CHAPTER - 2

REVIEW OF PREVIOUS LITERATURE

Embryological studies in the family Compositae are quite extensive and date back to the previous century. Hofmeister studied the development and structure of the female gametophyte of Helianthus annuus as far back as 1849. Schnarf (1931) has given a very valuable summary of the work done upto 1930 in his book 'Vergleichende Embryologie der Angiospermen'. Davis has summarised the more salient embryological features of the family in 1966. More recently, Pullaiah (1983 b) has summarised the embryological work on Compositae.

The anther in the family is usually tetrasporangiate. But bisporangiate anthers are met with in Parthenium hysterophorus (Deshpande, 1960; Pullaiah 1982 a), Cotula australis, C. coronopifolia, Calotis hispidula, C. squamigera (Davis, 1962a, 1966), Spilanthes acmella (Sundara Rajan, 1974), Blumea membranacea, Ageratum conyzoides and Gynura nitida (Pullaiah, 1979b, 1982c, 1983a). The archesporium is hypodermal and consists of single row of cells. The anther wall development follows the Dicotyledonous type of Davis (1966). A fibrous endothecium is differentiated. The middle layer becomes crushed and degenerated during meiotic divisions in the

pollen mother cells. Anther tapetum is of the Periplasmodial type. However, in a few cases like Chrysothamnus (Snow, 1945; Anderson, 1970), Vernonia cinerea, V. cinerascens (Tiagi and Taimni, 1963), Sonchus oleraceus, S. asper (Walter and Kuta, 1971), Hypochoeris radicata (Kaul, 1972), Youngia japonica (Kaul, 1973), Tragopogon gracile (Singh and Kaul, 1974) and Sonchus arvensis (Kaul et al, 1975) it is reported that a Glandular tapetum occurs. Tapetal cells are usually bi-or multi-nucleate. In some cases, anther tapetal cells show nuclear divisions and fusions resulting in polyploid nuclei of various shapes. The primary sporogenous cells give rise to the microspore mother cells. In some plants the sporogenous cells undergo several divisions, in others only a few divisions and rarely there are no divisions at all, so that the primary sporogenous cells function directly as microspore mother cells. Arnica alpina (Engell, 1970), Brachycome iberidifolia (Sharma and Murthy, 1977) are the examples of third kind. Launea pinnatifida (Venkateswarlu and Maheswari Devi, 1955a), Ammobium alatum (Davis, 1962b), Bidens pilosa (Maheswari Devi, 1963), Tragopogon gracile (Singh and Kaul, 1974), Sonchus asper, S. arvensis (Kaul et al, 1975), Vernonia elaegnifolia, V. divergens, Elephantopus scaber, Blumea malabarica, Sonchus oleraceus, and Emilia

sonchifolia (Pullaiah, 1979a,b, 1982b, 1983a) are the examples of second kind. While in majority of members, the primary sporogenous cells undergo mitotic divisions in all planes resulting in a moderately extensive mass of pollen mother cells.

Gelin (1934) reported that in Coreopsis tripteris at the close of the mitotic divisions chromatic material migrate from one cell to another and this process is known as 'Cytomixis'. The pollen mother cells undergo meiotic divisions and produce tetrahedral, isobilateral and decussate pollen tetrads. Cytokinesis is by furrowing. Pollen grains at the time of shedding are three-celled with 3 germ pores. Pollen polymorphism was observed in members like Wedelia calendulacea (Ghosh, 1962), W. biflora (Rao and Ong, 1971), Polymnia laevigata (Fisher and Wells, 1962), Melampodium divaricatum (Maheswari Devi and Pullaiah, 1976a), Eupatorium triplinervis (Mukherjee and Desai, 1980) and Lagascea mollis (Pullaiah, 1981a).

A number of abnormalities in the microsporogenesis and pollen development have been observed in apomictic members like Chondrilla (Poddubnaja-Arnoldi, 1933), Erigeron annuus (Bergman, 1944), Taraxacum pieninicum (Malecka, 1961), Antennaria carpatica (Urbanska - Woytkiewicz, 1962a,b), Arnica alpina (Afzelius, 1936; Engell,

1970), Minuria integerrima, Brachycome ciliaris (Davis, 1964a, b) and Eupatorium odoratum (Maheswari Devi and Pullaiah, 1977b).

