

- AECU-1007 (1951). Hurd C.D. and A.R. Macon: *J. Am. Chem. Soc.*, 84, 4524 (1951).
 Pines H. and G. Benoy: *ibid.*, 82, 2483 (1960).
 4) Biggerstaff, W. R. A. P. Menditto and I. Yokoyama: *J. Org. Chem.*, 19, 934 (1954).
 5) "Organic Syntheses with Isotopes" part I, ed. by A. Murray III and D. L. Williams, Interscience Publishers Inc., New York, N. Y., 1958 p. 861..
 6) Phillips, R. U. L. W. Trevoy, L. B. Jaques and J. W. T. Spinks: *Can. J. Chem.*, 30, 844 (1952).
 7) Clarke H. T. and E. R. Taylor: "Org. Syn.", col. vol. 1, p. 150 (1941).
 8) Sato T. and M. Oki: *Bull. Chem. Soc. Japan*, 30, 859 (1957).

Mating Vigour and Sexual Competitiveness of Chemosterilized Males of *Culex fatigans*.

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17. 不妊剤で処理された *Culex fatigans* 雄の交尾活性 On Prakash Raghuwanshi (Aligarh Muslim University, Aligarh, India) 44. 6. 19 受理

幼虫期に apholate で処理して不妊化した *Culex fatigans* の雄成虫と、正常の雄とをいろいろの割合で混在させ、雌と自由に交尾させて、不妊雄の交尾活性、交尾競争を卵のふ化で調べた。その結果不妊雄は交尾競争で劣ることはなかった。180匹の雄を不妊雄1:正常雄2の割合で、180匹の雌と籠の中で交尾させ、150卵塊を得た。この内57卵塊は不ふ化(ふ化率5%以下)であり、この期待値は50卵塊であった。

A number of workers have studied the effects of radiation and chemosterilization on the mating vigour and sexual competitiveness of male mosquitoes. Davis *et al* (1959) observed a significant deficiency in the mating vigour of irradiated males of *Anopheles quadrimaculatus*. Normal females when allowed to mate with irradiated and normal males in 1:1:1 ratios laid eggs having a hatch rate of 74.0% as compared to the normal hatch rate of 96.0%. Both the irradiated and chemosterilized males of *Musca domestica* were found to be equally competitive to normal males, but males of *A. quadrimaculatus* irradiated at 12,000 r or fed on 1.0% apholate suffered a reduction of about 26% (Schmidt *et al.* 1964). The same workers observed that irradiation of males at 10,000 r or exposure to 7 mg/ft² tepa residues for two hours had practically no effect on their mating behaviour. LaBrecque *et al.* (1962) observed that male houseflies got sterilized when fed on 1.0% apholate and were equally or even more aggressive than the normal males in their mating power. On the other hand a loss in the mating vigour of the males of *Aedes aegypti* when treated with chemosterilants has been observed by Dame *et al.* (1964).

The findings reported above suggest that the

effects of sterilizing agents on the mating vigour of males are rather specific and vary with the mode of treatment. As no attempt has been made to study the effects of apholate on the mating vigour and sexual competitiveness of *C. fatigans*, the phenomenon was studied by making treatments in the larval stage.

Materials and Methods

Test insect and chemical

The mosquitoes used in the present studies were drawn from the normal laboratory strain initially developed from larvae collected from a tank in Aligarh. The larval food consisted of dried yeast and blood albumen and the adults were reared on 10% glucose solution. The females were also fed on chicken blood.

Apholate was obtained through the courtesy of Dr. C. N. Smith of United States Department of Agriculture.

Experimental procedure

Five-day old larvae were released in water treated with 30 ppm apholate and were allowed to pupate. The pupae were sexed and the ones destined to become males were placed for emergence in wire frame cages covered over with muslin cloth and mosquito netting. The emerging males, when three-day old were released in cages

measuring $6'' \times 6'' \times 6''$ in size along with the desired number of normal males and females of the same age. Egg rafts were obtained after the females had taken a blood meal and the rate of hatching for individual rafts was determined. In another test normal females were caged with treated males to determine the maximum and minimum sterility induced by the males.

Results and Discussion

Assuming that the sterilized and normal males were equally aggressive, the expected number of sterile rafts was calculated from the total number of rafts obtained on the basis of the proportion of sterilized males to the normal males. The expected number of sterile egg rafts when compared to the number of egg rafts actually obtained shows that the latter exceeded in all but two cases where the difference was almost negligible. This shows that the sterile males were no less vigorous and competitive in mating than the normal ones. In other words the females received the sterilized and normal males with equal preference.

The sterilized males, obtained from larvae exposed to 30 ppm apholate induced 95% or more sterility as against less than 10% unhatchable eggs obtained from crosses between normal males and females. Thus all rafts with a hatch rate of 5% or less can be grouped as sterile rafts and those with 90% or more hatch as the normal ones. The hatch rate obtained in the individual rafts was either less than 5% or nearer to the normal hatch so that it can be said that no instance of intermediate hatch occurred during the present studies. Dame *et al* (1964), however, found the males of *Ae. aegypti* treated with apholate in the larval stage to be comparatively less vigorous in mating with the females. Those workers also observed that mixing of sperms in the normal females, mated first to treated males and then to untreated males, greatly reduced the sterilizing effects of the treated males. The present author, however, could not observe any such effect. Infact as observed earlier by La-Brecque *et al* (1962) in the case of *Musca domestica*, a higher sterility level in the eggs obtained from the normal females caged with sterilized and normal males was found by the

present author. This may be due to the fact that the sterilized males or for that purpose the sterile sperms are more vigorous than the normal males or sperms. In a cross where 180 sterilized and normal males in a ratio of 1:2 were caged with 180 females, 150 egg rafts were obtained. Of these 57 were sterilized rafts as against an expected number of 50 such rafts (Table 1). It is possible that, inspite of their being double in number the normal males either could not compete with the sterilized ones in mating with the females or that the sterilized males on mating with the normal females nullified the effects of normal matings. In yet another experiment where the number of sterilized males was double than the normal ones, the number of actually obtained sterile rafts was still higher; 107 as against the expected number of 95.3. These observations therefore, clearly show that the chemosterilization of *C. fatigans* in the larval stage does not effect the mating potentialities of the males.

