EVALUATION OF NEW INSECT GROWTH REGULATORS AGAINST MOSQUITOES WITH NOTES ON NONTARGET ORGANISMS[1]

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ABSTRACT. Three new insect growth regulators (IGRs) were tested against *Culex, Aedes* and *Psorophora* mosquitoes. In the laboratory the 3 IGRs were active in the range of 0.3 to 1.5 ppb against *Cx. quinquefasciatus*. In field tests, the IGRs fenoxycarb and S-31183 formulations yielded complete control of floodwater mosquitoes at the rates of 0.005 to 0.01 lb AI/acre. In field tests against *Cx. tarsalis*, S-31183 formulations produced complete inhibition of emergence at the rates of 0.005 to 0.025 lb AI/acre. Fenoxycarb formulation produced similar results at the rate of 0.1 lb AI/acre. It is possible that initial and residual field activity of both IGRs can be increased by employing suitable formulations.

INTRODUCTION

A variety of insect growth regulators (IGRs) have exhibited excellent activity in the laboratory and field against a wide range of stagnant and floodwater mosquitoes. The urea type IGRs such as Bay Sir-8514 and diflubenzuron produced excellent control of *Culex tarsalis* Coquillett, *Psorophora columbiae* (Dyar and Knab), *Aedes nigromaculis* (Ludlow) and *Anopheles quadrimaculatus* Say at field rates ranging from 0.0025 to 0.1 lb AI/acre (Kottkamp and Meisch 1985, Mulla and Darwazeh 1975, 1976, 1979; Mulla et al. 1974, 1975), the lower rates being efficacious against synchronous, floodwater mosquitoes, and the higher rates against asynchronous, stagnant water mosquitoes. Most of the mortality with these urea-type materials occurred in the larval stages, and satisfactory control was obtained within 48 hr after treatment. At the lower rates some mortality also occurred in the pupal and adult stages. Other types of IGRs such as carbamates (fenoxycarb), benzylphenols and benzodioxoles (J-2644, J-2645, J-2931) and benzamides (EL-7063, EL-1215) were also found to be highly active against some important mosquito species such as *Aedes nigromaculis, Ae. melanimon* Dyar, *Ae. aegypti* (Linn.), *Culex tarsalis* and *Cx. quinquefasciatus* Say (Mulla et al. 1985, Nelson et al. 1985; Schaefer et al. 1981, 1984), but with these materials most of the mortality occurred in prepupal or pupal stages, requiring 3–10 days for assessing results.

Insect growth regulators, in general, appear to be selective for mosquitoes, and at practical rates have had no apparent ill effects on prevailing nontarget organisms (Mulla et al. 1975, 1979, 1985; Schaefer et al. 1981, 1984). Additionally, most IGRs are known to have low mammalian toxicity and a good margin of safety to fish and wildlife. Therefore, their use in mosquito control programs offers certain advantages over some currently used materials.

In recent laboratory tests, 2 new IGRs (S-21149 and S-31183) showed excellent activity in the laboratory against *An. quadrimaculatus, Ae. aegypti,* and *Cx. tarsalis*. Both materials inhibited 95% of adult emergence at low concentrations ranging from 0.0003 and 0.017 mg/liter (Estrada and Mulla 1986). Due to their high level of activity in the laboratory, further evaluation of these two IGRs under field conditions was deemed essential. In addition, fenoxycarb (RO13-5223) 1.0% attaclay granules, as reported earlier (Mulla et al. 1985), produced excellent control of *Ps. columbiae* and *Ae. melanimon* at the low rates of 0.005–0.01 lb AI/acre. At these low rates, the required amount of (1%) granules was difficult to apply evenly over the mosquito breeding area. To insure adequate coverage, a new 0.2% granular attaclay formulation of fenoxycarb was made available for experimentation. The present studies were initiated to evaluate various formulations of the 2 new IGRs (S-21149 and S-31183) in the laboratory and under field conditions, and to determine their impact on prevailing nontarget organisms in experimental ponds. Field tests were also conducted on available formulations of the IGRs and 0.2% attaclay granules of fenoxycarb against several mosquito species.

