

in absence of insecticide and the last one was selected in alternate generations of rearing. The continuous selection pressure resulted an increase in resistance ratio. However, the level of resistance was greatly lowered when the flies were bred in an environment free of insecticide. The colony which was selected in alternate generations of rearing showed no decline of resistance ratio.

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References

- Abedi, Z. H.: *Proc. Pan Indian Ocean Sc. Conf. Sect. B.*, 85 (1958).
 Bruce, W. N. and G. C. Decker: *Soap and Sanit. Chem.*, 26, 122 (1950).
 Busvine, J. R.: *Nature* (London), 168, 193 (1951).
 D'Alessandro, G. and M. Mariani: *Bull. Soc. Ital. Biol. Sper.*, 29, 687 (1953).
 Georghiou, G. P.: *Nature* (London), 207, 983 (1965).
 Keiding, J.: *Bull. Wild. Hlth. Org.*, 29, Suppl., 51 (1963).
 King, W. V.: *J. Econ. Ent.*, 43, 527 (1950).
 Khan, N. H. and J. A. Ansari: *Symp. on pesticides*, Mysore, India, 339 (1964).
 Pimentel, D., et al.: *J. Econ. Ent.*, 46, 295 (1953).

Mating Vigour and Sexual Competitiveness of Chemosterilized Males of *Musca domestica nebulosa* Fabr. Musharraf A. ANSARI (Department of Zoology, Aligarh Muslim University, Aligarh (U. P.), India.) Received August 1, 1972, *Botyu-Kagaku* 37, 125, 1972.

18. イエバエ不妊化雄の交尾時の活性と競争 (Musharraf A. ANSARI (Aligarh Muslim 大学, 動物学教室) 47. 8. 1. 受理)

apholate, tepa, metepa, hempa 及び hemel によって不妊化したイエバエ雄は、交尾活性において、正常雄となら活性に差はみられなかった。正常雄の数を不妊化雄の2倍入れた交尾試験では、理論値の33.3%に近い値の不妊化率を示した。

Several workers have studied the effects of radiation and chemosterilization on the mating vigour and sexual competitiveness of male insects. Davis *et al.* (1959) observed a significant loss in the mating vigour of males of *Anopheles quadrimaculatus* when they were exposed to gamma irradiation. Similar results were obtained by Dame *et al.* (1964) in chemosterilized males of *Aedes aegypti*. On the other hand no reduction in sexual competitiveness could be found in males of *Culex fatigans* when treated with apholate (Raghuwanshi, 1969). The irradiated and chemosterilized males of *M. d. domestica* were also equally vigorous to the normal ones (Schmidt *et al.*, 1964). Labrecque *et al.* (1962) reported that male houseflies sterilized with 1.0 percent of apholate were almost equally or even more aggressive than the normal ones. The same author with his associates demonstrated in 1966 that hempa did not impair with the mating com-

petitiveness of males or of the motility of the sperm when fed on 1.0 percent of this chemical. This was later confirmed by Ogata and Tanaka (1967) who observed that hempa treated males of *M. d. vicina* were almost as vigorous as the normal ones. Males of *M. sorbens* when sterilized with metepa were also as competitive as the normal ones in mating with the normal females (Hafez *et al.*, 1970).

The findings reported above suggest that the effects of sterilizing agents on the mating vigour of males are some what specific and vary with the mode of treatment. Since no attempt has been made to study the effects of such chemicals on the mating behaviour of *M. d. nebulosa*, an attempt has been made to study this phenomenon by incorporating the candidate chemosterilant in the diet of the adults.

Materials and Methods

The flies used during the present studies were obtained from a normal strain of *M. d. nebulosus* that is being maintained in the laboratory since 1961. They were reared on cotton pads soaked in diluted milk at a temperature of $28 \pm 1^\circ\text{C}$ and 60 to 70% relative humidity.

The samples of chemosterilants were obtained through the courtesy of Dr. A. B. Borkovec, In Charge, Pesticide Chemicals Research Branch, USDA, Beltsville, Maryland (U. S. A.).

Freshly emerged flies were sexed and those belonging to each sex were reared separately in such a way that approximately half of each sex were fed on sugar treated with the desired con-

centration of the chemosterilant while the other half was given untreated sugar. When the flies were five day old, crosses were made in $8 \times 8''$ cloth cages with different ratios of sterilized males, normal males and virgin females. Eggs were collected on black moist cloth and the rate of hatching was determined after twenty four hours. Percent net sterility was calculated from the formulae as suggested by Hair and Adkins (1964). Observations were taken at interval of 24 hours for ten days. Presuming that the sterilized males were no less vigorous than normal males, the expected percent sterility was calculated on the basis of the proportions of sterilized and normal males and was compared to the net sterility observed in tests.

Table 1. Percent sterility obtained in normal females mated with normal and apholate treated males.*

Type of Mating					
Treated males	Normal males	Normal females	S/N males (%)	Eggs obtained per female	Percent net sterility
15	0	15	100.0	124.2	100.0
20	20	40	50.0	121.9	46.8
40	20	60	66.6	114.9	68.3
30	15	30	66.6	122.9	66.4
40	20	20	66.6	127.1	70.9
20	40	60	33.3	115.4	31.8
15	30	30	33.3	106.8	36.3
20	40	20	33.3	137.5	32.9
15	15	15	50.0	144.8	49.4

* Males were treated with 0.125 percent of apholate.

