

## Geosciences and border disputes

The Indian subcontinent has active boundaries on its north, northeast and northwest. The origin of the Great Himalaya has followed the subduction of a Neo-Tethys sea under the Tibet–Eurasia region, before the northward-moving Indian lithospheric plate collided with Eurasia (at ~57 Ma), first on its northwest corner and then rotated anti-clockwise to form the northern margin stretching from Nanga-Parbat to Namcha-Barwa, resulting in the rise of the Himalaya. The convergence of the Indian lithosphere and Tibet is still taking place at the rate of ~4–5 cm/yr in nearly northeast direction. In fact, according to some recent seismic investigations (viz. INDEPTH), even the Indian continent or shield has underthrust the southern part of Tibet. On the northeast and eastern sides also lies a deep-penetrating subduction zone, wherein one lithospheric plate dips down and gradually sinks into the earth's interior.

Further, both NE and NW parts of the subcontinent appear to have been affected by mantle plumes (Kerguelen and Reunion).

Now, it is well known that subduction, collision and plume activity, all the three geodynamic processes, can create an extremely significant scenario for the development of natural resources like energy (or hydrocarbons), minerals and gem-stones. The thermomechanical, tectonomagmatic and metamorphic processes active during subduction and collision could result in concentration and formation of important and rare resources which are essential for socio-economic needs of the country. One does feel that the natural resource potential of Tibet could be one of the main reasons for it being claimed. Evidently, potential of all these economically important occurrences may lie along the north, northeast and northwest borders of the Indian con-

tinental lithosphere. Since India is engaged with neighbouring countries in negotiations for settling the border disputes, it may be an essential pre-requisite that due care is taken to incorporate the geoscientific inputs, (integrated geological, geophysical and geochemical studies) from the border corridors. In other words, geoscientific assessment of the resource potential of disputed border corridors and adjoining regions needs to be considered before negotiations. Unfortunately, such a crucial role of geosciences has not been sufficiently recognized/appreciated and obviously this needs to be rectified soon.

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## Is entomology curriculum affecting insect biodiversity in India?

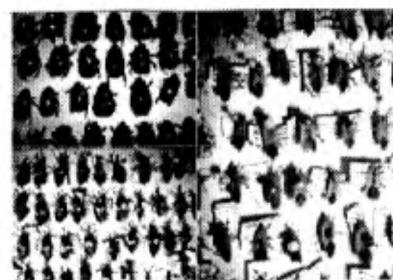
Insects represent one of the most important forms of life on this planet; they form about three-fourths of the total organisms present on earth<sup>1</sup>. Of the 5.57–9.8 million estimated animals in the world, 4–8 million species are known to be insects<sup>2,3</sup>. Approximately 0.1 million species of insects occur in India<sup>4</sup> and according to a recent global biodiversity assessment, it would be 10–15 times more than the earlier estimation<sup>5</sup>. Some species of insects are vectors of different diseases of humans/plants or pests of crops; and a few are beneficial organisms. Various basic and applied aspects of insects are studied to understand their role and management in nature. Usually insects are studied in the context of a major threat to crops and human health. Hence entomology, which is the science of insects, is taught as a paper under zoology/biology curriculum in undergraduate and postgraduate courses, or in many cases entomology is a separate core curriculum in postgraduate courses in several Indian universities.

The practical aspects of entomology syllabus deal with collection, identification, mounting and preservation of insects, insecticide bioassay and resistance stud-

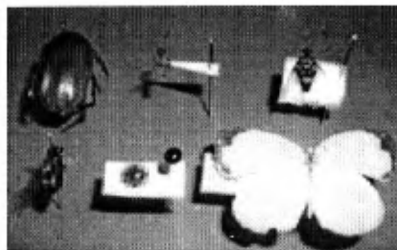
ies, physiology experiments, etc. Among these, collection of various insect species and submission of mounted insects in practical classes is mostly compulsory for students. As students have to submit mounted and preserved insect specimens, they collect various species of insects frequently from small areas of sylvan in the college/university campus or from similar places in the neighbourhood every year. Students collect the same species (Figure 1), mostly non-injurious and attractive species (for example butterflies, praying mantis, leaf insects, beetles, bugs, etc.) every year from the same region. Thus the threat to insect biodiversity of a particular region is imminent, which in turn severely disturbs lives from producers to top consumers in a given ecosystem. Some insects are the major predators and parasites on various plant feeding insect pests; they are the major pollinators of different kinds of plants; they play major role in the decay of organic matter, and they serve as food for variety of animals<sup>1,6</sup>. Once I met a student who was studying in Bangalore collecting insects for his sister studying in Delhi, as insects were not found in a particular area in Delhi due to frequent collections from

past several years. Even in this mandatory collection, preservation and identification of insects, students normally are not taught seriously to identify the collected insects to genus and species level using taxonomic keys and thus insect submission assignment is a monotonous routine.