METHODS AND MATERIALS

Materials evaluated included S-21149 [0-(2-4'-phenoxyphenoxy)ethyl propionaldoxime], S-31183 [1-(4'-phenoxyphenoxy)-2-(2'pyridyloxy)

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propane], and fenoxycarb (RO13–5223) [Ethyl-*p*-phenoxy-phenoxy)ethylcarbamate]. S-21149 and S-31183 were provided by Sumitomo Chemical Co. Ltd., Osaka, Japan as technical grade, 5% microencapsulated, and 10% emulsifiable concentrate. Granular formulations of fenoxycarb (0.2%) provided by Maag Agrochemical Co., Vero Beach, FL, and S-31183 (0.5%) were also utilized in these studies.

LABORATORY EVALUATION. Procedures utilized in these studies were described elsewhere (Mulla et al. 1985). In brief, 1% stock solutions, and serial dilutions of the technical grade materials were prepared in acetone, while distilled water was utilized in the preparation of the 1% stock suspension and serial dilutions of the emulsifiable concentrate and the microencapsulated formulations of S-21149 and S-31183. The required amount of the proper strength dilution was added to 10 oz disposable plastic foam bowls (Dixi Marathon Product, American Can Co., Greenwich, CT), containing twenty 4th-instar larvae of *Culex quinquefasciatus* in 200 ml of distilled water. Each formulation was tested 3 times at 4 different concentrations, utilizing 3 replicates each time per concentration. Additionally, in each test, 3 bowls were treated with 1 ml of acetone each, and 3 bowls were left untreated as checks.

Percent mortality values obtained (up to the adult stage) at each concentration tested were subjected to probit regression analysis with a desk type computer (Compucorp 145E) to determine the LC_{50}–LC_{90} values in mg/liter for each formulation.

FIELD EVALUATIONS. *Experimental ponds.* Studies were conducted at the Aquatic and Vector Control Research Facility in the Coachella Valley of southern California, which has been described earlier by Mulla et al. (1982).

Materials tested in the ponds were: 0.5% granules and 5% microencapsulated formulation of S-31183, and 0.2% granules of fenoxycarb. The granules were applied with a salt and pepper shaker with an adjustable opening to insure good coverage. The required amount for each rate of application of 5% microencapsulated formulation was mixed with 120 ml of tap water, and applied with polyethylene squeeze bottle. In all tests, 2 replicates per application rate were utilized, and 2 ponds were left untreated as checks. Mosquito population at time of treatments consisted of all larval instars of *Culex tarsalis*.

To assess the effect of these formulations on the larval population and nontarget organisms prevailing in the ponds during each test, 5 dips per pond were taken prior to treatment, and 2, 7, 14 and 21 days after treatment. The 5 dips from each pond on each sampling date were combined into one sample, preserved in 60% ethyl alcohol, and dominant macroinvertebrates present were counted and identified under a dissecting microscope in the laboratory.

To study the delayed effect and mortality or survival of the succeeding stages, twenty 4th-instar larvae were placed in each of 2 isolation units per pond 2 and 7 days after treatment. These units were described elsewhere (Mulla et al. 1974). Every 3–4 days after larval isolation and placement in the units, mortality readings were taken, and dead organisms were counted and removed, until all surviving organisms died or reached the adult stage. Percent inhibition of emergence (%EI) was calculated on the basis of dead organisms in all stages as compared to the initial number of larvae isolated in the sentinel cages. Since inhibition of emergence in the checks was low, mortality in the check was not taken into consideration in calculating %EI in treatments.

Irrigated pastures. Efficacy of EC and attaclay granular (1%) formulations of fenoxycarb was assessed against *Aedes melanimon* and *Psorophora columbiae* in Inyo and Riverside counties in earlier studies. Since these formulations produced excellent control of both species at the rates of 0.005–0.01 lb AI/acre (Mulla et al. 1985), only S-31183 (0.5% granules) was evaluated against *Ae. melanimon* in Inyo County at the rates of 0.0025, 0.005 and 0.01 lb AI/acre. Tests were conducted in Mark Johns pastures on Reynolds Avenue and Highway 395 near Big Pines, and in Jack Tatum pastures, Highway 6 and Dixon Lane in Bishop, CA.

In the San Joaquin Valley, new granular formulations (0.2% granules) of fenoxycarb and S-31183 (0.5% granules) were evaluated against *Ae. nigromaculis* in Cotta pastures, located on Madison and 18th Avenue, 3 km southeast of the town of Stratford in Kings County, CA. Fenoxycarb (0.2% granules) was evaluated at the rates of 0.005 and 0.01 lb AI/acre, while S-31183 (0.5% granules) was tested at 0.0025 and 0.005 lb AI/acre.

