CHAPTER V

SUMMARY AND CONCLUSIONS

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In the present study, 30 taxa have been investigated. Among the 18 taxa of Solanaceae, genera Nicandra, Lycium and Withania are represented by one species each, Physalis by 2 species and Solanum by 12 species and one form. Remaining 12 taxa belonging to family Fabaceae, include 11 species of Tephrosia and Psoralea corylifolia.

An attempt has been made to analyse the positions of selected taxa in the light of known systems of classification, for the two families. In the present study, morphological, cytological and micromorphological observations pertaining to these taxa have been included. For presenting these observations Wettstein's (1895) treatment for Solanaceae and Baker's (1876) treatment for Fabaceae have been followed.

Summary of the observations and the conclusions drawn for both the families are presented separately one after the other.

SOLANACEAE

Populations of Physalis minima, P. longifolia and Solanum nigrum showed marked morphological differences among themselves. In the morphological description of these species these differences are given due emphasis and same are also

taken into consideration along with cytological findings to decide the presence of ecotypes.

The cytological observations pertaining to chromosome number, karyomorphology, meiotic behaviour and pollen fertility, for different populations of the species selected, are included. In the present study n number for Physalis longifolia, Solanum heterodoxum, S. purpureilineatum, S. nigrum (red veined form) and 2n number for P. longifolia, Lycium barbarum and S. nigrum (red veined form) are worked out for the first time. Moreover, the karyotype details of 6 species are also worked out for the first time.

Occurrence of B-chromosomes in spinaceous species of Solanum has been reported by earlier cytologists. However, their presence in tetraploid and hexaploid species of S. nigrum complex is recorded for the first time.

Few meiotic abnormalities such as non synchronised movement of chromosomes, early separation, variable number of laggards and formation of bridge in various investigated species of the Solanaceae are also recorded for the first time.

Among the micromorphological features, venation pattern study for the genera Nicandra, Lycium and some species of Solanum, has been attempted for the first time. In addition, occurrence of short stalked with multicellular head type of glandular trichomes in Nicandra physalodes, is worth mentioning.

Comparison of exomorphological and karyomorphological data of different populations of Physalis minima, P. longifolia and S. nigrum revealed the presence of 2 ecotypes in each. Whereas, in different populations of Nicandra physalodes, Solanum trilobatum and S. nigrum presence of 3, 2 and 3 cytotypes respectively, is recorded.

Various base numbers, ranging from 3 to 30 have been suggested for different members by researchers in the past. However, base number 12 for the family is supported by the study of 17 species belonging to 4 genera viz., Lycium, Withania, Physalis and Solanum. Whereas X = 9 + isochromosome and X = 10 are the two base numbers observed in Nicandra physalodes.

Cytological as well as micromorphological findings pertaining to the above mentioned genera support the distinctness of each of them. The karyotype of the genus Nicandra is distinct in its having less number i.e. 2n = 19 or 20 chromosomes in the somatic complement, longer chromosomes, more pairs with nearly median centromeres, presence of isochromosome and total absence of satellited chromosomes. In addition to these cytological characters, micromorphological features such as absence of bundle sheath jacketing the veins and presence of short stalked with multicellular head type of trichomes, distinguishes it from other genera under consideration.

Genus Lycium is distinct from the preceding one, in having 2n = 24, longer to medium sized chromosomes, higher value of L/S ratio and slightly more asymmetrical nature of the karyotype. Moreover, the chromosome pairs having nearly submedian centromeres, are only 2. Absence of intersecondaries, presence of only 3 types of stomata showing predominance of anomocytic type and presence of only eglandular uniseriate type of trichomes, are the micromorphological features, which distinguish it from other genera.

Karyomorphological features, such as short to medium sized chromosomes, more pairs with nearly submedian centromeres, more number of satellited pairs, asymmetrical and graded nature distinguish the genus Withania from preceding taxa. Conspicuous micromorphological characters like presence of branched candelabra and stellate types of trichomes, smaller sized areoles and predominance of paracytic type of stomata also help in distinguishing the genus Withania from others.

Like Withania, genus Physalis also has 2n = 48 chromosomes in its somatic complement. However, the karyotype of Physalis is distinct in its having short sized chromosomes, more pairs of satellited & secondarily constricted chromosomes and higher value of L/S ratio. Absence of prominent sinuousites of epidermal cells, predominance of anomocytic type of stomata accompanied by hemidiacytic type, in a low

percentage, are the two vague distinguishing micromorphological features, encountered in genus Physalis.

