

Meeting Report

Research Using the Fruit Fly *Drosophila* - A Great Conduit of Knowledge in Modern Biology-Gained Traction in India

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Tiny little insects hovering on the waste basket or fruit peels are common sites in most homes. They are almost omnipresent, and arrive within minutes of putting a ripe fruit in kitchen. For most people, these fruit flies may be an annoying pestilence, although not as bothersome as the ubiquitous house flies. Therefore, as a young student embarking on my research career, I was surprised to know that people studying these tiny fruit flies have made some of the most profound impacts in modern biology. The endeavour started neatly a hundred years back during the sabbatical visit of a Caltech faculty, Thomas Hunt Morgan, to the Marine Biological Laboratory at Woods Hole in Massachusetts, USA.

Morgan and his coworkers brought to light the utility of using *Drosophila melanogaster* and many other *Drosophila* species into the fold of systematic genetic analysis and research. He was awarded Nobel Prize in Physiology or Medicine in 1933 (Morgan, 1933) for showing that the chromosomes carry genes, the unit of inheritance of traits (Kenney and Borisy, 2009). Nearly sixty years later, Edward B Lewis (Lewis, 1998), Christiane Nüsslein-Volhard and Eric F Wieschaus (Nusslein-Volhard and Wieschaus, 1980) shared the prize in 1995 (Lewis *et al.*, 1995; Lakhota, 1995) for discovering how genes establish the body pattern during embryonic development, using *Drosophila melanogaster* ENREF_2. In between, the tiny fruit fly encouraged Seymore Benzer, while on a sabbatical at Caltech in 1967, to



Fig. 1: The fruit fly

explore the genetic basis of behaviour (Bonini, 2008). Along with many others, he helped to spawn the field of 'Neurogenetics'. They developed innovative tests to measure what the fly feels when they are subjected to different stimulus. Can you imagine, asking a little fly whether it likes the taste of fructose better than glucose, or teach those to avoid banana smell, even though it is an inherent attractant? Surprisingly, the answer is YES! The fruit flies have been used to identify the genetic basis of these actions, and helped to reveal, amongst many other things, that the ability to learn and remember, and even sleep at night, is genetically determined. Thus, the tiny pestilence, attracted by a ripening fruit in the drawer, has become a powerful conduit of knowledge.

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Therefore, it is no surprise that world wide *Drosophila* is one of the most widely used model animals for research (<http://www.flybase.org>). It is also favoured because of the relatively cheaper cost of maintenance and experimentations as compared to mice and fish. It has been used to understand almost every aspect of Biology-evolution to behaviour, cell biology to development, genetic bases of human disorders, and even molecular mechanisms of social activities such as ‘aggression’ and ‘love’. *Drosophila* researchers, commonly known as “fly pushers”, constitute a vibrant research community world wide. They are known for openness, and for freely sharing knowledge and resources.

The fly pushers’ community in India, first established in Kolkata in 1950s, is now spread all over the country. It is vibrant with several centres of excellences. The community already made, and continues to make, useful contributions to the international efforts as evident from a large number of highly impactful publications. Pioneers like S P Ray-Choudhuri (Sharma, 1994; Singh, 1994), M R Rajasekarasetty (Joshi, 2000; Rajasekarasetty *et al.*, 1979), and O Siddiqi (Krishnan *et al.*, 2012; Shirsat and Siddiqi, 1993; Vijayraghavan 2012) made significant research contributions in cytogenetics, population genetics, and chemosensory behaviour using *Drosophila*. They also motivated a large number of students and fellow researchers to take up the fly work and spread it in numerous research institutes and universities in the country. Currently, more than 90 active research groups in India are utilizing *Drosophila* as a model organism to pursue their research interests.

The *Drosophila* Meeting 2014, organized by the Cytogenetics Section, Department of Zoology, Banaras Hindu University during March 12-13, 2014 at the BHU campus, provided a new impetuous, and reestablished the platform for all *Drosophila* research groups in the country, to meet and exchange their knowledge and share information about the ongoing research programmes. A major objective of the meeting was to enable better networking and collaborations amongst the fly workers. Altogether 44 group leaders from different parts participated in

this meeting and presented an overview of their ongoing research. Indian *Drosophila* community is diverse. The members are broadly engaged in studying: (a) disease models, toxicology and stress biology; (b) ecological and evolutionary studies including research on cytogenetics of laboratory scale speciation; (c) molecular and cellular analyses of circadian rhythms; (d) molecular basis and cell biology of gene expression, regulation and signaling during development and (e) developmental cell biology of stem cells, tissue morphogenesis and differentiation.

