Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V15.I2.00006

Received: 18-10-2024 Accepted: 04-12-2024 Publication: 31-01-2025

Indian J.Sci.Res. 15 (2): 31-33, 2025 Original Research Article

A *Drosophila melanogaster* GYNANDROMORPH SHOWING MOSAIC SEXUAL DIMORPHISM

ANKITA DAS[a] AND A. K. SINGH[b1]

[ab]Genetics Lab, Department of Zoology, Institute of Science, Banaras Hindu University, Varanasi, U.P., India

ABSTRACT

Drosophila melanogaster **stands as a premier model organism in biological research, contributing extensively to our understanding of genetics since the early 20th century. The mapping of numerous genetic mutations to specific chromosomal loci in this species has been facilitated by its distinct phenotypic expressions and the linked inheritance patterns of certain genes. Some of the remarkable phenotypes observed in *D. melanogaster* have provided crucial insights into the mechanisms of sex determination within the *Drosophila* genus. Among these is the spontaneous emergence of gynandromorphs—individuals that exhibit both male and female characteristics. In our laboratory, we recently identified a gynandromorph in the Oregon-R strain, a highly inbred line that has been maintained under controlled conditions for several years. This short communication highlights the unique characteristics of this gynandromorph, with a focus on the mosaic distribution of sexual dimorphism, and the insights into the potential mechanisms underlying its development.**

KEYWORDS*:* *Drosophila melanogaster,* Gynandromorphs, Chromosome Non-Disjunction, Genetic Mosaic

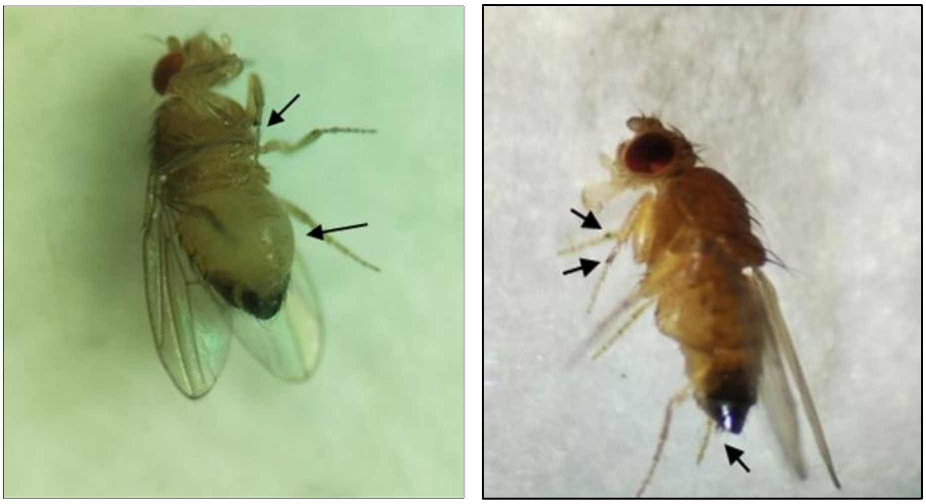
Gynandromorphs are the individuals that share male as well as female features (Cokendolpher *et al.,* 1983). These individuals are completely different from monoecious (hermaphrodites) forms because monoecious animals are bisexual and possess normal male and female reproductive structures. Gynandromorphism has been observed in a number of insect species like, butterflies, moths, flies, locusts, crickets, dragonflies, ants, termites, and bees (Morgan 1914; Nissani 1977; Maeno and Tanaka 2007; Lucia*et al.*, 2013; Miyaguni *et al.*, 2017; Morris 2018; Taniyama *et al.*, 2018; Renjith and Chandran 2020)

Although, reports regarding gynandromorph have been available across the diversified animal kingdom but the case of such peculiarity in phenotype was first discovered by Morgan in *Drosophila melanogaster* (1914). In *D. melanogaster*, there is a distinct variation in the two sexes where, the male one possesses a slender abdominal end with black coloration and sex-comb in the first sub-tarsus segment of first pair of legs. The female, on the other hand possesses larger abdominal portion with its pointed end laced with a protrusion called ovipositor. Very rarely, there may be an appearance of a gynandromorph in its population which is reported to be of three types (Salceda-Sánchez *et al.*, 2020). Firstly, bilateral where male and female morphology are distributed in the two half of the body, second one is transverse where the male and female morphology get distributed randomly in the whole body and the third type is mosaic one where random distribution of two sexual characters occurs (Fusco *et al.*, 2023). We have been able to spot a gynandromorph of the third category that shows speckled distribution of male and female characteristics.

OBSERVATION

In one of our laboratory stocks, i.e., Oregon R, we observed a fly that looked differently from others. It showed a female-like body size with a tilted ovipositor at its abdominal tip and possessed sex combs in the tarsus segment of prothoracic leg as is seen in a normal male fly. (Fig1A). Half of the abdominal tip remained black in this fly which is in fact, the male characteristic of *D. melanogaster* (Fig1B). This fly was being observed every day and on 9th day, it was placed with an adult naive male to ascertain whether the pair mates with each other. We observed the vials and transferred the fly in new vials for next 10 consecutive days, but no egg laying was observed. Significant reduction in the size of gynandromorph ovipositor could be seen at about 15th day onward. Although, we did not witness the occurrence of mating between the gynandromorph and the normal male kept in the food vial, however, change in the shape of the ovipositor may be due to attempts of mating between them. Further, at day 25th, the gynandromorph fly was dissected to see its primary reproductive organs, like ovary/testis. The gynandromorph gonads showed resemblance with testicular organs, instead of a pair of ovaries. The thread like paired elongated testes were found to be excessively long than the normal testes in *D. melanogaster* (Fig 2)

