Cytology in relation to Taxonomy

Role of cytology in taxonomy

- Cytology deals with study of Cell Morphology and Karyology.
- The Nucleus study is an important tool to solve biosystematics problems and also conclude about evolution.
- Chromosomal characters and their behavior during Cell division provide relevant information for species identification and their systematics.
- The chromosomes vary from species to species and this is due to the result of different evolutionary history,

Role of cytology in taxonomy

- These variation are very small in related species but they may be quite larger in various related groups.
- The cytological differences provide important evidence for species evolution.
- The characteristics of chromosomes have greatest significance in biosystematics and in evolutionary studies

Role of cytology in taxonomy

- Solbrig (1968) pointed out that most of the cytotaxonomic studies have largely made use of following aspects:

1. Chromosome number
2. Morphology of Chromosomes
3. Behaviour of Chromosomes during the Cell division

Chromosome number

- Extensive work on chromosome numbers in plant species were carried out by Darlington and Janaki-Amal (1945), Darlington and Wylie (1955), Federov (1969) and Löve et al. (1977).
- Regnum vegetable, a series for the Index to Plant Chromosome Numbers published by The International Association of Plant Taxonomy (IAPT, 1967 and 1977), is published in 9 volumes which is mostly forming annual lists of chromosome numbers.

Chromosome number

- The Missouri Botanical Garden maintains the update of records on chromosome numbers and this can be inquired for online information about recorded plant species.
- The chromosome numbers are recorded as diploid number (2n) in somatic cell and in a germ cell (gamete) numbers are recorded as haploid (n).
- The gametophytic chromosome number in diploid species is designated as base number (x).

Chromosome number

- In a diploid species represented n = x, whereas in a polyploid species n is always multiples of x.
- In a hexaploid plant species with 2n = 42 will thus have n = 21, n = 3x and 2n = 6x.
- The angiosperm shows a great variation in their chromosome number.
- The highest chromosome numbers are recorded in Poaceae member Poa littoroa (n = 132) and the lowest number in Asteraceae member Haplopappus gracilis (n = 2).

Chromosome number

- The highest chromosome number in a plant species is occurs in Pteridophytes member Ophioglossum reticulatum (n = 630).The duplication of chromosome numbers (polyploidy) also have taxonomic significance e.g. the grass genus Vulpia species contains hexaploid (2n = 42) and tetraploid (2n =28) where as diploid (2n = 14).

Chromosome number

- On the basis of chromosome numbers many scientists worked to solve some taxonomic problems for many taxa e.g. Raven (1975) worked on chromosome numbers at the family level in angiosperms and concluded that the original base-number for angiosperms is 7x.
- The 5x in Paeonia with large chromosomes has been separated to others into the family.
- Paeoniaceae, this placement is supported by other morphological, anatomical and embryological characters.

