EFFECTS OF GROWTH REGULATORS ON *PSOROPHORA COLUMBIAE* (DYAR AND KNAB) AND NON-TARGET AQUATIC INSECT SPECIES IN RICE FIELDS

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ABSTRACT. Methoprene or Altosid (isopropyl 11-methoxy-3, 7, 11-trimethyldodeca-2, 4-dienoate), Monsanto-0585 (2, 6-di-tert, butyl-4-(α, α,-dimethylbenzyl) phenol), Stauffer-20458 (1-(4-ethylphenoxy-6, 7-epoxy-3, 7-dimethyl-2-octene) and Thompson-Hayward-6040 (1-(4-chlorophenyl)-3-(2, 6-diflurobenzoyl)-urea) effectively controlled rice field populations of *Psorophora columbiae* (Dyar and Knab) at 0.025 lb AI/acre. These chemicals caused significant ($P<0.01$) reductions in certain nontarget aquatic insect populations (*Tropisternus* spp. adults and libellulid immatures). A significant ($P<0.05$) increase in Bactidae and Chironomidae immatures occurred in association with the reduction in populations of these predators. No significant ($P>0.05$) reductions in *Notonecta* spp. adults and immatures, corixid adults and immatures and *Thermonectus* spp. adults occurred at application rates of 0.25 lb AI/acre.

Massive populations of *Psorophora columbiae* (Dyar and Knab) occur in the rice producing areas of Louisiana as a result of water management practices used in the cultivation of rice. Many chemicals are known to be effective in controlling *P. columbiae;* however, residue problems and the effects on non-target organisms have emphasized the need for chemicals which provide mosquito control yet cause the least adverse effects to the rice field ecosystem.

Chemicals capable of inhibiting insect development (insect growth regulators, insect juvenile hormones and other types of compounds) have been shown to be effective mosquito control agents Spielman and Williams (1966), Spielman (1970), Jakob and Schoof (1971), Sacher (1971), Wheeler and Thebault (1971), Jakob and Schoof (1972), Schaefer and Wilder (1972), Steelman and Schilling (1972), Schaefer and Wilder (1973), Jakob (1973), and Mulla et al. (1974).

The effects of these compounds on certain non-target aquatic organisms have been reported by Steelman and Schilling (1972) and Miura and Takahashi (1973).

The present study was conducted in small plots and in commercial rice fields to determine the rate of application for 4 of these compounds necessary to control *P. columbiae* and to determine their effects on non-target aquatic insects.

MATERIALS AND METHODS

Small plot tests were conducted at the Louisiana State University Rice Experiment Station, Crowley, Louisiana. Plots 18 x 41 ft. were drill-planted with Saturn rice at a rate of 100 lbs/acre and simultaneously fertilized with 500 lbs of 16–8–8 fertilizer per acre. The plots were flushed 14 days after planting with approximately 2 in. of water to facilitate rice plant growth and this procedure also stimulated oviposition by *P. columbiae*. The plots were sprayed topically with propanil at a rate of 3 lbs/acre by aircraft 21 days after planting for weed control. Three days after propanil application, the plots were flooded to a depth of 6 in.

TEST 1. Emulsifiable concentrate formulations of Monsanto 0585 (2, 6-di-tert, butyl-4-(α, α,-dimethylbenzyl) phenol), methoprene or Altosid (isopropyl 11-methoxy-3, 7, 11-trimethyldodeca-2, 4-dienoate) and Stauffer-20458 (1-(4-ethylphenoxy-6, 7-epoxy-3, 7-dimethyl-2-octene) were applied in these tests. The amount of chemical necessary to provide treatment concentrations of 2.0, 1.0 or 0.5 ppm in the total volume of water contained in individual plots was mixed with 1 gallon

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of water in a 3 gal. capacity hand-pump sprayer. It was then applied uniformly over the entire surface of a plot. The plots were sprayed at 12 psi with a fan nozzle held ca. 3 ft. above the water surface. All treatments including the untreated check were replicated four times. Treatments were assigned to the plots in a randomized block design.

Four days after flood when *P. columbiae* larvae were in the 4th instar of development, the plots were treated with the designated juvenile hormone mimic.

Immediately following treatment two population samples, each consisting of ten 4th instar larvae, were dipped from each treated plot and each sample was placed in a plastic emergence cage (Mulla et al. 1974). One of these cages was then placed at each end of each treatment plot from which they had been obtained and observed at 24, 48, and 72 hours post treatment for larval and pupal mortality.

