

*Proc. zool. Soc., Calcutta*, 22 : 53-61 (1969)

A NEW SPECIES OF *DROSOPHILA* FALLÉN (INSECTA: DIPTERA:  
DROSOPHILIDAE) FROM INDIA

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THREE TEXT-FIGURES

ABSTRACT

A new species of *Drosophila* belonging to the *melanogaster* group of the subgenus *Sophophora* is described. It is closely related to *Drosophila nepalensis* Okada, but differs from it in having the black patch on the wings of male not extending to the 4th longitudinal vein, larger sex-combs and smaller conical process of posterior paramere.

Mitotic metaphase plate shows two pairs of V-shaped chromosomes, one pair of rods and one pair of dot-like chromosomes. X and Y represent the rods, Y being smaller. The chromosome complex of the salivary gland nuclei consists of five long arms and one very small strand radiating from the common chromocenter. In male, X stains slightly lighter than autosomes. Each arm is identified by locating certain constantly occurring banding patterns. Squash preparations of the salivaries from different geographical strains and their hybrids did not show chromosomal rearrangements, but all were found with a standard sequence of banding pattern.

INTRODUCTION

Bezzi (cited by Sturtevant, 1921), Brunetti (1923), Duda (1923, cited by Parshad and Paika, 1964), Malloch (1924), Sturtevant (1927), Ray-Chaudhuri and Mukherjee (1941), Parshad and Paika (1964), and Parshad and Duggal (1965) have reported several species of drosophilids from India. Judging, however, from the reports on *Drosophila* taxonomy from other parts of the world, it appears that India is a virgin field. The author has, therefore, undertaken a survey of the drosophilid fauna of India with a view to providing cytotaxonomic data so as to enable future workers in their studies on population genetics, ecology and related problems of the group. The present paper deals with the cytotaxonomic studies of a new species, belonging to the subgenus *Sophophora* of the genus *Drosophila*.

MATERIAL AND METHOD

The collection of drosophilid material was made in the Chakia forest, situated about 48 kilometers south-east of Varanasi, Uttar Pradesh. The forest extends over an area of about 1100 square kilometres. It is characterized by a variety of

ecological niches open to Drosophilidae owing to the presence of many species of fruit-bearing trees, fungi and other vegetation.

Drosophilid flies were trapped by exposing fermenting fruits such as banana, guava, oranges, etc, supplemented with baker's yeast in small paper cups ('lures' of Spencer, 1950) with a capacity of about 150 ml. Traps were hung on the lower branches of trees and bushes in shady places about one metre above the ground and three metres apart. Flies were generally obtained from these cups by means of a funnel shaped card-board collector, 25 cm long. Its narrow end bears an empty glass vial  $2.5 \times 7.5$  cm while its broad end, 7.5 cm in diameter, is open.

The taxonomic characters of imagines were studied under Carl Zeiss SM XX Stereo-microscope after etherization. The description of *Drosophila* species has been made according to the standard scheme of Sturtevant (1942). All the diagrams were drawn with the help of camera lucida attached to an Olympus research microscope.

Mitotic chromosome slides were prepared from the neuroblast cells of the larvae. The salivary gland chromosomes were prepared by the usual squash method as suggested by Strickberger (1962). The chromosome map presented in the paper is based on camera lucida drawings of salivary gland chromosomes from five cells. The banding pattern and the details of morphology of the chromosomes which were observed constantly in all different individuals, were noted as the important landmarks. The following terminology is used in describing the various kinds of bandings. A faintly stained continuous striation of moderate thickness is called as light band. A moderately stained continuous striation of moderate thickness is termed as band. A deeply stained striation relatively thicker than an average band is called a heavy band. A deeply or moderately stained striation, whose thickness is more than that of a heavy band, is called a disc. Two consecutive striations similar in thickness and staining behaviour, are termed as doublet. Two bands or heavy bands united at their edges giving the appearance of a capsule is termed as such.

The flies were also tested for chromosomal polymorphism by mating the wild ones with the 'standard stock' of the laboratory, and the  $F_1$  larvae were examined for inversions and translocations in the salivaries.

