OPERATIONAL AND SCIENTIFIC NOTES

EFFECTS OF SELECTED INSECT GROWTH REGULATORS AND PESTICIDES ON *DUGESIA DOROTOCEPHALA* AND *DUGESIA TIGRINA* (TRICLADIDA: TURBELLARIA)

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The predatory potential of the brown planarians, *Dugesia dorotocephala* (Woodworth) and *Dugesia tigrina* (Girard) in reducing populations of different species of immature mosquitoes under laboratory and field conditions has been reported by several authors (Ali and Mulla 1983, Legner and Yu 1975, Legner 1977, Medved and Legner 1974, Nelson 1981, George et al. 1983). Levy and Miller (1978) and Nelson (1981) found *D. dorotocephala* refractory to certain pesticides and insect growth regulators (IGRs). However, to be maximally effective as biological control agents of immature mosquitoes, planarians should exhibit resistance to a wide range of pesticides and insect growth regulators selected for use in mosquito control programs. The current study assessed the survival and asexual multiplication rates of *D. dorotocephala* and *D. tigrina* under stress of various pesticides and IGRs.

The predators, *Dugesia dorotocephala* and *D. tigrina* were obtained from Carolina Biological Supply Company, Burlington, NC. Insecticides were provided by: Holiman Equipment Inc., Jackson, MS [Scourge® 18% + 54%[1]], Mobay Chemical Co., [fenthion (45% EC)], American Cyanamid Co., Kansas City [temephos (4E)] and the technical IGR compound J2931 (99.5%) by Dr. L. Jurd, Western Regional Research Center, ARS, USDA; and cyromazine (95.6%), CGA112913 (99.3%), CGA19255 (93%), also technical IGRs, by Dr. Don Allemann, CEIBA-GEIGY, Greensboro, NC. The tests were conducted in 2 phases. All planarians tested were allowed to acclimate in glass culture dishes each containing 1,000 ml of pond water for 24 hr at ambient temperature (24–27°C).

In the initial tests, laboratory bioassay were conducted in (250 x 80 mm) culture dishes. Twenty mature planarians of each species (10 planarians in each of 2 dishes) ca. 10–15 mm long were exposed for 72 hr in 1,000 ml of 0.05, 1.0, 2.0, 5.0 or 10.0 ppm solution of each of the 7 compounds tested. Each concentration was run in duplicate and replicated 2 times. In addition, for each test, 4 culture dishes (2 with 0.5 ml acetone/dish and 2 acetone-free) containing 10 planarians were held as controls. The planarians were fed mixed groups of *Aedes aegypti* (Linn.) and *Culex quinquifasciatus* Say 3rd or 4th instar larvae at the beginning of the test. Planarians were removed from treatments, counted and microscopically examined to determine any induced abnormalities at the termination of the exposure period.

After 72 hr of exposure, 10 planarians were randomly selected from each concentration, rinsed 3 times with pond water and transferred to 6.5 ml dishes (5 planarians/dish) containing 200 ml of pond water. In addition, 5 planarians were removed from each of the 4 chemical-free dishes to separate 6.5 ml dishes containing similar amounts of water. All the planarians were also fed mixed colonies of *Ae. aegypti* and *Cx. quinquefasciatus* larvae at the beginning of the test and 96–120 hr later. Posttreatment observations of the posttreated planarian populations were made daily and their numbers assessed at the end of 240 hr to determine if there were any latent effects due to 72 hr of continuous exposure.

The results obtained from 72 hr of exposure are summarized in Table 1. The various concentrations tested induced neither mortality nor deleterious effects among individuals of *D. dorotocephala* and *D. tigrina* in our study. These data (Table 1) support the results of Levy and Miller (1978) with temephos (Abate®), fenthion (Baytex®), malathion (Cythion®), chlorpyrifos (Dursban®), diflubenzuron (Dimilin®) and methoprene (Altosid®) against *D. dorotocephala* and diflubenzuron (Nelson 1981) against the same predator species. Asexual multiplication occurred at all concentration levels as well as among the controls. The average population increases of *D. dorotocephala* during continuous exposure varies from a low of 3% (Scourge) to a high of 45% for the IGR (CGA112913) while for

[1] Active ingredients: 18% resmethrin and 54% piperonyl butoxide technical.

Table 1. Effects of pesticides and insect growth regulators on the survival of *Dugesia dorotocephala* and *Dugesia tigrina* at indicated treatment levels.

Species treatment	Concentration levels (ppm)					Average no. alive	% increase
	0.05	1.0	2.0	5.0	10.0		
Dugesia dorotocephala							
Cyromazine	32*	22	28	36	22	28	40
J2931	32	28	27	35	21	29	43
CGA 112913	32	25	30	33	25	29	45
CGA 19255	28	28	28	28	22	27	34
Fenthion	33	21	26	37	20	27	37
Scourge	20	21	21	21	20	21	3
Temephos	32	23	26	31	20	26	26
Water	17	22	24	37	24	25	24
Water + acetone	28	24	22	36	21	26	31
Dugesia tigrina							
Cyromazine	21	23	21	24	33	24	22
J2931	25	20	20	20	25	22	10
CGA 112913	21	20	20	22	22	21	5
CGA 19255	22	22	21	20	20	21	5
Fenthion	28	21	20	21	23	23	13
Scourge	20	21	21	21	20	21	18
Temephos	27	24	20	20	21	22	12
Water	27	21	21	32	20	24	21
Water + acetone	20	20	22	24	29	23	15

* Number of planarians alive after 72 hours.

D. tigrina the average population increases ranged from 5% (CGA112913, CGA19255) to 22% (cyromazine). Average population increase of the controls (Table 1) varies from 15 to 31%. The low population increases of 3 and 5% indicated in this study did not compare favorably with the controls. However, based on a previous study (Nelson 1979), the senior author concluded that these increases will result in long term population build-up as planarians have doubled their respective population in less than 20 days. Furthermore, it does appear that the IGR compounds CGA112913, J2931 and cyromazine may have had some stimulating effects on the reproductive potential of *D. dorotocephala*. Additional studies will be required to determine if prolonged exposure to these compounds will enhance population increases by fission.

There was also 100% survival with no detectable adverse effects among the postexposure populations of *D. dorotocephala* and *D. tigrina* and the controls. Asexual reproduction 240 hr posttreatment, in most cases, increases at a greater rate when compared to planarians subjected to continuous exposure. However, there was no relationship between concentrations and the increase in numbers of both species of planarians. The highest posttreatment increases recorded were 110 and 70% (cyromazine), 110 and 80% (J2931), 100 and 60% (CGA112913), 120 and 80% (CGA19255), 140 and 130% (Scourge), 150 and 70% (fenthion), 150 and 100% (temephos) for *D. dorotocephala* and *D. tigrina*, respectively.

Although the asexual multiplication rates of *D. dorotocephala* exceeded *D. tigrina*, the 2 mosquito predators nevertheless appeared to be equally tolerant of insect growth regulators and pesticides. A number of these pesticides are currently used to reduce nuisance and/or vector population of mosquitoes. Thus, it appears unlikely that the survival, reproductive and population growth potential of these planarians will be affected by concentrations of a number of different pesticides used in the field for mosquito larvae control. The data from this study together with those from previous studies (Levy and Miller 1978, Nelson 1981) seem to indicate that the two *Dugesia* species are promising candidates for trials in integrated mosquito larviciding programs.

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