Plant reproductive biology studies crucial for conservation

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India is recognized as one of the mega-biodiversity countries of the world and nurtures enormous plant diversity. It is estimated that as many as 5285 species of angiosperms belonging to 140 genera are endemic to the country[1]. However, this plant wealth is eroding at a fast pace due to habitat loss, fragmentation, over exploitation, invasion of exotics, pollution and climate change[2]. According to Singh and Khurana[3], about 25% of the higher plant species is expected to disappear in the next few decades and another 25% may be lost by the end of the 21st century. The growing awareness of the importance of plant diversity and the rapid decline that has come to notice, have given an unprecedented impetus for monitoring and conservation. A variety of approaches and techniques both *in situ* and *ex situ*, have been proposed and implemented for conservation of plant resources. The *in situ* strategy emphasizes on the protection of natural ecosystems for the conservation of overall diversity of genes, species and ecological processes. Biosphere Reserves, National Parks and Wildlife Sanctuaries have been set up. The *ex situ* strategies rely on botanical gardens, conservation stands, seed and pollen banks and germplasm banks to help conserve species outside the natural habitat. India relies heavily on both these approaches. The *ex situ* approach finds more applications for economic plants and the *in situ* approach for wild plants. However, the existing conservation strategies do not guarantee an effective protection of the rare, endangered and threatened (RET) species.

Any conservation approach has to be based on an in-depth study of plant reproductive biology. Reproductive characteristics such as seed dispersal, germination capacity, survival rate of seedlings and adults, age at flowering, reproductive lifespan and number of flowers and seeds refer to a set of responses that allow a species to adapt to a particular environment. Besides these, the processes of gamete development, pollination, endosperm and embryo development and other reproductive features can provide important clues regarding the reproductive constraints of plants that need conservation. The studies can also help in developing certain protocols to combat the problems that impede regeneration. Understanding reproductive biology of plants where there are few propagules for future generations will yield promising results. Botanists around the world have been concentrating on comparative and descriptive embryology and have generated a pool of data and information regarding various reproductive features and anomalies in a large number of plants. However, most of the valuable information has not been put to use in those aspects of study which are crucial for conservation.

Although habitat fragmentation and over exploitation are the more apparent casual factors, failure of reproductive processes to cope with environmental changes is often the fundamental reason for species loss. Sexual reproduction is the only natural process that incorporates variability and ensures survival of species under adverse conditions. Sexual reproduction is based on the phenomenon of syngamy and double-fertilization. Successful fertilization is dependent on effective pollination. Pollination studies alone can provide a gamut of information about the loss of many species, because pollination is the fundamental step in plant reproduction. Successful pollination is an essential pre-requisite for survival of plants in natural communities and is dependent on many biotic and abiotic factors. Plants have coevolved with their pollinators and large ecological changes can decouple their coinciding flowering and breeding cycles. Conservationists need to focus on the pollinators and their biology as well while framing any conservation strategy. Wilcock and Neiland[4] have assigned the decline of many ornithophilous and entomophilous plants to unsuccessful pollination because of loss of their pollinators. For outcrossing of entomophilous plants, population size and plant density are closely associated with the attraction and activity of pollinators. Because small populations may be less attractive to pollinators, the reduction in population size results in decreased fruit or seed production because of insufficient pollen transfer[5]. Some plants have narrow amplitude in which these can flower and fruit. The conditions must be favourable for plants to produce flowers. A study conducted by a reproductive biology group in Italy on *Rhus aculeatus*, an evergreen shrub, has yielded some interesting results. On the RET list the plant is threatened because of unsuccessful pollination. Information was gathered in the laboratory by observing the absence of pollen grains on the stigmatic surface of 80 flowers in anthesis samples randomly in field during the flowering period[6]. Studies on the reproductive biology of *Lactoris fernanndeziana*, an endemic plant of an island in Chile belonging to a monotypic family Lactoridaceae, have helped in conserving the species. Seed germination and seedling vigour are problems, and promotion of outcrossing helps in its survival[7].

For biodiversity conservation, reclamation and restoration, study of reproductive biology can provide important paradigms. Such studies would prove to be fruitful in planning various programmes specific to different habitats. Studies in reproductive biology will also help in developing strategies to preserve the genetic potential of rare species and are crucial for restoration and reintroduction. The knowledge will also help in the reintroduction of many plant species which are raised by micropropagation techniques. Many of the micropropagation protocols that produce positive results in laboratories fail to take-off in the field because of lack of information about their reproductive features. This information will be useful for designing mathematical models and augumentation programmes and make our conservation efforts successful. The studies can provide information for preserving seedling longevity, pollen viability and prolonging dormancy in seed banks and pollen banks. Reproductive biology studies thus have to be an integral feature of all conservation projects.

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