The same author in 1966 found that the development of the immature stages of these flies could be prevented by exposing the infested fruits and vegetables to a dose of 10 kilo roentgens.

Knipling (1955) proposed the sterile male release technique and Steiner and Christenson (1956) conducted experiments for
evaluating the usefulness of gamma irradiation and sterile fly release method against the *Ceratitis capitata* in Hawaii. Steiner et al. (1962) obtained 90.0% reduction in infestation when they released irradiated males of *C. capitata* but failed to get complete eradication in a large scale operation against *D. dorsalis*. Steiner et al. (1965) also succeeded in eradicating the melon fly *D. cucurbitae* from the Island of Rota through the release of sterilized male flies. Keiser and his associates (1965) could induce complete sterility in both sexes of *D. cucurbitae*, *D. dorsalis* and *Ceratitis capitata* by feeding them on diet contaminated with tepa, metepa, apholate or tretamine. Topical applications of these materials to pupae or adults or the exposure of the adults to deposits of the chemosterilants produced sterility in both the sexes. Whereas methotrexate, aminopterin, colchicine and 5-fluorouracil treatments sterilized the females. Tepa showed promise for field applications in combination with attractive protein hydrolysates.

Shaw and Riviello (1965) used the puparia of Mexican fruit fly, *Anastrepha ludens* which had been immersed in a 5 per cent aqueous solution of tepa for one minute, to sterilize the emerging adults and an estimation of fruit infestation in the treated groove showed that adults from all the batches of treated pupae were sterile and the fertility of the eggs was considerably lowered.
A number of parasites have also been tried against the melon fly. Though Usman and Puttarudriah (1955) have reported several parasites of *D. cucurbitae* from India, the most useful is *Opus fletcheri* (Nishida, 1954). The braconid parasite *Opus fletcheri* which attacks the melon fly larvae was found in India and introduced into Hawaii (Pullaway, 1916).

Willard (1920), Newell (1952) and Nishida (1955) found that *O. fletcheri* could be successfully used for the control of *Dacus cucurbitae*. Clausen et al. (1965) found that *Opus oophilus* an egg parasite of *D. dorsalis* was more effective than *O. longicaudatus* and *O. candenboschi* against *Dacus dorsalis*.

Dipping of infested papayas in hot water containing 108.0 mgs of ethylene dibromide per litre at 115.0°F or 120 mgs of ethylene dibromide per litre at 110.0°F for 20 minutes provided adequate quarantine security (Burditt et al., 1963). While Balock et al. (1963) found that comparatively low doses of gamma rays from radio active cobalt (60 Co) affect the eggs and larvae of *Dacus dorsalis* so that development does not extend beyond the pupal stage. Exposure of day old eggs to 13,000 r, of day-old larvae to 30,000 r and of full grown larvae to 160,000 r could reduce pupation by 95 per cent in *D. dorsalis* and an exposure to 140,000 and 160,000 r could similarly effect the larvae of *D. cucurbitae* and *C. capitata* respectively.
MATERIALS AND METHODS

Test-Insects:

The melon fly *Dacus cucurbitae* is a pale white insect whose wings are conspicuously marbled with dark markings and thorax bears yellow stripes. They can be readily obtained from infested fruits of *Luffa aegyptiaca* (Torai) which during the present studies were collected from the fields in and around Aligarh or were obtained from the vegetable markets. The infested fruits were kept in glass jars 8" x 4" in size and containing a four inch layer of sand. The larvae after completing their development in the fruits came to the surface and entered the vermiculite for pupation. Pupae were separated from the sand and kept in petridishes in 1 foot square wire meshed wooden cages. On emergence the adults were fed on sucrose, protinex (10:1) and water.

Rearing technique:

The flies were reared at a temperature of 28 ± 1°C and 70.0 to 80.0 percent relative humidity on a diet of sucrose and Protinex, containing protein hydrolysate with vitamins, carbohydrates and minerals. Fresh pieces of Spanish gourd, *Cucurbita maxima* and pieces of sponge soaked in water were kept in the rearing cages. The Spanish gourd pieces containing the eggs
were removed from the cages at 24 hour intervals and were kept in glass jars 8" x 4" in size and containing four inches thick layer of sand at the bottom. Sodium benzoate was sprinkled in each jar to prevent fungal growth. The jars were covered with muslin cloth in order to prevent the larvae from escaping out. On hatching the larvae were fed on the pulp of the fruits. Mature larvae left the fruit and pupated in the sand. The jars were filled with water and gently stirred and the pupae floating on the surface were picked up and dried on the blotting paper and later placed in petridishes in cages for emergence.