In connection with taxonomic studies, Gadgil<sup>7</sup> stated that students with a postgraduate degree in zoology have difficulty in identifying 5–10 species of birds, lizards, fish or butterflies put together. The same is true regarding identification of insects and thus we have hardly 100



**Figure 1.** Same species of insects collected and mounted in large numbers.



**Figure 2.** Different types of insect mountings.

workers seriously engaged in the taxonomic study of insects in India<sup>8</sup>. Taxonomy that deals with identification of insects is a basic requirement to know their correct names prior to taking up any kind of studies on them. However, rampant collection of precious species of insects in the field for the sole purpose of submission of specimens to fulfil the curriculum requirement without proper training in taxonomy does not serve the

purpose. More importantly, it affects insect biodiversity of a particular region.

About 60,000 insect species are described in India and 0.4–0.6 million or more insect species are yet to be discovered and catalogued<sup>8</sup>. Hence, insect taxonomy in the curriculum is crucial to train students in India. As different types of mounting (Figure 2), preservation, and naming of diverse species of insects are part of the basic training in taxonomic study, students could be asked to collect various household insect pests such as cockroaches, houseflies, mosquitoes, ants, and other agricultural pests for this purpose. A batch of students should not be allocated to collect the same species of insects (which are not pests) in large numbers from the field for paltry submission of specimens. Using existing laboratory specimens or utilizing a few vital specimens from the field, students could be trained meticulously in taxonomy.

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## Incidence of a mosaic disease in *Jatropha curcas* L. from eastern Uttar Pradesh

*Jatropha curcas* L. (Ratanjot) is an important multipurpose plant belonging to the family Euphorbiaceae. It is cultivated mainly for non-edible oil on wastelands to prevent soil erosion and as a field barrier. To some extent, the plant has gained commercial importance due to its thriving capacity in varied regional climates. During routine survey, serious disease symptoms were observed on a large number of *J. curcas* plants in various localities of Balrampur District, Uttar Pradesh during the rainy season of the year 2005. The symptoms consisted of mosaic from mild to severe, marked reduction in leaf size, rolling of leaf margins and puckering of leaf surface. Chlorotic areas of irregular shape were present between the secondary veins (Figure 1 a and b).

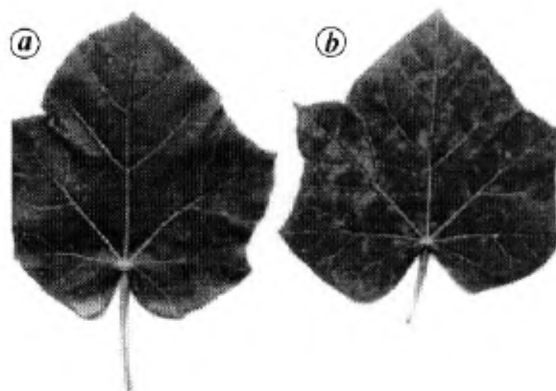
Transmission tests were conducted with seeds collected from diseased plants. The seedlings remained healthy showing that the seeds do not transmit the disease.

Sap transmission from diseased leaf to healthy, vigorously growing test plants of *J. curcas* seedlings that were raised in an insect-proof chamber was done in the usual manner using carborundum powder as an abrasive. Test plants developed

mild mosaic after twenty days showing that the disease was sap-transmitted. The disease was also transmitted by cleft graft in new shoots showing typical symptoms of the disease, thus confirming its viral nature. Attempts to transmit the disease by dodder (*Cuscuta* sp.) failed.

The disease could not be transmitted to any other plant, except *J. curcas*. Attempts made by sap inoculation and grafting to

*Nicotiana glutinosa* L., *Lycopersicon esculentum* Mill., *Solanum melongena* L., *Datura stramonium* L. and *Carica papaya* L. were not successful. Insect transmission trials were conducted with *Aphis cracivora* Koch, *Aphis nerii* B. and *Bemessia tabaci* Gen. The test insects were allowed to feed on diseased plants for 24 h. These were then released on 30-day-old *J. curcas* seedlings. Ten to 15 insects were allowed



**Figure 1.** a, Healthy leaf of *Jatropha curcas* L. b, Infected leaf of *Jatropha curcas* L. with mosaic symptoms.