Table 1. Sexual competency of male *C. fatigans* treated with apholate.

Type of mating	Egg rafts obtained	Egg rafts with 5.0% hatch or less	
		Expected	Obtained
50: 50: 50*	36	18	17
60:120: 60	51	17	20
50:100:100	82	27.3	23
60:120:180	150	50	57
120: 60: 60	52	34.7	37
100: 50:100	90	60	58
120: 60:180	143	95.3	107
60: 60:120	100	50	50
50: 00: 50	41	41	41

* The figures indicate the number of sterilized males, normal males and normal females in each mating.

Summary

Effect of apholate on the mating vigour and sexual competency of male *Culex fatigans* was studied. Chemosterilized males were allowed to mate with normal females in presence of normal males in various ratios and rate of hatching was determined in individual egg rafts. It was observed that chemosterilization had an effect

on the mating competitiveness of male *C. fatigans*. In a cross where 180 sterilized and normal males in a ratio of 1:2 were caged with 180 females, 150 egg rafts were obtained. Of these 57 were sterilized rafts as against an expected number of 50 such rafts.

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References

- Dame, D. A., *et al*: Chemosterilization of *Aedes aegypti* (L) by larval treatments. *Mosquito News* 24 (1), 1~6. (1964).
- Davis, A. N., *et al*: Exploratory studies on gamma radiation for the sterilization and control of *Anopheles quadrimaculatus*. *J. econ. Ent.* 52 (5), 868~870. (1959).
- LaBrecque, G. C., *et al*: Mating competitiveness of chemosterilized and normal male houseflies. *Science* 136 (3514), 388~389. (1962).
- Schmidt, C. H., *et al*: Radiosterilization vs. chemosterilization in houseflies and mosquitoes. *J. econ. Ent.* 57 (5), 753~756. (1964).

Studies on Piericidin. I. Effects of Piericidin A and B on Mitochondrial Electron Transport in Insect Muscle Comparing with Rotenone. Takashi MITSUI*, Jun-ichi FUKAMI*, Kazuo FUKUNAGA*, Takao SAGAWA**, Nobutaka TAKAHASHI*** and Saburo TAMURA*** (* The Institute of Physical and Chemical Research, Saitama. ** Research Laboratories of Chugai Pharmaceutical Co., Ltd. Tokyo. *** Department of Agricultural Chemistry, The University of Tokyo, Tokyo) Received June 23, 1969. *Botyu-Kagaku*, 34, 126, 1969.

18. ピエリシジンに関する研究 I. ピエリシジンAおよびBのミトコンドリアの電子伝達系に及ぼす影響 満井 喬*, 深見順一*, 福永一夫*, 佐川隆夫**, 高橋信孝***, 田村三郎*** (* 理化学研究所 ** 中外製薬株式会社, 総合研究所 *** 東京大学農学部) 44. 6. 23 受理

ピエリシジンAおよびBのワモンゴキブリ筋肉ミトコンドリアの電子伝達系に及ぼす影響について、ロテノンと比較検討した。ピエリシジンAおよびBは、NADH酸化酵素系ではロテノンとはほぼ同濃度で呼吸を阻害する。また、その作用性からみて、ロテノンとはほぼ同一部位を阻害するものと考えられる。コハク酸酸化酵素系に対しては高濃度で弱い阻害がみられる。また酸化的リン酸化に対しても阻害が認められる。

NADH酸化酵素系において、ビタミンK₃による by-pass はロテノンと同様にラット肝臓ミトコンドリアでは認められるが、ワモンゴキブリでは、ほとんど認められない。この by-pass に関与する DT-diaphorase 活性は、ラット肝臓に比してワモンゴキブリでは約1/10に過ぎなかった。

Piericidin A and B have been isolated from *Streptomyces mobaraensis* and their chemical structures were elucidated by Tamura, Takahashi *et al.*^{1,2)} These compounds were found to have insecticidal activity to certain insects.

Hall *et al.* (1966)³⁾ found that Piericidin A was a powerful inhibitor of mitochondrial electron transport in beef heart mitochondria and they concluded that insecticidal activity of Piericidin A might be based on its inhibition of mitochondrial function.

The effect of Piericidin A to the aerobic oxida-

tion of substrates linked to pyridine nucleotides was as sensitive as previously described with rotenone.⁴⁻⁸⁾ In contrast with rotenone, however, Piericidin also inhibited succinoxidation system at considerably higher concentration. The fact that Piericidin resemble Co Q in the chemical structure and respiration was restored in succinoxidation system inhibited by Piericidin A by adding Co Q in this inhibited system suggested Piericidin A act as a competitive inhibitor of Co Q.

More recently, Miji *et al.* (1968)^{9,10)} further