Test methods:

The susceptibility level of the adult flies to various formulations of DDT, gamma BHC and aldrin was determined by the topical applications method. Measured drops of the desired insecticide solution were applied on the dorsum of the individual flies by means of a hypodermic syringe. The flies were anaesthetized by carbon dioxide which helped in handling the flies during the testing operations. Each fly was held by its wing with a fine forceps and brought to the tip of the needle. In this way the desired quantity of the insecticide solution was applied on the dorsum of a fly. The size of the drop was controlled by means of the screw gauge fitted against head of the syringe and was kept constant throughout the tests. The treated flies were kept in 4" x 2" cages made of rice paper and cardboard. A small amount of granulated sugar was added to each cage
through a hole which was cut in its top. The hole was plugged with moist cotton to provide suitable moisture conditions. A cage was used only once in order to avoid any possible contamination. Mortality counts were made after 24 hours of the treatments and LC₅₀ values were derived from dosage mortality regression lines as fitted by eye. The slope of the lines was expressed as the change in probits per ten fold changes in dosage (Hoskins and Gordon, 1956).

Chemicals:

The chemicals used during the present studies were DDT, gamma BHC and aldrin. P,P'DDT was obtained through the courtesy of Mr. J.W. Wright of the World Health Organization, gamma BHC from Diamond Alkali Campan. These chemicals were dissolved in two solvents, acetone and risella oil.
SENSITIVITY OF Dacus cucurbitae TO DDT, BHC AND ALDRIN AS SHOWN BY DOSAGE MORTALITY REGRESSION LINES

As early as 1910, Marsh observed considerable reduction in melon fly population on cucumbers and contaloupes which had been treated with aqueous sprays containing molasses and either paris green or lead arsenate and Steiner (1954, 1955) successfully controlled Dacus cucurbitae, Dacus dorsalis and Ceratitis capitata with a wettable powder containing 25.0 percent malathion. Mishida and Bess (1957) sprayed border vegetation of a tomato field with a 25.0 percent wettable powder of parathion at a concentration of one pound per 100 gallons of water and succeeded in considerably reducing the fly population. Bhatia and Kaul (1965) found that carbaryl was most toxic and acorous the least when adult flies were released in between petridishes treated with deposits of 0.001287 mg/cm² of the desired chemical. The toxicity of other insecticides in decreasing order was endrin, parathion, EPN, trichlorphon, phosphamidon, diazinon, malathion, toxaphene heptachlor, chlordane, endosulfan, lindane, P,P'DDT and aldrin. Later in 1968, Keiser found that the melon fly Dacus cucurbitae was more tolerant to chlorthion and DDT and was considerably susceptible to trichlorfon, carbaryl and endosulfan.

During the present studies the susceptibility of Dacus cucurbitae to DDT, gamma BHC and aldrin was determined by
dissolving the insecticides in risella oil and in acetone and applying measured drops of the insecticide solution on the dorsum of the flies. Fifteen day old flies were used in all the tests and mortality counts were made after 24 hours of treatments. The LC$_{50}$ values were derived from dosage mortality regression lines fitted by eye and the slope of the line was expressed as the change in probits per tenfold change in dosage (Hoskins and Gordon, 1956). The amount of the insecticide solution applied per fly was 0.0009 cc throughout the experiments and applications were made by means of a hypodermic syringe.

The results obtained (Table 1 and 2) clearly show that the males of *Dacus cucurbitae* were more susceptible to the various insecticides used than the females. This might be due to their smaller size and rapid respiratory rate. The results of all the experiments as summarised in Table 3 and 4 show that of the three insecticides used, aldrin was the most toxic and DDT was the least. DDT and BHC solutions in risella oil were more toxic than solutions in acetone whereas aldrin was more effective when dissolved in acetone. This may be due to its greater solubility in acetone.

Topical applications of 0.0009 cc of risella oil and acetone alone gave a mortality of 4.0% and 3.2% respectively as compared to a mortality of 2.9% obtained in the case of the normal strain. This showed that neither acetone nor risella oil were toxic to *D. cucurbitae*. 
Table 1. Susceptibility of *D. cucurbitae* to DDT, BHC and aldrin solutions in risella oil.

