Figure 1. *Rhizophora* species in mangrove forest of Pichavaram. ***a***, *Rhizophora* hybrid tree; ***b***, *Rhizophora apiculata*-Green (wild) propagule along with yellow (albino); ***c***, *Rhizophora mucronata*-Green (wild) propagules; ***d***, *Rhizophora apiculata*-Green (wild) propagule along with rose (albino).

(Figure 1). Flowering, fruit development and seed germination in several mangroves occupy a relatively short time and the seeds germinate while they are still attached to the mother plant (vivipary). Germinating seedlings of mangroves manifest certain marker characters, including albinism (chlorophyll deficiency in plants), which can be scored by simple visual observations. These morphological markers can be effectively utilized to understand the following aspects of genetics in simple classroom experiments.

1. Mendelian genetics by strict imposition of self-pollination.
2. Out-crossing rates and pollination biology by observations on natural pollination.
3. Penetrance and expressivity of marker genes in populations.
4. Mutation frequencies and possible causes.
5. Biochemical attributes of different chlorophyll mutants in laboratory experiments on the basis of diversity of pigmentation.
6. Implications of these genetic phenomena on evolution.

The advantage of utilizing these perennial plants as tools of learning genetics lies in the small frame required for observations (flowering to seed germination) and in the manifestation of marker characters by the germinating viviparous seedlings. Mangroves have already proven themselves to be useful in the study of mating systems, mutation frequencies and biochemical aspects of chlorophyll deficiency using the marker characters of albinism[1–3].

Besides their use as tools in learning basic genetics, mangroves can also be visualized as components of an evolutionary system in which the genes interact (epistacy, hypostacy and complementation) to produce manifested effects. Possibly Mendelian dihybrid and/or trihybrid systems operate in these populations to by-pass the lethality imposed by chlorophyll deficiency. This is the result of a long process of natural selection being expressed in the current generation. These observations can stimulate students to apply their minds in deductive reasoning, to understand and elucidate the basic facts and in the application of genetic logic in the processes of evolution.

1. Chen, X. Y., Lin, P. and Lin, Y. M., *Hereditas*, 1996, **125**, 47–52.
2. Klekowski, Jr E. J., Lowenfeld, R. and Hepler, P. K., *Int. J. Plant Sci.*, 1994, **155**, 373–381.
3. Corredor, J. E., Klekowski, Jr E. J. and Lowenfeld, R., *Int. J. Plant Sci.*, 1995, **156**, 55–60.

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Withering Indian English and science

Indian English, though it differs in pronunciation in different regions, continues to contribute to literature, winning international awards. However over the past twenty-five years the general standard of Indian English has been falling, and this threatens the entire fabric of the student community at large. This has a telling effect on the learning and communication skills and also ultimately reflects on the research standards. Regarding Indian science, although the cream of the student community goes abroad or registers for doctoral programmes in premier institutions, the worst affected lot is the group in other research institutions like the universities, which cannot take up research projects in emerging areas like genetic engineering, etc. When faculty members from these institutions get

research grants, they rarely get NET-qualified candidates.

Think of the plight of the faculty who are constrained to take these students sometimes as non-stipendiary research scholars, for the sake of career-development schemes. The project investigators agree that they take only 'technicians' and are aware that ultimately it is the investigator who has to write the student's thesis. Such doctorates add to the agony of educated unemployed, aggravating the social disorganization; their brains virtually become the devil's workshop. The self-financing institutions come to their rescue. They easily 'start' courses such as gene technology and genetic engineering taught by these doctorates. Such doctorates who are already in teaching and research institutes add to the woes of the student community. It is like one blind person leading other blind persons. Most of the enrolled students for such programmes are rich and just want a degree. A. Gnanam, Chairman of NAAC, once said that, 'the expenditure incurred on producing an undergraduate is appallingly low when compared to that of a professional degree holder. Unfortunately these people ultimately turn out to become the major part of the service sector and reflect the deteriorating quality here too'.

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Rationally cautious: GM crops

S. K. Ghosh (*Curr. Sci.*, 2001, **81**, 655–660) advocates the use of transgenics in commercial agriculture. The issue of gene pollution, however, did not get its due attention. Especially in the context of herbicide and insect pest-tolerant transgenics, there is a potent danger of the transgene passing on to the weedy relatives of the crop in question, through natural outcrossing. Such a possibility in case of wheat and its wild relative, viz. jointed goatgrass (*Aegilops cylindrica*) has already been reported[1]. Additionally, insect pest-resistant transgenics can lead to evolution of a resistant gene in the pest species or can accelerate the faster multiplication of pest strains carrying such genes. Possibility of such a hazard has already been proved correct in case of transgenics utilizing *Bt* gene[2,3].

The potent danger of the transgene getting passed on to weedy relatives can, however, be overcome by placing the desired gene in a plastid. Chloroplast transformation[4] has come a long way from the time it was conceptualized initially. This technology offers unique advantages in plant biotechnology, including high-level foreign protein expression, absence of epigenetic effects, and gene containment due to the lack of transgene transmission through pollen, thus ruling out the possibility of any transgene getting passed on to the wild and weedy relatives from the cultivated transgenic. Recently, Ruf *et al.*[5] have described a plastid transformation system for tomato. In the report on the generation of fertile transplastomic plants in a food crop with an edible fruit, Ruf *et al.* have shown that chromoplasts in the tomato fruit express the transgene to 50% of the expression levels in leaf chloroplasts. Given the generally very high foreign protein accumulation rates that can be achieved in transgenic chloroplasts (> 40% of the total soluble protein), this system paves the way to efficient production of edible vaccines, pharmaceuticals, and antibodies in tomato. The viable option thus is to place transgenes offering resistance to insect pests and herbicides in plastids; however, the more perfected systems of nuclear transformation may continue to be used for transferring genes for enhanced productivity or those that confer tolerance to abiotic stresses, which ultimately will enhance productivity levels.

1. Mallory Smith, C. A., Snyder, J., Hansen, J. L., Wang, Z. and Zemetra, R. S., Proceedings of a Symposium held at Keele, UK, 12–14 April 1999, p. 165.
2. Gahan, L. J., Gould, F. and Heckel, D. G., *Science*, 2001, **293**, 857–860.
3. Griffits, J. S., Whitacre, J. L., Stevans, D. E. and Aroian, R. V., *Science*, 2001, **293**, 860–864.
4. Pal Maliga, *Trends Biotechnol*, 1993, **11**, 101–106.
5. Ruf, S., Hermann, M., Berger, I. J., Carrer, H. and Bock, R., *Nature Biotechnol.*, 2001, **19**, 870–875.

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Why should bee-keeping be utilized as an input in agriculture?

A majority of people in India are vegetarian and depend on agriculture for their food, nourishment and clothes. Though the country has attained self-reliance in food-grains production, there is a shortage of edible oil, fruits, vegetables, condiments, spices, etc. The average yield of the crops providing these commodities in the country is much below the expected one. The simple reason is the failure of these crops due to inadequate pollination.