The ovary is inferior, bicarpellary syncarpous and unilocular with a single anatrogous, unitegmic and tenuinucellate ovule. Very rarely, two ovules per ovary have been recorded in Tagetes patula (Venkateswarlu and Maheswari Devi, 1955b), Centaurea collina, Carduus defloratus (Mestre, 1957), Ainsliaea aptera (Kapil and Sethi, 1962a), Elephantopus scaber, Blumea malabarica and Galinsoga parviflora (Pullaiah, 1979a, b, 1981a). Integumentary vascular traces are present in some members while they are absent in others. The inner most layer of the integument differentiates as integumentary tapetum at the time of megaspore tetrad formation. In majority of Compositae, this layer remains uniseriate with unimucleate cells. Embryos from endothelial cells have been reported in Melampodium divaricatum and Carthamus tinctorius (Maheswari Devi and Pullaiah, 1976a, 1977a).

The nucellus in most of the Compositae consists of a single layer of epidermal cells surrounding a single archesporial cell. But in some Compositae like Chrysanthemum spp. (Palm, 1914; Tateishi, 1929; Fagerlind, 1941; Harling 1951a; Martin and Smith, 1955; Borgen, 1972),

Erigeron spp, Haplopappus croceus, Cotula turbinata (Harling, 1951b), Artemesia arborescens (Martinoli, 1942), Anacyclus radiatus, Achillea millefolium, Lonas inodora (Harling, 1951a), Anthemis spp. (Harling, 1960) and Pyrethrum roseum (See Poddubnaja-Arnoldi, 1976) the female archesporium is multi-celled.

The archesporial cell functions directly as the megaspore mother cell and undergoes the two meiotic divisions resulting in a megaspore tetrad. In a majority of Compositae the development of embryo sac is of the Monosporic Polygonum type. In these cases the megaspore tetrad is linear. Usually the chalazal megaspore functions while the micropylar three degenerate.

In a majority of Compositae, the development of embryo sac follows Monosporic Polygonum type, but some times Bisporic Allium and Endymion types, Tetrasporic Fritillaria, Adoxa, Peperomia and Drusa types have also been reported. Besides these, some unclassified types are also met with. Allium type of embryo sac was observed in Chrysanthemum spp. (Harling, 1951a, Borgen, 1972), Erigeron spp. (Harling, 1951b), Ammobium alatum (Avanzi, 1948) etc. Endymion type was recorded in Erigeron alpinum (Chiarugi, 1927), E. frigidus (Harling, 1951b) and E. unalaschkensis (Holmgren, 1919; Harling, 1951 b). Drusa type was

recorded in Anthemis spp. (Harling, 1950, 1960), Chrysanthemum spp. (Harling, 1951a), Erigeron spp (Harling, 1951b) and Minuria denticulata (Davis, 1963). Fritillaria type was recorded in Rudbeckia spp, Gaillardia spp and Ratibida spp (See Pullaiah, 1983b). Besides the above mentioned types in some members like Balsamita vulgaris and Chrysanthemum cineriaefolium (Fagerlind, 1939, Martinoli, 1939) the development of embryo sac shows some abnormal features and is unclassified.

The synergids may be hooked or beaked. In a few cases like Ursinea spp (Vidayathi, 1973; Ahlstrand, 1978), Cotula australis (Davis, 1961), Elephantopus scaber (Pullaiah, 1979a) and Platycarpha carlenoides (Ahlstrand, 1979) synergid haustoria have been recorded. Antipodal cells in the family Compositae show a great variation both in the number of cells and their nuclei. Occurence of antipodal haustoria in Compositae was reported as early as in 1892 by Norris in Grindelia squarrosa. Since then they have been reported in a number of Compositae (See Pullaiah, 1983b). Fertilisation is porogamous. Polyspermy is met with in some cases like Crepis capillaris (Gerassimova, 1933), Parthenium argentatum, P. incanum, (Dianova et al, 1935), Taraxacum kok-soghyz (Warmke, 1943), Melampodium divaricatum, Carthamus tinctorius (Maheswari Devi and Pullaiah, 1976a, b) and Tithonia rotundifolia (Pullaiah, 1978b).