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<th>Insecticide</th>
<th>Sex</th>
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<th>0.00195</th>
<th>0.0039</th>
<th>0.0078</th>
<th>0.01562</th>
<th>0.03125</th>
<th>0.0625</th>
<th>0.125</th>
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</tr>
<tr>
<td>Males</td>
<td>-</td>
<td>12/50</td>
<td>18/58</td>
<td>23/48</td>
<td>39/54</td>
<td>40/45</td>
<td>239/246</td>
<td>61/61</td>
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<td></td>
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<td>14/56</td>
<td>12/35</td>
<td>28/56</td>
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<td>(60.9)</td>
<td>(82.1)</td>
<td>(93.6)</td>
<td>(100.0)</td>
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<td>BHC</td>
<td>Males</td>
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<td>61/68</td>
<td>80/85</td>
<td>59/60</td>
<td>51/51</td>
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<td>(27.7)</td>
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Drops of 0.0009 cc applied to each fly.
Table 2. Susceptibility of *D. cucurbitae* to DDT, BHC and aldrin solutions in acetone.

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<th>Insecticides</th>
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<td>Proportions and percentages (in parenthesis) of flies killed</td>
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<td>0.000975 0.00195 0.0039 0.0078 0.01562 0.03125 0.0625 0.125 0.25 0.5 1.0</td>
</tr>
<tr>
<td>M</td>
<td></td>
</tr>
<tr>
<td>DDT F</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td></td>
</tr>
<tr>
<td>BHC F</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td></td>
</tr>
<tr>
<td>Aldrin M</td>
<td></td>
</tr>
<tr>
<td>Aldrin F</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Insecticides</th>
<th>Sex 0.000975 0.00195 0.0039 0.0078 0.01562 0.03125 0.0625 0.125 0.25 0.5 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td></td>
</tr>
<tr>
<td>DDT F</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td></td>
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<tr>
<td>BHC F</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td></td>
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<tr>
<td>Aldrin M</td>
<td></td>
</tr>
<tr>
<td>Aldrin F</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td></td>
</tr>
</tbody>
</table>

**Drops of 0.0009 cc applied to each fly.**

**M** = Male; **F** = Female
Table 3. *Lc*$_{50}$ values and slopes of *Dacus cucurbitae* to DDT, gamma BHC and aldrin solution in Risella oil and acetone.

| Insecticide | Risella oil | | | Acetone | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | Lc$_{50}$ | Slope | Lc$_{50}$ | Slope |
| DDT | .035 | 1.7 | .115 | 1.7 |
| gamma BHC | .0021 | 2.1 | .0098 | 2.2 |
| Aldrin | .0039 | 1.3 | .0035 | 1.8 |

Table 4. Summarised results of experiments on the toxicity of DDT, gamma BHC and aldrin to *D. cucurbitae* expressed as Lc$_{50}$'s solutions in Risella oil and acetone.

<table>
<thead>
<tr>
<th>Risella oil</th>
<th>Acetone</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDT</td>
<td>Gamma BHC</td>
</tr>
<tr>
<td>.035</td>
<td>.0021</td>
</tr>
<tr>
<td>.0137</td>
<td></td>
</tr>
<tr>
<td>DDT</td>
<td>.075</td>
</tr>
</tbody>
</table>
Figure 1. Susceptibility of D. cucurbitae to insecticide solutions in risella oil.
Figure 2. Susceptibility of *D. cucurbitae* to insecticide solutions in acetone.
DEVELOPMENT OF RESISTANCE IN DACUS CUCURBITAE

Though the resistance of San Jose scale to lime sulphur was detected by Melander in Washington in 1908, the resistance problem came on the scene when in 1946 it was reported that populations of Musca domestica could not be controlled with DDT formulations which had been highly effective against the species two or three years back. Among insects of agricultural importance, DDT-resistance made its appearance in 1951, developing in codling moth, the oriental peach moth, the cotton boll worms and a number of other pests so much so that today we know of at least 29 plant feeding insects which have become tolerant to DDT (Brown, 1967).

Ten (1959) observed that the melon fruit fly, Dacus cucurbitae could become resistant to DDT and other chlorinated compounds. He exposed the adults for three hours to deposits of several insecticides on filter paper and found that while significant resistance to DDT was developed in 14 generations hardly any tolerance was developed against chlordane. During the present studies an attempt was made to find out if the Indian form of D. cucurbitae is liable to develop any tolerance to DDT when subjected to insecticide pressure in the laboratory.

Measured drops of DDT solution in risella oil were applied topically on the dorsum of fifteen day old flies after the manner
described by Abedi (1957). The treated flies were kept in 
4" x 2" cages made up of rice paper and cardboard and mortality 
counts were made after 24 hours of the insecticide treatments. 
The survivals were bred to produce the next generation which was 
again subjected to insecticide pressure. In this way selection 
was carried out for five generations.