Studies in irrigated pastures in Inyo and Kings counties were conducted in 1/32, 1/8, 1/4 or 1/2 acre plots, depending on the size of the mosquito breeding source. Two replicates per rate of application were utilized, and along with each test, 2 plots in the same field were left untreated as checks. Large size (150 ml capacity) salt shakers with an adjustable opening were utilized for the treatment of the small plots (1/32 acre), while PCB model B spreader (U.S. Borax, Los Angeles, CA) was utilized for the treatment of the larger plots. To insure

good coverage, the required amount of material for each rate of application was mixed with blank granules of similar size and texture, and applied at the rate of 3.5 kg of the mix/acre.

To assess the efficacy of the IGR granules against floodwater mosquitoes, the following sampling methods were employed:

1. Standard dipper method: Twenty dips per plot were taken prior to treatment, and 1, 2, 3 and 4 days after treatment. Percent reduction (%R) calculation was based on number of larvae and pupae in posttreatment counts vs. pretreatment.

2. Larval and pupal isolation: Twenty-four and 48 hr after treatment, larvae and pupae respectively were collected from treated plots and the checks. Twenty larvae or 20 pupae, in triplicates, were placed in 4 oz disposable cups (Sweetheart Cup Div., Baltimore, MD) containing 100 ml of field water, from where the larvae and pupae were collected.

In Inyo County, larval and pupal isolates were placed in the laboratory at the University of California White Mountain Research Station, Bishop, CA, while isolated organisms in Kings County were placed in the laboratory at Kings County Mosquito Abatement District, Hansford, CA. At both locations, ambient temperature was maintained at 25.5°C and no food was provided the larvae placed in the cups. Mortality readings were taken daily, and dead larvae, pupae and adults were counted and removed. Drowned adults attached to the pupal skins (exuviae) were considered as dead adults, while separated exuviae were considered to yield live adults. After all surviving organisms died or reached the adult stages, percent inhibition of emergence (%EI) was determined on the basis of overall mortality and calculated in the manner described above.

3. Insect net sweep: Three or 4 days after treatment, when young adults were observed emerging in the check plots, a standard insect net was used in sampling 4 different areas in each treated and check plot. Adult mosquitoes caught in the net in each sweep were counted, and mean number of adults caught was determined. This assessment provided additional information on the final and overall efficacy of a given treatment.

RESULTS AND DISCUSSION

LABORATORY. In the laboratory, S-21149 was less active than S-31183; however; both IGRs were highly active against 4th-instar larvae of *Cx. quinquefasciatus* (Table 1). The technical grade of S-31183 was the most active, causing 90% inhibition of emergence at the low concentration of 0.0003 mg/liter. The 10% EC of this compound was slightly less active, requiring 0.0004 mg/liter to produce similar results, while the 5% MC formulation was the least active. The 5% MC formulation of S-21149 produced 90% inhibition of emergence at the concentration of 0.0009 mg/liter (Table 1). In general, S-31183 appeared to be 1.3 to 6 fold more active than S-21149 against *Cx. quinquefasciatus*, depending on the type of formulation. Compound S-21149, however, was reported to be more active against *An. quadrimaculatus* than S-31183, but S-31183 was more active against *Ae. aegypti* and a resistant strain of *Cx. tarsalis* (Estrada and Mulla 1986).

Table 1. Activity of various formulations of IGRs against 4th-instar larvae of *Culex quinquefasciatus* in the laboratory.

Material	Formulation	mg/liter (AI) LC_{50}–LC_{90}	Slope
S-21149	5% MC[a]	0.00006–0.0009	1.08
S-21149	Technical	0.00010–0.0015	1.11
S-21149	10% EC[b]	0.00010–0.0025	1.00
S-31183	Technical	0.00004–0.0003	1.39
S-31183	10% EC	0.00004–0.0004	1.39
S-31183	5% MC	0.00010–0.0007	1.61

[a] Microencapsulated.
[b] Emulsifiable concentrate.

FIELD. In the pond experiments, all larval instars of *Cx. tarsalis* were present at time of treatment. Due to continuous oviposition and presence of all instars in the ponds, larval populations in fenoxycarb and S-31183 treated ponds prevailed at high levels as determined by the dipping technique throughout the experiment (data omitted). However, dead pupae were observed in the treated ponds 2 and 7 days after treatment. Since both these materials induce mortality in the prepupal and pupal stages, larval assessment does not provide a good method for evaluation of efficacy. To determine the magnitude of delayed action of these compounds, larval cohorts were confined in sentinel or isolation units.

