PART IV

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

Totally forty six species and one variety of Indigofera, Desmodium, Dendrolobium and Alysicarpus belonging to the tribes Indigoferae and Desmodiae of Fabaceae are investigated in the present work.

The taxonomic position of different genera studied, are discussed in brief. The species are arranged following the classifications of Gillett (1958) for the genus Indigofera, Ohashi (1973) for Desmodium and Dendrolobium and Baker (1876) for Alysicarpus. For presenting morphological and cytological observations of the species the above mentioned classifications have been followed.

Different populations of Indigofera trita, Desmodium gangeticum, Alysicarpus vaginalis, Alysicarpus longifolius and Alysicarpus wallichii complex showed morphological variations. When these variations are subjected to polygraphic study, they revealed the existence of consistent differences amongst the populations of a species or related taxa.

The observations pertaining to chromosome number, karyomorphology, meiotic behaviour of chromosomes and determination of pollen fertility for each species are included. Among the

taxa studied, the cytology of 8 species, karyotypes of 16 species and meiosis of 5 species are worked out for the first time.

The polygraphic and karyomorphological studies of different populations of Indigofera trita, Desmodium gangeticum, Alysicarpus vaginalis and Alysicarpus longifolius showed the presence of 3, 2, 5 and 5 ecotypes respectively. A similar study of Alysicarpus wallichii complex revealed the existence of 3 different species, which were variously treated by taxonomists. The present study of the complex supports Sedgewick's (1919) contention of maintaining them as distinct species. Similarly the present cytological observations of Indigofera linifolia var. campbelli supports Wight's view (See Cooke, 1902) of maintaining it as a variety. In contrast to this, different populations of Indigofera linifolia, Indigofera linnaei, Indigofera tinctoria, Indigofera hirsuta, Indigofera glaudulosa, Indigofera trifoliata, Alysicarpus procumbens, Alysicarpus monilifer and Alysicarpus wallichii, though morphologically similar, showed heteromorphism in karyotypes indicating the presence of cytotypes.

The cytological study of different species of the genera Indigofera, Desmodium, Dendrolobium and Alysicarpus supports

the suggested basic numbers 8, 10 and 11 for the tribes as well as for the family. However, X = 4 suggested by Frahm-leliveld for the genus Indigofera in perticular and for the family Fabaceae in general, is not observed in any of the taxa investigated presently. Hence, X = 4 has to be accepted with reservations, till more critical evidences are brought forth. Two basic numbers (X = 10 and 11) observed in the genus Desmodium, supports Rotar and Urata (1967) in considering the dibasic nature of the genus.

Polyploidy is encountered in some species of the genus Indigofera viz. I. hochstetteri, I. angulosa, I. heterantha and I. amblyantha, which are from the areas with extreme climatic conditions. This supports Löve and Löve (1943, 1949, 1957) as well as Frahm-leliveld's view (1966) of considering the presence of polyploidy in the species growing in higher altitudes or drier climate.

Precise determination of arm ratios of chromosomes in different species of all the genera revealed only nearly median and nearly submedian types of chromosomes. However, two species of Indigofera show the presence of a pair of exactly median (I. amblyantha) and submedian (I. trita) types of chromosomes. The karyotypes of different species are mostly of asymmetrical and graded type.

The karyotypes of different species of the genus Indigofera belonging to the tribe Indigoferae can be arranged in the following evolutionary sequence : I. duthei - I. colutea - I. spicata - I. astragalina - I. hirsuta - I. trifoliata - I. vicioides - I. linnaei - I. tinctoria - I. cordifolia - I. limifolia var. campbelli - I. limifolia - I. glandulosa - I. oblongifolia - I. arrecta - I. subulata - I. trita - I. hochstetteri - I. angulosa - I. heterantha - I. amblyantha.

Based on the karyotypic data the three genera studied in the tribe Desmodiae can be arranged in the following sequence : Alysicarpus - Dendrolobium - Desmodium. The karyotypes of 12 species of the genus Alysicarpus showed the following evolutionary sequence : A. bupleurifolius - A. procumbens - A. rugosus - A. glumaceus - A. longifolius - A. heyneanus - A. wallichii - A. styracifolius - A. tetragonolobus - A. ovalifolius - A. monilifer - A. vaginalis.

In the genus Dendrolobium the only species (i.e. D. triangulare) studied resemble the species of Desmodium in its karyotype. This indicates that, both the genera are closely related to each other.

Based on the karyotypic data the species of Desmodium

can be represented in the following evolutionary sequence : D. salicifolium - D. laxiflorum - D. uncinatum - D. dichotomum - D. triflorum - D. heterocarpon var. strigosum - D. velutinum - D. sandwicense - D. intortum - D. elegans - D. rotundifolium - D. gangeticum.

It is evident from the karyotypic data that, minor alterations are noticeable between different species. None of the karyotypes exactly resembles the other indicating that these differences can be correlated with their specific differences. This certainly indicates the role of structural alterations of chromosomes in speciation. However, occurrence of polyploidy in the genus Indigofera indicates its share in speciation.