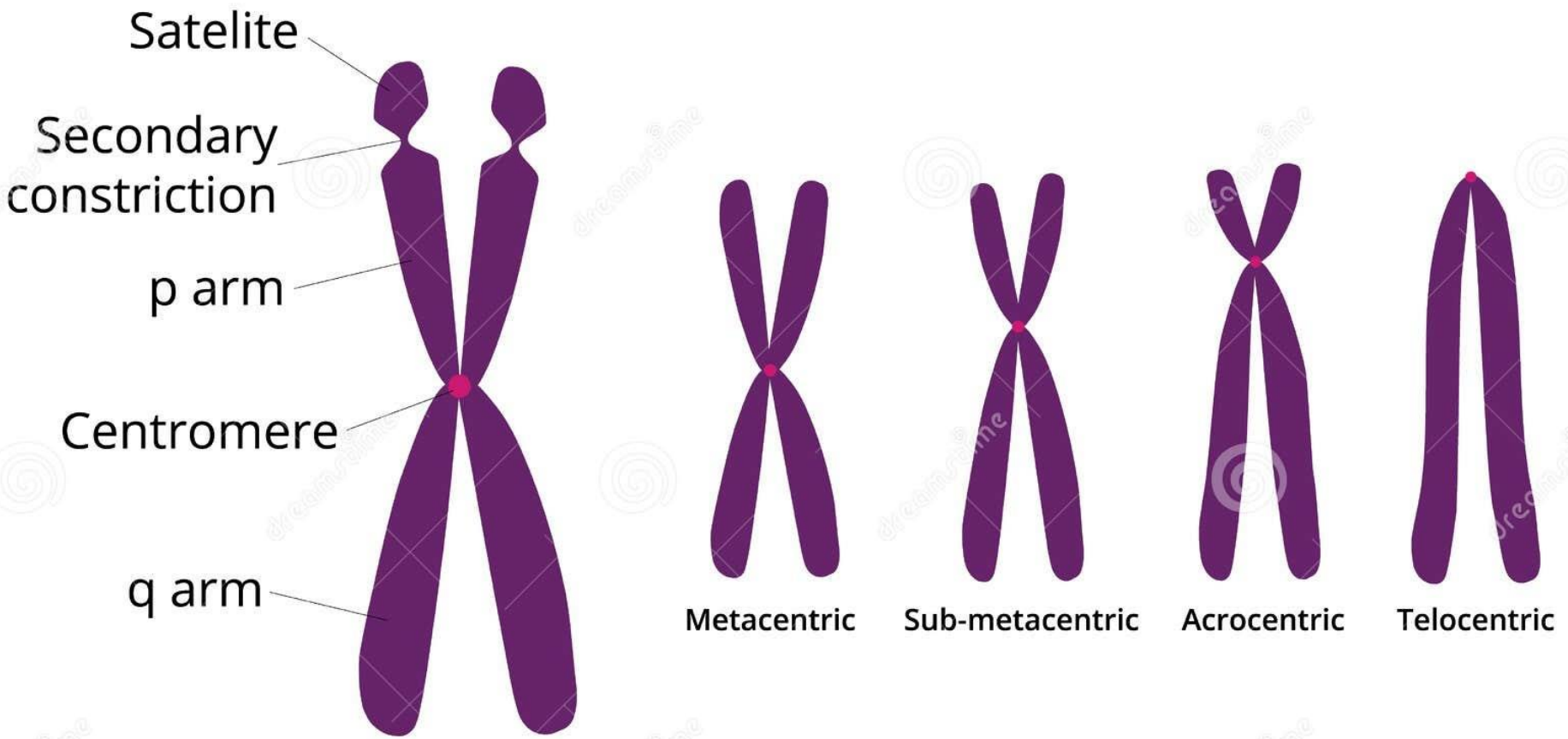
Chromosome number

- Similarly in Poaceae subfamily Bambusoideae has 12x, whereas Pooideae has 7x.
- In Mentha genus the chromosome numbers provide strong support to subdivision viz. Audibertia (9x), Pulegium (10x), Preslia (18x) and Mentha (12x).

