NOTE: DIFFERENTIAL SENSITIVITY OF THREE SPECIES OF *Drosophila* TO TWO CYCLIC HYDROCARBONS

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ABSTRACT

Sensitivity of three *Drosophila* species namely *D. melanogaster, D. nasuta nasuta* and *D. sulfuricaster neonasuta* to two cyclic hydrocarbons, namely: Dithranol (1, 8, 9-trihydroxy anthracene), and 2,4-dichloro-1-naphthol was studied. Dithranol at 500, 750 and 1000 ppm and 2,4-dichloro-1-naphthol at 100, 150 and 200 ppm were administered to the larvae of the three species. Larval viability and development of all the species tested were significantly affected. Differential sensitivity of the three species in the light of their biomass is discussed.

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KEY WORDS: *Drosophila melanogaster. D. nasuta nasuta. D. sulfurigaster neonasuta.* Dithranol (1,8,9-trihydroxy anthracene). 2,4-dichloro-1-naphthol. Monomorphic strains. Mortality. Differential sensitivity. Toxicity.

Cyclic hydrocarbons may exist either in the form of a few hormones in man and other animals, as environmental pollutants, as components of pesticides, or as pharmaceuticals. They have been pointed out by Lucas (1975) to be common in cigarette smoke, diesel fumes, smoked food and various industrial effluents.

Many of these hydrocarbons are carcinogenic and majority are mutagenic (Brookes, 1977). This study determined the toxicity of two cyclic hydrocarbons (Dithranol and 2,4-dichloro-1-naphthol) to three *Drosophila* species. Dithranol (1,8,9-trihydroxy anthracene) is an anti-psoriatic drug and 2,4- dichloro-1-naphthol is an industrial chemical. *Drosophila* is a very good submammalian assay insect because it is adopted both for mutagenecity screening and toxicity evaluation. In addition, differential sensitivity studies of different *Drosophila* species will be useful to correlate sensitivity with that of biomass.

Three *Drosophila* species, namely: *Drosophila melanogaster* of the *immigrans* group, *D. nasuta nasuta* and

D. sulfurigaster neonasuta of the *nasuta* subgroup were studied. Monomorphic strains of these species were maintained in standard wheat cream agar medium with yeast at 24 ± 1°C to assess differential sensitivity. The larvae (first to third instar) were continuously fed with wheat cream agar medium supplemented with Dithranol and 2,4-dichloro-1- naphthol. The normal food medium served as the control. Eggs of the same age (±4 hrs) were collected following the procedure of Delcour (1969) and placed in equal numbers (25/vial) in 7.6 cm x 2.5 cm vials, containing chemical supplemented or control media. Dithranol at 500, 750 and 1000 ppm; and 2,4-dichloro-1-naphthol at 100, 150 and 200 ppm were used for all the species and 28 to 40 replicates were maintained per concentration. The counts of emerged flies and their sexes were recorded everyday from the first to the last day of eclosion. Corrected mortality percentages have been calculated by applying appropriate formula (Laamanan et al., 1976). Average weight of the flies was determined using a single pan electric balance. All the experiments were conducted at a constant temperature of 24 ± 1°C.

The lowest Dithranol concentration (500 ppm) employed produced 27.0%, 32.8% and 71.2% mortality in *D. melanogaster, D.n. nasuta* and *D.s. neonasuta* respectively which are significantly higher than the respective controls (Table 1). Likewise, the lowest 2,4-dichloro-1-naphthol concentration (100 ppm) used produced 20.5%, 54.0% and 70.2% mortality in *D. melanogaster, D.n. nasuta* and *D.s. neonasuta*, respectively (Table 2). For both chemicals, mortality percentage and concentration were linearly related.

The mean development time of all the species tested was significantly different from the respective controls (Tables 3 and 4). However, the species did not significantly differ in the mean development time. Moreover, the treatment and mean development time were not linearly related.

Differential sensitivity of the three *Drosophila* species to Dithranol and 2,4-dichloro-1-naphthol was analyzed. Sensitivity was based on the extent of toxicity of the chemicals. The toxicity of a chemical can be determined by the development rate and viability of the test organism (Luning, 1966). Tables 1-4 show that 2,4-dichloro-1-naphthol, a naphthalene derivative is more toxic than Dithranol, an anthracene derivative.