The meiotic behaviour of chromosomes in majority of the taxa investigated is mostly regular showing 8 (Indigofera and Alysicarpus) and 11 (Desmodium) bivalents at diakinesis and metaphase I. However, the occurrence of univalents, association of bivalents, interbivalent connections, precocious movement, non-synchronised movement, unequal distribution, laggards, micronucleii and cytomixis are some of the abnormalities recorded in different species. In Indigofera angulosa the formation of 8 groups of 16 bivalents as a result of secondary association are observed at metaphase I. This indicates that, the ancestral forms of the species must have 8 chromosomes in

the haploid set. The most commonly observed abnormalities are grouping of chromosomes at metaphase II and cytomixis (noticed at all stages of meiosis,including the premeiotic stage). Grouping of chromosomes is observed in almost all the species investigated. Cytomixis is recorded in all the species of Alysicarpus, 2 species of Indigofera (I. cordifolia and I. glandulosa) and 4 species of Desmodium (D. laxiflorum, D. velutinum,D.heterocarpon var.strigosum and D. distortum).

As all these abnormalities are present in very low percentage, the meiotic behaviour in general points towards the stabilized nature of the species investigated.This is further evidenced by high pollen fertility (86-96%) recorded in different species.

Gillett (1958) has divided the genus Indigofera into subgenera, sections and subsections. The present cytological findings are coherent in some respects with Gillett's treatment of the genus. This is particularly true with subsections hirsutae, Microcarpae and Brevi-erectae, as the species of these subsections showed close resemblance among themselves in karyotypes. The present study of 7 species of the subsection tinctoriae, exhibit marked differences in chromosome number and morphology, supporting Gillett's view of considering the subsection as the most diverse one.

The genus Desmodium is also divided into subgenera,

sections and subsections (Ohashi, 1973). Of the 13 species investigated, 10 belong to the subgenus Sagotia. Based on the morphological characters, this subgenus is considered as polymorphic and most advanced one. This is justified by the present cytological study.

The cytological observations of the species belonging to the remaining 2 subgenera show that, the subgenus Desmodium is primitive, while subgenus Dollinera is advanced. This is just the reverse of Ohashi's treatment of the two subgenera.

Ohashi (1973) considers the genus Dendrolobium as the most primitive one. In contrast to this the cytological study of Dendrolobium triangulare shows the advanced karyotype, which resembles those of Desmodium species.

Baker (1876) has divided the genus Alysicarpus into 2 groups viz. Microcalycinae and Macrocalycinae. The species of both the groups show primitive as well as advanced karyotypes indicating their parallel evolution. However, the karyotypes of the species belonging to the group Microcalycinae are more advanced than those of Macrocalycinae.

Among the four genera studied, the genus Alysicarpus can be considered primitive, as majority of the species studied, show uniformity in exomorphological characters, chromosome

number and size. The morphological diversities in the genus Indigofera accompanied by different chromosome numbers (2n = 16 to 48) and high ploidy levels metwith in different species are indicative of its advanced nature. While, the genera Desmodium and Dendrolobium occupy the positions in between Alysicarpus and Indigofera.

Based on the cytological study of the genera belonging to the tribes Indigoferae and Desmodiae, it can be concluded that, both the tribes must have diverged very early and followed their own course of evolution.

The data obtained from the study of limited taxa cannot be considered sufficient to draw definite conclusions regarding the delimitations of tribes, genera and species in the family. A thorough investigation on the line suggested above, of the other taxa in the family can further clarify the situation.

Davie (1933) while, working with Malvaceae has rightly emphasized that, from purely cytological evidences, it is difficult to assemble the genera in a phylogenetic sequence. Since the chromosome number and morphology are not absolutely diagnostic. The broad cytological data are of more value for sectional relationships than for alignment of the species. Chromosome differences between the complements of two taxa is

not necessarily a measure of great difference in their external morphology and converse is also true (ecological races i.e. ecotypes, cytotypes and ecads within the circumscription of a species). Workers like,Darlington (1956), Stebbins (1959) and Love (1960) have opined that, too much emphasis on such characters and comparing them with morphological traits would be a serious misunderstanding of the principles of evolutionary biology. However, the data concerning the karyomorphology and the comparison of karyotypes are useful tools, for checking the existing groups, based solely on morphological (phenotypic) criteria. On occasions, when conventional taxonomy failed, this approach has provided solutions in recognisation of taxa at various levels of classification and also served as an indicator, suggesting the probable phylogenetic relationships.

As it stands at present, the traditional descriptive taxonomy should be considered as the basic foundation and other approaches (cytology, cytogenetics, anatomy, physiology, palynology, etc.) should be profitably used by modern taxonomists (omega taxonomy - Turrill, 1938) in realization of the envisaged phylogenetic system of classification.

*****