CHIRONOMID MIDGES AND THEIR CONTROL IN SPRING VALLEY LAKE, CALIFORNIA [1]

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ABSTRACT. The chironomid midge fauna of Spring Valley Lake, a man-made residential-recreational lake, was studied. Larval populations prevailed at 50–200 per sample (6 x 6 x 2 in.) of bottom mud, their density increasing in the spring and summer months. At least 14 species of midges (6 species either undescribed or unidentifiable) were collected. The midges emerged in large numbers, creating a nuisance.

The organophosphate insecticides, malathion, chlorpyrifos, methyl parathion, temefos (Abate), fenthion, and phenthoate were applied for larval control. Chlorpyrifos, fenthion, and temefos yielded excellent control of larvae for over a month. Malathion and phenthoate gave similar results, controlling the larvae for 2–3 weeks. Methyl parathion gave poor control for a period of 2–3 weeks.

The insect growth regulator Dimilin® or TH-6040 [1-4(4-chlorophenyl)-3(2,6-difluorobenzoyl)-urea] at 0.1 lb/acre (.003 ppm) active, gave excellent control by inhibiting adult emergence for a period of 2–3 weeks. This IGR provides an additional effective tool for the control of nuisance aquatic midges.

INTRODUCTION

The nuisance problem created by chironomid midges in residential-recreational lakes in southern California was reported by Mulla (1974) and Mulla et al. (1971). These man-made lakes with long shorelines and shallow depth with input of nutrients from surrounding premises provide ideal breeding conditions for chironomid midges.

Systematic studies on the development of chemical control strategies against pest midges were initiated several years ago (Mulla and Khasawinah 1969). These studies were expanded into residential-recreational lakes in the foothill areas of Los Angeles County, California (Mulla et al. 1971, 1973), where several organophosphorus insecticides were found to give satisfactory control of midge larvae. Recently, insect growth regulators (IGR's) were also found to yield excellent control of midges in these lakes (Mulla et al. 1974).

The current studies were initiated to evaluate the efficacy of several organophosphate larvicides and IGR's against problem midges in a freshwater lake located in the high Mojave Desert in southern California.

MATERIALS AND METHODS

These studies were conducted in Spring Valley Lake located in the high Mojave Desert at about 4000-ft elevation, 6 miles south of Victorville in San Bernardino County. The lake covers an area of 200 acres, with an average depth of 12 ft and a shoreline of 7 miles. The bottom of the lake consists of impermeable clay introduced to stop water seepage, and the shoreline strip (5 ft wide) at the waterline is covered with concrete. The lake was filled with nutrient-laden water from the Mojave Fish Hatchery in 1969. Due to its poor quality the hatchery water was diverted from the lake in late 1975 and, instead, 12 deep wells were established as shown on the map of the lake in Figure 1, to replenish water lost to seepage and evaporation.

Studies on the chironomid midge problem were initiated in June 1974. Benthic midge larvae were assesed by taking 10–20 Ekman dredges (6 x 6 x 2 in.) at various locations in the lake. The bottom mud was mixed with water and washed

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through a 50-mesh screen (Mulla et al. 1971); the residue was then transferred to plastic cups, placed in an ice chest and brought into the laboratory. The larvae were floated and counted by the procedures developed earlier (Mulla et al. 1971). The larvae were grouped into chironomines (R) and tanypodines (T); the few *Cricotopus* larvae sampled were included in the latter group.

For determining the effectiveness of larvicides and the IGR's, either granular, emulsifiable concentrate or WP formulations were used. The granules were applied by means of a Cyclone Spreader mounted on the front of a 30-foot double