The data were analyzed as a 3 x 3 factorial (3 compounds x 3 concentrations plus a control) in a randomized block design. Thus, there were 4 replications of each treatment with 2 emergence cages per plot.

For residue analysis two 600 ml water samples were taken from each rice plot that received a treatment with methoprene at intervals of 1, 24, 48, 72, and 240 hr. after treatment, respectively. These samples were analyzed for methoprene residue by Gas-Liquid-Chromatography (GLC).

Rice plant material for chemical residue analysis was collected from each plot receiving methoprene at 10 and 14 days post treatment. Two 3 lb samples were taken from each treatment plot and the check, respectively.

The rice in each plot was harvested with a combine in order to determine the effects of the juvenile hormone mimics on crop yield. Rice yields were computed at 12% moisture. At harvest time two 3 lb samples of rice grain and two 3 lb samples of rice straw were collected from the plots receiving the methoprene treatments and analyzed for residue.

TEST 2. In test 2, treatments consisted of different concentrations of (1) a 10% slow release formulation (SR-10) of methoprene, (2) a 4 lb AI/gal slow release formulation of Stauffer-20458, (3) a 3 lb AI/gal emulsifiable concentrate formulation of Mon-0585, (4) a 25% WP formulation of Thompson-Hayward-6040 (1-(4-chlorophenyl)-3-(2,6-diflurobenzoyl)-urea) and (5) an untreated check.

The appropriate amounts of the chemicals necessary to provide concentrations of 0.25, 0.125, 0.05, 0.0125, 0.005, and 0.001 lb AI/acre were mixed with 1 gal of water and applied uniformly to the surface of plots with 3 gal capacity hand-pump sprayers as described above.

All treatments including the untreated check were replicated 3 times. Treatments were assigned to the plots in a randomized block design.

Three days after flood, when *P. columbiae* larvae were in the 3rd instar, the plots were treated with the designated chemical.

Twenty-four hours after treatment, two samples (10 larvae and a 0.5 pint water) were dipped from each treated plot and each sample was placed in a 1.0 pint glass jar. These samples were transported to the laboratory and observed at 24 hr. intervals to determine the effects of chemical treatments.

Rice plants in all treatments were observed for injury from spray applications, and the rice grain in each plot was harvested with a combine to determine the effects of chemical treatments on crop yield.

Eighty days post treatment aquatic insects were collected from rice plots by two methods. First, an insect net (30 mesh) was drawn through the surface water along the length (41 ft) and width (18 ft) of each plot which caused ca. 47 ft^3 of water over a 30 ft^2 of plot surface area to pass through the net. Insects collected in this manner were immediately placed in 70% ethyl alcohol. Secondly, ca. 1.5 ft^3 of soil and plant material were collected in the insect net by dragging it through

the top 2 to 3 in. of soil along the bottom of the plot for a distance of 18 ft. The samples were then concentrated to a 0.5 pt. size sample by washing the sample in the collection net. The sample was then placed in a 1 pt. glass jar containing 70% alcohol.

In the laboratory each sample was washed with water to remove alcohol and soil. Insects were then separated from plant material by flotation (placing the samples in a saturated salt solution). Aquatic insects collected from each plot by the two sampling methods were combined, identified and counted.

COMMERCIAL RICE FIELD TEST. A 10% slow release formulation of methoprene, a 4 lb AI/gal slow release formulation of Stauffer-20458 and a 25% WP formulation of TH-6040 were compared to untreated checks in this test.

Each chemical was applied to two 5–6 acre rice fields with an Ag Wagon aircraft. Wind speed was 5–7 mph during the time of application and each compound was applied at 20 ft. altitude. The aircraft was flown at a speed of 120 mph and the spray formulations were applied at 60 psi. Appropriate amounts of each chemical were mixed with water and applied at 2 qt. of finished formulation/acre which provided a concentration of 0.025 lb AI/acre.

In test location 1, each chemical was applied to a rice field plot area that contained late 3rd or early 4th instar larvae. The pretreatment population averaged 18 larvae per dip in Test 1.

In commercial field test 2, the treatments were applied to a rice field area that contained late 2nd or early 3rd instar larvae. The pretreatment population averaged 21 larvae per dip in Test 2.

Twenty-four hours after application ten 0.5 pt. water samples containing 10 larvae per sample were taken from each test field location and comparable untreated check plots and placed in 1 pt. glass jars covered with 18 mesh plastic screening. These jars were then taken to the laboratory for observation where the larvae were fed finely ground rabbit pellets daily. Effects of chemicals on larvae held in the laboratory were evaluated at 1, 2, 3, 4 and 5 days after treatment.

