Studies on embryogenesis of the Indian Taxa of Rutaceae - A review

by *R. B. GHOSH

Recibido 6-XI-75

Monotonous classification of the plant kingdom on the basis of exomorphology is now discouraged and has been proved inadequate and insufficient to correlate phylogeny and affinity of different genera and species in a family or under an order with one or many families. Therefore, stresses have been made for better appraisal of phylogeny in the fields of morphology, anatomy, palynology and cytology. But the contributions of embryology towards taxonomy are inadequate to formulate properly a comprehensive classification. Embryological considerations for taxonomic evaluation have been made by SOUZDES (1939), SCHNARF (1931), MAHESHWARI (1950), CAVE (1953), JOHRI (1963) and DAVIS (1966). By using embryogenic concepts systematists could no doubt improve existing classifications, because they would have a new key in their hands for the solution of some of their problems.

In a general sense, embryogenic data only confirm the validity of the genera but this is not always true of higher taxa. Therefore, besides families drawing completely homogeneous embryonic characters, there are others with varied types of embryonic development, so that some genera showing purely fortuitous resemblances, have been placed together although belonging to absolutely distinct

(*) Present address: Indian Botanic Garden, Shibpur, Howrah, West Bengal, India.
(**) The above text presented here is a portion of the approved dissertation of Ph. D. in Botany of the Calcutta University.
phyletic series. Since in many families embryogenesis has been studied in only one or two species, it is presently impossible to give a thorough review of this problem.

In the present text of information, the author has come forward to review Rutaceae of Hooker's (1875) system on the basis of recorded embryogenic data for better understanding of phylogeny and inter-relationships of the genera and species of the four prescribed tribes of the same family.

**Tribe I: Rutae**

*Ruta*

Schnarf (1931) has stated that in *Ruta graveolens*, the embryo development conforms to the Crucifer-type. Johansen (1950) after his review work on Rutaceae opines that embryo development in the aforesaid species mostly resembles that of “Onagrad-type”, of course, with some differences. Cappalletti (1929) observed nucellar and zygotic embryos in *Ruta patavina*.

*Peganum*

Soueges (1953b) did not mention any type of “adventive embryony” in *P. harmala*. Recently Kapil and Ahluwalia (1963) recorded the presence of “Zygotic embryo” which conforms to the “Solandtýpe”. Occasionally the persistent synergid gives rise to a small additional 2-celled pro-embryo.

*Dictamus*

Single embryo was found to be present in a seed, but whether it is zygotic or nucellar in origin could not be determined by Mauritzon (1935).

**Tribe II: Zanthoxyleae**

*Melicope*

Mauritzon (1935) recorded the presence of “nucellar embryo” in the taxon.
Zanthoxylum

Mauritzon (1935), Furusato (1951, 1953) and recently Dasai (1962) reported the occurrence of adventive “nucellar polyembryony” in several species of the genus.

Tribe III: Toaddalieae

Skimmia

Mauritzon (1935) recorded the presence of “nucellar embryo” in the taxon.

Tribe IV: Aurantieae

Glycosmis

Desai (1962) has observed the occurrence of 2-celled “Zygotic embryo” in G. pentaphylla. No report of the origin of nucellar embryony has been made therein by him. But Ghosh (1965) has noticed the phenomenon of “adventive nucellar embryony”.

Murraya

Two species of the genus, as such, M. exotica and M. koenigii were worked out incompletely by Chakravarty (1935, 1936) which showed the presence of “nucellar embryony” no regular formation of embryo was noted. In her embryological investigation, Desai (1962) has recorded “nucellar embryony” in those species of Murraya which conforms to the observations of Chakravarty (1935, 1936).

Triphasia

Both “nucellar and Zygotic embryos” occur in the taxon (Mauritzon, 1935). The cap-cells are found to produce 5 nucellar embryos.
Ravenia = (Lemony)

No species of the genus has yet been investigated from the view point of gametogenesis and embryogeny. Ghosh (1969) has recorded the occurrence of regular type of embryo formation, i.e., "Asterad type" with Polygonum variation and also synergid embryo in the taxon Ravenia spectabilis Engl.