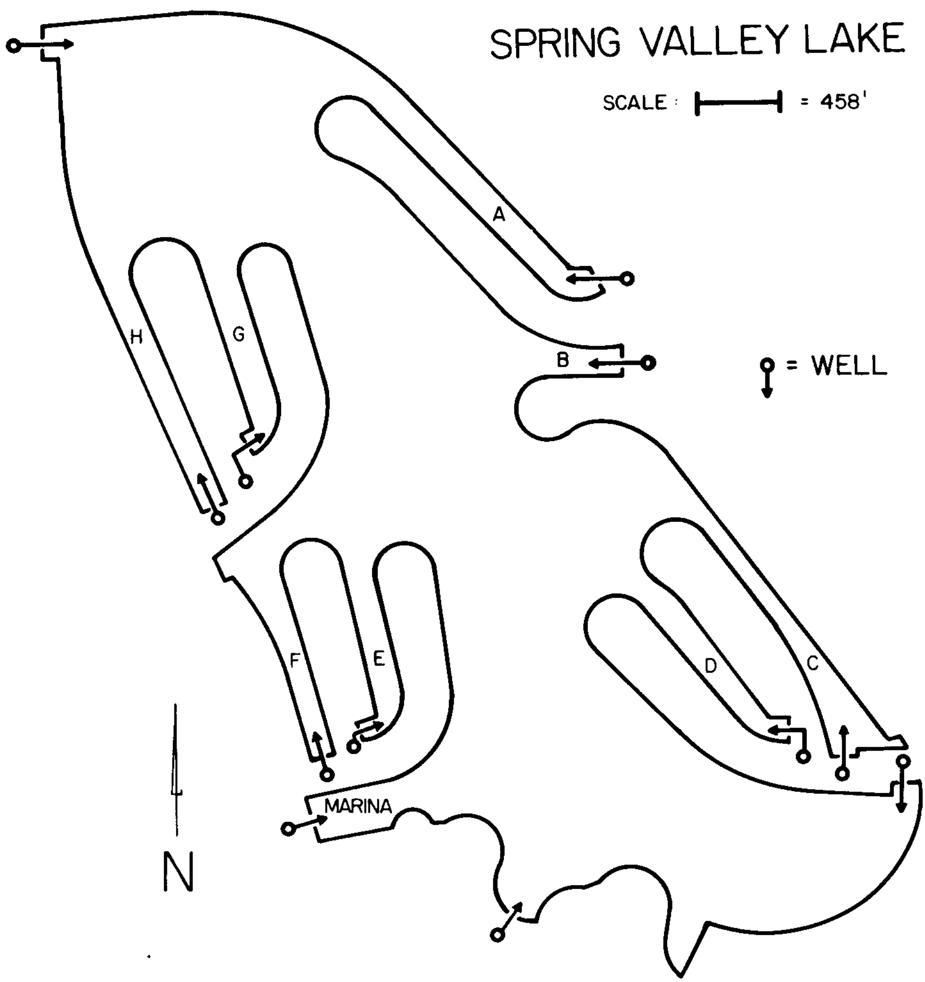

Fig. 1. Outline of Spring Valley Lake showing location of wells and fingers employed in midge larvicides and IGR evaluation.

hulled pontoon boat. The EC or WP formulations were mixed with water in a 3-gallon pressurized hand sprayer and applied in the prop wash of the outboard motor. One finger (ranging 3–7 acres) was treated with each dosage and one finger used as a check. Dosages are expressed as lbs./surface acre of water. For assessment, 5 bottom mud samples were taken from beyond the midpoint to the closed end of each finger. The % reduction due to any treatment was calculated by Mulla's formula (Mulla et al. 1971):

$$\% \text{ Reduction} = 100\left(\frac{C_1}{T_1}\ \frac{T_2}{C_2}\right)\ 100,$$

where:

C_1 = Avg. no. larvae pretreatment in check

T_1 = Av. no. larvae pretreatment in treated

C_2 = Av. no. larvae postreatment in check

T_2 = Avg. no. larvae postreatment in treated

The IGR Dimilin® (TH-6040){1-(4 chlorophenyl)-3(2,6-difluorobenzoyl)-urea} was applied to the entire lake by mixing 25% WP with water. This mixture was siphoned and mixed with additional water pumped from the lake and sprayed into the prop wash of the outboard motor. Larval density was assessed by taking 16 bottom mud samples from the fingers. Additionally, adult midge emergence was obtained overnight several times in the manner described elsewhere (Mulla et al. 1974). For adult assessment, 5 submerged emergence traps were set overnight in each of 4 fingers. The emerging adults were brought into the laboratory, segregated into genera and counted.

RESULTS AND DISCUSSION

MIDGE POPULATION. Spring Valley Lake is used for residential-recreational purposes. There are approximately 4000 residential lots near the lake. Additionally, country club, golf course, tennis courts, equestrian center, and business properties are located within the flight range of nuisance midges from the lake. The lake is used for boating, fishing, swimming, and water skiing. Soon after the lake was filled in 1969, large numbers of chironomid midges emerged and created a severe nuisance around houses and marinas. During the day, these midges were found resting on land-based structures (Figure 2) and vegetation, flying and buzzing when disturbed, and flying and swarming late in the afternoon.

