THE EFFECTIVENESS OF CYROMAZINE FOR THE CONTROL OF MIDGE LARVAE IN OXIDATION SEWAGE PONDS

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Aquatic midges of the Chironomidae family are a public nuisance in the vicinity of bodies of stagnant or slow moving water such as sewage oxidation ponds. Early work established the efficacy of organochlorine and organophosphate insecticides for control of these aquatic midges (Prof. R. Harrison pers. comm.). Organophosphate insecticides are still the current control methods used (L. Martin pers. comm.). As a result of publicity over the presence of adult midges causing a nuisance to households, and the environmental concerns on the use of organophosphates, a series of trials were carried out from 1989 to 1992 in the laboratory and in the field to evaluate the efficacy of cyromazine.

Cyromazine, discovered and developed by Ciba-Geigy, is a substituted melamine chemically related to the triazine group. It has insect growth regulator activity particularly against dipterous larvae (Fluck and Herzog 1976). Cyromazine acts by interrupting the life cycle around the time of egg hatch or by interfering with moulting and puparium formation due to induced morphological aberrations. The subsequent emergence of adults is suppressed or incomplete. Application is most effective against young larvae where it acts as a stomach poison. At higher concentrations and against older larvae it also displays contact activity.

Two pot trials and two field trials were carried out to evaluate a 2% granular formulation of cyromazine. The two pot trials consisted of three replicates of 5-10 field collected, mixed aged chironomidae larvae per pot. The pots had a surface area of 290 cm² (1.7 litre capacity). Ninety cm³ of sieved sludge collected from the oxidation ponds was placed in the bottom of each pot as a habitat for the larvae. Water, again taken from the oxidation ponds, was put in to a depth of 5 cm. The tops were covered with nylon mesh to retain any emerging adult midges. The larvae were left to establish for 2-3 hours before the treatments were applied. Cyromazine was applied at 0.25, 0.5, 1.0 and 2.0 kg/ha surface area of water. Trial A evaluated the mortality at 12 days after application while Trial B evaluated the mortalities at 2, 4, 7 and 14 days after application. Assessments were made by sieving the sludge to recover the seeded larvae, pupae or emerged adults.

TABLE 1: Percent mortality of Chironomidae larvae in pot Trials A and B.

Treatment	Rate (kg ai/ha)	DAT	Trial A		Trial B		
			12	2	4	7	14
cyromazine	0.25		65 B	0	30 B	83 bA	87 A
cyromazine	0.5		93 A	0	60 A	100 aA	97 A
cyromazine	1.0		100 A	0	70 A	97 aA	100 A
cyromazine	2.0		100 A	3	60 A	100 aA	93 A
untreated	-		0 C	0	0 C	0 cB	0 B

Any two means in a column followed by the same letter are not significantly different $P < 0.05$ (lower case), $P < 0.01$ (capitals).

The results from the laboratory pot trials (Table 1) demonstrated that cyromazine granules applied to mixed aged populations of chironomidae larvae (*Chironomus*

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zealandicus Hudson) had efficacy against larvae with maximum mortality occurring 7-14 days after treatment. The level of mortality increased as the rate of cyromazine was increased from 0.25 to greater than 0.5 kg/ha. All rates of cyromazine granules applied gave a significantly higher level of mortality compared with the untreated, with no difference in mortality at rates above 0.5 kg/ha. These results showed that cyromazine at rates above 0.5 kg/ha should give a significant measure of control of chironomidae larvae in aquatic situations.

The two field trials were carried out at the Mangere sewage treatment station, Auckland. In Trial C cyromazine granules were applied at 1 kg/ha on 9 November 1989 and compared with an untreated area. This trial lasted for 12 days before overspraying occurred. The second part of this trial commenced on 21 November and compared cyromazine granules applied by hand at 0.5, 0.75 and 1.0 kg/ha with an untreated area. Assessments were carried out for 22 days after treatment though the untreated area was oversprayed 13 days after treatment and was no longer evaluated in the trial. The plots in these trials were 2 x 100-200 m and assessments were made at 10 positions in the middle 20 m length of the plots. Assessments were difficult due to the rocky terrain and subsurface of the oxidation ponds and channels. The method utilised was agitation of the bottom within a defined area of approximately 700 cm² by a garden spade and netting off, counting and identification of larvae that floated to the surface. Taxonomic identification of larvae were made according to Winterbourne and Gregson (1989) and Forsyth (1971). The results are presented as the mean number of larvae/treatment and percent reduction was calculated by the method of Mulla *et al.* (1971). Trial D was commenced on 10 January 1991 using 2 x 100 m plots evaluating cyromazine granules at 1 kg/ha and an untreated area, replicated four times. Assessments of larval numbers were made as in Trial C, at weekly intervals up to 28 days after treatment.

TABLE 2: Number of Chironomidae larvae/assessed area in 1989 Field Trial C.

	Rate (kg ai/ha)	DAT	9 Nov application			21 Nov application			
			0	5	12	0	7	13	22
cyromazine	0.5						4	22	24
cyromazine	0.75						4	41	28
cyromazine	1.0			4	15		2	10	7
untreated	-		12	41	31	14	25		
% reduction				90	51		90		

The field trials demonstrated the difficulty of evaluating control procedures using an untreated control in an environmental and publicly sensitive area. Due to the high emergence of adults in the vicinity of the trial and public pressure, the untreated areas had to be sprayed before the end of the assessment period in Trial C. The results from Trial C showed a 90% reduction in larval populations 5-7 days after treatment (Table 2). The numbers of larvae increased noticeably at the lower rates of cyromazine (0.5-0.75 kg/ha) compared with the 1 kg/ha rate, at 13 and 22 days after treatment. The final field trial D (1991) evaluated the optimum rate of cyromazine (1 kg/ha) and although the percent reduction was not as great as achieved in earlier trials, numbers of larvae were lower over a period of 3 weeks (Table 3).

TABLE 3: Number of Chironomidae larvae/assessed area in 1991 Field Trial D.

	Rate (kg ai/ha)	DAT	0	7	14	21	28
cyromazine	1.0			53	38	27	105
untreated	-		9.2	89	72	58	223
% reduction				40	47	46	47

These trials have demonstrated that cyromazine granules have activity against Chironomidae larvae in aquatic situations. The level of control was variable, and the reasons for the variability have yet to be ascertained but significant reductions in Chironomidae larvae did occur. Cyromazine applications will reduce the larval populations but may be less effective than organophosphate insecticides. However cyromazine may have a role in an overall management strategy for the control of midge larvae in environmental and publicly sensitive areas.

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