In the isolation units where 4th-instar larvae were confined, delayed mortality in the 5% MC (microencapsulated) and 0.5% granules of S-31183, and 0.2% granules fenoxycarb treated plots, occurred upon pupation. In the cohort isolated 2 days after treatment, S-31183 (5% MC) produced 97% inhibition of adult emergence at the low rate of 0.01 lb AI/acre, while complete inhibition of emergence was obtained at rates of 0.025 and 0.05 lb AI/acre (Table 2). Seven days after treatment, the highest rate remained active, and no 4th instar larvae were

Table 2. Efficacy of IGRs against *Culex tarsalis* in experimental ponds in the Coachella Valley, CA.

Rate	Mean (%) cumulative mort. and (%EI) in larval isolates							
	2 days posttreatment				7 days posttreatment			
lb/acre	L	P	A	(%EI)	L	P	A	(%EI)
S-31183 (5% MC)[a]								
0.010	26	70	1	97	36	34	8	78
0.025	13	87	0	100	8	73	6	87
0.05	26	74	0	100	No 4th-instar larvae			
Check	6	5	0	11	10	10	0	20
S-31183 (0.5% granules)[b]								
0.005	10	90	0	100	43	31	11	85
0.010	3	97	0	100	18	70	4	92
0.025	10	90	0	100	36	63	1	100
Check	5	4	0	9	10	1	0	11
fenoxycarb (0.2% granules)[b]								
0.025	18	33	9	60	36	13	4	53
0.050	18	70	6	94	49	15	5	69
0.100	6	91	1	98	9	55	6	70
Check	5	4	0	9	10	1	0	11

[a] April 1985, water temperature mean min. 18.6°—mean max. 30°C.
[b] October 1985, water temperature mean min. 16.4°—mean max. 25.6°C.

present in treated ponds. However, activity began to decline at the 2 lower rates of 0.01 and 0.025 lb/acre. S-31183 (0.5% granules) produced better results than the 5% MC formulation, causing complete inhibition of adult emergence at 0.005, 0.01 and 0.025 lb AI/acre, 2 days after treatment. All 3 rates remained active for one week. The low rate of 0.005 lb/acre caused 85% inhibition of adult emergence, while the 2 higher rates yielded 92 and 100% inhibition of emergence one week after treatment. It is very likely that efficacy at the highest rate continued for 3 weeks or longer.

Fenoxycarb (0.2% granules) was about 10-fold less active than S-31183 (0.5% granules), causing 60, 94 and 98% inhibition of adult emergence within 2 days after treatment at the rates of 0.025, 0.05 and 0.1 lb AI/acre, respectively. One week after treatment, a drastic decline in activity of fenoxycarb (0.2% granules) was observed at all rates applied (Table 2).

In tests against *Ae. melanimon*, S-31183 (0.5% granules) produced some initial reduction in the larval populations (as assessed by the dipping technique) at rates of 0.005 and 0.01 lb AI/acre (Table 3). This decline was faster than in the check plots where 60 and 94% reduction in larvae and pupae occurred on transformation into pupae and adults respectively. Reduction in treatments was gradual, and most mortality in the surviving larvae occurred upon pupation, 3–4 days after treatment. In sweeping of the resting sites no young adults were observed in the treated plots, while large number of teneral adults were observed resting on vegetation in the check plots.

In addition to the above, several field tests were conducted against *Ae. melanimon*, on 3 different occasions in irrigated pastures, using S-31183 (0.5% granules) at rates of 0.0025, 0.005 and 0.01 lb AI/acre. Larval counts in the dipping samples from the additional tests are omitted even though there was some decline in the larval population due to treatments at effective rates. However, at the low rate of 0.0025 lb/acre, no satisfactory inhibition of adult emergence was obtained, while complete inhibition of adult emergence was produced at the rates of 0.005 and 0.01 lb/acre in the larval and pupal isolates (Table 4). In earlier studies (Mulla et al. 1985), fenoxycarb 10% EC and 1% granules also produced similar results against

Table 3. Efficacy of the IGR S-31183 (0.5% granules against *Aedes melanimon* in irrigated pastures[a] (Inyo County, CA, June 1985).