The polymorphic genus Solanum differs from all the preceding genera in showing different ploidy levels. Also in contrast to others, it has small sized chromosomes in the somatic complements of different species. Moreover, asymmetrical & evolved nature of the karyotypes, occurrence of B-chromosomes and presence of more pairs of chromosomes with nearly submedian centromeres, help to distinguish the genus Solanum from others. Like the genus Nicandra, in Solanum also micromorphological characters such as, prominent sinuousites of the epidermal walls, presence of 4 types of stomata and predominance of anisocytic type, are observed. However, the genus Solanum is characterised in having more number of intersecondary veins.

Both cytological and micromorphological features can be profitably used for generic distinction. When considered alone, however, micromorphological features fail to depict evolutionary status of these genera. On the basis of cytological data and comparison of the karyotypes, 5 genera included in the present study, can be arranged in the following evolutionary sequence :

Nicandra, Lycium, Withania, Physalis and Solanum.

Of the 12 different schemes proposed by different

taxonomists, only in Wettstein's (1895) treatment of the family Solanaceae, the above mentioned phylogenetic sequence of the placement of these genera, is evident. The present findings, therefore, are in agreement with the Wettstein's system.

Between the 2 species of Physalis analysed P. minima appears slightly less advanced than P. longifolia. Both the species share the common karyotypical characters i.e. 2n = 48, medium to short sized chromosomes. But they differ from each other in number of each 'type' of chromosomes, quantitative values of L/S ratio and TF%. The species also show great resemblance in their micromorphological features. P. minima, however, differs from P. longifolia in showing occasional occurrence of stomata with single subsidiary cell and biseriate trachieds in its areoles.

The 3 spinaceous species viz., Solanum trilobatum, S. heterodoxum and S. viarum have 2n = 24 chromosomes in their somatic complements. In general, the chromosomes are long to medium sized depicting asymmetrical & graded nature of the karyotypes. Like other non-spinacent Solanum species, these species also show the predominance of anisocytic type of stomata. Of the 3, S. trilobatum can be considered primitive in showing equal pairs of chromosomes with nearly median and nearly submedian centromeres, while the advance nature of S. viarum is evident in its having 10 pairs of

chromosomes with nearly submedian and only 2 pairs with nearly median centromeres, S. heterodoxum occupies position, in between the two. Micromorphologically also, S. trilobatum is distinct in showing the presence of stellate type of hairs, similarly the distinctness of S. heterodoxum is evidenced by the observation of cuticular thickenings, in the form of small pads, at poles of guard cells and sinuous course of secondary veins.

For the convenience of comparison, the other species of Solanum can be grouped into 3 groups, characterised by 2n = 24, 2n = 48 and 2n = 72 chromosomes.

Based on karyotype data, the members of the first group i.e. with 2n = 24 chromosomes, can be arranged in following evolutionary sequence :

S. americanum, S. nigrum, S. nodiflorum. These 3 closely related species also share a number of common micromorphological features. However, presence of stellate and long uniseriate stalked with unicellular head type of trichomes, occurrence of only 2 types of stomata in S. americanum and presence of only conical uniseriate type of eglandular trichomes, 4 types of stomata in S. nodiflorum, are the distinctive micromorphological features of the two.

Morphologically, closely resembling 4 species also have 2n = 48 chromosomes in their somatic complements. Although they show gross resemblance in their karyotypes but comparison

and close scrutiny of the karyotypes show the evolutionary sequence as : Solanum villosum subsp. villosum, S. villosum subsp. puniceum, S. purpureilineatum and S. roxburghii. It is difficult to make distinction of these 4 tetraploid species on micromorphological characters. However, locally available common taxa, S. purpureilineatum and S. roxburghii show the presence of only one type of trichomes i.e. eglandular uniseriate. On the other hand, both exotic species, S. villosum subsp. villosum and S. villosum subsp. puniceum revealed the presence of 2 types i.e. eglandular and glandular trichomes on their leaves.

Based on the karyomorphological analysis the 4 hexaploid species can be tentatively arranged in this order : Solanum chenopodioides, S. scabrum, S. nigrum and S. nigrum (red veined form). Greater resemblance in the karyotypes of S. chenopodioides and S. scabrum is seen. Same is also true about the S. nigrum and S. nigrum (red veined form). Between S. chenopodioides and S. scabrum, the former one is distinct in showing the presence of extension cells and uniseriate trachied. Of the remaining 2 species, S. nigrum (red veined form) is distinct from the type species in showing the presence of a rare type (short stalked with multicellular head) of trichomes and binucleate, persistent, stomatal cell.

FABACEAE

Among the members of the family Fabaceae included in the present study, earlier report of X = 11 and 12, designating the dibasic nature of genus Tephrosia, is confirmed.

In the present work 2n and n numbers for 3 species of Tephrosia viz., T. strigosa, T. jamnagarensis and T. subtriflora; n number for T. falciformis and 2n number for T. wallichii are reported for the first time. Though the 2n number for many species of Tephrosia included in the present study were known, the karyotype analysis of 6 species has been attempted for the first time.