#### OBSERVATIONS

##### *Drosophila (Sophophora) raychaudhuri*, new species

EXTERNAL CHARACTERS OF IMAGINES: MALE and FEMALE: Arista with about 4-5 dorsal and 3 ventral branches in addition to terminal fork. Antennae pale yellow; 3rd segment slightly brownish. Front including ocellar triangle pale yellow, former with numerous fine hairs; front over about  $\frac{2}{3}$  as broad as width of head. Anterior reclinate orbital bristle about  $\frac{1}{2}$  other two, proclinate

orbital little smaller than posterior reclinate. Carina pale yellow, narrow and nose-shaped. Second oral about  $\frac{4}{5}$  length of vibrissa. Palpi straw-colored with one large bristle and several small fine setae. Face and cheek whitish yellow, the greatest width of cheek from the base of oral to eye border about  $\frac{1}{10}$  greatest diameter of eye. Eyes scarlet.

Acrostichal hairs regular, in 8 rows, no prescutellars. Anterior scutellars convergent, posterior scutellars cross each other. Distance from anterior dorso-central to posterior dorsocentral about  $\frac{2}{5}$  distance between two anterior dorso-centrals. Mesonotum and scutellum unicolourous, pale yellow. Thoracic pleura yellow. Sterno-index about 0.8. Legs straw-colored, pre-apicals on all three tibiae; apicals on 1st and 2nd tibiae. Two transverse sex-combs on metatarsal joint of male prothoracic leg, proximal comb with about 4-6 black teeth; distal one with about 3-4 similar teeth (Text-fig. 1A).

Wings (Text-fig. 1B) clear; a large black patch at tip of 2nd longitudinal vein extending to 3rd in male only. C-index about 2.8; 4V-index about 2.1; 4C-index about 1.0; 5X-index about 1.9. Two stout, equal bristles at apex of 1st costal section; heavy bristles on basal about  $\frac{2}{3}$  3rd costal section. Halteres yellow.

Abdomen shining yellow, tergite 2-5 in male with black band on posterior margin; 1st tergite pale yellow, caudal tergites black. Abdominal tergites in female yellow and with black band on their posterior margin. Male hypopygium retracted into abdomen so that the terminal end of abdomen appears cut off when viewed from above.

Average length of male body (10 individuals): 2.12 mm.

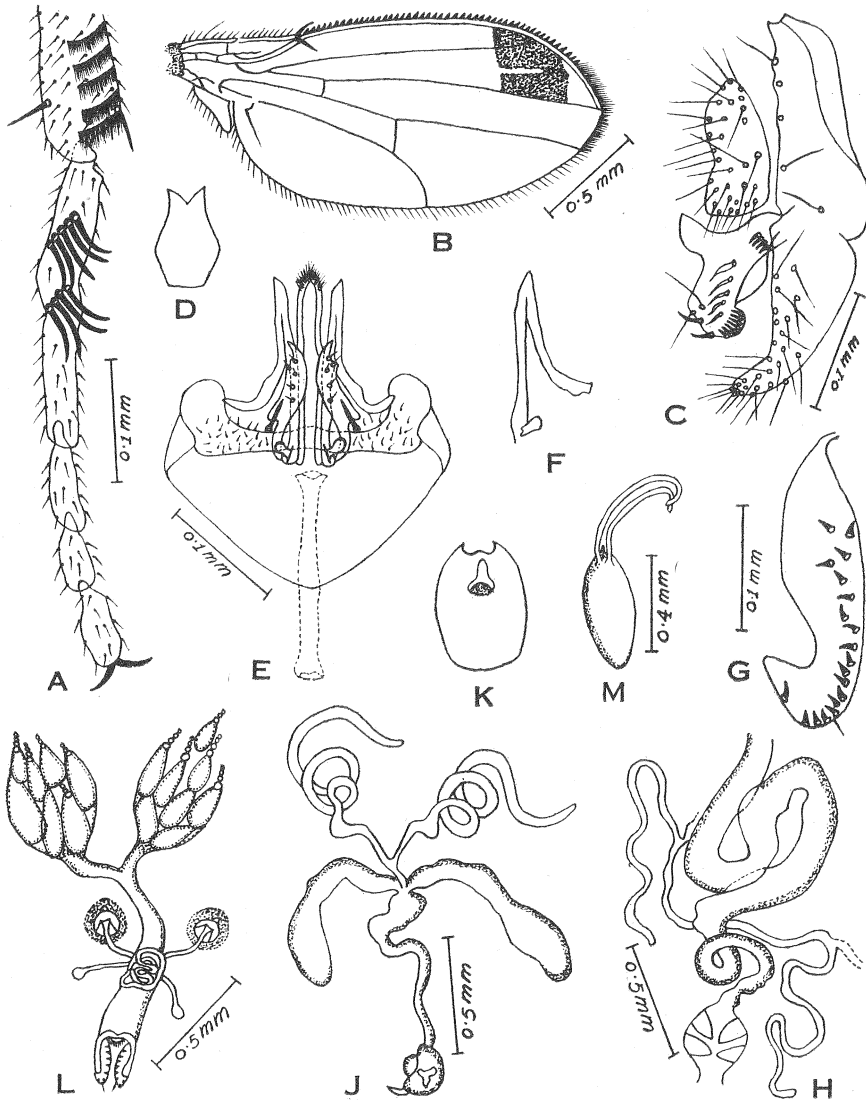
Average length of female body (10 individuals): 2.56 mm.