The species of adult midges[3] collected (1973–74) around premises in the community of Spring Valley Lake were:

Procladius freemani Sublette, *Chironomus infuscatus* Malloch, 3 undescribed species of *Cricotopus, Chironomus attenuatus* Walker (=*decorus* gr.), *C. frommeri* Atchley & Martin, *Dicrotendipes californicus* (Joh.), *Crypto-chironomus* sp., *C. ponderosus* Sublette, *Parachironomus abortious* (Joh.) *Parachironomus* sp., *Cladotanytassus* sp., and *Glyptotendipes barbipes* (Straeger).

The trend of benthic larval populations is presented in Figure 3, covering the period June 1973 to December 1974. Only populations from mud samples taken from the fingers are presented. The fenthion treatment in July was applied to the main channel of the lake, the fingers were not treated. The treatment had some effect on the larval density in the fingers. The TH-6040 treatment was applied to the entire lake. As expected, there was a gradual decline in larval populations, especially the tanypodines. The decline was more pronounced when adult emergence ensued 30 days after treatment (see table 4), as this emergence acted as a mortality force, depleting the larval population.

In general, the larval density fluctuated between 50–200 larvae/sample. During the winter months (December-February), the larval numbers were 50–100/sample.

[3] Identification and confirmation of species provided by Dr. James E. Sublette of Eastern New Mexico University, Portales, N.M. 88130.

Emergence of adults began in March and large numbers of midges were prevalent from April to the end of October.

Organophosphate Larvicides. In a preliminary test, chlorpyrifos granules at 2 rates yielded better suppression of midge larvae of both groups (Table 1). Control of midges with the granular formulation probably lasted for much longer than shown here. Malathion granules also

Table 1. Effectiveness of various insecticides against larvae of chironomid midges in Spring Valley Lake, CA (September, 1973).

		Avg. no. larvae/sample in Sept.								
		5[a]			11			18		
Material and formulation	lb/A surface	R[b]	T[b]	Tot	R	T	Tot	R	T	Tot
Chlorpyrifos G 2	0.10	34	8	42	0	1	1	0	0	0
	0.25	58	2	60	4	2	6	2	0	2
Chlorpyrifos EC 2	0.10	28	1	29	31	2	33	24	1	35
	0.25	27	8	35	14	4	18	5	3	8
Malathion G 1	0.10	41	4	45	8	3	11	10	2	12
	0.25[c]	45	8	53	1	3	4	0	2	2
Check	...	50	6	56	24	6	30	3	1	4

[a] Pretreatment
[b] R=Chironomine, T=Tanypodine.
[c] Only ½ of the finger was treated.

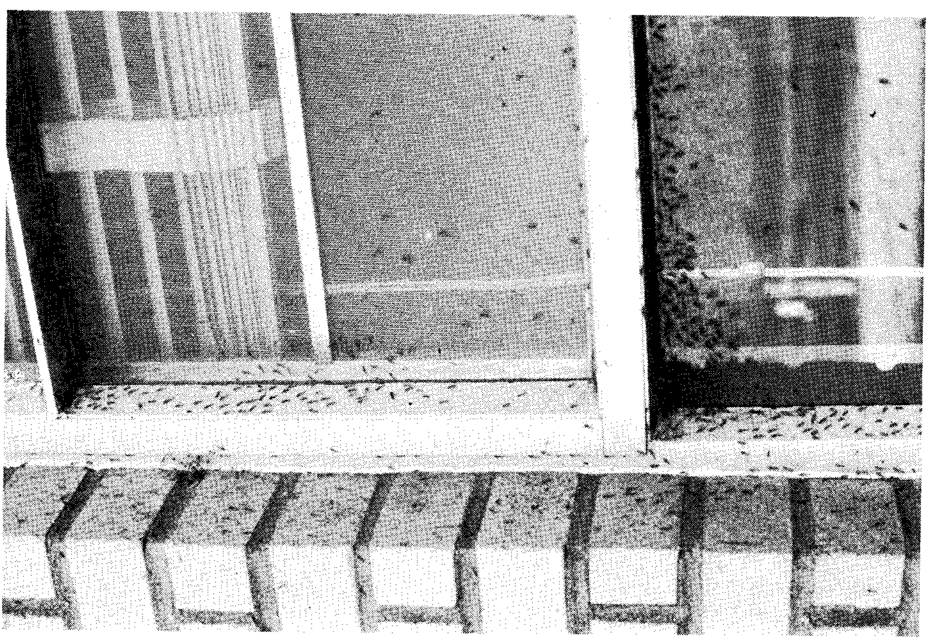

Fig. 2. Adult chironomid midges resting on windows in the middle of the day.

yielded good control of midge larvae, the higher rate producing greater reduction than the lower rate of application.

