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PENINSULAR INDIAN *IMPATIENS* L. (BALSAMINACEAE)

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INTRODUCTION

The large genus *Impatiens* had caused considerable difficulty for a satisfactory taxonomic treatment. Hooker devoted much attention to this genus towards the end of his life. Many species of *Impatiens* are endemic to South India.

Apart from Hooker (1874-75, 1904a, b, 1905, 1906, 1910, 1911) and Hooker & Thomson (1859), the South Indian *Impatiens* have been collected and studied by Barnes (1938, 1939), Beddome (1859), Fischer (1930, 1931, 1934, 1935, 1936, 1938), Santapau (1948, 1961), Sebastine (1962) and Sedgewick (1918). Herbarium studies reveal that both botanists and non-botanists have collected these pretty plants.

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MATERIAL AND METHODS

The delicate and fragile nature of the vegetative body makes it very difficult to prepare herbarium specimens. Even as the specimens are being picked up, the flowers and leaves dry up, the petals fall apart, and the mature fruits being autochorus do not remain long on the specimen. This makes it impossible to judge the nature of the wing petals and structures of other reproductive parts. As such, material has to be preserved in liquid. It is also advisable to carry a small portfolio made of drying paper, measuring 7.5 × 5.0 × 2.5 cm, in which the detached floral parts can be arranged, so that their shape, size are retained without shrivelling or masking the features which would otherwise get lost. This also obviates the necessity of again dissecting flowers for study. Flowers are then mounted on a piece of white card and dried. The cards are enclosed in packets and finally mounted on the respective herbarium sheets. The herbarium sheet, the card and the envelope of all our collections carry the same collection number. (*See* also Bhaskar and Razi 1978, 1978a).

OBSERVATIONS

This perplexing genus has two main centres of distribution in India; the Himalayas in the north and the Western Ghats in the south, the latter forming the second richest area of *Impatiens* in India. Out of the 211 species in India mentioned in literature up to 1972, 82 are South Indian. The latter in-

clude the widely distributed *I. chinensis* and *I. balsamina*. The important cultivars include *I. balsamina, I. sultani, I. holstii* and *I. repens.*

During the present study, (started in 1971) a total of nearly 350 days was spent in the field between 1972 and 1975. Collections made from the various hill ranges number up to 200; these yielded 56 species of which two species and four varieties are new to science. The only report for *I. dendricola* Fischer was of the type collection made in 1935. We have now collected this in 1975 from the type locality *i.e.*, Thadiandamol, the highest peak in Coorg District. Some species are available in very restricted areas *e.g.*, *I. agumbeana, I. barnesi* among others. Many of the original habitats of these plants are greatly disturbed by human interference. Yet, all efforts were made to collect as many species as were available. In addition, over 1000 herbarium specimens obtained from various herbaria in the country were critically examined together with the type descriptions and a few types.

PENINSULAR HABITATS AND ADAPTATIONS

Plants of *Impatiens* occur at high altitude (1500 m) where there is monsoon rainfall, a temperature of about 20° C, mist and optimum sunlight. In the hilly ranges of the Western Ghats a phytogeographically important topographical unit of South India consist of areas with intermettent rain, percolation of water in the shallow soils, roots of herbs and mosses which provide ideal conditions for a flourishing growth of balsams. These hills abound in innumerable valleys in the middle ranges and are covered by grassy hill tops which are unique to peninsular subcontinents. Through these regions flow several perennial streams, often cascading down projecting rocks and throwing up sprays of water, an appropriate habitat for the balsam.

For recording the distribution of herbaceous and shrubby *Impatiens*, South India can be divided into the south-west zone and the north-east zone, depending on which area, monsoon is more active. Herbs characterise the first, while shrubs predominate the second. It is also observed that species with spinulate pollen are confined to the north-east monsoon regions including Sri Lanka.

The seeds of South Indian *Impatiens* exhibit dormancy for 7-8 months to overcome dry months from December to May, as also, the tubers in the case of scapigerous and other tuberous species. They produce vegetative buds only on the onset of cooler and wet weather during the monsoon months. The starch stored in the tubers allows them to grow and develop quickly during the following monsoon months and thus enables them to complete their life cycle before the end of the monsoon season. The trichomes on the leaf surfaces absorb moisture from the atmosphere, maintaining the turgidity of cells. The mechanical efficiency of these plants is almost entirely due to the turgid parenchyma. The mucilage in the pith also helps in the absorbing and storing of water in the stem. Presence of chloroplasts in bundle sheaths is another adaptation in these plants to the tropical montane climate. It indicates the possible existence of HSK pathway of carbon-di-oxide fixation during photosynthesis as in other tropical plants. Their absence in an equal number of species may indicate the absence of the HSK pathway and may assist the taxonomist in classifying the whole group into HSK and non-HSK species.

