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A Review :

Is it monosporic or bisporic development in *Cyamopsis psoralioides* DC.?: further evidence of a criticism of Maheshwari (1955) and Rembert (1967a - Ph.D. Thesis, 67b, 69, 71)

S. A. SALGARE
Salgare Research Foundation Pvt. Ltd. Prathamesh Society, Shivaji Chowk, KARJAT (M.S.) INDIA

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Cyamopsis psoralioides DC. is a member of the Papilionaceae. In one micropreparation a linear arrangement of three spores was noted, perhaps the micropylar one is a dyad member, while the chalazal two are megaspores. In another micropreparation again three cells were observed, where the micropylar one is in the stage of degeneration. The chalazal cell is having two nuclei, while the next to it is having a nucleus which in the stage of division.

Key words : Embryology of the Angiosperms.

The issue of this critical review will focus on the culmination of megasporogenesis – megaspore organization. Megasporogenesis is initiated in most Papilionaceous species by the development of an archesporium hypodermally oriented in the nucellus. In Papilionaceae an archesporium, whether multi-cellular or uni-cellular, is characteristically hypodermal. The megasporocyte undergoes meiotic divisions to produce a tetrad of megaspores.

Battaglia (1955) considers the concept of the spore and emphasizes that the term should be limited to a cell produced by regular or irregular meiosis, originating in the sporophyte and giving rise to a gametophyte. Battaglia (1951) discusses the importance of the position of the megaspore nuclei in determining the final form of the megagametophte. He states that “natural modification” in megasporogenesis determine the morphology of the gametophyte. This is an important point, and its implications should be realized. Megasporogenesis culminates with the production of megaspores.

A generalized or hypothetical (ancestral) pattern may be postulated as consisting of four megaspores in linear arrangement. Any one of these megaspores has equal potential for maturing into a megagametophyte. From this ancestral pattern following conditions are considered to be derived: (a) loss of spore function, (b) change in division plan, (c) loss of cell wall, and (d) loss of nuclear division. Coulter (1908) was the first to make a clear distinction between divisions which formed megaspores, and divisions that produced nuclei of megagametophytes. This, as it turned out, was a very important distinction, and separates the meiotic divisions leading to megasporogenesis from the mitotic divisions leading to megagametogenesis.

Several additional variations in megaspore formation are reported in Papilionaceae. One pattern of development results from the failure of the upper or micropylar member of the first meiotic dyad to undergo the second meiotic division. The lower or chalazal member undergoes the meiotic division, resulting in a linear arrangement of three cells. The chalazal megaspore functions. The pattern has been reported in the Papilionaceae by Guignard (1881) in *Phaseolus multiflorus* and *Medicago arborea* by Brown (1917) and Weinstein (1926) in *Phaseolus vaulgaris*, by Cooper (1935) in *Medicago sativa*, by Rembert in *Wisteria sinensis*, (1967b), and *Robinia pseudo-acacia* and *Vicia villosa* (1969), and by Salgare in *Cyamopsis psoralioides* (1973, 75c), *Canavalia ensiformis* (1975b), *Dumasia villosa* (1975f) and *Dolichos lablab* (1975al). Satin and Blakeslee (1935) demonstrated a condition in *Datura* which may have some significance here. In their work it is reported that the micropylar dyad member fail to undergo the second meiotic division, while the chalazal member proceeded with meiosis II. Satina and Blackeslee showed that the failure of the second meiotic division in some plants of *Datura* is caused by a recessive gene found in some F_2 progeny of a plant that had pollen treated with radium.

Some embryologists speak a row of three megaspores - triad. This is incorrect, because only two cells of the row can be megaspores and third must be dyad cell. Such a condition can arise in both monosporic and bisporic type of development. In the former it is due to the omission of the second meiotic division in the non-functional dyad cell. Failure to recognize the two different modes of origin of triads has often given rise to confusion and misinterpretation.

Depending on the number of megaspore nuclei taking part in the development, the megagametophytes of angiosperms has been classified into three main types: monosporic, bisporic and tetrasporic (Maheshwari, 1950; Johri, 1963). In the first only one of the four megaspores, in the second two megaspore nuclei, and in the third all the four megaspore nuclei take part in the development of the megagametophyte.

