ROLE OF EMBRYOLOGY IN TAXONOMY

MBOTCC·6
Unit V

M.Sc. Sem II
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Introduction:

In modern biosystemic approaches in plant taxonomy several embryological characters have been valuably used in resolving debatable taxonomic positions of all hierarchies, especially at the family, genus and species levels. However, the role of embryology in solving taxonomic problems was first of all advocated and practiced by Schnarf (1931), a German embryologist. Maheshwari (1950) and Radford later emphasized the importance of diverse embryological characters in the re-assessment of doubtful taxonomic identity and re-allocation of new taxonomic positions. Embryological characters being less prone to adaptive stress are relatively stable and have acquired great significance in Plant Taxonomy.

Some Classical Examples:

Following are some classical examples where embryological characters have been used in taxonomic characterization and validation:

(i) Dicots and Monocots in angiosperms are universally established on the basis of the number of cotyledons – a basic embryological feature.

(ii) Helobiae – A monocotyledonous order, treated as a sub-class by some modern taxonomists, is named after Helobial endosperm ted embryo and little or no endosperm occurrence characterize this order.

(iii) Orchidales – Presence of undifferentiapseudo embryo sac from the nucellus characterize this family.

(iv) Podostemonaceae – Formation of

(v) Lemnaceae – Derivation of Lemnaceae from Helobiales or from Araceae has phylogenetically been determined. But Maheshwari (1950) suggested that

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Lemnaceae have evolved from Araceae stock and not from Helobiae.

(vi) Crassulaceae – On the basis of embryological characters this family has been assigned a new position under Rosales.

Broader Areas of use:

Plant taxonomists have used embryological characters in various ways:

a. In the analysis of evolutionary trends
b. In the circumscription and delimitation of taxa
c. In resolving systematic positions of debatable taxonomic treatment

Basic Embryological Characters of Taxonomic significance:

(i) Presence and type of anther tapetum (glandular / amoeboid)

(ii) Number and arrangement of anther locules

(iii) Type of endothecium of the anther (structure, thickening & nature)

(iv) Pattern of quadripartitioning of MMC (By furrowing or by cell plates) – whether the mode of division is simultaneous or successive

– Arrangement of microspores (Tetrahedral, isobilateral, linear, T-shaped or otherwise)

(v) Number and position of germ pores on the pollen, exine stratification, number of cells in the pollen at the time of anthesis

(vi) structure, position and development of the ovule vasculature of integuments, and orientation of ovule

(vii) Crassinucellate or tenuinucellate ovules, presence or absence of hypostase and persistence or gradual disappearance of the nucleus

(viii) Origin and extent of ovular sporogenous tissue

(ix) Features of megasporogenesis and nature of embryo sac development

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(x) Organization of the embryo sac
(xi) Endosperm type - Nuclear, cellular or helobial
(xii) Nature of food reserves and its persistence or gradual disappearence in the seed
(xiii) Features of the seed coat
(xiv) Abnormalities in embryo and seed development - Parthenogenesis, Apogamy, Adventive embryony, Polyembryony, etc.

Application of embryological characters in Taxonomy:

Embryological features may be used in the resolution of complex or controversial taxa either above the family level or at or below the family rank. Some examples are as hereunder:

A. Above the Family Rank

1. Caryophyllales (or Centrospermae)

(i) Characterized by tri-nucleate pollen, bitegmic, crassinucellate ovules (campylotropous or amphitropous)
(ii) Seed with a curved peripheral embryo roughly surrounding the food storage tissue (usually perisperm)

2. Polygoniales & Plumbaginales

(i) These two orders are related to each other as well as to Caryophyllales as they largely share common embryological features.

3. Lecithidales

(i) Formerly considered related to Myrtales
(ii) Centrifugal stamens, lack of internal phloem and a series of embryological features have now validated its distinction from Myrtales.

4. Ericales

(i) A homogeneous order of sympetalous families, Ericales includes members sharing

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common embryological features including, notably formation of pollen tetrads.

5. Gentianales

(i) Characterized by well marked internal phloem, lack of integumentary tapetum and nuclear endosperm

(ii) These features have prompted its separation from other sympetalous orders.

– Families like Buddlejaceae, Menyanthaceae and Oleaceae, earlier placed under Gentianales have now been separated on the basis of above mentioned features.

6. Helobiae

(i) This Englerian monocotyledonous order is characterized by helobial endosperm

(ii) Recent systems of classification have raised this order to the level of a subclass.

7. Orchidales

(i) Characterized by undifferentiated embryo and very scanty or no endosperm

B. At and Below the the Family Rank

(i) Several embryological evidences have led to the proper placement of some disputed families and genera, with their doubtful systematic position.

(ii) These include Onagraceae, Empetraceae, Cyperaceae, Cactaceae, Garryaceae, Liliaceae, Lemnaceae, etc.

(iii) A number of genera have been assigned new positions on the basis of their embryological features

Thus comparative embryology has been an important factor in revealing the relationships of taxa at all levels. Contributions of Maheshwari (1950, 1963), Davis (1966), Johri (1967, 1970) Patel (1975), Kapil and Bhatnagar (1980), and Bhojwani and Bhatnagar (1983) have made significant contributions to this end. To discover true phylogeny is an obsession among botanists, and new contributions from embryology Howards this end are replete.

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