In the second experiment, granular formulations of methyl parathion, temefos, or Abate (*O,O*-dimethyl phosphorothioate *O,O*-diester with 4,4'-thiodiphenol), and fenthion were evaluated at the rate of 0.5 lb/acre active. Methyl parathion yielded mediocre reduction of larvae, especially the chironomine group (Table 2). Abate yielded excellent and consistent reduction of larvae for the duration of the experiment (35 days). This material was more effective against the chironomine larvae than the tanypodines. Fenthion gave excellent control of both groups of midges for 28 days after treatment. It is thus apparent that methyl parathion and Abate have good activity against the chironomine larvae only, while fenthion like malathion and chlorpyrifos shows activity against both groups of midges.

In another test, granular formulations of chlorpyrifos, malathion, and phenthoate (Cidial®) were evaluated. The former compound at 0.25 lb/acre active yielded complete control of both groups for 32 days. (Table 3). Good level of reduction was obtained for up to 46 days or longer. Malathion at 0.5 lb/acre active gave excellent control of larvae for 11 days or so, but the level of reduction declined rapidly 25 days postreatment. Phenthoate at 0.5 lb/acre active, gave excellent control of both groups for up to 18 days posttreat-

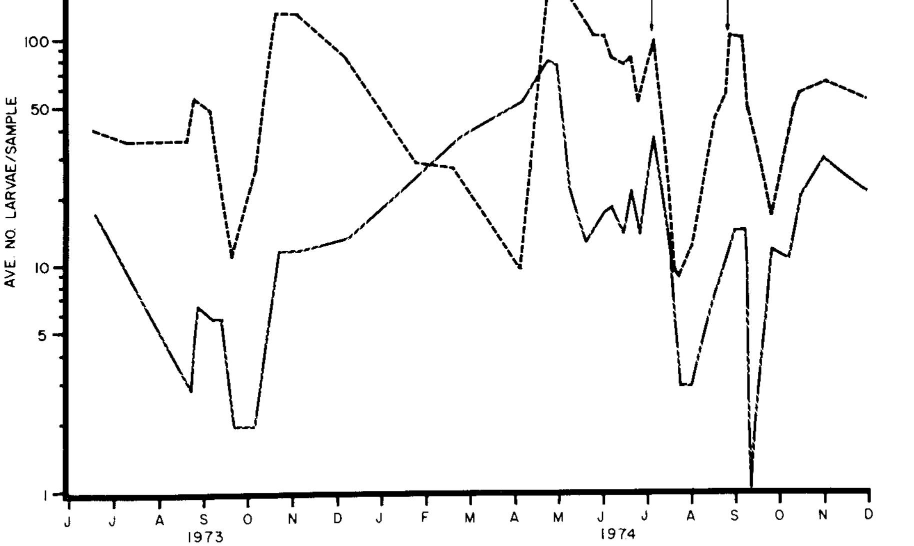

Fig. 3. Population trends of chironomid midge larvae and water temperature in Spring Valley Lake prior to and after a regimen of chemical treatments

Table 2. Effectiveness of various granular insecticides (applied at 0.5 lb/a active) against larvae of chironomid midges in Spring Valley Lake, CA. (April 8, 1974).

Material and formulation	Posttreat days	Avg. no. larvae/sample and % reduction			
		R	T	Total	% reduction
Methyl parathion G 2 15 mesh	pre	11	30	41	..
	4	3	20	23	61
	15	8	12	20	87
	21	44	11	55	74
	28	83	6	89	22
	35	135	3	138	63
Abate G 1 20/30 mesh	pre	11	64	75	..
	4	4	50	54	49
	15	1	45	46	83
	21	0	49	49	87
	28	0	28	28	86
	35	13	2	15	90
Fenthion G 1 15 mesh	pre	13	29	42	..
	4	3	6	9	85
	15	3	3	6	96
	21	2	3	5	98
	28	2	1	3	97
	35	46	2	48	44
Check	pre	10	56	66	..
	4	28	66	94	..
	15	158	85	243	..
	21	263	82	345	..
	28	161	22	383	..
	35	123	13	136	..

ment, yielding results similar to malathion.

