EVALUATION OF A NEW BENZOYLPHENYLUREA INSECT GROWTH REGULATOR (UC-84572) AGAINST CHIRONOMID MIDGES IN EXPERIMENTAL PONDS[1]

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Benzoylphenylurea (BPU) insect growth regulators (IGRs) possess an excellent insecticidal potential and have been investigated since the early 1970s (Mass et al. 1981, Ratnakaran et al. 1985). Numerous IGRs have been evaluated against dipterous vector and nuisance insects under laboratory and field conditions (Ali and Lord 1980, Ali et al. 1987, Mulla and Darwazeh 1979). The BPUs, diflubenzuron, Bay Sir 8514, and UC-62644 [2,6-difluoro-*N*-(((4-(3-dichloro-5-trifluoromethyl-2-pyridinyloxy) -3,5-dichlo rophenyl)-amino)carbonyl)benzamide] have proven to be highly toxic to mosquitoes and pestiferous midges (Chironomidae) in a variety of habitats (Ali and Stanley 1981, Mulla and Darwazeh 1979, Schaefer et al. 1978).

The generally superior insecticidal activity of BPU compounds has resulted in the discovery of new analogs of these chitin synthesis inhibitors by the chemical industry. A new BPU, UC-84572, was highly toxic to a wide variety of mosquito and midge species in the laboratory (Ali and Nayar 1987). Reported here is the efficacy of UC-84572 tested against chironomid midges in outdoor experimental ponds.

The ponds employed in this study are located at the University of Florida's Central Florida Research and Education Center, Sanford, and supported natural populations of chironomid midges. Each pond is 6 × 4 m and is filled to a depth of 40–45 cm. Water level in each pond is maintained constant by a float valve. The water supply to the ponds is from an underground artesian source which maintains water depth to the desired level.

On May 6, 1985, a 10-EC formulation of UC-84572 (Union Carbide Agricultural Products Co., Inc.) was applied to the ponds at 1, 5 and 10 ppb of the active ingredient. Diflubenzuron (Dimilin® 25 WP) at 10 ppb AI was also applied as a standard because of its large data base. Each treatment rate of UC-84572 and diflubenzuron was applied to 3 ponds (replicates) in a randomized block design; three ponds were left untreated to serve as controls.

Separate spray bottles (500-ml capacity) were used for each treatment of UC-84572 and diflubenzuron. The required amount of each formulation for a pond was thoroughly mixed with 300 ml tap water in the bottle and applied evenly to the pond surface.

At predetermined intervals after the treatments and immediately prior to the treatments, one night's emergence of adult chironomids and midge larval samples from each pond were collected. The adult emergence from each pond was sampled with a 30-cm high metal-cone submerged emergence trap (Ali 1980) covering 0.25 m^2 of the pond bottom. Three larval samples were collected from each pond using an 11 × 8 cm scoop sampler, and by washing collected mud through a 250 μ pore sifter.

Air and water temperatures during the experiment were measured with a remote recording thermograph. The water temperature was taken by placing the thermistor at a fixed location in one pond.

In the laboratory, larval and adult samples were examined to count and identify midges. Reductions of different midge species or groups due to the treatments were assessed by the formula given in Mulla et al. (1971). This formula has provision for correcting reductions in the treated ponds by adjusting the corresponding simultaneous population fluctuations in the control ponds. The pre-, and periodic posttreatment population data of different midge taxa were also compared by analysis of variance and Duncan's Multiple Range Test; the data were transformed to log (n + 1) for the analysis.

The effects of UC-84572 and diflubenzuron on chironomid emergence from experimental ponds are shown in Table 1. Emergence of adult *Chironomus decorus* Johannsen, *C. stigmaterus* Say, *Goeldichironomus holoprasinus* Goeldi, and Tanytarsini was inhibited by UC-84572 as well as diflubenzuron. Even at 1 ppb, UC-84572 caused a maximum of 90% adult reduction of *C. decorus*, 66% each of *C. stigmaterus* and *G. holoprasinus*, and 53% of Tanytarsini, 2 days after treatment. However, the overall reduction of total adult midges at 1 ppb ranged from 0 to 67% during the 28 days of posttreatment. At 5

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Table 1. Effects of insect growth regulators (IGRs) UC-84572 (10-EC) and diflubenzuron (Dimilin® 25 WP) on chironomid midge emergence from experimental ponds[a] at the aquatic research facility of the University of Florida's Central Florida Research and Education Center at Sanford, FL (May–June 1985).