MORPHOLOGICAL CHARACTERS

South Indian balsams are characteristically short capsuled; none among them is known to have an additional sepal which is noted in the North Indian species. Two of the sections, *viz.*, 'Scapigerae' and 'Epiphyticae' are exclusively South Indian. Deep red and scarlet flowered balsams (*e.g. I. phoenicea*,

I. parasitica and *I. verticillata*) are uncommon in North India. Similarly, yellow flowers are scarce in the south, the only exception being the endemic *I. dalzellii* of Maharashtra.

POLLEN MORPHOLOGY AND CHROMOSOME NUMBERS

In a recent paper Bhaskar & Razi (1979) have described pollen in 109 species. Of this number, 105 have reticulate exine. Spinulate sculpturing and granulate sculpturing are seen in two species each. 20 species are 3-zonocolpate and the rest 4-zonocolpate; while porate form is seen in *I. acaulis*. Granulate exine sculpturing was found in *I. acaulis* from Charmadi Ghat in Karnataka (Bhaskar & Razi, 1973). On this character and the presence of porate nature, a variety—*I. acaulis* var. *granulata* has been reported by Bhaskar *et al.*, (1975). Since the spinulate exine sculpturing was restricted to a certain region, Hyunh (1968) calls this "pollinic endemism".

Bhaskar & Razi (1973 a) and Bhaskar (1976) reported chromosome numbers of 43 species. A range of chromosome numbers is known in Peninsular *Impatiens*. Noteworthy is the occurrence of n = 3, the lowest chromosome number in the genus in *I. leschenaultii* from Doddabetta (Nilgiris). The second or the next lowest chromosome number is n = 6 as in *I. talbotii* from Jog and Agumbe in Karnataka. Haploid numbers vary from section to section, the commonest being n = 7, 8 and 10 in sections 'Microsepalae', 'Annuae' and 'Scapigerae' and 'Sub-umbellatae' respectively. Another interesting phenomenon is the occurrence of 'chromosomal drift', *i.e.*, the drift in the chromosome numbers from plant to plant in the same or neighbouring populations. As for example, in the same populations of *I. scapiflora* and *I. modesta* in Nilgiris, we have encountered n = 10, 16 and 20 and n= 8, 9 and 16 respectively. In the case of *I. scapiflora* in Sampaje Ghat (Coorg) two divergent populations just 3 km apart exhibit different chromosome numbers and characteristics. One population has n = 6 with no satellites, while the other has n = 10 with satellites.

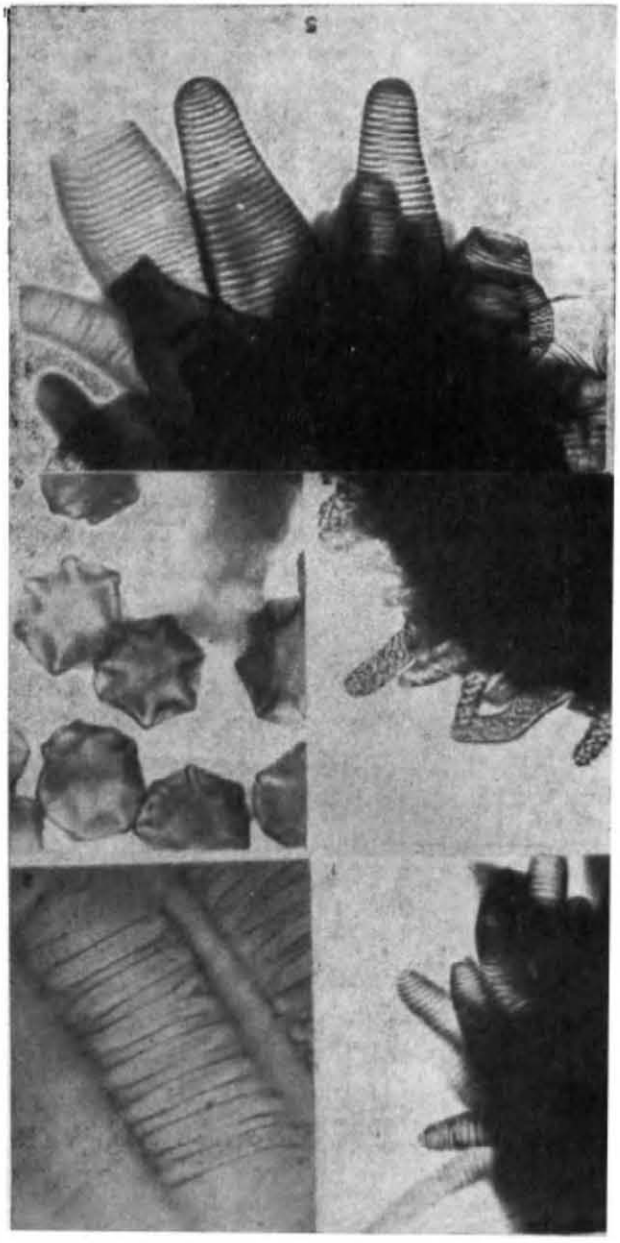
ANATOMICAL CHARACTERS

Among several anatomical characteristics, the presence of chloroplasts in the bundle sheaths of petioles which characterise the HSK plants of tropics, and the occurrence of crescent-shaped 'epidermal flanges' are notable. The latter is confined to a species complex of the section 'Microsepalae', and thus adds further confusion in identifying the individual species of this complex.

