OPERATIONAL AND SCIENTIFIC NOTES

DISTRIBUTION AND CONTROL OF *CHIRONOMUS RIPARIUS* (DIPTERA: CHIRONOMIDAE) IN A POLLUTED CREEK

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ABSTRACT. Mass emergences of adult *Chironomus riparius* have been regularly occurring in late February near residential areas adjacent to a creek receiving municipal sewage effluent located in Lexington, Kentucky. Prior to attempting control of this chironomid, the larval distribution of this species in the creek was investigated. Although large numbers of larvae were being produced in this creek, the greatest larval density occurred downstream from an adjacent horse "muck" pile and an adjacent landfill. Application of Vectobac®-6AS reduced larval density in these areas but Vectobac®-G did not.

Mass emergences of *Chironomus riparius* Meigen adults have been occurring in late February from the Town Branch Creek in Lexington, Kentucky, for the last 5 years. These emergences have created a nusiance to the surrounding residential area and resulted in numerous complaints to the local health department. Unfortunately, most of the published literature on the control of midges has focused only on problems associated with lakes or ponds and is considered not applicable to situations such as sewage effluent channels or creeks where water currents are involved (Polls et al. 1975).

In response to the health department's request to help alleviate the midge nusiance, we initiated a study to establish the distribution of *C. riparius* in Town Branch Creek and identify areas for larval control. We also report on field efficacy trials using 2 formulations of *Bacillus thuringiensis* var. *israelensis* in areas of the creek where the greatest number of midge larvae had been collected.

The Town Branch Creek originates at the City of Lexington sewage treatment plant and flows 16.4 km before merging with the Little South Elkhorn Creek. Town Branch varies in width from approximately 3 to 15 m with a depth of 0.4–1.5 m. The normal water velocity in the creek ranges from 0.1 to 1.0 m per sec. The sewage treatment plant augments the flow of the creek with secondarily treated effluent for an average flow of about 68 million liters per day.

The creek bottom is primarily clay overlaid by silt, with several areas of the creek covered with either sand, rock or pebbles. The banks are steep (approximately 3–8 m), lined with trees and free of other vegetation.

Chironomus riparius occurred in silt tubes along the bottom of the creek, therefore, bottom substrate samples were taken using a standard 1 pint (0.5 liter) plastic mosquito dipper. Using the dipper as a scraper, a 0.3 m long × 0.11 m wide swath (8 cm deep) was taken along the creek bottom approximately 0.3 m from the bank. Sixteen sample stations, 0.8 km apart, were selected and 10 samples per station were collected. The first sample station was 2.5 km from the sewage treatment plant. All samples were washed through a 22 cm (length) × 22 cm (width) × 4 cm (height) sieve (mesh opening = 1.4 mm) with creek water and the contents at each station pooled and placed in separate 1 liter glass jars. Samples were then transported to the laboratory where the midge larvae were counted within 24 h. At the time of collection, chlorine and pH were determined at each station using a portable water analysis test kit (Hach Chemical Co., Loveland, CO). Sampling was conducted from 900 to 1700 h EST on one day prior to the application of *B.t.i.*

Two formulations of *B.t.i.* (Vectobac®-G and Vectobac®-6AS) were evaluated as larvicides. Field trials were conducted in September. Vectobac-G (corn cob grit granules, 5/8 mesh size) was applied to a 465 m^2 area located at station 12 which was 11.3 km from the sewage treatment station. A duplicate area located on the opposite creek bank was also treated similarly. A backpack blower (Model ECHO DM-9) was used to apply the granules at a rate of 22.4 kg/ha (20 lbs/acre). The granules were applied by aiming the nozzle of the blower perpendicular to the water's surface. This forced the granules through the water's surface, down onto the bottom of the creek where the larval tubes were

located and where the midge larvae have been reported to feed (Credland 1973). Water velocity at the time of treatment was approximately 0.1 m per second. Substrate larval samples were taken directly from the treated areas at 0 and 72 h after treatment as described earlier.

Vectobac-6AS was applied 4.9 km (station 4) and 9.7 km (station 10) from the treatment plant at the rate of 2.6 and 4.0 kg total material per application, respectively. The insecticide was manually poured into the creek while walking back and forth along a bridge for 1 minute. The water current distributed the insecticide downstream. Velocity of the water in the creek at the time of treatment was 0.8 m/sec for station 4 (discharge 1.4 m^3/sec) and 0.5 m/sec for station 10 (discharge 0.9 m^3/sec). Thus, using the amount of water discharged at each site, the amount of Vectobac-6AS applied to the creek equaled 50 ppm. Substrate larval samples were taken at the site of treatment and 0.2, 0.4, 0.8, 1.6 km downstream before and 72 h after treatment. Water temperature, pH, and chlorine content were recorded at the time of sampling for all stations in both trials as stated earlier. Larva and adult voucher specimens of *C. riparius* have been deposited in the University of Kentucky, Department of Entomology insect collection.