IGRs	Treatment rate (AI ppb)	Mean[b] no. adults/trap[c] pre- and posttreatment (days)						Significance[d]
		Pretreatment	2	7	14	21	28	
				Chironomus decorus				
UC-84572	1	70a	30ab	49ab	37ab	37ab	18b	*
UC-84572	5	23a	1c	14a	12ab	15a	6b	**
UC-84572	10	30a	0d	0d	5c	10b	4c	**
Diflubenzuron	10	46a	0c	9b	11b	13b	5b	**
Control	—	11b	47a	61a	9b	8b	3c	**
				Chironomus stigmaterus				
UC-84572	1	9	7	4	11	10	5	NS
UC-84572	5	12a	2b	4ab	9ab	4ab	4ab	*
UC-84572	10	5a	0c	0c	0c	1bc	3ab	**
Diflubenzuron	10	5a	0b	0b	2ab	3ab	3ab	**
Control	—	3ab	7a	3ab	5ab	3ab	2b	**
				Goeldichironomus holoprasinus				
UC-84572	1	11b	3cd	30a	1d	2cd	5bc	**
UC-84572	5	20a	0b	1b	2b	1b	2b	**
UC-84572	10	16a	0d	1cd	3cd	3bc	10ab	**
Diflubenzuron	10	63a	0c	6b	6b	5b	5b	**
Control	—	56a	45a	8b	3bc	2c	3bc	**
				Tanytarsini				
UC-84572	1	4c	8bc	11bc	42ab	74a	43ab	*
UC-84572	5	3b	1b	4b	79a	60a	54a	**
UC-84572	10	2b	0b	4b	53a	61a	68a	**
Diflubenzuron	10	4bc	0c	10ab	16ab	49a	32a	**
Control	—	3b	12ab	16ab	82a	55a	42a	*

[a] Ambient water temperatures 22–32°C; air temperatures 18–37°C.

[b] Means in a row followed by the same letter are not significantly different from each other when subjected to analysis of variance and Duncan's Multiple Range Test; data were transformed to log (n + 1) for the analysis.

[c] Each trap covered 0.25 m^2.

[d] Significance: NS = not significant; * and ** = significant at 5 and 1% levels, respectively.

and 10 ppb, UC-84572 gave better midge control in terms of magnitude and longevity. The rate of 5 ppb gave complete control of *G. holoprasinus*, a maximum 99% reduction of *C. decorus*, and 94% reduction each of *C. stigmaterus* and Tanytarsini, with an overall 96% control of total chironomids. At 10 ppb, UC-84572 caused complete inhibition of adult emergence of all chironomids within 2 days posttreatment, lasting for 2 weeks for *C. stigmaterus*, one week for *C. decorus* and <1 week for *G. holoprasinus* and Tanytarsini. Diflubenzuron at 10 ppb also induced complete inhibition of adult midge emergence, but it lasted for <1 week for all midge species except for *C. stigmaterus* remaining completely controlled for up to 7 days posttreatment. The comparison of UC-84572 and diflubenzuron at the same treatment rate (10 ppb) revealed that UC-84572 generally produced slightly longer lasting control of *C. decorus*, *C. stigmaterus* and *G. holoprasinus* than diflubenzuron. Emergence of Tanytarsini, however, remained reduced for longer periods of time in the diflubenzuron-treated ponds. Both of the IGRs caused no significant reductions of midge larvae in the ponds (data not included). The benthic larval populations in the various ponds fluctuated between 49 to 153 larvae/0.0175 m^2 during the 22 days of the observation period.

At rather low application rates ranging from 1 to 10 ppb, UC-84572 gave excellent control of midges in the experimental ponds. This IGR in a laboratory study proved highly toxic to larvae of several species of *Aedes*, *Anopheles* and *Culex*, as well as *Wyeomyia mitchellii* (Theobald) mosquitoes, and *Glyptotendipes paripes* Edwards, and *Chironomus crassicaudatus* Malloch midges, with LC_{90} values ranging from 0.53 to 11.64 ppb (Ali and Nayar 1987). A general comparison of the laboratory activity of UC-84572 with diflubenzuron had indicated that UC-84572 was at least 4 times more active than diflubenzuron against most of the mosquito species and 2 times and 4 times more active against *G. paripes* and

C. crassicaudatus, respectively (Ali and Nayar 1987).

In a previous study (Ali and Stanley 1981) in the same experimental ponds as employed in this study, another BPU, UC-62644, had shown superior activity to diflubenzuron. At rates ranging from 5.5 to 12.0 ppb, UC-62644 had induced 99% inhibition of emergence of adult midges with control lasting for >4 weeks; the IGR, however, had simultaneously caused significant reductions of the midge larvae. The new IGR, UC-84572, generally provided similar levels of control in the experimental ponds as UC-62644 at comparable rates of treatment but caused no significant reductions of the midge larvae. In the laboratory, UC-84572 was slightly superior in activity against midge larvae than UC-62644 as indicated by the LC_{90} values of *G. paripes*, 3.1 ppb with UC-62644 (Ali and Stanley 1981), and 2.37 ppb with UC-84572 (Ali and Nayar 1987). Thus, UC-84572 offers an excellent potential for chironomid control. However, the impact of this new IGR on aquatic nontarget organisms coexisting with mosquitoes and midges needs to be investigated.

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