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THE EFFECT OF ULTRAVIOLET IRRADIATION UPON FECUNDITY OF DROSOPHILA MELANOGASTER

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The effect of ultraviolet rays upon Drosophila was studied as early as 1914 by Guyénot, whose work showed, first, that eggs subjected to ultraviolet irradiation failed to develop; second, that larvae were not affected by exposures of 15 minutes' duration, but were by exposures of 30 to 45 minutes' duration; third, that adult females irradiated after copulation laid eggs during the first three days which developed normally, but after the third day the number of non-developing eggs increased until the fifth day, after which non-development was the rule. He noted that most irradiated individuals died within fifteen days after treatment. However, he centered his attention on certain melanic forms which appeared in his irradiated strains, which he believed arose as a result of the ultraviolet irradiations. That this was true, however, he did not conclusively demonstrate.

Guyénot's work was deficient in these respects. He failed to report the age of the flies at the time of irradiation, the distance of the flies from the source of irradiation, or the temperature to which the flies were subjected at the time of irradiation. All or any of these factors would have influenced the results obtained.

Although much experimental work has been done testing the effect of ultraviolet rays on various types of animals, little has been reported in recent years relative to the effect of ultraviolet rays on Drosophila. To see if ultraviolet rays would have any pronounced effect on Drosophila the following experiments were performed.

In this set of experiments fecundity and length of life were the only factors upon which data were obtained. By fecundity is meant the total egg production of a female.

Method. Flies of the species *Drosophila melanogaster*, stock Wild D were used. The origin of this stock is unknown, but it has been kept for some years in the Purdue laboratories. Flies 12 hours or less in age were secured from the stock bottles and etherized. Males were separated from the females. After a period of 10 to 12 hours allowed to permit the flies to recover from the anesthesia, they were placed in a small wire cage about 30 mm. in diameter and 25 mm. deep. This was covered by a quartz plate 2 mm. in thickness. The flies were then exposed for various periods of time to the rays of an air-cooled quartz mercury vapor lamp (Hanovia Alpine Sun Lamp). The distance of the flies from the source of light was approximately 9 inches. The temperature at the time of exposure varied between 27° and 31° C.

For controls flies from the same stock and usually the same bottle were used. They were subjected to the same treatment as the experimental flies except that the wire cage was covered with a glass plate instead of a quartz plate. Controls were usually irradiated at the same time and under the same light and temperature conditions that the experimental flies were subjected to.

After irradiation the flies were separated into pairs, one male and one female, and each pair was placed in a shell vial 75 mm. by 22 mm. In some cases the males were not irradiated. Food consisted of a molasses-cornmeal-banana-agar mixture prepared according to Rifenburgh's formula, to which was added a drop of yeast solution. The food was heated until semi-fluid and then about one-half of a cubic centimeter was placed on a glass slide cut to fit into the vial. The semi-fluid food would flatten out on the slide providing a smooth surface. A drop of yeast solution was then added to the surface of the food. The slide was then inserted into the vial with the flies. Eggs were deposited on the surface of the food where they were easily seen. Rarely were eggs deposited on the sides of the vial.

Each day the slides were removed from the vials and the eggs counted. Usually some of the eggs had hatched before counting, in which case the number of larvae was added to the number of unhatched eggs. A new slide bearing fresh food was inserted in the place of the one removed. The flies were kept in an incubator at about 25° C.

Discussion. The experiments showed that egg laying in Drosophila was definitely inhibited by subjecting the females to ultraviolet irradiation for short periods of time. Eight or more minutes' exposure at a distance of 9 inches from the source of light resulted in almost complete sterilization. Exposure less than eight minutes in duration resulted in partial sterility. As the length of the exposure period decreased the number of eggs laid gradually increased until at 5 minutes exposure egg laying was about one-half normal.

Exposure to ultraviolet light also materially reduced the average length of life of the flies. This would obviously result in a decrease in the total number of eggs laid by the experimental flies.

Experiment	Time of exposure	No. females irradiated	No. eggs produced	Ave. No. eggs per female	Ave. life in days	Age of oldest
I	30 min.	13	0	0	5.7	7
		1	3	3	7.0	7
		1	1	1	7.0	7
II	20 min.	10	0	0	5.5	7
III	10 min.	9	0	0	4.6	7
		1	1	1	6.0	6
IV	8 min.	6	0	0	7.6	10
		16	218	13	7.2	11
		2	1,102	551	38.0	44
	control	1	1	1	note 1	.....
		8	6,069	758	note 1	.....
		7	3,100	443	note 1	.....
V	7.5 min.	3	0	0	7.3	10
		9	54	6	9.0	12
		2	480	240	16.0	19
	control	6	2,066	360	30.0	42
VI	7 min.	5	0	0	6.4	16
		25	305	13	8.3	14
		7	373	53	11.0	16
		1	121	121	8.0	8
		1	213	213	17.0	17
	control	6	4,317	719	note 2	.....
VII(a)	6 min.	7	0	0	9.1	20
		2	2	1	8.5	10
		7	226	32	12.0	31
		10	1,202	120	14.3	25
		7	3,325	475	26.6	37
	control	7	1,293	185	17.3	37
VII(b)	6 min.	11	0	0	6.2	9
		6	48	8	11.0	25
		4	161	40	10.8	14
		3	304	101	12.0	13
	control	7	2,444	349	note 3	.....
VIII	5 min.	10	2,747	274	22.0	37

Note 1—eggs were counted for only 11 days.
Note 2—eggs were counted for only 25 days.
Note 3—eggs were counted for only 12 days.

Other experiments showed that the time of irradiation was of importance. Flies exposed to ultraviolet rays within five hours after emergence were rendered sterile by short exposures. Flies more than 24 hours old were much more resistant to ultraviolet irradiations than flies

less than 24 hours old. This was probably due to the fact that the pigment which developes in the epidermis was incompletely developed for a period of a few hours after emergence. Also very young flies were much less viable and were much more liable to become caught in the food media. Or it may be that the developing ova were much more susceptible to the effects of the rays during the period immediately after emergence than later.

Males were more resistant to ultraviolet irradiations than females. Much longer periods of irradiation were necessary to bring about sterility. Irradiated males lived on an average longer than did irradiated females.

Experiment 7a showed irregularities which were not readily accounted for. Controls showed a lessened egg production and were shorter lived than the experimental flies. The fact that several of the experimental and the control flies died on the 13th day after irradiation suggests the possibility that some environmental factor might have been involved, for example a sudden rise in the temperature of the incubator.

In experiment 4, two irradiated flies showed a near-normal egg production. This might have been due to the individual resistance of these flies or it may have been that with a large number of flies in a small cage during irradiation, these two might have been partially shielded from the full effects of the ultraviolet rays.

It is the writer's belief that in nature, ultraviolet irradiations might play an important part in the reproductive activities of insects. Under some conditions, ultraviolet rays might stimulate egg production, under other conditions, inhibit it. There is a possibility that ultraviolet light because of its sterilizing power might be used in the control of certain insect pests.

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