PERIPHALLIC ORGANS OF HYPOPYGIUM (Text-fig. 1C): Genital arch long, constricted at middle, lower portion with about 24-27 bristles; upper portion with about 5 bristles; heel absent and toe pointed. Anal plate triangular and separated from genital arch. Clasper one, large, primary teeth in two rows, upper one straight 3-5; lower one 6-7 arranged in a concave row; marginal bristles also in two sets; upper one slightly stout 5-7; lower one 4 at pointed tip; one slightly long and directed upwards.

DECASTERNUM (Text-fig. 1D): Median piece as an elongated plate slightly swollen at middle; anterior end distinctly forked.

PHALLIC ORGANS (Text-fig. 1E): Aedeagus elongated, dark yellow, apparently bifid, pubescent ventro-apically and slightly curved dorsally at tip. Anterior paramere black, long, apically narrowly pointed and curved, with about 5 sensilla. Posterior paramere dark yellow, dorsally dilated and proximally with a small conical process (Text-fig. 1F). Ventral fragma triangular, broader than long. Novasternum with lateral process; median projection very small and with a pair of submedian spines. Phallosomal index about 0.8.

EGG-GUIDE (Text-fig. 1G): Lobe yellowish, constricted posteriorly at discal



TEXT-FIGURE 1.—*Drosophila raychaudhuri*, Gupta. A, sex-comb; B, wing of male; C, hypopygium (right half); D, decasternum; E, phallic organs; F, posterior paramere; G, egg-guide; H, proximal intestine; I, male reproductive organs; J, ejaculatory apodeme; K, female reproductive organs; L, egg; M, egg.

portion and with about 15-19 dark brown marginal teeth. Ultimate tooth situated slightly far from penultimate tooth. Discal teeth absent. Subterminal hair situated between 4th and 5th marginal teeth. Basal isthmus short.

INTERNAL STRUCTURES OF IMAGINES: PROXIMAL INTESTINE (Text-fig. 1H):  $C=2.0$ . RECTAL PAPILLAE:  $R=1.3$ . MALPIGHIAN TUBULES long, their common stalks about  $\frac{1}{8}$  total length. TESTIS (Text-fig. 1J) yellowish with about 2.5 outer and 0.5 inner coils. EJACULATORY APODEME (Text-fig. 1K) with oval plate grooved at distal end. VENTRAL RECEPTACLE long. SPERMATHECA oval (Text-fig. 1L).

OTHER CHARACTERISTICS: EGG (Text-fig. 1M): with two long filaments, curved at free end.

PUPARIA: Brown. Anterior spiracles with about 5-6 filaments, horns including spiracles about  $\frac{1}{2}$  length of puparium. Posterior spiracles divergent. Pupation takes place mostly on cotton plugs of laboratory vials.

