or checked our identifications of, at least one specimen of each species included in this list.

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OBSERVATIONS ON THE EFFECT OF CYROMAZINE ON INHIBITION OF LARVAL MOSQUITO DEVELOPMENT IN DILUTED WASTEWATER

JOSEPH COHEN[1]

Federation of the Kibbutz Movements, Health Committee, 25208 Kfar Masaryk, Israel

Cyromazine belongs to the group of compounds known as insect growth regulators (IGRs). These compounds affect only dipterous insects such as flies and mosquitoes and prevents the emergence of the adults by inhibiting the development of the larvae and the transformation of pupae to adults. High susceptibility is particularly noted in the first larval instar and to a lesser extent in the other instars. In addition to their low mammalian toxicity, these compounds are innocuous to aquatic insects, Hymenoptera, Coleoptera and other natural enemies of flies and mosquitoes.

During 1983–84, laboratory observations and field experiments were conducted to determine the effect of cyromazine on larvae of house flies and mosquitoes. The results were compiled and analyzed by Avi Lev (unpublished data, 1985). Trials were also conducted on leafminers on flowers grown for export.[2] This compound was found to be useful and of long residual activity when spread or sprayed on chicken droppings or manure piles. It prevented the development of house fly maggots and adult eclosion over a long period of time.

In field trials cyromazine was found to inhibit development of mosquito larvae and emergence of adults in wastewater canals and oxidation ponds for a period of 5–8 weeks (depending on the rate of water cycling). The compound was effective for more than two months in simulated tests using 200 liter drums.[3] Due to the encouraging results obtained in the above mentioned trials, experiments were conducted under more difficult and problematic situations, in a drainage ditch polluted by wastewater.

Observations were made in a stagnant water drainage ditch polluted by wastewater in Kfar Masaryk, situated in the north of Israel. The ditch was surrounded by heavy growth of several types of weeds and brush which provided a habitat for a high density of *Culex pipiens* Linnaeus. The volume of water in the ditch was approximately 100 m^3 wastewater after primary treatment. Physical properties of the wastewater were: Cl–900 mg/liter, NO_2–O mg/liter, C.O.D.–260 mg/liter, B.O.D.–120 mg/liter and pH 7.5. During March, water temperature was 13–19°C in the ditch and 14–21°C during April 1985. Rainfall was 2 mm in March and 65 mm in April 1985. In the laboratory, the water temperature was 15–21°C during March and 17–23°C during April 1985.

The water was treated with 2% granular cyromazine at a rate of 25 gm granules per 1 m^3 water (0.5 gr AI/m^3) as recommended by the manufacturer, Ciba Geigy, Basel, Switzerland. Larval counts were made before and after treatment by the dip method, taking 5 dips per trial and averaging the counts. The larvae were segregated according to instars and transferred to the laboratory in the same wastewater. They were held in 1,500 ml glass jars for further observation on larval development, pupation and adult emergence. Observations were made for 44 days after treatment or until sufficient number of adults emerged from the pupae. During the period of observation there was a great potential for egg laying and for the development of large numbers of *Culex pipiens* (Table 1). The results show that the use of cyromazine in the given concentration prevented larval development, pupation and adult emergence for approximately 40 days. It is also evident that the 10-day period of

[1] Chief Health Officer.

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Table 1. Effect of cyromazine on mosquito development in a wastewater ditch (treatment on March 18, 1985).

Days after treatment	No. of larvae per dip (Average of 5 dips) Instar I	II	III	IV	Total no. of larvae/dip	No. of pupae/dip
0-time*	18	12	8	6	44	5
3	10	5	3	0	18	0
7	9	4	2	0	15	0
11	8	5	2	0	15	0
18	12	5	3	0	20	0
24	14	8	7	1	30	0
31	12	6	5	2	25	0
38	10	7	5	3	25	0
41	9	8	7	5	29	1
42	11	11	9	6	37	3
44	10	10	9	8	37	6

* 0-time = average larvae/dip before treatment (control).

laboratory observations was sufficient to determine larval mortality or adult emergence (Table 2) Twelve pupae and an equal number of adults were obtained 42 and 44 days, respectively after treatment.

It is anticipated that effective control of larvae for more than a month can be accomplished in other areas of the country under conditions similar to the present trial. Ordinarily, four treatments are necessary to accomplish good larval control during this period (about 5–6 weeks). However, in the present trial, only one treatment with cyromazine yielded the same results.

Table 2. Effect of cyromazine on mosquito development under laboratory conditions. Specimens brought from the field before and after treatment (treatment on March 18, 1985) counted in laboratory 10 days after sampling.

Days after treatment	No. of larvae/jar	No. of pupae	No. of adults
0-time*	245	42	30
3	90	2	2
7	75	0	0
11	75	0	0
18	100	2	0
24	150	2	0
31	125	5	2
38	125	3	0
41	150	4	2
42	200	12	3
44	215	20	12

* 0-time = No. of larvae/jar before treatment (control).

No deleterious effect on other aquatic organisms was noted. An abundance of water bugs, chironomids, tadpoles, *Daphnia* and various beetles were present in the water after treatment with cyromazine.

I wish to thank Mr. Avi Lev of Milchan Bros., Ltd., representatives of Ciba Geigy in Israel, for providing scientific guidance in the use of cyromazine as well as providing the product, and to Shaul Ducas from Kfar Masaryk for his help in maintaining the wastewater ditch during the experiment.

FIELD EXPERIMENTS ON PERSISTENCE OF *CULICINOMYCES CLAVISPORUS*

GEOFF. R. ALLEN AND A. W. SWEENEY

Army Malaria Research Unit, Ingleburn, NSW 2174, Australia

The fungus *Culicinomyces clavisporus* Couch, Romney and Rao has the potential to recycle in mosquito populations by sporulating on the external cuticle of dead larvae; however, larval control in field tests has not been obtained beyond 1–2 weeks after application (Sweeney 1981, Sweeney et al. 1983). It has been suggested that the application of doses lower than those used in previous tests may increase the proportion of larvae which develop post-mortem sporulation and enhance the possibility of recycling. Evidence for this was obtained in laboratory observations which showed that exposure of larvae to 10^3 conidia/ml produced greater external sporulation on larval cadavers than did exposure to 10^6 conidia/ml (Cooper and Sweeney, 1986). This paper reports investigations of the persistence of *C. clavisporus* after field application.

All experiments were undertaken adjacent to the Army Malaria Research Unit, Ingleburn in 1 m^2 artificial ponds containing 100 liters of water, similar to those used by Schaefer et al. (1974) but lined with plastic sheeting rather than turf. A plastic container (28 × 28 × 58 cm) with 250 μm stainless steel screens, fitted to 11 × 11 cm holes in each side and to a 14 × 14 cm hole in the center of the bottom, was placed in the middle of each pond. The volume of pond water within each enclosure was approximately 10 liters.

The in vitro inoculum was produced in 20 liter laboratory fermenters as described previously (Sweeney 1981). Dead fourth-instar larvae bearing external conidia were used as in vivo inoculum. The numbers of conidia on dead larvae were estimated by haemocytometer counts of a sample of 20 specimens homoge-