Pre- and post-treatment (days)	Mean no. of larvae and pupae/10 dips at indicated rates								
	0.005 lb/acre			0.01 lb/acre			Check		
	L	P	(%R)[b]	L	P	(%R)[b]	L	P	(%R)[c]
Pretreatment	197	0	—	261	0	—	146	0	—
1	158	0	20	103	0	61	165	0	0
2	152	0	23	55	0	80	171	0	0
3	72	9	59	33	2	87	52	7	60
4	21	17	81	24	28	80	3	6	94

[a] Test conducted in ⅛ acre plots, surviving pupae were expected to die beyond the 4-day observation period. Water temperature, mean min. 14.4°—mean max. 27.7°C.
[b] Reduction due to pupal mortality, no resting teneral adults.
[c] Reduction due to normal adult emergence. Young adults were found in check plots only.

Table 4. Efficacy of the IGR S-31183 (0.5% granules) against *Aedes melanimon* in irrigated pastures (Inyo County, CA).

Rate	(%) cumulative mort. and (%EI) in isolated organisms						
	Larval isolates				Pupal isolates		
lb/acre	L	P	A	(%EI)	P	A	(%EI)
				June 26, 1985[a]			
0.005	5	95	0	100	100	0	100
Check	0	5	0	5	0	0	0
0.010	3	97	0	100	100	0	100
Check	0	0	0	0	0	0	0
				Aug. 19, 1985[b]			
0.005	25	75	0	100	100	0	100
Check	0	15	0	15	0	0	0
				Aug. 20, 1985[c]			
0.0025	15	24	0	39	46	4	50
Check	0	3	0	3	5	0	5

[a] Water temperature, mean min. 14.4°—mean max. 27.7°C.
[b] Water temperature, mean min. 11.7°—mean max. 28.3°C.
[c] Water temperature, mean min. 11.1°—mean max. 28.3°C.

Ae. melanimon and *Ps. columbiae* in irrigated pastures.

Against another irrigated pasture mosquito (*Ae. nigromaculis*), both fenoxycarb (0.2% granules) and S-31183 (0.5% granules) were equally effective causing moderate initial reduction (0–54%) in the population at the rate of 0.005 lb AI/acre as assessed by the dipping technique (Table 5). Reduction occurred as larval development progressed, and mortality occurred upon pupation, 3–4 days after treatment, as it was observed in previous studies against *Ae. melanimon* and *Ps. columbiae*. Extent of mortality in the pupal and adult stages are better determined in the sentinel units, although adult mortality was minimal.

Larval and pupal isolates confirmed these findings, where most of the mortality occurred in the pupal stage, and minimal level of mortality in the larval and adult stages was noted (Table 6). Fenoxycarb caused 98 and 97% inhibition of adult emergence in the larval and pupal isolates at the rate of 0.005 lb/acre, and complete inhibition of adult emergence was obtained in both larval and pupal isolates at the rate of 0.01 lb AI/acre. At the low rate of 0.0025 lb AI/acre, S-31183 caused 69 and 82% inhibition of adult emergence of *Ae. nigromaculis* in the larval and pupal isolates respectively. At the high rate of 0.005 lb/acre, complete inhibition of adult emergence was obtained in both larval and pupal isolates. It appears that the level of activity for both IGRs used as granules is essentially the same against floodwater mosquitoes.

From the experimental data presented here it is evident that S-31183 (0.5% granules) appears to be a highly effective IGR against stagnant and floodwater mosquitoes and that this material would very likely provide satisfactory control of these mosquitoes at the rates of 0.005 to 0.01 lb AI/acre. Fenoxycarb (0.2% granules) and the former material produced similar results against floodwater mosquitoes

Table 5. Efficacy of IGRs against *Aedes nigromaculis* in irrigated pastures in Kings County, CA (September 1985).