RESULTS AND DISCUSSION. SMALL PLOT TEST 1. Control of *P. columbiae* in small rice plots treated with methoprene, Stauffer 20458 and Monsanto 0585 is shown in Table 1. A highly significant difference ($P<0.01$) existed between Monsanto 0585 and both methoprene and Stauffer 20458 at 24 and 48 hr. after treatment. These data indicate difference in the speed of action between these chemicals. Monsanto 0585 killed the pupae soon after pupation was complete while methoprene and Stauffer 20458 usually killed at the time of adult emergence.

A highly significant difference ($P<0.01$) existed between the 3 concentrations used in the methoprene and Stauffer 20458 compounds at 24 and 48 hr. after treatment. Monsanto 0585 at 0.5 ppm was significantly different ($P<0.01$) from both the 1 and 2 ppm concentrations at 24 hr. after treatment. No significant ($P>0.05$) differences were shown between the concentrations of Monsanto 0585 at 48 hr. after treatment.

Table 1. Control of *P. columbiae*[a] in rice plots with growth regulators. Crowley, La. 1972.

Treatment concentration	Average % control[b]		
	Methoprene	Stauffer 20458	Monsanto 0585
	24 hr. post-treatment		
2.0 ppm	7.89[c]	7.89[e]	69.74[h]
1.0 ppm	2.73[d]	4.06[f]	68.72[h]
0.5 ppm	1.32[e]	0.00[g]	75.00[i]
	48 hr. post-treatment		
2.0 ppm	65.28[c]	20.83[f]	88.89[i]
1.0 ppm	15.61[d]	4.77[g]	88.74[i]
0.5 ppm	9.72[e]	0.00[h]	90.28[i]
	72 hr. post-treatment		
2.0 ppm	88.24[c]	96.08[c]	100.00[c]
1.0 ppm	92.06[c]	96.03[c]	98.01[c]
0.5 ppm	86.27[c]	90.20[c]	98.04[c]

[a] 4th instar larvae at time of treatment.
[b] Corrected by Abbott's formula.
[c] Those mean numbers not followed by the same letter are significantly different at the p .01 level of probability.

At the end of the test (72 hr. after treatment) no significant ($P>0.05$) difference was shown between the 3 compounds or the 3 concentrations tested. Monsanto 0585 used at 2 ppm caused 100% mortality to *P. columbiae* and 98% mortality at 1 and 0.5 ppm concentrations. Stauffer 20458 used at 2, 1 and 0.5 ppm caused 96, 96, and 90% mortality, respectively. Methoprene used at 2, 1 and 0.5 ppm caused 88, 92, and 86% mortality respectively.

When compared to yields in untreated plots, no significant difference ($P>0.05$) in the yield of rice treated with juvenile hormone mimic compounds was shown in this test.

Methoprene residues of 0.81, 0.09 and 0.03 ppm were detected in water samples from plots treated with 2 ppm methoprene 1, 24 and 48 hour after treatment, respectively. Plots treated with 1 ppm methoprene in total volume of water showed residues of 0.31, 0.03 and 0.11 ppm at 1, 24 and 48 hr. after treatment, respectively and residues of 0.12 and 0.01 ppm were detected in water from plots treated with 0.5 ppm methoprene at 1 and 24 hr. after treatment, respectively.

No residue was detected after 72 hrs. in water from plots treated with 1 and 2 ppm methoprene and no residue was found after 48 hrs. in the plots that received 0.5 ppm methoprene. Similar water residue results have been reported previously by Schaefer and Dupras (1973).

A 0.02 ppm methoprene residue was detected in water at 72 hrs. from the untreated plot. It is considered that this sample was contaminated at the time of collection or at the time of analysis.

A methoprene residue of 0.17 ppm was detected 10 days after treatment in rice plant material from plots treated with a concentration of 2 ppm. At 14 days after treatment, a residue of 0.006 ppm was detected in rice plant material from these plots. Residues of 0.12 and 0.05 ppm were detected in rice plant material collected 10 and 14 days after treatment, respectively, when plots were treated with 1 ppm methoprene.

A residue of 0.004 ppm was detected in green rice plant material collected from plots treated with 0.5 ppm methoprene 10 days after treatment. After 14 days no residue was found in plots that received 0.5 ppm methoprene.

No methoprene residue was detected in rice grain or straw collected at harvest (approximately 85 days after the material was applied).