SEEDS

Seeds of *Impatiens* offer stable characters in classifying the peninsular species. Mainly there are two types of seeds, viz., brown ones with thin testa and black ones with horny shining testa. The latter ones are characteristic of the section 'Annuae', but do not offer much variation to distinguish species. The brown seeded condition in the other sections offers a variety of differences among species in the exceptional pattern of architecture on the hairs which are found on the testa (Figs. 1-5). Sometimes the testa indument exhibits dimorphic hairs on the same seed as can be seen in *I. gardneriana* Although this species has got single axillary flowers and n = 8 as in other members of the section 'Annuae', it needs to be placed under a separate subsection VERTICILLATAE due to its verticillate leaves and exceptional seed characters. The banding pattern on the seed hairs may also be reticulate as in *I. flaccida* or spiral as in most of the scapigerous balsams. The hairs may be confined to one end or both ends, or may be spread all over the surface, of the seed. An interesting situation may be seen in the 'Microsepalae' wherein a transition can be seen from globular horny seeds towards flat thin-walled ones as in

I. balsamina and *I. scabriuscula*. In their related species (*I. mysorensis, I. leschenaultii, I. cuspidata* and others) the seeds exhibit reduction series with the hairs almost reduced to mere projections on the testa and having radiating bands. The different degrees of banding on the testa hairs are a vivid example of an adaptation which ensures survival of the species under the hazardous rainy conditions on the hills.



Figs. 1-5 : 1-2. Testa indument of *Impatiens anaimudica* showing spiral bands × 100, × 230 (reduced to ½). 3. Seed hairs of *Impatiens holstii* with opposite spiral bands × 200. (reduced to ½). 4. Reduced testa indument in *Impatiens mysorensis* × 1200. (reduced to ½). 5. Seed hairs of *Impatiens tangachee* showing spiral bands × 250. (reduced to ½)

REPRODUCTIVE BEHAVIOUR

South Indian *Impatiens* are both cross and self pollinated. Cross pollinated species are perennial and are most predominant in the north-east monsoon regions which remain more or less continuously humid and cold even during the dry parts of the year. All the autogamous species are annuals, and mostly occur in areas having south-west monsoons.

Most of the species of *Impatiens* bloom at night and the pollen grains germinate during nights only (Bhaskar & Razi, 1974). The septate microsporangium is another characteristic feature in the genus which may turn out to be useful in species distribution. A large number of differences may also be found in these species in such features as time of anthesis, number of nuclei in pollen at the time of shedding, time of germination of pollen grains, time required for initiation of division of the generative nucleus, the site of gametogenesis and the type of division and the type of female gametophytes among others. It is interesting to note that while the sections 'Scapigerae'. 'Tomentosae' and 'Annuae' are exclusively monosporic in the mode of female gametogenesis, the others include both monosporic and bisporic types.

VARIATION AND SPECIES COMPLEXES

The sections 'Scapigerae', 'Annuae' and 'Microsepalae' are rich in subtly varying taxa and include highly confusing species. For example, it was observed in the Nilgiris that a scapigerous balsam growing on rocks near a stream between Naduvattam and Pykarai exhi-

bited the combined characteristics of two scapigerous species growing on either side of it, *I. modesta* (Naduvattam) and *I. clavicornu* (Pykara). The leaves are like those of *I. clavicornu* and the flowers resemble those of *I. modesta*. Similarly, *I. chinensis* population in Haadya (Saklespur) offer a good example of introgressive hybridisation. It has produced an array of variant plants. The 'Annuae' and the 'Microsepalae' exhibit a complex morphological heterogeneity which has created acute problems for taxonomists to delimit the species. In most instances interspecific hybridisation has apparently been involved in the formation of stable populations with the same number of chromosomes as the parental species. The prevalence of same chromosome numbers supports their hybrid origin, since crosses between taxa with the same chromosome numbers are generally easy to cross between populations of the same taxon. Furthermore, varying back crosses tend to obscure the morphological limits between the initial hybridizing species. Intergrading of characters is so rampant as to reduce species, identification to only a guess. The plants also vary with the intensity of rainfall; and in different regions, and to such an extant as to make them appear almost like different species. A correct identification, needs thorough familiarity of the plants both in their natural habitat and in the herbarium. When they are dried, closely related species look almost alike, and have been identified differently in the past. The presence of species complexes with highly varying characters adds further to these difficulties. Species are very often only to be distinguished by very minute differences in the shape of flowers, lip, wings and colour. Hence, for overcoming these difficulties one needs to accumulate a very large number of characters by biosystematic study, as done now.

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