Morphology of Chromosomes

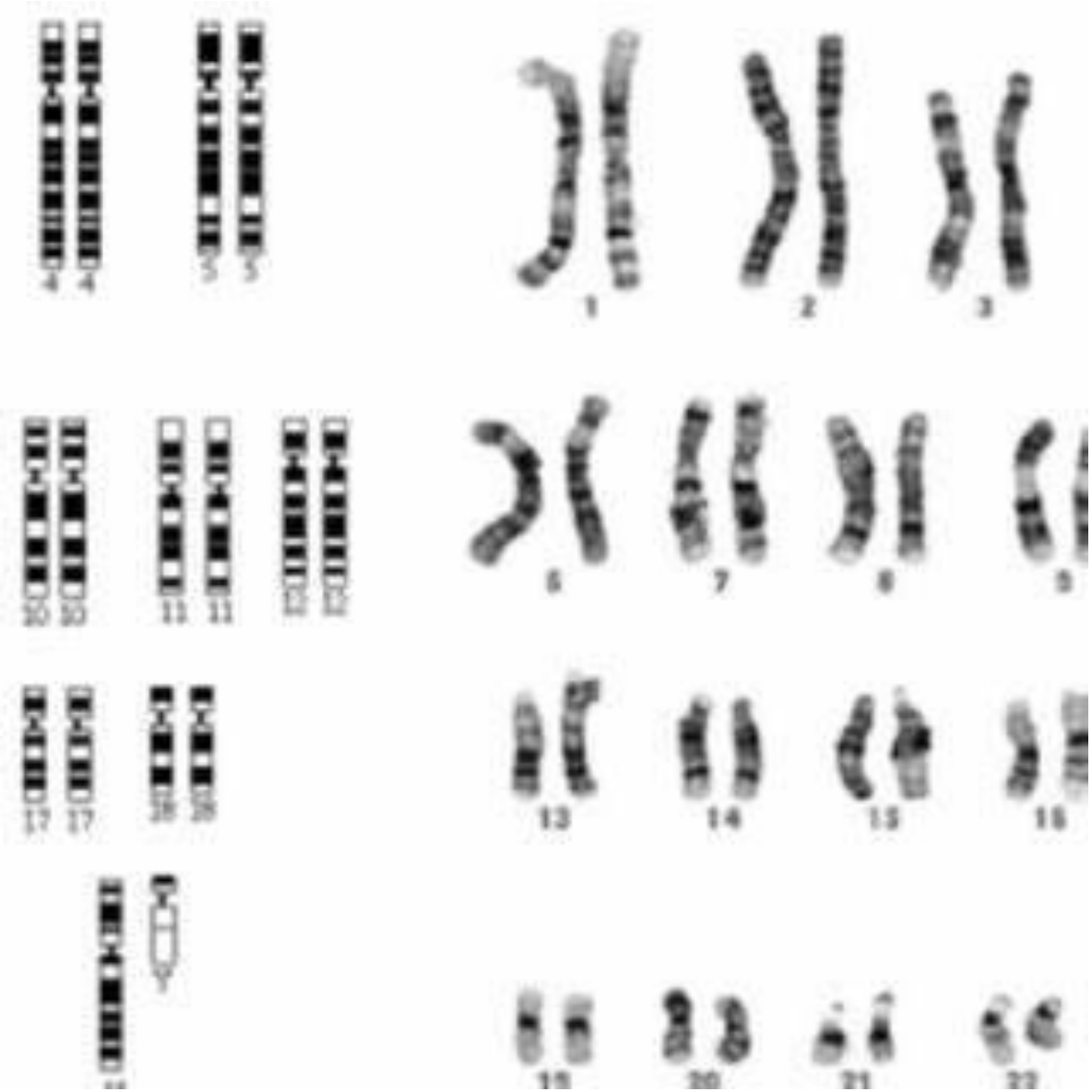
- Generally the chromosomes morphology is considered on the basis of chromosome size, position of centromere and presence of secondary constriction position.
- The centromere position causes the different size of both arms some time they may be equal or unequal, as metacentric (centromere in middle), submetacentric (away from middle), acrocentric (near the end) or telocentric (at the end).

Chromosome Types



Morphology of Chromosomes

- The whole chromosomal structure in a species is called karyotype and their diagrammatically represented is term as idiogram/ karyogram.
- The idiogram/ karyogram are specific for the each species e.g. Lyris (n=12: 6- metacentric and 6- submetacentric); Pseudosago (n=22: 1-telocentric, 6- submetacentric, 5-metacentric) and Pseudolyris (n=12: 2- metacentric and 22- telocentric).



Idiogram **Karyogram**

Behavior of Chromosomes during the Cell division

- The chromosomes behavior during pairing (synapsis) and subsequent separation is useful sometimes in studying the interrelation of taxa.
- Meiosis also sometime provides taxonomic information e.g. Juncaceae and Cyperaceae families have small Chromosomes with unlocalized centromere.
- The genus Paeonia was traditionally put in the family Ranunculaceae.

Behavior of Chromosomes during the Cell division

- On the basis of cytological data of the Paeonia is different from the Ranunculaceae members, as the basic chromosome numbers 5x which is unlike to other Ranunculaceae members like they possess 6x, 7x and 8x.
- Similarly the Yucca and Agave shows same type karyotypes which are asymmetrical, comprising 10 large and 30 small chromosomes.
- On the basis of morphological characters similar habit and secondary growth both genus keep in a same family Agavaceae as both are separately put in distinct families.

THANK YOU