No detectable phytotoxic injury to rice plants occurred from any of the treatments used.

PLOT TEST 2. Data relative to control of *P. columbiae* in rice plots treated with insect growth regulators are shown in Table 2. TH-6040 caused 100% mortality at all concentrations used in this study, whereas methoprene and Mon-0585 caused significantly higher ($P<0.01$) mortality at the 0.05 lb AI/acre rate and those higher when compared to the 0.0125 lb AI/acre rate and those of lower concentrations. Stauffer-20458 caused only 20% mortality at the 0.0125 lb AI/acre concentration while the 0.05 lb AI/acre rate and higher

Table 2. Average percent control of *P. columbiae* treated as 3rd instar larvae with growth regulators in rice plots. Crowley, La., 1973.

Treatment (lb AI/ACRE)	Avg. percent control			
	Methoprene	Mon-0585	Stauffer-20458	TH-6040
0.25	100	100	100	100
0.125	100	100	100	100
0.05	100	100	80	100
0.0125	80	85	20	100
0.005	75	80	0	100
0.001	40	60	0	100

caused greater than 80% mortality.

No significant difference in rice yields due to chemical treatment for mosquito control was observed in Test 2. No detectable phytotoxic injury to rice plants resulted after the application of these chemicals.

The non-target aquatic insects collected consisted of: Hemiptera-*Belostoma* sp. (adults and immatures, *Notonecta* spp. (adults and immatures), Corixidae (adults and immatures), Mesoveliidae (adults and immatures); Coleoptera-*Thermonectus* spp. (adults and immatures), *Laccophilus* (adults and immatures), *Hygrotus* (adults), *Hydrocanthus* (adults), *Tropisternus* spp. (adults and immatures), *Helophorus* sp. (adults), *Berosus* sp. (immatures), *Lessonoptrus* sp. (adults and immatures); Odonata-Libellulidae (immatures), Coenagrionidae (immatures); Ephemeroptera-Baetidae (immatures); Diptera-Stratiomyidae (immatures), Tabanidae (immatures), Chironomidae (immatures), Chaoborinae (immatures) and Ceratopogonidae (immatures).

Sufficient numbers of *Notonecta* spp. (adults and immatures), Corixidae (adults and immatures), *Thermonectus* spp. (adults), *Tropisternus* spp. (adults), Libellulidae (immatures), Baetidae (immatures) and Chironomidae (immatures) were collected for statistical analysis.

The analyses of variance for effects of the chemical treatments on non-target aquatic insects are shown in Table 3. The average numbers of non-target aquatic insects by species collected after treatment are compared to the untreated populations in Table 4. A highly significant difference ($P<0.01$) existed between replications which probably occurred because of the small number of replications used (3) and the lack of uniform population dispersal over the field test area. A similar situation occurred in the non-target aquatic insect study reported by Steelman and Schilling (1972) where a reduction in hydrophilid larvae was believed to have occurred due to chemical treatment, however variation between replications strongly indicated lack of uniform population distribution among plots.

No statistically significant difference ($P>0.05$) was detected between the treated and untreated populations of (1) adult or immature *Notonecta,* (2) corixid adults or immatures and (3) *Thermonectus* spp. adults (Table 4).

Although all 4 chemicals caused a highly significant ($P<0.01$) reduction in the *Tropisternus* spp. adult population when compared to the untreated population, the effect of methoprene was significantly ($P<0.01$) less than the other 3 compounds. This population reduction was similar to that reported by Steelman and Schilling (1972) when a similar effect on *Tropisternus* spp. was found to be caused by Mon-0585. However, Miura and Takahashi (1973) reported no visible effects on *Tropisternus lateralis* (F.) when adults were exposed to 1 ppm methoprene for

Table 3. Analyses of variance for effects of growth regulators on non-target aquatic insects.

Sources of variation	df	Mean square				
		Notonecta (Immatures)	*Tropisternus* (Adults)	Libellulidae (Immatures)	Baetidae (Immatures)	Chironomidae (Immatures)
Reps	2	69698.44[b]	24021.29[b]	644.25[b]	30629.85[b]	32077.69[b]
Control vs treated	1	9790.00	18336.13[b]	575.73[a]	893.24	4522.00
Compound	3	23019.28	9265.94[b]	66.09	57985.04[b]	9054.68[a]
Level	5	37639.02	2327.09	25.06	13760.69[a]	5038.50
Compound x Level	15	19867.81	3023.37	61.49	14799.02[b]	2423.31
Error	48	14034.36	2038.88	98.13	4181.33	2480.99
Total	74	....	....	....	....	....