MATING BEHAVIOUR: It has been observed that the male while vibrating one of his wings chases the female touching her ovipositor with his proboscis. This act is then followed by a dance around the female with stretched wings in a semi-lunar fashion. This is then followed by a posture necessary prior to copulation which lasts about 1-3 minutes. Several unsuccessful attempts are also observed probably indicating the non-receptive nature of the female.

MATERIAL: HOLOTYPE: ♂; in spirit; Chandraprabha (Chakia forest), Varanasi District, U.P.; collected by J. P. Gupta; Jul 1965. Deposited at the Department of Zoology, Banaras Hindu University, Varanasi. 1

PARATYPES: 2 ♂, 5 ♀ (1 ♀ designated as 'allotype'); in spirit; collected together with the holotype. 10 ♂, 8 ♀; Naini, Allahabad District, U.P.; collected by Miss P. Grover; Feb 1966. 17 ♂, 11 ♀; Digha sea-beach, Midnapur District, West Bengal; collected by Mr B. N. Singh; Oct 1966. Deposited at the Department of Zoology, Banaras Hindu University, Varanasi.

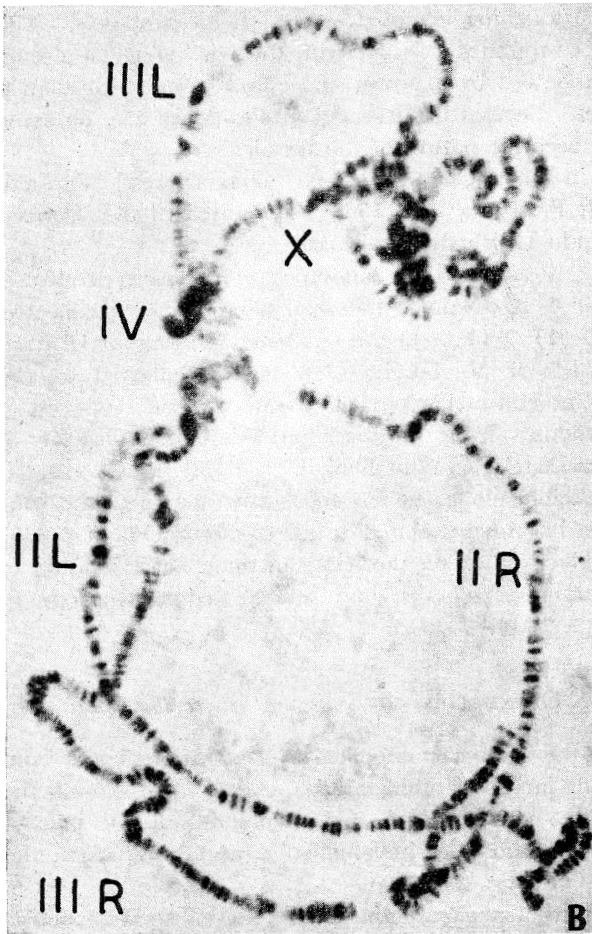
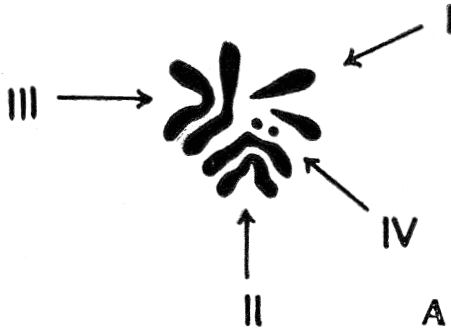
DISTRIBUTION: So far known only from Varanasi and Allahabad Districts of Uttar Pradesh, and Midnapur District of West Bengal.

RELATIONSHIP: This new species belongs to the *melanogaster* group of the sub-genus *Sophophora*. It seems to be closely related to *D. nepalensis* Okada (1955) but differs from it in having black patch on the wings of male not extending to the 4th longitudinal vein, larger, sex-combs, and smaller conical process of posterior paramere.

