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GENETIC ANALYSIS OF A LARVAL COLOR MUTANT, *YELLOW LARVA,* IN *ANOPHELES SUNDAICUS*

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ABSTRACT. One larval body color mutant, *yellow larva* (*yl*), was isolated from a newly established cyclic colony of *Anopheles sundaicus.* The inheritance pattern revealed that *yellow larva* was an autosomal recessive mutant.

Anopheles sundaicus (Rodenwaldt) was a primary vector of malaria throughout its range in coastal areas of Andhra Pradesh, Orissa, Tamil Nadu, West Bengal, and the Andaman and Nicobar group of islands (Christophers 1912, Iyengar 1931, Senior White 1947). At present this species is restricted to the Andaman and Nicobar group of islands, where it plays a major role in malaria transmission (Malaria Research Centre 1989). Although *An. sundaicus* has not been incriminated since 1927 (Covell 1927), it is believed that *An. sundaicus* is the only vector responsible for malaria transmission on these islands, as evidenced by epidemiological findings (Kalra 1980).

Until now colonization of *An. sundaicus* has not been attempted and, therefore, our knowledge of its biology and genetics has remained rudimentary. We have now successfully colonized *An. sundaicus,* and in this process we isolated a mutant, *yellow larva* (*yl*). This paper reports the mode of inheritance of this new larval mutant.

Anopheles sundaicus breeds mainly in creeks and other brackish water bodies. On Car Nicobar Island, breeding of this species has also been noticed in freshwater ponds, pools, wells, and puddles.

Nearly 500 *An. sundaicus* gravid females were collected with the help of a mouth aspirator and torch light between 0500 and 0800 h from keori (*Pandanus larum*) bush, one of the daytime outdoor resting sites of this species. Live mosquitoes were transported to the Malaria Research Centre laboratory located at Car Nicobar Island (Malacca, 6–10°N, 92–94°E, in the Bay of Bengal). Mosquitoes were held in a 60 × 60 × 60-cm cloth cage and kept in the insectary maintained at 28 ± 2°C and 70–80% RH. Eggs were collected in plastic bowls containing water and lined with filter paper. Larvae were reared in enamel trays and fed on a mixture of dog biscuit and yeast powder in a ratio of 3:2. After emergence adults were offered 1% glucose-soaked cotton pads and fresh water-soaked raisins. On the 5th day after emergence females were bloodfed on a pigeon. In the larval rearing trays of the wild colony 9 *yellow larva* mutants were observed. These were isolated and a pure homozygous colony of the mutant was established from 6 adult females and 3 adult males emerged from these 9 larvae. The mutant strain, *yellow larva,* and the wild type were inbred separately for 3 continuous generations before they were accepted as pure homozygous strains. The *yellow larva* mutant expresses its phenotype from the early 2nd instar through the pupal stage, but the adults are not distinguishable from the wild type. Series of genetic crosses were set up between *yellow larva* and the wild type. Individual gravid females from different crosses were held in small plastic ice cream cups (100-ml capacity) containing little water and lined with filter paper for single female oviposition. After oviposition each batch of eggs from one female was reared as a single isofemale progeny. Because mutant phenotypes were easily distinguished at an early instar, larvae were separated and the phenotype was recorded at the 2nd larval stage. This procedure provided accurate numbers in each category and helped in avoiding errors due to occasional mortality in the late instars.

Yellow larva and the wild type were crossed reciprocally and the results of crosses showing the mode of inheritance of *yellow larva* and its linkage relationship with sex are given in Table 1. Absence of the mutant phenotype in F_1 progeny of both the reciprocal crosses (crosses 1 and 2) indicated that *yellow larva* is a recessive mutant. This was further supported by a 3:1 ratio of wild type to *yellow larva* in F_2 progeny, when F_1 progeny of cross 1 were inbred (cross 3). When F_1 males and females obtained from cross 1 were backcrossed to mutant females and males, respectively (crosses 4 and 5), wild and mutant phenotypes were obtained in a ratio of 1:1. Absence of mutant phenotypes in F_1 males of cross 2 indicated that *yellow larva* is not a sex-linked mutant, assuming that the sex determination mechanism in *An. sundaicus* is XX and XY type as in *Anopheles stephensi* Liston (Aslamkhan 1973) and *Anopheles culicifacies* Giles (Sakai et al. 1977), where the females are homogametic (X/X) and the males are heterogametic (X/Y). This was further supported by free segregation of *yellow larva* with sex and nonsignificant chi-square values of 0.12, 0.58, and 1.78 observed in F_2 progeny of crosses 3, 4, and 5, respectively. The *yellow larva* is a recessive, autosomal mutant that showed complete penetrance and constant ex-

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Table 1. Crosses elucidating the mode of inheritance of *yellow larva* in *Anopheles sundaicus*.

Cross no.	Parental genotype ♀	×	Parental genotype ♂	Families tested	Progeny phenotype: Wild type ♀	Wild type ♂	Wild type Total	Yellow type ♀	Yellow type ♂	Yellow type Total	χ^2 (df 1)
1	$\frac{+yl}{+}$	×	$\frac{yl}{yl}$	13	457	434	891	—	—	—	—
2	$\frac{yl}{yl}$	×	$\frac{+yl}{+yl}$	17	502	491	993	—	—	—	—
3	$\frac{+yl}{yl}$	×	$\frac{+yl}{yl}$	13	355	341	696	108	118	226	0.12 (ns)
4	$\frac{yl}{yl}$	×	$\frac{+yl}{yl}$	8	188	201	389	176	192	368	0.58 (ns)
5	$\frac{+yl}{yl}$	×	$\frac{yl}{yl}$	15	296	275	571	322	295	617	1.78 (ns)

ns = Not significant.

pressivity. This is the first report of any mutant in *An. sundaicus*.

The mutant *yellow larva* is reported in *Culex quinquefasciatus* Say (Shetty and Chowdaiah 1976) as autosomal recessive and in *Culex pipiens* Linnaeus (Iltis et al. 1965) as partially dominant. Similar larval mutants *yellow larva* are also reported in *Aedes togoi* Theobold (Tadano 1977), *Aedes mascarensis* MacGregor (Hartberg and Craig 1974), *Aedes aegypti* Linnaeus (Craig and Gilham 1959), and *Aedes albopictus* Skuse (Bat-Miriam and Craig 1966).

The X-linked mutant *golden body* has been reported in *An. culicifacies* (Sakai et al. 1981). Another autosomal mutant, *yellow,* reported in *An. culicifacies* was recessive to the wild type but codominant with *black* allele at a single locus (Dubash et al. 1982). In *An. stephensi, golden yellow* larva has been reported as an autosomal and recessive marker (Adak et al. 1990).

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