The sewage effluent in Town Branch Creek served as a productive system for *C. riparius* species. This agrees with what Gower and Buckland (1978) and Polls et al. (1975) reported for similar polluted aquatic habitats. The total number of midge larvae collected from the Town Branch Creek ranged from 152 to 28,664 larvae per m^2 (Fig. 1). The greatest numbers were found at stations 4, 10 and 11 which were 4.9, 9.7 and 10.5 km downstream from the sewage treatment plant, respectively. Straw bedding and horse manure (referred to as muck) had been stacked along the banks and was periodically dumped by the farm workers into the creek 0.6 km upstream from sample station 10. We believe this contributed to the increased numbers of larvae found at sample stations 10 and 11. Also runoff from organic refuse on a landfill (1,000 m^2) located approximately 0.8 km upstream from sample station 4 may have contributed to the greater larval abundance at this station. According to Credland (1973), additional organic matter increases the filamentous algae which these larvae use as food. No consistent patterns emerged in the pH or chloride content of the creek water at the time of sampling. The water pH level averaged 7.28 ± 0.08 (SE) (range 6.5–7.6) while the chloride content averaged 0.15 ± 0.04 ppm (range 0–0.50 ppm).

Vectobac-G did not reduce the chironomid population at the site of application in either of the 2 treated plots. We estimated that approximately 50% of the granules floated downstream. This may have produced a concentration of *B.t.i.* too low to kill the chironomid larvae. Downstream areas were not sampled to determine the effect on larval abundance in subsequent areas from the floating Vectobac granules.

The Vectobac-6AS formulation resulted in >97% larval reduction, regardless of instar, 0.8 km downstream from station 4 and decreased to 63.7% at 1.6 km (Table 1). Greater than 98% larval reduction was achieved 0.2 km downstream from station 10 and decreased to approximately 78% at 0.4 km. No larval reduction occurred 0.8 km downstream. The absence of control 0.8 km from station 10 was due to dilution of the treatment by an undetected small tributary approximately 0.25 km upstream from the 0.8 km sample station. Water temperature during the Vectobac-G and -6AS trials averaged 25°C and pH averaged 7.5; no chlorine was de-

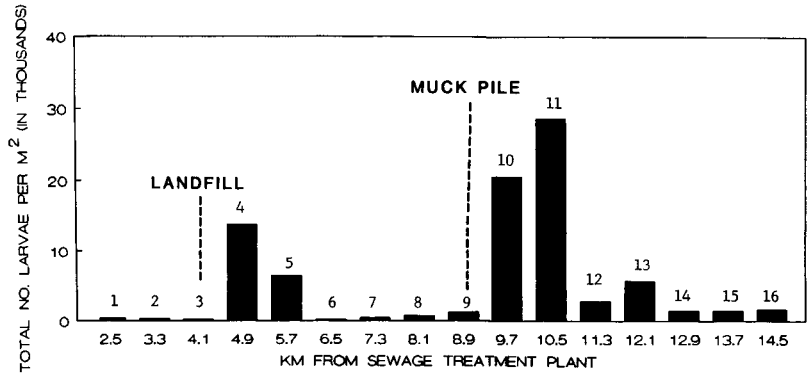

Fig. 1. Distribution of *Chironomus riparius* larvae in Town Branch Creek, Kentucky. The numbers of 1–16 indicate the sampling stations.

Table 1. Field trial efficacy of Vectobac-6AS against *Chironomus riparius* larvae in Town Branch Creek, Lexington, Kentucky.

Sample site and distance from treatment (km)	Total no. larvae per m^2		
	Pretreatment	Post-treatment (72 h)	% reduction
Station 4			
0	13,635	61	99.6
0.2	10,605	303	97.1
0.4	9,852	212	97.9
0.8	8,181	242	97.0
1.6	18,544	11,817	63.7
Station 10			
0	15,353	151	99.0
0.2	12,393	91	98.5
0.4	9,423	2,060	78.1
0.8	27,361	51,177	0
1.6	14,589	33,787	0

tected. From these studies it appears that Vectobac-6AS is an effective formulation of *B.t.i.* for controlling *C. riparius* larvae in sewage polluted creeks.

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