#### MITOTIC AND SALIVARY GLAND CHROMOSOMES OF *D. raychaudhuri*

Several metaphase plates in the aceto-carmine squash preparations made from the neuroblast cells of the young larvae were examined. All of them showed the same configuration, namely, two pairs of V-shaped chromosomes, one pair of rods and one pair of dot-like chromosomes in females, X and Y represent the rods, Y being slightly smaller (Text-fig. 2A).

The chromosome complex of the salivary gland nuclei in this species consists of five long arms and one very short strand radiating from the common chromo-center (Text-fig. 2B). The arms can be easily identified by their gross morpho-



TEXT-FIGURE 2.—*Drosophila raychaudhurii* Gupta. **A**, camera

logy, banding pattern and the structures of the free ends. To avoid confusion these arms have been arbitrarily designated I for the X chromosome, IIL and IIR for left and right arms of one pair of V-shaped chromosomes, III L and III R for left and right arms of another pair of V-shaped chromosomes and IV for the small strand representing the metaphase dots. The X chromosome is identified by its slightly lighter staining than that of the autosomes in the males.

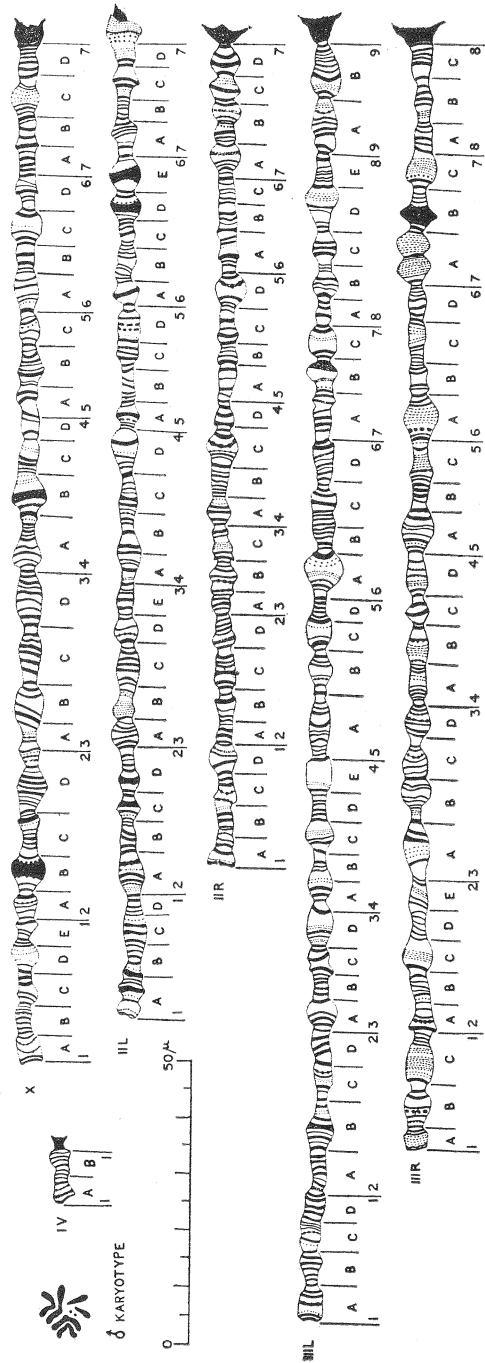
Each arm of the salivary gland chromosomes is identified by its gross morphology and by locating certain constantly occurring banding pattern (Text-fig. 3). The diagram of the different arms presented in the sketch is to be taken as the description of the banding pattern. A brief reference to some of these, which will help to identify the arms readily, is, however, given below. In good preparations all

lucida drawing of mitotic metaphase chromosomes from male individual; **B**, photomicrograph of the salivary gland chromosomes ( $\times 700$ ).

of the major chromosome arms may be recognized readily by the banding pattern at the tips.

*X Chromosome:* The X chromosome is represented by a single arm which is identifiable in males because it is slightly thinner and paler in appearance than the autosomes. Besides this, three closely placed deeply stained heavy bands named as 'three brothers' at the junction of the regions 1C-D, a bulb with a wide disc at the middle bearing chromomeres with paler centres in 2B, two consecutive spindle-like structures with characteristic dark bands in regions 3C-D, a large bulb with a centrally located diffused disc having vacuolated chromomeres in 4B, a doublet in 5A, a bulb with a pair of darkly stained bands on either sides in 6C, and lastly, a small bulb-like swelling with lightly stained bands in region 7C are observed as important diagnostics of this arm.