Several groups discussed how they are studying evolutionary and ecological theories in laboratory scale experiments using *Drosophila*. They have adapted, and actively maintain, local *Drosophila* varieties in the laboratory, which can provide a rich resource for large scale genetic analysis of quantitative trait propagation in future. A few groups are also engaged in documenting local varieties of the *Drosophilid* species in different habitats, useful for ecological assessments. Talks also highlighted some significant contributions of indigenous *Drosophila* research to the mainstream developmental and cellular biology. These include fundamental aspects of developmental patterning, neuron and muscle development, stem cell maintenance, cell behaviour in epithelium, lipid metabolism and signaling. A novel RNA-based regulation of gene expression and translation during stress, and its impact on development, has been identified. One of the most exciting was the discourse on the effects of social and environmental composition on circadian rhythm. It is learnt how the life style of a solitary fly changes in presence of the same and opposite sex, which bears an uncanny similarity with that of other animals including humans!

All the talks were well attended and generated extensive discussion. It was clear that fly researchers in the country are successfully exploiting the enormous advantage of highly refined molecular-genetic technology offered by the *Drosophila* model for precise analysis of diverse cellular phenomena at molecular level, and at the same time to integrate the



Fig. 2: Speakers at the *Drosophila* Meeting 2014

knowledge to the systems level biology. An abstract book containing details of the talks and a compendium of electronic copies of recent publications of most of the fly researchers in the country are available online (FLY-ABSTRACTS, <https://googledrive.com/host/0B21ZiBUQtvisZ0pXRZCMS1LSU0>). This link also includes details of the current fly researchers in India.

It is internationally accepted that the fly model offers an economic and highly efficient alternative platform for in-depth and broader experimental analyses of a diverse range of contemporary biomedical issues. It was encouraging to note, from the presentations at this meeting, that this trend is growing in the country. The new generation of fly researchers in the country has diversified into studying molecular cell biology, developmental phenomena and behaviour, and has made good contributions.

It was even more heartening to note that a sizable portion of the young faculty is aiming to solve

some of the most contemporary questions in research using *Drosophila*. In addition, it became apparent during the discussions that files can be used as an effective teaching tool to disseminate a variety of biological concepts, at a cost much less than many other alternatives.

The fly research in India, however, is severely handicapped due to inadequate student training at the undergraduate and postgraduate levels, and due to limited access to the up-to-date knowledge base. It is further compromised by limited access to the fly stocks and reagents that are otherwise freely available internationally. In spite of these limitations, research is thriving in many pockets of excellence. Several laboratories have made significant advances in their respective research focus, and some of them are indeed comparable to the best in the world. The need now is to spread such advanced level research practices on a much wider scale in the country so that Indian researchers can provide leadership in technology development using *Drosophila*.

With a view to achieve this, a discussion session was held on 13th March 2014 with the following set of brain-storming agenda:

- Facilitating the process of procuring *Drosophila* stocks by individual scientists/ institutions from abroad
- Planning for a National *Drosophila* Stock & Research Centre in India
- Formulation of strategies to spread the use of *Drosophila* in class-room teaching at under- and post-graduate courses across the country
- Establishment of a portal for continuous exchange of information about new research findings and new reagents (mutants, clones, transgenic lines etc) generated in different laboratories
- Organizing future *Drosophila* Meetings on a regular schedule, i.e., once every year.

It was unanimously agreed that all the above issues need to be addressed so that the existing fly researchers could make a better impact of their efforts, and enable more such groups to come up and prosper. Therefore, members attending the *Drosophila* meeting nominated S C Lakhota (BHU, Varanasi), L S Shashidhara (IISER, Pune), L Mandal (IISER, Mohali), V K Sharma (JNCASR, Bangalore), M Mutsuddi (BHU, Varanasi) and U Nongthomba (IISc, Bangalore) to constitute an *ad-hoc* 'Indian Fly Board' and develop suitable proposals in respect of all the above noted issues. The fly board is mandated to prepare and submit a proposal within three months to the DBT for establishing a 'National *Drosophila* Stock and Research Centre' in India and to formally manage the other issues raised by the community. It was generally agreed that (i) the proposed National *Drosophila* Stock and Research Centre should preferably be housed as an autonomous centre within a University campus in partnership with the Department of Biotechnology (DBT); Govt. of India,

(ii) it should have adequate staff, space and infrastructure, which should be fully supported on a long-term basis by the DBT; and (iii) it should function as (a) national stock centre, (b) undertake research, including development of newer technologies, (c) provide adequate facilities to desiring researchers for undertaking extensive genetic screens, (d) train university/college and school teachers in using fly for classroom learning, and (e) periodically organize fly meetings and training workshops in research methodologies. The board will also work out strategies to develop a web portal for continuous exchange of information about new research findings and new reagents (mutants, clones, transgenic lines etc.) generated in different laboratories in the country.

The Indian Fly Board will initiate discussions and steer the process of generating curricula and laboratory manuals for teaching Genetics, Cell & Developmental Biology and Systems Biology using *Drosophila* in class rooms. It will also suggest suitable modules for using *Drosophila* for teaching ecology, evolutionary and behavioral biology.

The members also resolved to meet every year at a suitable location accessible to all participants and at costs affordable to the students. All the faculty members were urged to participate with students and other academic members of their laboratories in the future fly meetings. The gathering generated an optimism that the proposed activities would indeed help the fly community of India, not only to become internationally influential in research, but also let it contribute to the development of novel research ideas and reagents for world-wide use.

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