Contd- **Modern trends in plant taxonomy (II)**

Cytology in relation to taxonomy (Cytotaxonomy)

It was a new approach of many cytologists to link cytology with taxonomy, which gave the birth of a new term Cytotaxonomy. Studies of chromosome characters and their variation in different taxa led them to interpret that these characters and their variations may prove a basis of solving many taxonomic enigmas.

Cytotaxonomy is the discipline, which utilizes cytological characters to solve the taxonomic problems. This was widely used in the 20thcentury scientists such as Ehrendorfer (1964),Moore (1968), Solbrig (1968), Abraham (1958),Mathew(1958a,b),Sharma(1956,1964) ,Pathak (1940),Cheenaveriah(1962) and many more. Cytological data are based on the number, size and structure of chromosomes (Karyotype) of different taxa. There is great variation in above parameters in plants.

Karyotype components-

Chromosome number- There is great variation in chromosome number among taxa. It ranges from few to hundreds. This is one of the criterions to distinguish genera.

Chromosome size- Length of chromosome in general ranges from 0.5µ-30µ.This variation is used in Karyotype studies. There is also variation in position of centromere and on this basis chromosomes are metecentric (middle centromere), telocentric (centromere terminal) and acrocentric (centromere sub-terminal). According to Darlington and La Cour (1940), Dyer (1963) and Kurbayashi (1958) size and structure of chromosomes may be used in identifying plants below specific level. The amount of heterochromatin, volume of chromosomes may also be used for taxonomic purposes.

Monocots have usually larger chromosomes than the Dicots. In general woody plants have smaller chromosomes than their herbaceous relatives.

In the family *Ranunculaceae* these criteria have been found useful in arrangement of genera and their tribes. Two major tribes *Helloboreae* and *Anemoneae* have genera with base chromosome numbers of 7, 8 and 9 and both the tribes have genera with large and small chromosomes. The genera *Aquilegia* and *Isopyrum* of *Helleboreae* and *Thallictrum* and *Anemonella* of *Anemoneae* have base number 7 with small type chromosomes. Thus, these four genera have been segregated in a separate tribe *Thalictreae.*

The genera *Agave* and *Yucca* were placed in separate families *Amaryllidaceae* and *Liliaceae* respectively by earlier taxonomists, but due to presence of 5 long and 25 short chromosomes in both they have been placed in a single family *Agavaceae* as has also done by Hutchinson.

Similarly the two genera of family *Brassicaceae, Physaria* and *Lesquerella* were recognized by many taxonomists as a single genus. Cytological evidence, however, suggests that they should remain separated.

There are many reports on Karyotype based taxonomy up to family and even higher levels of taxon

Cytotaxonomy has been useful in judging the phyletic relationships among taxa at generic as well as specific level, but this cannot be an independent complete basis of classification.

Chemotaxonomy (Chemosystematics)

The application of chemistry to systematic is called chemotaxonomy. Plants are unique in nature, as they synthesize variety of biochemicals during their metabolic processes. Large number of plant species is known to produce compounds of interest. Biochemical peculiarities of plants have been used for taxonomic purposes since long times. Though it is very old discipline, but this branch has developed rapidly in recent years. This gave birth to a separate discipline "biochemical *systematics or chemosystematics*". Several screening and assay of plants have been done to collect the knowledge of the biochemical composition of large number of plants. On the basis of these compounds many taxonomic problems could be solved.Hegnauer (1965) suggested that both organic and inorganic constituents be considered for chemotaxonomic considerations.

The history of biochemical systematic began with the comparison of morphological features and their chemical composition in grouping taxa. Petiver (1699) published such correlations but that did not gain popularity. Harborne's (1967) indication of chemotaxonomy as an aspect of phytochemistry provided it a status of separate discipline.Mc Nair (1965) opined that evolution of chemical substances in plants accompanied plant evolution itself and hence, advanced taxa possess most complex chemical constituents. However, Gibbs (1965) opposed this view and asserted that chemotaxonomy is an attribute of significance in solving the taxonomic problems.

Biochemical compounds which serve the purpose of taxonomy include secondary metabolites, such as phenolics, flavonoids, alkaloids, and non-protein amino acids.

Phenolic compounds- These are one of the secondary metabolites, which have protective function and act as a defense mechanism for plants against the pathogens. These are produced in large quantity and can be easily extracted and identified. They are used to catetgorise plants.

Flavonoids- These are the largest group of naturally occurring phenolics compounds that occur in most plant tissues and, especially in vacuoles. They also occur as mixture of single or polymeric compounds in bark and heart woods. Many of them are inhibitory or toxic to pathogens. Various types of flavonoids include flavones, flavonones, isoflavonoids, anthocyanidins, etc.

The presence of leuco-anthocyanin is correlated with woody habit. They were detected in 60% of the woody families, whereas in only 15% of the herbaceous families. Ellagic acid is present only in the tribe *Kerrieae* of the subfamily *Rosoideae* of the family *Rosaceae*, where it is absent in other tribes of subfamily.

Alkaloids- These are heterogeneous group of organic nitrogen containing bases. These are present in large amounts in the tissues, particularly in the vacuoles. There are more than 5000 kinds of alkaloids found in angiosperms, mostly from Dicots. Distribution of alkaloids has been found useful in deciding the position of genera in the family *Fabaceae.* Three genera of *Fabaceae* namely *Genista, Ammodendron* and *Adenocarpus* contain the alkaloid **ammodendrine-hystrine**. Of these, Genista and Adenocarpus were included in the *Genisteae*, whereas Ammodendron was placed in the *Sophoreae,* a tribe characterised by the presence of *Matrine* alkaloids. This suggests the transfer of Ammodendron to the tribe *Genisteae .*

Non-protein amino acids- There are large number of non protein amino acids. Their taxonomic significance is due to their discontinuous distribution and less susceptibility to rapid change. In *Fabaceae* ,such amino acids are present in unusually high concentration. Seven intrageneric groups are recognised in the genus *Lathyrus*. This is of taxonomic importance, free amino acid **Lathyrine** is so far known only in the genus *Lathyrus.*