Rate	Mean no. of larvae and pupae/20 dips pre- and posttreatment (days)										
	Pretreatment		2			3			4		
lb/acre	L	P	L	P	(%R)	L	P	(%R)	L	P	(%R)
					Fenoxycarb (0.2% granules) water temp. 18.3°–28.8°C (0.5 acre plots)						
0.005	930	0	517	215	21	8	95	89	0	21	98[a]
0.010	1261	0	382	203	54	1	16	99	0	6	99[b]
Check	854	0	225	152	—	2	115	—	0	19	—[c]
					S-31183 (0.5% granules) water temp. 18.3°–27.7°C. (⅛ acre plots)						
0.0025	173	0	206	0	0	74	10	51	17	41	66[d]
0.005	159	0	280	0	0	310	22	0	7	27	79[b]
Check	368	0	945	0	—	305	460	—	27	340	—[e]

[a] Reduction in immatures occurred due to pupal mortality and normal adult emergence (5 teneral adults/sweep).
[b] Reduction in immatures occurred due to pupal mortality (no teneral adults/sweep).
[c] Reduction in immatures occurred due to normal adult emergence (200 teneral adults/sweep).
[d] Reduction in immatures occurred due to pupal mortality and normal adult emergence (8 teneral adults/sweep).
[e] Reduction in immatures occurred due to normal adult emergence (33 teneral adults/sweep).

Table 6. Efficacy of IGRs against *Aedes nigromaculis* in irrigated pastures in Kings County, CA (September 1985).

Rate	(%) cumulative mort. and (%EI) in isolated organisms						
	Larval isolates				Pupal isolates		
lb/acre	L	P	A	(%EI)	P	A	(%EI)
Fenoxycarb (0.2% granules)							
0.005	5	93	0	98	97	0	97
0.010	0	100	0	100	100	0	100
Check	0	14	0	14	17	0	17
S-31183 (0.5% granules)							
0.0025	0	63	3	69	77	5	82
0.005	0	95	5	100	100	0	100
Check	0	18	0	18	7	7	14

such as *Ae. nigromaculis, Ae. melanimon* and *Ps. columbiae,* but was 10-fold less active against *Cx. tarsalis,* requiring 0.05 to 0.1 lb AI/acre for optimum results. However, this differential range of activity can probably be narrowed by using slow-release or other types of formulations.

At all rates applied, fenoxycarb 0.2% granules and S-31183 0.5% granules did not exhibit any marked ill effects on nontarget organisms prevailing in the experimental ponds during the duration of these studies (Table 7). The dominant macroinvertebates found in the breeding sources prevailed in good numbers in the treated ponds and the checks and their numbers fluctuated in a similar manner. These were mayfly naiads (*Callibaetis pacificus* Seeman), dragonfly naiads (*Tarnetrum corruptom* Hagen and *Anax junius* Drury), several species of diving beetle larvae and adults (Hydrophilidae and Dytiscidae) and two species of ostracods (*Cypridopsis* sp. and *Cyprinotus* sp.).

In conclusion, fenoxycarb seemed to be more active than methoprene (Altosid®), but was equal in activity to Bay Sir-8514 and diflubenzuron. The most active IGR tested was S-31183 (0.5% granules) as it exhibited higher activity against all species tested (Mulla and Darwazeh 1975, 1979; Mulla et al. 1974). From the information available to date, the two IGRs studied here seem to have a good margin of safety to dominant macroinvertebrates prevailing in the breeding sources. Low mammalian toxicity and relative safety to fish and wildlife and dominant macroinvertebrates are some of the desirable attributes of these IGRs for use in mosquito control programs.

Table 7. Effect of IGR granules on nontarget organisms in experimental ponds[a] (Coachella Valley Facility, CA, Oct. 1985).

Pre- and posttreatment (days)	Mean no. of nontarget organisms/5 dips at indicated rates (lb AI/acre)[b]				
	Fenoxycarb (0.2%)		S-31183 (0.5%)		
	0.05	0.10	0.010	0.025	Check
Mayfly naiads					
Pre-	8	76	18	23	18
7	15	17	23	32	48
14	18	10	24	38	31
21	19	26	17	35	34
Dragonfly naiads					
Pre-	0	0	0	0	0
7	1	1	1	6	1
14	1	7	2	6	8
21	2	9	5	7	8
Diving beetle adults					
Pre-	22	14	9	12	8
7	3	4	1	2	4
14	2	2	2	1	2
21	2	1	2	3	2
Diving beetle larvae					
Pre-	0	0	0	0	0
7	4	3	2	2	4
14	3	3	6	2	4
21	4	4	3	1	1
Ostracods					
Pre-	4	14	7	0	4
7	98	60	46	84	60
14	60	39	228	98	56
21	74	105	67	74	102

[a] Water temperature, mean min. 16.4°—mean max. 25.6°C.

[b] Data for the lower rate (0.005 lb AI/acre) omitted.

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