GENETICS OF WHITE EYE IN *ANOPHELES CULICIFACIES*

R. K. SAKAI AND R. H. BAKER

Pakistan Medical Research Center, University of Maryland, 6, Birdwood Road, Lahore, Pakistan

ABSTRACT. Genetic analysis of a white eye mutant in *Anopheles culicifacies* Giles indicates that it is sex linked, recessive in females and hemizygous in males. The data indicate that white eye is allelic to another sex linked mutant, rose eye.

Anopheles culicifacies Giles, an important malaria vector in the Indo-Pakistan subcontinent, has been under intensive investigation in our laboratory for the past few years. A number of mutants have been described (Sakai et al. 1977, 1979a,c), a few enzyme polymorphisms have been investigated (Ahmad et al. 1978), a polytene chromosome map has been prepared (Saifuddin et al. 1978), a number of translocations have been induced, isolated and characterized (Baker et al. 1978), and the chromosomes have been correlated to their respective linkage groups (Sakai et al. 1979b).

During routine culling of a sex-linked translocation strain, *T(X,3R)1* (Baker et al. 1978), which was maintained as a heterozygote by crossing phenotypically wild type females to rose (Sakai et al. 1977) males, a few females with pale rose eyes were found. These females were crossed to wild type males of the standard Sattoki strain and the resulting F_1 progeny consisted of wild type females and rose and white eyed males. In the next generation the white eyed males were crossed to their phenotypically wild type sisters and in some of the resulting families both white eyed females and

males were recovered. These were used to obtain a true-breeding white eye strain. This paper reports the results of genetic analyses which suggest that white eye (re^w) is an allele of the rose eye (re) locus.

MATERIALS AND METHODS

The following strains were used in the crosses: 1) Sattoki—This is the standard wild type strain. 2) Rose eye (re)—This strain contains the sex-linked mutant, rose eye (Sakai et al. 1977), which is recessive in females whereas the males are hemizygous for this locus. 3) White eye (re^w)—a pure breeding strain with eyes lacking pigment.

The methods of performing the crosses and the rearing procedures were as previously described (Sakai et al. 1977).

RESULTS AND DISCUSSION

Table 1 summarizes the crosses between the standard wild type Sattoki strain and the white eyed strain. The data for the families within each cross were pooled as there was no significant heterogeneity among families within a cross, and the sex ratios were 1:1 ($P>.05$). Crosses 1 and 2 are reciprocal crosses between the Sattoki wild type and the white eyed strains. When the female was wild type (cross 1), all the offspring were wild type, whereas if the female was white eyed, the resulting female progeny were wild type and all the males were white eyed (cross 2). Backcrosses of F_1 females from either crosses 1 or 2 with wild type males resulted in three classes of progeny: wild type females and wild type and

Table 1. Crosses to elucidate the mode of inheritance of white eye.

Cross	Presumptive parental genotypes[1] ♀		♂	f[2]	Progeny Phenotypes ♀ +	♀ w	♂ +	♂ w
1	X + / X + (wild type)	X	X w / Y − (white)	8	380	0	392	0
2	X w / X w (white)	X	X + / Y − (wild type)	9	412	0	0	403
3	X + / X w (wild type)	X	X + / Y − (wild type)	11	600	0	302	328
4	X w / X + (wild type)	X	X + / Y − (wild type)	12	650	0	351	351
5	X + / X w (wild type)	X	X w / Y − (white)	7	168	152	165	188
6	X w / X + (wild type)	X	X w / Y − (white)	12	341	365	329	364
7	X + / X + (wild type)	X	X + / Y − (wild type)	7	311	0	292	0
8	X + / X + (wild type)	X	X w / Y − (white)	12	643	0	616	0
9	X w / X w (white)	X	X + / Y − (wild type)	4	133	0	0	105
10	X w / X w (white)	X	X w / Y − (white)	12	0	583	0	526

[1] X, Y = X and Y chromosomes, respectively; $w = re^w$ = white eye; + = re^+ = wild type.
[2] f = number of families tested.

white males in a 2:1:1 ($P>0.05$, crosses 3 and 4). Crosses of either F_1 females with white males resulted in wild type and white females and males in a 1:1:1:1 ratio ($P>0.05$, crosses 5 and 6). Crosses of white type females to either type of F_1 males resulted in all wild type progeny (crosses 7 and 8). When F_1 males from cross 1 were crossed to white females, the progeny consisted of wild type females and white males (cross 9) whereas white females crossed to F_1 males from cross 2 resulted in all white progeny (cross 10).