[1]**Corresponding author**



(A) (B)

Figure 1: A. Ventral view of fly showing posterior abdominal end of the fly with half male and half female portion, and, the presence of sex comb in both the pro-thoracic legs. B. Lateral view showing sex comb in pro-thoracic legs and an ovipositor at posterior end

Figures 2: A pair of testes showing elongated tubular structure on either side

DISCUSSION

There are certain reports regarding appearance of gynandromorphs in *D. melanogaster* populations (Morgan 1914, Nissani 1977). In one of such reports, a fly having left side female (XX) with red eye colour and the right-side male (XO) having white eye colour was a matter of curiosity at that time which in fact helped to understand the phenomenon of sex determination in this genus. Such gynandromorph developed from a female zygote having heterozygosity at her white eye gene locus, i.e., her genotype was w^+/w. Half of her body portion with w^+/w genotype expressed as female part having red eye colour whereas, the other half with w/- genotype depicted maleness having white eye phenotype. Bilateral gynandromorphs having half male and half female structures are mentioned sporadically by researchers (Morris *et al.,* 2018), however, a fly being genetic mosaic expressing male and female phenotypes scattered all along its body has not been observed so far. This gynandromorph fly showed the presence of sex combs in both the prothoracic tarsus segment indicating anterior part developing as male portion, whereas, in the posterior abdominal portion, half side as male and other half as female was observed. Its well-known fact that it's the female zygote which may experience chromosomal non-disjunction particularly, of X-chromosomes giving rise to a gynandromorph fly, however, the present form displayed asymmetrical distribution of male and female phenotypes. Surprisingly, its internal anatomy showed dominance of male reproductive organs because instead of ovarian development, it possessed tubular testes.

Among insects with XX-XY or XX-XO pattern of sex determination, females are homogametic (XX types). The two XX chromosomes in early female embryo may undergo unequal separation during mitotic cell division (non-disjunction of the XX chromosomes) causing mosaic distribution of cells. The cells descended from XX form femaleness and those with XY or XO form maleness. Since insect's morphological development is independent to sex hormones, each cell makes its own sexual decision (Shingleton *et al*., 2022). The present form of gynandromorph is the consequence of XX chromosome non-disjunction at the initial stage of embryonic development when the two different types of tissues (XX and X-) aligned in a mosaic order to make the adult body.

ACKNOWLEDGEMENT

Author is thankful to University Grants Commission (UGC), New Delhi for financial support in the form of Junior Research Fellowship. Authors also wish to acknowledge the financial support from Institute of Eminence (IoE) grant, Banaras Hindu University.

REFERENCES

Cokendolpher J.C. and Francke O.F., 1983. Gynandromorphic Desert Fire Ant, Solenopsis aurea Wheeler (Hymenoptera: Formicidae). Journal of the New York Entomological Society, **91**: 242–245.

Fusco G. and Minelli A., 2023. Descriptive versus causal morphology: gynandromorphism and intersexuality. Theory in Biosciences, **142**: 1–11.

Lucia M. and Gonzalez V.H., 2013. A New Gynandromorph ofXylocopa frontaliswith a Review of Gynandromorphism in Xylocopa (Hymenoptera: Apidae: Xylocopini). Annals of the Entomological Society of America, **106**: 853–856.

Maeno K. and Tanaka S., 2007. Morphological and behavioural characteristics of a gynandromorph of the desert locust, Schistocerca gregaria. Physiological Entomology, **32**: 294–299.

Miyaguni Y., Nozaki T. and Yashiro T., 2017. The first report of gynandromorphy in termites (Isoptera; Kalotermitidae; Neotermes koshunensis). Naturwissenschaften, **104**: 7–8.

Morris K.R., Hirst C.E., Major A.T., Ezaz T., Ford M., Bibby S., Doran T.J. and Smith C.A., 2018. Gonadal and Endocrine Analysis of a Gynandromorphic Chicken. In Endocrinology, **159**: 3492–3502.

Morgan T.H., 1914. Mosaics and gynandromorphs in Drosophila. Experimental Biology and Medicine, **11**: 171–172.

Nissani M., 1977. Gynandromorph analysis of some aspects of sexual behaviour of Drosophila melanogaster. Animal Behaviour, **25**: 555–566.

Renjith N.R. and Chandran N.A.V., 2020. A record of gynandromorphism in the libellulid dragonfly Crocothemisservilia (Insecta: Odonata) from India. Journal of Threatened Taxa, **12**: (9).

Salceda-Sánchez B., Sánchez-Montes S., Soto-Gutiérrez J.J. and Sandoval-Espinosa M.R., 2020. A case of gynandromorphism in Rhipicephalus sanguineuss.l. from Mexico. Experimental & Applied Acarology, **82**: 405–409.

Shingleton A.W. and Vea I.M., 2022. Sex-specific regulation of development, growth and metabolism. In Seminars in Cell and Developmental Biology, **138**:117–127.

Taniyama K., Onodera K. and Tanaka K., 2018. Sexual identity and sexual attractiveness of a gynandromorph of the lawn ground cricket, Polionemobius mikado (Orthoptera: Trigonidiidae). Entomological Science, **21**: 423–427.