[a] Significant ($P<0.05$); [b] highly significant ($P<0.01$).

Table 4. Effects of chemicals which inhibit insect development on non-target aquatic insects in Louisiana rice fields.

Insects	Concentration (lb. AI/Acre)	Avg. no. insects per sample				
		Compound				
		TH-6040	R-20458	Altosid	Mon-0585	Control
Notonecta (Adults)	0.25	32	34	34	39	
	0.125	53	31	52	27	
	0.05	45	46	31	41	
	0.0125	29	33	24	40	
	0.005	64	22	37	31	
	0.001	26	42	15	36	
Compound Mean		42	35	32	36	41
Notonecta (Immatures)	0.25	69	103	130	232	
	0.125	144	17	151	201	
	0.05	107	15	132	108	
	0.0125	223	54	149	200	
	0.005	428	167	177	351	
	0.001	336	93	249	70	
Compound Mean		218	135	165	194	122
Corixidae	0.25	3	2	1	4	
	0.125	4	0	6	1	
	0.05	3	0	0	10	
	0.0125	9	1	2	3	
	0.005	4	3	0	4	
	0.001	6	2	1	0	
Compound Mean		5	1	2	4	2
Corixidae (Immatures)	0.25	20	15	10	43	
	0.125	15	3	10	24	
	0.05	112	13	6	5	
	0.0125	12	27	21	9	
	0.005	91	22	18	28	
	0.001	28	32	36	3	
Compound Mean		27	19	17	19	26
Thermonectus (Adults)	0.25	2	3	2	4	
	0.125	2	1	1	3	
	0.05	2	3	3	2	
	0.0125	1	1	2	2	
	0.005	5	1	2	3	
	0.001	1	0	1	1	
Compound Mean		2	2	2	2	4
Tropisternus (Adults)	0.25	9	17	61	15	
	0.125	30	25	180	12	
	0.05	27	6	39	21	
	0.0125	20	6	52	67	
	0.005	39	36	39	13	
	0.001	21	18	38	45	
Compound Mean		24[b]	18[b]	68[a]	29[b]	115[c]
Libellulidae (Immatures)	0.25	13	8	11	1	
	0.125	5	13	13	8	
	0.05	9	14	9	9	
	0.0125	9	4	16	11	
	0.005	6	18	6	2	
	0.001	5	4	9	8	
Compound Mean		8[d]	10[d]	11[d]	7[d]	23[e]

Table 4. Continued

Insects	Concentration (lb. AI/Acre)	Avg. no. insects per sample: Compound TH-6040	R-20458	Altosid	Mon-0585	Control
Baetidae	0.25	428	47	96	64	
(Immatures)	0.125	188	75	45	115	
	0.05	220	120	51	77	
	0.0125	93	108	123	81	
	0.005	115	81	46	49	
	0.001	84	68	76	29	
Compound Mean		188[a]	83[b]	73[b]	69[b]	86[b]
Chironomidae	0.25	64	56	16	46	
	0.125	147	17	9	26	
	0.05	46	15	13	25	
	0.0125	34	54	19	68	
	0.005	129	43	89	88	
	0.001	70	50	38	22	
Compound Mean		82[d]	39[e]	31[e]	46[e]	10[f]

[a, b, c] Difference between mean numbers not having the same letter were highly significant ($P<0.01$).
[d, e, f] Difference between mean numbers not having the same letter were significant ($P<0.05$).

120 hrs. In the present study larvae of *Tropisternus* spp. were exposed to the chemicals and their effects were observed 80 days later in the adult population. According to Leech and Chandler (1971) oviposition (in *Tropisternus* spp.) occurs during the spring and summer and there are normally only 3 larval instars (the first 2 of short duration). They indicated that the life cycle is completed during the summer and dispersal of the newly emerged adults occurs in August and September. Thus, the mortality to *Tropisternus* spp. by chemical treatment for rice field mosquito control in the tests reported herein probably occurred at a larval molt sometime between treatment (4 June) and collection (22 August). This emphasizes the need for long-term evaluation of these compounds.

The 4 chemical treatments caused a highly significant ($P<0.01$) reduction in the immature population of Libellulidae when compared to that in the untreated plots.

