INHERITANCE PATTERN OF TWO NEW MUTANTS, RED-EYE AND GREENISH BROWN-LARVA IN *ANOPHELES STEPHENSI*

V. P. SHARMA, SARALA K. SUBBARAO, M. A. ANSARI AND R. K. RAZDAN

Malaria Research Centre, (ICMR) 22 Sham Nath Marg, Delhi-110054.

ABSTRACT. Two new mutants, *red-eye* and *greenish brown-larva* have been isolated and genetically analyzed in *An. stephensi* type form. The inheritance pattern revealed that *red-eye* is a recessive sex-linked mutant and *greenish brown-larva* is an autosomal recessive mutant.

INTRODUCTION

Malaria resurgence on a nationwide scale and its importance as the preeminent vector-borne disease have led to intensified research on *Anopheles stephensi*, an important transmitter of malaria. As a first step, phenotypic markers of this vector are being isolated, characterized and maintained in our laboratory. These mutants would be of great help in assigning insecticide resistant genes to their respective chromosomes.

Two eye-color mutants, *colorless-eye* an autosomal mutant in *An. stephensi* type form (Sharma et al. 1977) and *white-eye*, a sex-linked mutant in *An. stephensi mysorensis* (Aslamkhan 1973) have already been studied. In addition to these, 3 autosomal larval mutants, black-larva (Mason and Davidson 1966), *Stripe* (Sakai et al. 1974), *green-larva* (Subbarao and Adak 1978), and several biochemical variants (Bianchi 1968, Bullini et al. 1971, Iqbal et al. 1973a, b) have been reported in *An. stephensi*. This paper describes the inheritance pattern of 2 more mutants, *red-eye* and *greenish brown-larva* in *An. stephensi* type form.

MATERIAL AND METHODS

Red-eye mutant was isolated in 1977 from a laboratory colony which was established in 1973 from Sonepat, Haryana, India. The *red-eye* (*r*) mutant expresses its phenotype, red colored eyes, from the 1st instar through adult stage. The *greenish brown-larva* (*gb*) was isolated from the wild populations of Pondicherry, India in 1975. This mutant expresses its phenotype-greenish brown color at the larval and pupal stages. In instar II, this mutant is darker in color compared to the wild type. As the larvae reach late III and IV instars the greenish brown color becomes more distinct with a slightly more greenish tinge in the thorax. True-breeding colonies of these mutants were established. Mosquito rearing was carried out following a procedure described by Ansari et al. (1978). Crossing experiments were carried out in 30×30×30 cm size cages in a laboratory maintained at 27–28°C and 70–80% RH.

RESULTS AND DISCUSSION

RED-EYE. The results of a cross between *red-eye* (*r*) and wild type (+) are given in

Table 1. In cross no. 1 where *red-eye* males (*r*/−) were crossed with wild type females (+/+), the F_1 progeny consisted of all wild type individuals suggesting that it is a recessive mutant. However, in the reciprocal cross (cross no. 2) where *red-eye* females (*r*/*r*) were crossed with wild type males (+/−), F_1 progeny consisted of wild type females and mutant phenotype males. This suggests that it may be a sex-linked mutant. In both the crosses F_1 progeny were inbred to obtain F_2 individuals. In cross no. 1 among the F_2 progeny, all females were of wild type, while in males both wild and red phenotypes were found. Absence of red females among F_2 progeny further supports the idea that it is a sex-linked mutant. This indicates that the appearance of a mutant phenotype in F_1 males of this cross was due to the hemizgyous condition of males and that sex determination is of X-Y type as reported in *An. stephensi mysorensis* (Aslamkhan 1973). Among males even though both types were present, red males were significantly fewer in number than wild types. In cross no. 2 the 2 categories were expected in 1:1 ratio but the red type was much more scarce than the wild types. However, in each category males and females were in 1:1 ratio. The fact that red males were fewer than the wild type in cross no. 1, and both males and females of the red category were fewer than the wild type in cross no. 2 suggests that some lethality was associated with the mutant. *Red-eye* is the first sex-linked mutant reported in *An. stephensi* type form, and this mutant can be used as a good phenotypic marker in any genetic study.