The detailed cytological analysis of different populations of T. villosa and T. pumila revealed the presence of 3 and 2 cytotypes respectively.

Earlier report of presence of 1 or 2 B-chromosomes in Psoralea corylifolia by Bakele & Sharma (1979) is not substantiated by the present work.

Study of the venation pattern of the different species of Tephrosia has been attempted for the first time. Other micromorphological features such as trichomes and stomatal types for some species of the genus had been reported earlier. However, some of the species like, T. strigosa, T. jamnagarensis, T. uniflora subsp. petrosa, T. subtriflora, T. falciformis,

T. wallichii and T. candida and Psoralea corylifolia have been studied for the first time.

Based on chromosome number, 11 species of Tephrosia studied can be broadly grouped into 2 groups : one with 22 and second with 24 chromosomes. In the first group i.e. with 2n = 22 8 species are included. Among these T. strigosa and T. jamnagarensis, karyotypically appear primitive. Karyotypes of the 2 species show gross resemblance. But, slightly more evolved nature of T. jamnagarensis is seen in its having comparatively high value of L/S ratio, presence of a pair of satellited and B-chromosomes in its karyotype. Both species show more or less identical micromorphological features. Another 2 species of this group : T. villosa and T. pumila are also karyomorphologically very close to each other except for the presence of 2 B-chromosomes in T. villosa. Slightly more evolved species of this group viz., T. uniflora subsp. petrosa, T. subtriflora, T. candida have 9, 10 and 11 pairs of chromosomes with nearly submedian centromeres, respectively. Moreover, the karyotypes of these taxa have one or more pairs of satellited and/or secondarily constricted chromosomes. Among these above mentioned 5 species, T. pumila shows resemblance with T. subtriflora in micromorphological characters. Same is also true in case of T. villosa and T. uniflora subsp. petrosa, as regards the micromorphological features, such as highest degree of vein order and size of the areole. Only in T. candida, isolated trachieds lying free in the areoles are noticed.

On the basis of karyotypical analysis the species of this group can be arranged in the following evolutionary sequence :

Tephrosia strigosa, T. jamnagarensis, T. villosa, T. pumila, T. uniflora subsp. petrosa, T. subtriflora and T. candida.

Second group is comprised of species having 2n = 24 chromosomes in their somatic complements. The detailed karyotypic analysis of these revealed the following evolutionary sequence :

Tephrosia purpurea, T. wallichii and T. hamiltonii. As regards the micromorphological features, species of this group show resemblances among themselves as well as with the species of the previous group.

Based on the foregoing discussion and summary it can be concluded that :-

In the family Solanaceae, among the genera studied, only in case of Solanum, polyploidy has played a significant role in speciation. While in others, structural alterations are responsible for the same.

Recognised genera viz., Nicandra, Lycium, Withania, Physalis and Solanum can also be distinguished from one another on the basis of karyomorphological and micromorphological features.

Uniformity, as regards the types of chromosomes, among the species of Physalis and Solanum substantiates their inclusion in the respective genera.

Overall regular meiotic behaviour, observed in all the taxa studied, suggests their established and evolved nature.

Micromorphological features, alone fail to give clue for specific distinction. But differences in quantitative values of these characters are noticed in different species.

Surprisingly, the order of placement of genera is more or less the same, as proposed by Wettstein in 1895, in his treatment of the family.

Polyploidy does not seem to have played any role in speciation for both the genera of the family Fabaceae.

Between the two, Tephrosia is dibasic (X = 11 and X = 12) while, Psoralea is monobasic (X = 12).

Overall resemblance in the karyotypes of different species of Tephrosia supports their inclusion in the genus. Minor structural differences noticed in the karyotypes of different species, however, can serve as good indicators for specific distinction.

The established nature of different species of Tephrosia and Psoralea corylifolia can also be seen in their regular meiotic behaviour.

Micromorphological features are also greatly uniform in different species of Tephrosia. Therefore, specific distinction on these features will prove futile.

Hutchinson (1967) has raised the level of subtribes Tephrosieae and Psoralieae to the levels of tribes.

Present study of karyotypes and micromorphological characters, of different species also justifies their inclusion in distinct tribes.

Quite a few prominent investigators have opined that too much emphasis on karyomorphological and micromorphological characters, is not desirable. However, data concerning these characters can serve as useful tools for checking the existing groups, based solely on morphological (phenotypic) criteria. On many occasions when conventional taxonomy failed, such approaches have provided solutions in reorganization of taxa at various levels of classifications and also served as indicators suggesting the probable phylogenetic relationships.

As only limited taxa have been investigated in the present work, therefore, conclusions concerning their

phylogeny and interrelationships may not be considered as final. It will be all the more necessary, that remaining taxa of these two families are thoroughly investigated from these approaches, to further clarify the situation and draw final conclusions.

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