Table 2. Percent sterility obtained in normal females mated with normal and teпа treated males.*

Type of mating					
Treated males	Normal males	Normal females	S/N males (%)	Eggs obtained per female	Percent net sterility
15	0	15	100.0	138.1	100.0
20	20	40	50.0	110.2	50.4
40	20	60	66.6	108.7	68.9
30	15	30	66.6	103.8	68.1
40	20	20	66.6	107.4	71.9
20	40	60	33.3	100.5	35.8
15	30	30	33.3	99.3	34.1
20	40	20	33.3	127.5	37.2
15	15	15	50.0	135.8	54.5

* Males were treated with 0.03125 percent of teпа.

Table 3. Percent sterility obtained in normal females mated with normal and metepa treated males.*

Type of mating					
Treated males	Normal males	Normal females	S/N males (%)	Eggs obtained per female	Percent net sterility
15	0	15	100.0	131.1	100.1
20	20	40	50.0	98.6	50.6
40	20	60	66.6	104.9	70.3
30	15	30	66.6	118.3	64.4
40	20	20	66.6	135.0	70.0
20	40	60	33.3	103.6	37.6
15	30	30	33.3	123.1	29.6
20	40	20	33.3	137.5	36.4
15	15	15	50.0	120.8	57.3

* Males were treated with 0.125 percent of metepa.

Table 4. Percent sterility obtained in normal females mated with normal and hempa treated males.*

Type of mating					
Treated males	Normal males	Normal females	S/N males (%)	Eggs obtained per female	Percent net sterility
15	0	15	100.0	139.9	100.0
20	20	40	50.0	117.0	49.2
40	20	60	66.6	110.2	67.2
30	15	30	66.6	118.3	72.9
40	20	20	66.6	129.2	69.3
20	40	60	33.3	111.06	36.5
15	30	30	33.3	100.2	32.3
20	40	20	33.3	140.2	36.6
15	15	15	50.0	111.6	56.4

* Males were treated with 1.0 percent hempa.

Table 5. Percent sterility obtained in normal females mated with normal and hemel treated males.*

Type of mating					
Treated males	Normal males	Normal females	S/N males (%)	Eggs obtained per female	Percent net sterility
15	0	15	100.0	121.6	100.0
20	20	40	50.0	117.5	50.2
40	20	60	66.6	121.5	69.7
30	15	30	66.6	137.5	73.8
40	20	20	66.6	113.4	74.2
20	40	60	33.3	103.03	35.8
15	30	30	33.3	127.6	30.8
20	40	20	33.3	130.4	29.4
15	15	15	50.0	137.06	54.2

* Males were treated with 2.0 percent of hemel.

Results

The detailed results of tests performed with apholate, tepa, metepa, hempa and hemel are presented in Tables 1 to 5 which clearly indicate that males of *M. d. nebulo* when treated with these chemicals do not lose any vigour and are as competitive as the normal ones. In other words virgin females mated with sterilized males and normal males with equal preference.

Discussion

The males sterilized by apholate, tepa, metepa, hempa and hemel and mated with equal number of virgin females along with the same number of normal males, produced 49.4, 54.5, 57.3, 56.4 and 54.2% net sterility as against an expected sterility of 50.0% (Tables 1-5). This shows that with the exception of apholate actual sterility levels in the eggs obtained from normal females caged with sterilized and normal males were higher in comparison to expected sterility. Similar results were obtained by Labrecque *et al.* (1962) who found a high degree of sterility in the eggs from a cage containing normal females, sterilized males and normal males. This might be due to the fact that sterilized males were more aggressive than the normal ones. In other series of tests, when 60 sterilized and normal males in a ratio 1 : 2 were introduced in a cage containing 60 virgin females, 31.8, 35.8, 37.6, 35.6 and 35.8% net sterility was obtained with apholate, tepa, metepa, hempa and hemel respectively as against 33.3% expected sterility suggesting thereby that in spite of their double number, the normal males could not equally compete with the sterilized males. It is also possible that the sterilized males mating with normal females nullified the effect of normal mating. In contrast where the sterilized males were twice in number than the normal ones, 68.3, 68.9, 70.3, 67.2 and 69.7% net steri-

lity was obtained with apholate, tepa, metepa, hempa and hemel respectively. This is slight higher than the expected sterility.

The present findings also suggest that the males of *M. d. nebulo* sterilized with chemosterilants are no less vigorous than the normal ones. This is in line with the earlier observations in the case of *M. d. domestica* and *M. d. vicina*.

Summary

Mating vigour and sexual competitiveness of male, *Musca domestica nebulo* F. sterilized by apholate, tepa, metepa, hempa or hemel was studied by allowing the treated males to mate with virgin females of the same age along with normal males in various ratios. It was found that sterilized males were equally or even more aggressive than the normal ones in their mating potentialities. In a test where normal males were doubled in number than the treated ones, 31.8, 35.8, 37.6, 35.6 or 35.8% net sterility was obtained with apholate, tepa, metepa, hempa or hemel respectively as against 33.3% expected sterility.

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References

- Dame, D. A., *et al.*: *Mosquito News*, 24, 1 (1964).
 Davis, A. N., *et al.*: *J. Econ. Ent.*, 52, 868 (1959).
 Hafez, M., *et al.*: *J. Econ. Ent.*, 63, 213 (1970).
 Hair, J. A. and T. R. Adkins: *J. Econ. Ent.*, 57, 586 (1964).
 Labrecque, G. C., *et al.*: *Science*, 136, 388 (1962).
 Labrecque, G. C., *et al.*: *J. Med. Ent.*, 3, 40 (1966).
 Ogata, K. and I. Tanaka: *Jap. J. Sanit. Zool.*, 18, 32 (1967).
 Raghuwanshi, O. P.: *Botyu-Kagaku*, 34, 124 (1967).
 Schmidt, C. H., *et al.*: *J. Econ. Ent.*, 57, 753 (1964).