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Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho

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Methoxychlor is an organochlorine insecticide that has limited usage as a replacement for DDT. It is relatively biodegradable and has not appreciably biomagnified in model ecosystem experiments (KAPOOR et al. 1970). Although it is essentially non toxic to mammals (LD_{50} >6,000 mg/kg) it is moderately toxic to fish.

Methoxychlor is applied into irrigation canals 10-12 times during the summer months to control larvae of the black fly, Simulium vitattum Zedterstedt. Control of these pestiferous biting flies is conducted to protect sheep. Without control efforts these flies can cause a 6-12 pound-per-lamb decrease in weight gain (JESSEN 1977). Also sheep congregate when being harrassed by black flies. Where these congregation sites occur the rangeland is almost completely destroyed by the bands of 2,000-3,000 sheep (U.S. FOREST SERVICE, personal communication, 1977).

Methoxychlor applications to canals are highly efficacious and safe but restrictions by EPA on this insecticide usage prohibit treated water from entering fish-bearing streams. This study was conducted to measure methoxychlor levels at the end of a canal system in order to determine whether methoxychlor concentrations posed a threat to rainbow trout and other fish populations in the Snake River.

MATERIALS AND METHODS

Methoxychlor 2E (Miller's Methoxychlor 2E, EPA Reg. No. 802-466) was added to the water of the Twin Falls Canal Company canal system. The chemical was applied at the headgates of the canal where the water is held in a small lake (Fig. 1, Location A). Applications were made on the lakeside of the dam gates as the water flowed through the dam to insure mixing as the water and chemical went through the dam. A thirty-gallon drum of formulated product was placed one-third of the way in from each side of the dam. Methoxychlor was metered out of each barrel for a 15 min period to achieve a 0.3 ppm (parts per million) a.i. concentration (wt:wt) of chemical during that period. Average water flow in the canal during the treating season was 3,000 cfs (cubic feet per second). In 1980 the canal was treated on May 25; June 6 and 21; July 2, 12, 21, 29; August 7, 17, 29 and September 9 and 21.

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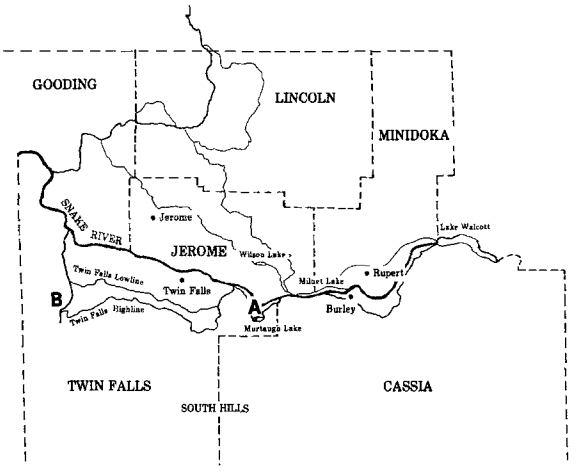

Figure 1. Canal systems of south central Idaho. Treatment site (A) and sampling site (B) as located on the Twin Falls canal system.

Water samples for residue analyses were taken after the July 12, 29 and August 7 and 17 applications. Water samples were taken from the canal approximately five miles west of Buhl, ID (Fig. 1, Location B). At this sampling location the water would have travelled approximately 75 miles (120 km) through the canal system. Water samples were drawn by taking a one-quart sample from the water surface at the center of the canal at 15 min intervals. The water was immediately transferred to a gallon glass jar which was sitting in ice. Four one-quart samples were put in each jar to obtain a gallon of water for each hour of sampling. Samples taken later than 51 h after treatment were obtained by taking a total sample of one gallon at one sampling time.

Water sampling was begun 42-45 h after applications because canal company personnel estimated it took 48 h for the water to get through the system. Water samples taken after the last two treatments were extended to 70 h after treatment to determine how long the methoxychlor "slug" took to get through the system.

After collection the water samples were shipped in ice chests to Moscow, ID for analysis.

Analytical Procedure. Water samples were analyzed using 50 mL aliquots, solvent extraction and gas-liquid chromatographic analysis as described by PEASE (1980). The gallon jugs of water were thoroughly shaken to resuspend any settled particulate matter. A 50 mL aliquot was removed and extracted three times with 100 mL portions hexane. The hexane was dried with sodium sulfate and reduced to a small volume in a rotary evaporator. The sample was transferred to a glass vial and evaporated just to dryness under a gentle stream of

nitrogen. The extract was then re-dissolved in 1 mL of hexane and analyzed by gas chromatography. A ^{63}Ni electron-capture detector was used with a 1.8 m x 4 mm i.d. glass column packed with 5% OV-101 on 80-100 mesh Chromosorb W-HP; column temperature was 200° C and nitrogen carrier gas flow rate was 60 mL/min.

Using this approach, recoveries were excellent (>95%); all samples were well above the limits of detection. We also determined that the methoxychlor was stable in ice cold water for at least 72 h.

RESULTS AND DISCUSSION

Methoxychlor residues peaked at the sampling site 45-46 h after most of the applications (Fig. 2). The highest residue level in the water at that time was 1.4 ppb (parts per billion). The mean peak residue was 1.1 ppb. These peak residue levels were 0.4% of the initial concentration. These data are quite similar to those obtained in Canada in treatments of the Athabasca River (CHARNETSKI et al. 1980).

Methoxychlor was still present in the canal water 70 h after application after the August applications. The "slugs" of methoxychlor applied over a 15 min period apparently spread out and took at least 26 h to pass through the sampling site. Residue levels at those later times, however, were only about 0.14 ppb. The majority of the methoxychlor "slug" passed through the sampling site during a 6-8 h period.

Since the canal effluent would be greatly diluted upon entering the Snake River it would appear that this efficacious treatment for black fly would benefit sheep without creating a hazard to fish.

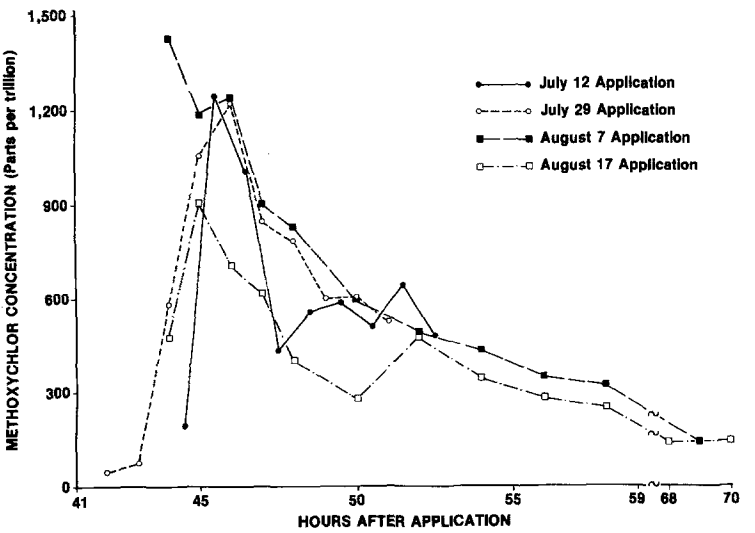

Figure 2. Methoxychlor residues in treated irrigation water at selected times after four applications.

The mean peak methoxychlor concentration of 1.1 ppb is far below the 52 ppb LC_{50} (Static) reported for rainbow trout by JOHNSON (1968). Further studies examining methoxychlor levels in the Snake River and fish tissues should be conducted to further substantiate these canal treatment results.

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