*III L:* It has a number of readily recognizable regions among which its narrow and constricted distal end with two proximally placed deeply stained discs, one in the region IA and the other marking the beginning of IB, a spindle extending from the middle of the region IB to ID with a doublet in IC, two consecutive small bulbs with vacuolated discs in regions 2C-D, a small bulb with a distally placed heavy band in 3D, two closely placed bulbs with vacuolated discs in regions 6D-E and the



TEXT-FIGURE 3.—*Drosophila raychaudhurii* Gupta. Map of the salivary gland chromosomes.

characteristic shape and banding in regions 7C-D are some of the important landmarks.

*IIR*: This arm is very easily recognized by its shortest length. It is further characterized by having several important topographical features. Among which, slightly expanded distal end having a darkly stained band at the tip, a doublet and a capsule in 2B, which sometimes appear as a dark band due to unfavourable stretching of the strand, the segment extending in the regions 4A-C comprising a small bulb with two pairs of dark bands broadening proximally and connected with another larger bulb, a bulb with a distally placed capsule at the junction of 5C-D and lastly, a bulb-like structure with four heavy bands in 7D are the natural landmarks.

*IIIL*: This is easily recognized by its largest size. Among the other identifiable natural landmarks its swollen tip, two closely placed dark bands at the junction of 1D and 2A, a bulb-like swelling with light bands in 3D, an onion-shaped structure with a proximally placed deeply stained disc in 6A, a bulb with a pair of dark bands on either extremities in 7C, and elongated bulb with lightly stained bands in its distal portion in 8D, and lastly, a large swelling with its narrow base in 9B are important features of this arm.

*IIIR*: This arm is immediately identified by its rectangular tip. Besides, an elongated bulb-like swelling with lightly stained bands in 1C, a very small swelling with two heavy bands in 4C, three closely placed dark bands or 'three brothers' in 5B, a large bulb with light bands in 6A, a very conspicuous structure in the regions 7A-C comprising two closely placed bulbs with light bands followed by another bulb with vacuolated chromosomeres forming a thick disc in 7B, an elongated bulb in 7C are some of the important topographical features of this arm.

*IV*: It is a very small strand radiating from the common chromocenter, in which it sometimes remains embedded. Very few but distinct bands are observed in this arm.

**REMARKS:** The utilization of the salivary gland chromosomes in the study of naturally occurring polymorphism, has yielded a great deal of information on the genetic structure of natural populations of *Drosophila* and has in some instances also indicated the pattern of evolutionary change which has occurred during species-formation.

Specimens of *Drosophila raychaudhurii*, as has been stated earlier, were collected from two different natural localities in Uttar Pradesh and one in West Bengal. It should not, therefore, be considered as a domestic species in the usual sense.

The larvae from these different geographical strains and their hybrids were squashed for salivaries and the preparations were examined for possible chromosomal polymorphism, but all were found to have a standard sequence of the banding pattern. In general, the more polymorphic a species is, the more environment it can use. Polymorphism is a means of coping with the diversity of the environments (Dobzhansky, 1949).



However, it is difficult at present to be definite about its non-polymorphic nature from the available data. But it is hoped that the future studies which are on the way will certainly provide right opportunities to elucidate its patterns of chromosomal polymorphism.

The species is named in honour of my teacher Dr S. P. Ray-Chaudhuri, Professor and Head of the Department of Zoology, Banaras Hindu University, Varanasi.

#### ACKNOWLEDGMENTS

The author's sincere thanks are offered to Prof S. P. Ray-Chaudhuri for suggesting the problem and for his constant encouragement. The author is highly obliged to Prof T. Okada, Tokyo Metropolitan University, Tokyo, Japan, for his help in confirming the identification as well as for critically going through the description of this species.

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*Accepted 20 August 1968. Read 10 June 1969.*

*Communicated by Prof S. P. Ray-Chaudhuri*