ENDOTHAL INDUCED MUTATIONS IN DROSOPHILA MELANOGASTER

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ABSTRACT. — Endothal, an herbicide and defoliant, known to have cytological effects on chromosomes, is found to be mutagenic for *Drosophila melanogaster*.

Endothal-3003 (Niagara Chemical Company) is an herbicide and a defoliant. It has been used in the past as a defoliant for cotton, corn, apples, and cherries to facilitate mechanical harvesting. The active ingredient is disodium-3,5-endoxohexahydrophthalate at a concentration of 19.2%.

The cytological effects of endothal on meristematic tissue have been investigated by Daniel (1952). Cytologically this compound has the following effects on pea root tip mitosis at doses as low as 0.1 part per million:

a. Moderate lowering of the mitotic index.
b. Clumping of metaphase, but not to an extent such as to prevent more or less normal anaphase separation.
c. Lagging or erratic movement of individual chromosomes relative to the main mass.
d. Translocations and possibly fragmentations.

Since the effects of this compound appeared to be largely on the chromosomes themselves rather than on the mechanisms, it is suggested that it might well be a mutagen.

METHODS AND MATERIALS

Oregon-R males of *Drosophila melanogaster* at an age of 24 hours or less were subjected to aerosol treatment with Endothal. An aeration chamber consisting of a 12″ glass tube ¾″ in diameter with a long strip of wet filter paper in it to prevent dessication was fitted with holed rubber stoppers and appropriate glass tubing, the ends of which were covered with cheese-cloth. The "entrance" end of the glass tubing passed to a "bubble" chamber containing the Endothal. Filtered laboratory air was passed through the Endothal in the "bubble" chamber from which the Endothal-saturated air was passed to the aeration chamber containing the flies. The chemical was used full strength (19.2% commercial). The flies were treated for 24 hours. A control group received the same treatment but without the Endothal. About 10% of the test flies died during treatment.

Each of 30 treated and 22 control flies was mated with a Muller-5 female in individual 4″ x 1″ clear plastic vials on corn meal-agar medium. Live yeast was omitted and twice as much Brewer's yeast was added. Brother-sister F-1 matings were performed using the same type vials and medium. The progeny

from the F-1 matings were examined for wild type males, the absence of which indicated the presence of a sex-linked, recessive lethal.

To determine site of the induced lethals, 10 females of the composition M-5/lethal were mated in single pairs with marker stock of the composition *sc,t,v,f,car/Y*. The F-1 were test-crossed and the progeny scored for cross-over classes. The medium used was corn meal-agar with live yeast added. All matings were carried out at 25 degrees centigrade.

Results

The results for sex-linked recessive lethals in the controls compares favorably with the normal expected spontaneous rate for Oregon-R of about 0.012-0.100%. The results for sex-linked recessive lethals in the treated flies show a mutation rate of about 8.5 times the spontaneous rate (Table 1.). Sub-lethals and visibles were not checked.

Table 1. The Occurrence of Sex-linked Recessive Lethals in Controls and from Aerosol Treatment of Adult Oregon-R Males of *Drosophila* with Endothal.

Experiment	No. of X-Chromosomes Tested	No. of Sex-linked Lethals	% of Sex-linked Lethals
Control	1633	1	0.061
Endothal	2863	15	0.524

Using standard mapping procedures, the 10 lethals so far checked occur at random along the entire length of the X chromosome, except that four of the lethals are located to the right of *carnation,* and to the left of the kinetochore, suggesting a mutation in the heterochromatin. To date the basis for these lethals has not been determined. Further investigations are being conducted in that respect. It would also be interesting to know at what stage in development these lethals were operating.

Discussion

It may be concluded from this preliminary investigation that Endothal is mutagenic. This has certain implications when one considers the use to which it has been put. Likewise, in view of the use of other defoliants in military operations, knowledge of its mutagenic effect takes on additional significance. An exact comparison of Endothal with other organic mutagens is not possible as modes of treatment, test stock used, and control rates vary, and since the present study did not include sub-lethals and visibles, an increase in the potency of Endothal as a mutagen might well be inherent.

It is difficult to compare the cytological effects of Endothal on mitosis and mutagenicity with other chemicals from the weak-to-moderate mutagen class as the cytological aspects of most other mutagens has not been investigated, although Mitomycin-C has been found to cause breaks and translocations in *Tradescantia,* and likewise has been found to increase the mutation rate in *Drosophila* (Mukherjee, 1965), thus apparently paralleling the effects of Endothal. An investigation to ascertain the correlation, if any, between the cytological effects on mitosis and the mu-

tagenicity of these classes of compounds would be fruitful.

Summary

Endothal, an herbicide and defoliant is known to have aberrant effects on chromosomes. This investigation indicates it is also a mutagenic agent for *Drosophila*. In view of the use of herbicides and defoliants by both the civilian and the military, its mutagenicity takes on added significance.

Literature Cited

Daniel, A. 1952. Cytological Effects of Endothal. M.S. Thesis, Michigan State University, Unpublished.

Mukherjee. Ramen. 1965. Mutagenic Action of Mitomycin C on *Drosophila melanogaster*. *Genetics 51* (6):947-951.

Manuscript received August 5, 1969.