GREENISH BROWN-LARVA. *Gb* was reciprocally crossed with wild type and the results are given in Table 2. Both in cross nos. 1 and 2, the mutant phenotype was not observed among the F_1 progeny indicating that it is an autosomal recessive mutant. This is further supported by the results in the F_2 generation where wild and greenish brown phenotypes appeared in the expected 3:1 ratio. It may be mentioned that the maintenance of this mutant is easy, but a clear color dis-

Table 1. Results of crosses involving *red-eye* and wild type *Anopheles stephensi*.

Cross No.	Parental phenotype and genotype ♀ ♂	F_1 progeny Wild type ♀	♂	F_1 progeny red eyes ♀	♂	F_2 progeny Wild type ♀	♂	F_2 progeny red eyes ♀	♂	Total ♀	♂	χ^2 df=2
1	Wild (+/+) red r/−	66	44	—	—	566 (566)	252 (255.5)	0 (225.5)	199	566	451	6.2 $p<0.05$
2	red r/r wild +/−	166	—	—	190	78 (65)	82 (67.5)	52 (65)	53 (67.5)	130	135	11.40 $p<0.01$

( ) Expected numbers.
Note: The expectations are based on the null hypothesis that within each sex the mendelian ratio appropriated to F_2 would appear. The values of χ^2 calculated for females and for males have been added, thus the values shown have two degrees of freedom.

Table 2. Results of crosses involving *greenish brown-larva* and wild type *Anopheles stephensi.*

Cross No.	Parental phenotype and genotype ♀	♂	F_2 progeny wild type ♀	♂	greenish brown ♀	♂	Total ♀	♂	χ^2 df=2 P=0.05
1.	Greenish brown *gb/gb*	Wild +/+	149 (141.75)	155 (149.25)	40 (47.25)	44 (49.75)	189	199	2.36 n.s.
2.	Wild +/+	Greenish brown *gb/gb*	217 (213.75)	208 (205.5)	68 (71.25)	66 (68.5)	285	274	0.3 n.s.

( ) Expected numbers.
n.s.=non-significant.
Note: The expectations are based on the null hypothesis that with each sex the mendelian ratio appropriated to F_2 would appear. The values of χ^2 calculated for females and for males have been added, thus the values shown have two degrees of freedom.

tinction is achieved only in the late third or early fourth instar.

ACKNOWLEDGMENT. We are thankful to Shri A. K. Mukherjee for his technical assistance.

References Cited

Ansari, M. A., V. P. Sharma and R. K. Razdan. 1979. Mass rearing procedure for *Anopheles stephensi* Liston. J. Commun. Dis. (in press).

Aslamkhan, M. 1973. Sex-chromosomes and sex-determination in the malaria mosquito, *Anopheles stephensi*. Pak. J. Zool. 5:127–130.

Bianchi, U. 1968. Genetica formale di una proteina dotate di attivita catalitica esterasica in *Anopheles stephensi*. Accad. Naz. Lincei Rend. Sci. Fis. Mat. Nat. 45:60–62.

Bullini, L., M. Coluzzi, G. Cancrini and C. Santolamazza. 1971. Multiple phosphoglucomutase alleles in *Anopheles stephensi*. Heredity 26:475–478.

Iqbal, M. P., R. K. Sakai and R. H. Baker. 1973a. The genetics of an alcohol dehydrogenase in a mosquito *Anopheles stephensi*. J. Med. Entomol. 10:309–311.

Iqbal, M. P., M. K. Tahir, R. K. Sakai and R. H. Baker. 1973b. Linkage groups and recombination in the malaria mosquito. J. Hered. 64:133–136.

Mason, Y. F. and Davidson, G. 1966. Morphological mutants in anopheline mosquitoes. Trans. Roy. Soc. Trop. Med. Hyg. 6:20.

Sakai, R. K., M. P. Iqbal and R. H. Baker. 1974. The genetics of stripe, a new morphological mutant in the malaria mosquito, *Anopheles stephensi*. Can. J. Genet. Cytol. 16:669–675.

Sharma, V. P., T. R. Mani, T. Adak and M. A. Ansari. 1977. Colorless-eye, a recessive autosomal mutant of *Anopheles stephensi*. Mosquito News 37(4):667–669.

Subbarao, Sarala K. and T. Adak. 1978. Genetic anaylsis of a larval color mutant, green larva, in *Anopheles stephensi*. Mosquito News 38:51–53.