D.s. neonasuta manifested the highest percentage mortality and hence, more sensitive to chemicals used. Although the average biomass (1.2 mg) for both *D.n. nasuta* and *D.s. neonasuta* is higher than that of *D. melanogaster* (0.68 mg), the first two species are more sensitive to the tested chemicals under study than the latter. This differential sensitivity may be due to the habitat of the species. *D. melanogaster* is a domestic species, exposed to a man-made environment and hence, more tolerant to the chemicals than the two wild species. Between the two wild spe cies, *D.s. neonasuta* is more sensitive to both hydrocarbons than *D.n. nasuta* despite their equal biomass Experiments by Ranganath and

Table 1. Sensitivity of three *Drosophila* species to dithranol.

Concentration (ppm)	*D. melanogaster* Mortality (%)	*D. melanogaster* Corrected Value	*D.n. nasuta* Mortality (%)	*D.n. nasuta* Corrected Value	*D.s. neonasuta* Mortality (%)	*D.s. neonasuta* Corrected Value
0 (control)	6.4	—	18.0	—	3.8	—
500	27.0*	22.0	32.8*	18.0	71.2*	56.5
750	29.0*	24.1	42.2*	29.5	75.2*	62.5
1000	34.4*	29.9	50.8*	40.0	76.6*	64.6

*Significant at 5% level based on student's t-test.

Table 2. Mortality of *Drosophila* spp. as affected by different concentrations of 2,4-dichloro-1-naphthol.

Concentration (ppm)	*D. melanogaster* Mortality (%)	*D. melanogaster* Corrected Value	*D.n. nasuta* Mortality (%)	*D.n. nasuta* Corrected Value	*D.s. neonasuta* Mortality (%)	*D.s. neonasuta* Corrected Value
0 (control)	6.4	—	18.0	—	33.8	—
100	20.5*	15.0	54.0*	43.9	70.2	55.0*
150	22.1*	16.8	55.4*	45.6	79.2	68.6*
200	23.0*	17.8	67.5*	60.4	85.4	78.0*

*Significant at 5% level based on student's t-test.

Krishnamurthy (1975) on competition between *D.n. nasuta* and *D.s. neonasuta* in the same ecological niche revealed that the former is more superior than the latter. Results conform with the findings of Gayathri and Krishnamurthy (1979) that the two wild species are equally sensitive to organomercurials than *D. melanogaster*. *D. melanogaster* also had higher alcohol tolerance than *D. bromeliae* (David, 1973). Based on this character *D. melanogaster* is distinct from other species of the *melanogaster* subgroup namely *D. simulans*, *D. erecta*, *D. uakuba*, *D. mauritiana* and *D. tiessieri* (David et al., 1974). David and Bocquet (1976) further demonstrated that *D. melanogaster* is more tolerant to different alcohols than its sibling species, *D. simulans*.

Table 3. Mean development period of *Drosophila* spp. as affected by different concentrations of dithranol.

Concentration (ppm)	Mean Development Period (days)		
	D. melanogaster	*D.n. nasuta*	*D.n. neonasuta*
0 (control)	12.61 ± 0.05	11.77 ± 0.05	11.00 ± 0.04
500	15.37 ± 0.13*	18.15 ± 0.09*	16.69 ± 0.23*
750 ppm	15.26 ± 0.11*	17.82 ± 0.14*	16.51 ± 0.16*
1000 ppm	16.83 ± 0.15*	18.97 ± 0.14*	16.89 ± 0.18*

*Significant at 5% level, based on student's t-test.

Table 4. Mean development period of *Drosophila* spp. as affected by different concentrations of 2,4-dichloro-1-naphthol.

Concentration (ppm)	Mean Development Period (days)		
	D. melanogaster	*D.n. nasuta*	*D.n. neonasuta*
0 (control)	11.51 ± 0.07	11.77 ± 0.05	11.00 ± 0.04
100 ppm	16.76 ± 0.08*	17.20 ± 0.10*	14.80 ± 0.28*
150 ppm	16.55 ± 0.01*	16.44 ± 0.14*	16.70 ± 0.25*
200 ppm	16.19 ± 0.08*	17.04 ± 0.29*	17.14 ± 0.25*

*Significant at 5% level, based on student's t-test.

Literatures suggest several explanations for the differential sensitivities of different species. One view is related to the mutagen sensitivity to DNA content. Abrahamson et al. (1973) reported that radiation induced mutation is genes controlling the repair of damage due to methyl methane sulfonate increases the sensitivity of the cells to this chemical (Cotton Menzl et al., 1976-77). The two chemicals tested on three dif ferent species might have induced mutations differently in genes controlling the repair of the induced damage which in turn resulted to the differential sensitivity of the insects. Cotton-Menzl et al. (1976-77) opined that differential sensitivity of different strains within the same species is due to the long independent evolutionary histories of the genetic composition of the respective strains. Results of the study show that the versa tile species, *D. melanogaster* is lower in biomass than the two wild species but is more tolerant to environmental stresses.

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