A very slight increase in the $L_{c_{50}}$ values for the normal 
and treated strains was observed (Table 6). A flatter position 
of the dosage mortality regression line of fifth generation 
indicates that the population under investigation was a 
heterogenous one (Hoskin and Gordon, 1956). The slight increase 
in the $L_{c_{50}}$ value for the fifth generation could be due to vigour 
tolerance factors.
Table 5. Susceptibility of normal and selected strain of *D. cucurbitae* to solutions of DDT in risella oil.

<table>
<thead>
<tr>
<th>Strain</th>
<th>Sex</th>
<th>Percentage mortality with different concentrations of DDT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.0078</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>24.0</td>
</tr>
<tr>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Females</td>
<td>16.6</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>20.6</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>21.5</td>
</tr>
<tr>
<td>F&lt;sub&gt;5&lt;/sub&gt;</td>
<td>Females</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>18.3</td>
</tr>
</tbody>
</table>
Table 6. \( Lc_{50} \) values and slopes of normal and selected strains of *D. cucurbitae* to solutions of DDT in risella oil.

<table>
<thead>
<tr>
<th>Strain</th>
<th>( Lc_{50} )</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>.035</td>
<td>1.57</td>
</tr>
<tr>
<td>F&lt;sub&gt;5&lt;/sub&gt;</td>
<td>.041</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Figure 3. Dosage mortality lines for DDT shown by the normal and selected strains.
CONCLUSIONS

1. *Dacus cucurbitae* Coq. was successfully reared at a temperature of 28 ± 1°C and 70 to 80 percent relative humidity on a diet containing proteinex and sucrose in a ratio of 1:10.

2. Topical applications of DDT, gamma BHC and aldrin showed that the adults were most susceptible to aldrin and least susceptible to DDT. The species can be effectively controlled with 0.02% aldrin and BHC.

3. BHC was more toxic when dissolved in risella oil whereas aldrin was more toxic when dissolved in acetone.

4. Males were more susceptible to all the insecticides tested than the females.

5. The species did not show any significant tolerance when selected with DDT for five successive generations under laboratory conditions.
SUMMARY

*Dacus cucurbitae* Coq. is a serious pest of cucurbitaceous fruits in India. The larvae are phytophagous and are commonly found in fleshy fruits. The adults rest on border vegetation and visit the host plant for oviposition. On hatching the maggots feed and tunnel the pulp until pupation and thus make the fruits inconsumable.

A number of methods have been tried for the control of *D. cucurbitae*. However the available data on the susceptibility of the species to the commonly used chlorinated hydrocarbons is not satisfactory and therefore an attempt was made to determine the efficiency of DDT, gamma BHC and aldrin against *D. cucurbitae* and some preliminary tests were conducted to find out if the species could develop any tolerance to DDT.

The flies were reared at a temperature of 28 ± 1°C and 70 to 80 percent relative humidity and were fed on protinex, sucrose (1:10) and water. Eggs were obtained on pieces of *Cucurbita maxima*, which were kept in glass jars containing sand. Adults were obtained in about 12 days after hatching. The susceptibility of fifteen day old flies to DDT, gamma BHC and aldrin was determined by applying 0.0009 cc of insecticide solutions in risella oil and acetone on the dorsum of individual flies.
Aldrin was found to be most toxic insecticide and DDT the least. Males were more susceptible to all the insecticides than the females. Aldrin was more toxic than BHC when dissolved in acetone while BHC gave a better kill when dissolved in risella oil.

The flies were selected with DDT for five successive generations in such a way that the survivals of each generation were inbred to produce the next generation which was again subjected to insecticide pressure. No tolerance could, however, be developed during these five generations of laboratory selection with the insecticide.
ACKNOWLEDGEMENTS

The author is deeply indebted to Professor Nawab Hasan Khan for his kind help and valuable guidance during the progress of research without which this work would never have come to light.

Special thanks are due to Professor S.M. Alam, Head of the Department for the persistent encouragement and invaluable aid throughout the work.

The author is grateful to Dr. M.M. Agarwal, Dr. O.P. Raghuwanshi, Dr. Islam Ahmed and Dr. M.A. Ansari for their help whenever needed. The author is also thankful to Dr. Serajuddin Khan, Mr. Mukhtar Ahmad, Mr. R.N. Shukla, Mr. B.C. Banerji and Mr. A.R. Rahmani for their cooperations.
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