IGR DIMILIN® (TH-6040). The treatment with Dimilin {1-(4-chloriphenyl)-3 (2,6-difluorobenzoyl)-urea} at 0.1 lb/acre active (0.003 ppm based on 12′ ft depth), yielded excellent control of midges by inhibiting adult emergence for a period of 2–3 weeks (Table 4). Adult emergence was at the pretreatment level 30 days after treatment. Due to the onset of cool weather at this time (end of September), adult activity subsided considerably and no further treatments were necessary for the rest of 1974.

The emerging adults prior to and at the end of the treatment were mostly *Chironomus attenuatus* and *Cryptochironomus* spp. A few *Cricotopus* sp. adults were also observed in the emerging population.

Dimilin applied at the same rate (0.1 lb/acre to Lake Calabasas, a shallower lake (average depth 5–6′), yielded much longer control of the aquatic midges (Mulla, unpublished data). The inhibition of emergence was complete for al-

Table 4. Control of chironomid midges with the insect growth regulator Dimilin (TH-6040) applied at 0.1 lb/acre active in Spring Valley Lake, CA. (August 26, 1974).[a]

Sampling post-treatment (days)	Avg. no. larvae/sample[b]	Avg. no. adutls/ trap/night[c]
Pretreat	124	23
3	..	4
7	120	0
12	52	0
30	27	25

[a] The whole lake was treated.
[b] 4 mud samples taken in each of fingers C, D, E, and F.
[c] 5 emergence traps were placed each time in each of fingers C, D, E, and F.

Table 3. Effectiveness of various granular insecticides against larvae of chironomid midges in Spring Valley Lake, CA. (May 20, 1974).

Material formulation	Lb/A	Posttreat days	Avg. no. larvae/sample and % reduction			
			R	T	Total	% reduction
Chlorpyrifos G 1 20/30	0.25	pre	125	13	138	..
		4	0	0	0	100
		11	0	0	0	100
		18	0	0	0	100
		25	0	0	0	100
		32	1	0	1	100
		39	36	0	36	47
		46	6	0	6	96
Malathion G 1 20/30	0.5	pre	111	17	128	..
		4	0	4	4	96
		11	0	5	5	96
		18	13	23	36	64
		25	47	23	70	23
		32	59	21	80	23
		39	41	3	44	30
		46	42	22	64	53
Phenthoate G 1 20/30	0.5	pre	135	3	138	..
		4	0	12	12	90
		11	0	2	2	98
		18	15	7	22	79
		25	73	15	88	10
		32	46	12	58	48
		39	18	7	25	40
		46	72	17	89	40
Check		pre	123	13	136	..
		4	110	15	125	..
		11	110	18	128	..
		18	87	19	106	..
		25	83	14	97	..
		32	88	22	110	..
		39	53	14	67	..
		46	105	39	144	..

most 4–6 weeks. It appears that the rate of application (per acre surface) should be increased to 0.2 lb/acre in a deeper lake such as Spring Valley Lake, so that an initial concentration of 0.006 ppm may be administered in the water.

From these studies, it is apparent that both organophosphate insecticides and the IGR Dimilin are effective against chironomid midges in Spring Valley Lake. This picture is in contrast to that developed in Westlake (Mulla et al. 1971, 1973) and other residential-recreational lakes in southern California. It is thus shown that different lakes will require specific pest control strategies for the suppression of nuisance aquatic midges.

References Cited

Mulla, M. S. 1974. Chironomids in residential-recreational lakes. An emerging nuisance problem—measures for control. Entomologisk Tidskr. 95 (Supp.):172–76.

Mulla, M. S. and A. M. Khasawinah. 1969. Laboratory and field evaluation of larvicides against chironomid midges. J. Econ. Entomol. 62:37–41.

Mulla, M. S., R. L. Norland, D. M. Fanara, H. A. Darwazeh and D. W. McKean. 1971. Control of chironomid midges in recreational lakes. J. Econ. Entomol. 64:300–307.

Mulla, M. S., R. L. Norland, T. Ikeshoji and W. L. Kramer. 1974. Insect growth regulators for the control of aquatic midges. J. Econ. Entomol. 67:165–70.

Mulla, M. S., R. L. Norland, W. E. Westlake, B. Dell and J. St. Amant. 1973. Aquatic midge larvicides, their efficacy and residues in water, soil, and fish in a warm-water lake. Environ. Entomol. 2:58–65.