Miura and Takahashi (1973) reported that no mortality occurred to damselfly naiads (*Argia* sp.) exposed to methoprene at 1 ppm for 48 hr. Damselfly naiads have 10 to 15 instars during a period that may be less than 1 year or more than 4 years (Smith and Pritchard, 1971). Thus, the importance of long-term evaluation of these compounds is shown by differences that are apparent between the results of the present study and that reported by Miura and Takahashi (1973).

The 4 chemicals caused no significant ($P>0.05$) reduction in the baetid population when compared to the untreated population. Significantly more ($P<0.01$) immatures of Baetidae were collected from the plots treated with TH-6040 than those treated with the other compounds or the untreated check plots. There was a highly significant ($P<0.01$) difference in number of the baetid immatures in relation to the concentrations used. These data indicate that less mortality occurred at rates below 0.05 lb AI TH-6040/acre and less than 0.0125 lb AI Mon-0585/acre than at other rates tested.

Significantly ($P<0.01$) more chironomid immatures were collected in the treated plots than in untreated plots (Table 4). This probably was due to control of predators in the treated plots since a significant ($P<0.01$) negative cor-

Table 5. Correlation of non-target aquatic insects after treatment with chemicals which inhibit insect development.

	Notonecta immatures	Corixidae adults	Corixidae immatures	*Thermonectus* adults	*Tropisternus* adults	Libellulidae immatures	Baetidae immatures	Chironomidae immatures
Notonecta Adults	0.28[a]	0.16	0.25[a]	0.58[a]	0.26[a]	—0.07	0.05	0.17[b]
Notonecta Immatures	....	0.30[b]	0.41[b]	0.36[b]	—0.04	—0.15	—0.02	0.51[b]
Corixidae Adults	....	....	0.15	0.02	0.08	—0.13	0.18	0.16
Corixidae Immatures	....	....	....	0.21	—0.09	—0.05	0.28	0.41[b]
Thermonectus Adults	....	....	....	....	0.12	0.08	—0.02	0.20
Tropisternus Adults	....	....	....	....	....	0.41[b]	—0.25[a]	—0.17
Libellulidae Immatures	....	....	....	....	....	....	0.06	—0.26[a]
Baetidae Immatures	....	....	....	....	....	....	....	0.16

[a] Significant ($P<0.05$) correlation; [b] highly significant ($P<0.01$) correlation.

relation existed between chironomid immatures and the presence of libellulid immatures (Table 5).

A significant negative correlation ($P < 0.05$) existed between baetid immatures and *Tropisternus* sp. adults (Table 5). These data indicate that as the reduction in the number of *Tropisternus* sp. adults occurred due to chemical treatment, an increase in the number of baetid immatures occurred.

Other negative correlations occurred with the various populations of non-target aquatic insects (Table 5). Although these negative correlations were not significant ($P > 0.05$) they did indicate that mortality to the known predator insects caused by chemical treatment was associated with an increase in the prey populations.

COMMERCIAL RICE FIELD TESTS. Each of the compounds utilized in these tests caused 100% mortality to *P. columbiae* 3–5 days post-treatment (Table 6). Time of mosquito development was lengthened in both tests when compared to that of the time required for development of mosquitoes in the check plots. However, faster kill was exhibited when mosquitoes were treated as late 3rd or early 4th instar (Test 1) than when treated as late 2nd or early 3rd instar (Test 2).

These data indicate that these compounds provided effective control of *P. columbiae* under field conditions. However, they directly reduced the populations of certain non-target aquatic insects and indirectly caused an increase in populations of other species by reducing populations of certain predatory insects.

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Table 6. Control of *P. columbiae* with growth regulators at 0.025 lb. AI/Acre in commercial rice fields; laboratory assay of field collected larvae, Cameron Parish, La., 1973.

Days post-treatment	Percent control			
	Methoprene	Stauffer	TH-6040	Check
	Test 1—Late 3rd-early 4th instar larvae treated			
1	96 (P)[a]	92 (P)	64 (L)	0 (P)
2	100 (P)	96 (P)	80 (P)	0 (A)
3	100 (P)	100 (P)	100 (P)	0 (A)
	Test 2—Late 2nd-early 3rd instar larvae treated			
1	0 (L)	0 (L)	0 (L)	0 (L)
2	0 (L)	0 (L)	0 (L)	0 (L-P)
3	16 (L-P)	6 (L-P)	18 (L)	0 (P)
4	48 (P)	31 (P)	80 (L-P)	0 (A)
5	100 (P)	100 (P)	100 (P)	0

[a] Letters in parenthesis indicate stage of development mosquitoes were in according to days post-treatment—L=larvae, P=pupae, A=adults.

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