These results suggest that white eye is sex linked, recessive in females and hemizygous in males. These data are similar to those obtained from the genetic analysis of another sex linked mutant, rose eye, in this species (Sakai et al. 1977). Therefore a series of crosses was made to explore the possibility of allelism between these 2 mutations (Table 2). Crosses 11 and 12 are the reciprocal crosses between the rose and white strain. When rose females are crossed to white males, the progeny females are pale rose and the males are rose. In the reciprocal cross (white females with rose males) the females are also pale rose but all the male progeny are white. Crossing either F_1 females to white males gave rise to pale rose and white females and rose and white males in a 1:1:1:1 ratio ($P>0.05$, crosses 13 and 14). Crosses of either F_1 females to rose males resulted in rose and pale rose females and rose and white males also in a 1:1:1:1 ratio ($P>0.05$, crosses 15 and 16). Crosses of white females to F_1 males from cross 12 gave white female and male progeny whereas

Table 2. Results of crosses to test for allelism between rose and white.

	Presumptive parental genotype[1]			Progeny Phenotypes				
				♀			♂	
Cross	♀	♂	f[2]	rose	rose	white	rose	white
11	X re / X re (rose)	X w / Y – (white)	3	0	76	0	69	0
12	X w / X w (white)	X re / Y – (rose)	4	0	152	0	0	151
13	X w / X re (pale rose)	X w / Y – (white)	10	0	227	212	220	209
14	X re / X w (pale rose)	X w / Y – (white)	5	0	92	118	112	125
15	X w / X re (pale rose)	X re / Y – (rose)	5	143	171	0	145	149
16	X re / X w (pale rose)	X re / Y – (rose)	5	115	136	0	133	110
17	X w / X w (white)	X w / Y – (white)	12	0	0	474	0	464
18	X w / X w (white)	X re / Y – (rose)	4	0	247	0	0	218
19	X re / X re (rose)	X w / Y – (white)	4	0	126	0	107	0
20	X re / X re (rose)	X re / Y – (rose)	6	231	0	0	248	0

[1] X, Y = X and Y chromosomes, respectively; *re* = rose eye; *w* = re^w = white eye.
[2] f = number of families tested.

the same type of females crossed to F_1 males from cross 11 resulted in pale rose female and white males (crosses 17 and 18, respectively). In cross 19 rose females were crossed to F_1 males from cross 12 and the progeny consisted of pale rose females and rose males. When rose female were crossed to the F_1 males from cross 11, the resulting progeny were all rose. The results suggest that *re* and re^w are allelic and codominant as the heterozygous females show a phenotype intermediate between those of the two homozygotes. These observations are similar to those of Curtis (1976) who concluded that white and pink eye in *An. gambiae* species A are under the genetic control of codominant alleles of a sex-linked locus.

References Cited

Ahmad, M., R. K. Sakai, R. H. Baker and R. W. Ainsley. 1978. Genetic analysis of two enzyme polymorphisms in a malaria vector mosquito. Octanol dehydrogenase and acid phosphatase in *Anopheles culicifacies* Giles. J. Hered. 69:155–158.

Baker, R. H., R. K. Sakai, U. T. Saifuddin and A. Parveen. 1978. Induced chromosomal aberrations in *Anopheles culicifacies*. Mosq. News 38:370–376.

Curtis, C. 1976. Allelism test of two eye color mutants in *Anopheles gambiae* species A. Trans. Roy. Soc. Trop. Med. Hyg. 70:281.

Saifuddin, U. T., R. H. Baker and R. K. Sakai. 1978. The chromosomes of *Anopheles culicifacies*. Mosq. News 38:233–239.

Sakai, R. K., M. Ahmad, F. Aslam and R. H. Baker. 1979a. Genetics of two new autosomal loci in linkage group II of the malaria vector, *Anopheles culicifacies*. Ann. Entomol. Soc. Am. 72:328–330.

Sakai, R. K., R. W. Ainsley and R. W. Baker. 1977. The inheritance of rose eye, a sex-linked mutant in the malaria vector, *Anopheles culicifacies*. Can. J. Genet. Cytol. 19:633–636.

Sakai, R. K., R. H. Baker, M. Ahmad, F. Aslam and U. T. Saifuddin. 1979b. Linkage group-chromosome correlation in the malaria vector, *Anopheles culicifacies*. Ann. Entomol. Soc. Am. 72:171–172.

Sakai, R. K., R. H. Baker and S. Javed. 1979c. Genetic and linkage analyses of dieldrin resistance in *Anopheles culicifacies*. Trans. Roy. Soc. Trop. Med. Hyg. 73:445–450.