Atalantia

Mauritzon (1935), and Desai (1962) have reported the presence of "nucellar embryony" in the taxon.

Citrus

Strasburger (1878) and Osawa (1912) reported "nucellar embryony" in C. aurantium. Bacchi (1943) reported the presence of polyembryony due to formation of "Zygotic embryo" from the "multiple gametophyte".

Feronia

Banerji and Pal (1958) have recorded the occurrence of "nucellar embryony" in the species Feronia limonia Sw.

Aegle

Nucellar embryony has been recorded in the species A. marmelos (Johri & Ahuja, 1957).

DISCUSSION

In reviewing the data of embryogenesis of the taxa of the Rutaceae as included by Hooker (1875), it may be presumed that there is a basic similarity in the formation of embryo. It is further interesting to note that almost all the taxa except a few genera appear to be homogeneous from the view point of embryogeny — both "nucellar embryony" and "nucellar polyembryony" are found to be a regular feature in the family under reference. In the genus
*Ruta* of the tribe Rutae, regular type of embryo formation has been recorded as revealed from the corroborative data of the text. The occurrence of both nucellar and zygotic embryo in the genera stated below indicates homogeneity of three tribes other than the tribe Rutae as enunciated by Hooker (1875). In the Rutaceae most of the taxa show unified method of embryogenesis, i.e., either nucellar embryony or nucellar polyembryony admixed with the formation of regular embryos following Johansen’s (1950) typification.

It may presently be suggested that the proposed four tribes of Hooker should be broadly divided into classes: i) Regulatae and eopolyembryonatae indicating the formation of regular embryo and absence of polyembryony; ii) Irregulatae and polyembryonatae indicating the formation of irregular, i.e. both zygotic and adventive embryo or embryos. A schematic representation of two classes as suggested including the taxa may be shown as follow:

i) Regulatae and Eopolyembryonatae:
   1. *Ruta*

ii) Irregulatae and Polyembryonatae:
   2. *Peganum*
   3. *Lemonia*
   4. *Dictamnus*
   5. *Melicope*
   6. *Zanthoxylum*
   7. *Skimmia*
   8. *Glycosmis*
   9. *Murraya*
   10. *Triphasis*
   11. *Atalantia*
   12. *Citrus*
   13. *Feronia*
   14. *Aegle*

In the light of substantive data of embryogenesis of the above mentioned taxa, the unexplored taxa of the four tribes should be investigated in order to bring forth results of embryogeny for establishing the validity of those four tribes of the family. Polyembryony in the gymnosperms is so prevalent that only an exhaustive study of the literature would make it safe to venture an estimate of its extent. In the angiosperms, sporophytic polyembryony appears to be considerably more limited in its taxonomic distribution than other types of polyembryony. On the basis of Ernst’s (1918) classification of true and false polyembryony, it
may be stated that the Rutaceae chiefly manifest the occurrence of "true polyembryony" rather than "false polyembryony", the latter phenomenon is only exemplified by the taxon *Citrus* in which multiple gametophytes contribute to the formation of plural embryos (Bacchi, 1943). This is worth mentioning that the genera now included under 'Irregulatae' show the unique sequence of formation of true plural embryos except *Citrus*. However, detailed study of embryogeny with special reference to polyembryony in the Rutaceae has some bearing on its taxonomy.

**BIBLIOGRAPHY**

**Bacchi, O.**

**Banerji, I.**

**Banerji, I. & Pal, S.**

**Cave, M. S.**

**Cappaletti, G.**

**Chakravarty, R. S.**

**Desai, S.**

**Ernst, A.**

**Furusato, K.**

**Ghosh, R. B.**
HooKeR, J. D.

JOHANSEN, D. A.

JooRI, B. M. & ARIJIA, M. R.

JooRI, B. M.

KAPIL, R. N. & KARVITA, A.

MAHESHWARI, P.

MAURITZON, J.

OSAWA, I.

SCHMID, K.
1931 Vergleichende Embryologie der Angiospermen, Berlin.

SOUCHEZ, R.
1939 Embryogenie et classification. 2e Fascicule, Paris.

STRASBURGER, E.

(* Not seen in original.)