Both Cellular and Nuclear types of endosperm development occur in this family. Embryo development is quite unique in that all the members of this family so far investigated show Senecio variation of Asterad type of Johansen (1950) and Grand period I, Megarchetype II, series A, sub series A_2 in the first group according to Souèges system.

Occurence of Apomixis is a common feature to Compositae. Aneuspory, Gonial apospory and Somatic aposory of the Hieracium type have been recorded in the family. Taraxacum type of Aneuspory has been recorded in Taraxacum officimale (Juel, 1904, 1905), Taraxacum spp (Schkorbatow, 1912; Osawa, 1913; Stork, 1920, Rosenberg, 1930; Sears, 1922; Poddubnaja-Arnoldi and Dianova, 1934; Gustafsón, 1934, 1946, 1947; Fagerlind, 1947a; Battaglia, 1948; Anzalone, 1949; Haran, 1952), Antennaria carpatica (Bergman, 1951), Chondrilla juncea (Rosenberg, 1912; Poddubnaja-Arnoldi, 1933; Bergman, 1944, 1950; Battaglia, 1949), Hieracium sub-genus Archieracium (Bergman, 1941), Taraxacum vulgare, T. mongolicum (Battaglia, 1948) and Solidago purpurea (Desai, 1982). Ixeris type of Anuespory has been recorded in Ixeris dentata (Okabe, 1932), Erigeron annuus (Bergman, 1944; Fagerlind, 1947b); Erigeron

karwinskianus var. mucronatus (Carano, 1921, 1924; Fagerlind, 1947b, Battaglia, 1950), Rudbeckia laciniata (Battaglia, 1945, 1946b; Fagerlind, 1946), R. speciosa (Battaglia, 1945, 1946a), R. daemi, R. sullivantii and R. trilobata (Battaglia, 1952, 1955).

Gonial apospory of the Antennaria alpina type has been met within Antennaria spp (Juel, 1898, 1900, Stebbins, 1932 a,b; Bergman, 1935c, 1937; Nygren, 1950), Arnica alpina, A. chamissonis, A. diversifolia (Afzelius, 1936; Flowik, 1940; Engell, 1970), Hieracium sub-genus Archieracium (Gustafsson, 1946, 1947; Bergman, 1935b; Gentcheff, 1937), Eupatorium glandulosum (Holmgren, 1919), E. odoratum (Maheswari Devi and Pullaiah, 1977b; Pullaiah, 1982c), Parthenium argentatum, P. incanum (Esau, 1944, 1946), Leontodon alpinum (Sokolowska-Kulczycka, 1959; Maugini, 1962), Brachycome ciliaris (Davis, 1964b) and Eupatorium triplinervis (Mukherjee and Desai, 1980).

Somatic apospory of the Hieracium type has been recorded in Hieracium sub-genus Pilosella (Rosenberg, 1906) Antennaria carpatica (Bergman, 1951); Artemesia nitida (Chiarugi, 1926 a,b), Coreopsis bicolor (Gelin, 1934), Crepis occidentalis, C. acuminata, C. atribarva, C. intermedia, C. bargigera (Babcock and Stebbins, 1938; Stebbins and Jenkins, 1939), Parthenium argentatum (Esau, 1946),

Picris hieraciodis (Bergman, 1935a), Calendula offcinalis (Vidayathi and Poddubnaja-Arnoldi, 1971), Minuria integerrima (Davis, 1964a), Bellis perennis (Carano, 1921), Centaurea squarrosa (Czabik, 1954), Melampodium divaricatum, Carthamus tinctorius (Maheswari Devi and Pullaiah, 1976a, 1977a) and Tithonia rotundifolia (Pullaiah, 1978b).

Semigamy, a rare phenomenon reported in Rudbeckia speciosa, R. laciniata and R. sullivantii (Battaglia, 1955; Movsesian and Kasparova, 1977). Parthenogeny was recorded in a number of cases. Polyembryony of both true and false type have been recorded.