In *Cyamopsis psoralioides* DC. the development is usually of Polygonum type but sometimes only a row of three cells is seen. This is said to consist of an upper undivided dyad cell and two megaspores arising from the division of the lower dyad cell. This is confirmed on the basis of the almost double the size of the micropylar cell than the chalazal two cells. As usual the chalazal megaspore is functional one. If this interpretation is correct, the development would be of the monosporic Polygonum type, but it is just as likely that the row of three cells comprises the undivided upper dyad cell and two megaspores. From these the micropylar one is seen to be degenerating as seen at another instance. Should this latter interpretation turn out to be correct, the megagametophyte would be of bisporic.

It should be noted that this bisporic development entirely differ from those of Rembert's (1969 – Patterns VIII, IX, X) and hence form type by itself. This proves that the system of megaspore tetrad patterns formulated by Rembert (1967a - Ph.D. Thesis, b, 69, 71) for the Leguminales is imperfect and misleading and needs its revision.

A bisporic eight-nucleate megagametophyte was first described from *Allium fistulosum* by Strasburger (1879) and has since been confirmed in several species of *Allium.* While monosporic development in megagametogenesis is the rule in Papilionaceae, bisporic development has occurred in *Lathyrus odoratus* (Jonsson, 1879-1880), in *Lupinus luteus* and *L. polyphyllus* (Guignard, 1881), in *Laburnum anagyroides* (Rembert, 1966), in *Wisteria sinensis* (Rembert, 1967b) as well as in *Pueraria lobata* (Rembert, 1969), in *Phaseolus aconitifolius* (Salgare, 1974a, 75e, k, l, 76e, f, 77b, 80, 97, 2003, 06), in *Sesbania aculeata* (Salgare, 1973a, 75a, b, j, m, 76a, h, 80, 97, 2003, 06), in *Canavalia ensiformis* (1975c, 76i, 80, 97, 2003, 06), in *Dumasia villosa* (Salgare, 1975h, i, 80, 97, 2003, 06), in *Sesbania aegyptiaca* (Salgare, 1974b, c, 75f, g, 76b, c, g, 80, 97, 2003, 06) and in *Cyamopsis psoralioides* (1973b, 75d, n, 80, 97, 2003, 06). It should be pointed out that all previous reports of bisporic development in Leguminales have been challenged by Maheshwari (1955). Work of Rembert (1966, 67, 69, 71) and Salgare (1973a, b, 74a, b, c, 75a, b, c, d, e, f, g, h, i, j, k, l, m, n, 76a, b, c, e, f, g, h, i, 77b, 80, 97, 2003, 2006) supports findings of Jonsson (1879-1880) and Guignard (1881). From this an extensive work it is very clear that Maheshwari's (1955) arguments are purely hypothetical ones and there is an occurrence of a bisporic development in Leguminales.

It should also be pointed out that Jonsson (1879-1880), Guignard (1881) and Rembert (1966, 67, 69, 71) came to the conclusion about the bisporic development only on the basis of the functional megaspores. However, it is only Salgare (1973a, b, 74a, b, c, 75a, b, c, d, e, f, g, h, i, j, k, l, m, n, 76a, b, c, e, f, g, h, i, 77b, 80, 97, 2003, 06), who for the first time went to trace out the bisporic development even up to the formation of the antipodals and the egg apparatus in most of the cases, hence its importance.

In addition to the above contributions of Salgare (1973a, b, 74a, b, c, 75a, b, c, d, e, f, g, h, i, j, k, l, m, n, 76a, b, c, e, f, g, h, i, 77b, 80, 97, 2003, 06) to embryology, the following findings in the embryology of Papilionaceous legumes may be added which are the first and the only reports in the field.

Twin megagametophytes (Salgare, 1975g, 76b, c, g)

Juxtaposed twin megagametophytes (Salgare, 1975c, 76i, 97)

Superposed twin megagametophytes (Salgare, 1973b, 75a, c, d, i, j, n, 76a, d, h, 77a, 97)

Superimposed twin megagametophytes (Salgare, 1973a, 74a, 75b, e, f, h, i, j, k, l, m, 76a, b, c, e, f, g, h, 77b, 97, 2003, 06)

It should be noted that the twin megagametophytes, juxtaposed twin megagametophytes, superposed twin megagametophytes and superimposed twin megagametophytes will result into the bisporic development.

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