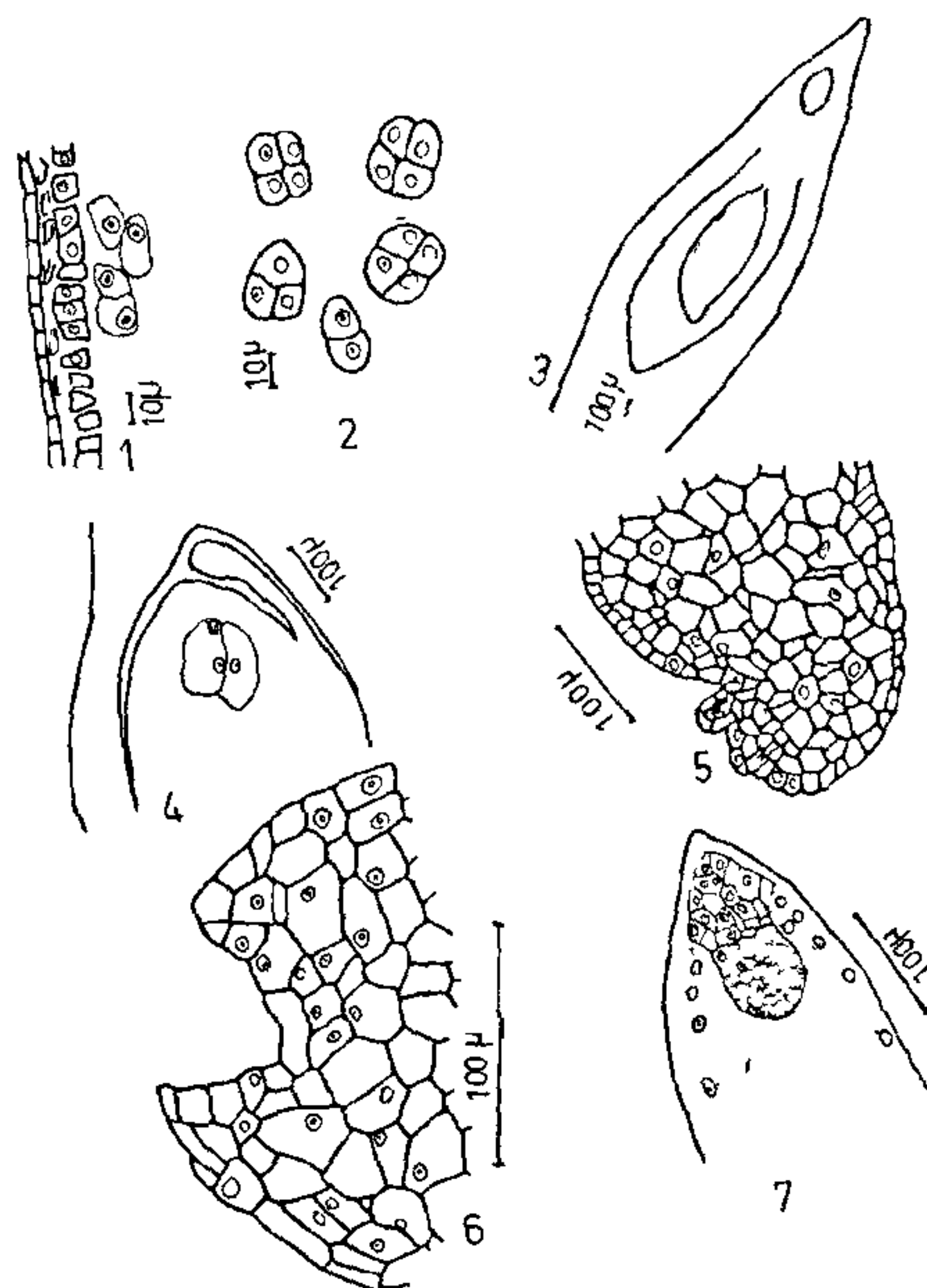


PRELIMINARY OBSERVATIONS ON THE EMBRYOLOGY OF *SPINIFEX LITTOREUS* MERR.

Spinifex littoreus Merr. is a gregariously growing woody shrub inhabiting the sandy beaches. During vegetative phase the branches spread on the surface and in the reproductive phase they grow erect and bear flowers in large globose radiating racemes.

The male spikelet is 2-flowered. The flower has four glumes, the first and second are empty and the other two are paleate and triandrous. The anther is elongated, ditheous and dorsifixed. A vertical row of uniseriate hypodermal archesporial cells, following the monocotyledonous type of development¹ produce three wall layers and innermost tapetum. The outermost wall layer, adjacent to the epidermis, does not show fibrous endothelial thickenings even after the pollen grains have considerably developed. The tapetum, parietal in origin, follows glandular type of development. The tapetal cells (Fig. 1) are uninucleate, distinctly vacuolate and persists even at a mature stage. The sporogenous cells after repeated mitotic divisions function as microspore mother cells. Simultaneous type of meiotic divisions take place in the microspore mother cells. The divisions are not synchronous and the occurrence of microspore mother cells and distinct microspores can be observed in one and the same microsporangium. Sometimes the nuclei of the dyads are of different sizes and their response to staining was also different. The tetrads of microspores exhibit isobilateral (Fig. 2), decussate, tetrahedral and linear configurations. The mature pollen grain, that could be observed with the available material, is uninucleate and uniporate with smooth exine. The female flower consists of four glumes—first and second are empty as in the male flower but larger in size, the third is paleate, empty or triandrous whereas the fourth glume is feminine. The ovary is monocarpellary, uni-ovulate and with two long styles and feathery stigmas. The ovule is unitegmic, anatropous and with an "obturator" roofing over the micropyle and extending towards the chalaza on the other side. A second envelope, often described as outer integument², is neither from the nucellar tissue nor grows along with the inner integument. Moreover when the ovule is making a shift in its position during its ontogeny, the outer envelope is not involved in it. This envelope, in longisection, stops as a hood over the micropyle and extends as an outgrowth at the chalazal region and is not in any way related to the position of the micropyle. By its origin it appears to be more apt to be designated as "Obturator", the exact ontogeny of which is being investigated. Sometimes an additional ovule arises from the apical massive region of the ovary. This ovule, in its structure and in the organisation of the female gametophyte, resembles



FIGS. 1-7. *Spinifex littoreus*. Fig. 1. L.S. of anther showing three wall layers, tapetum and microspore mother cells. Fig. 2. Isobilateral and decussate tetrads of microspores. Fig. 3. L.S. of ovary showing bivulvate condition. Smaller ovule outside the ovarian cavity. Fig. 4. L.S. of ovary. Twin embryo sacs, similar in size and with primary endosperm nucleus in each. Fig. 5. Chalazal part of mature endosperm depicting the pouch and incipient haustorial structure. Fig. 6. Mature endosperm with a well defined cavity around the position of the embryo. Fig. 7. Globular proembryo with massive suspensor. Nuclear endosperm concentrated around the embryo.

that in the ovarian chamber (Fig. 3). However, the apical ovule is somewhat smaller in size with its embryo lagging in development. When the proembryo of the basal ovule is at its globular stage that of the apical ovule remains at the 5-celled stage. The crassimucellate condition of the ovule is of dual origin: the periclinal divisions of the nucellar epidermis and the parietal tissue add layers of cells between the megaspore mother cells and the nucellar epidermis. The megaspore mother cell undergoes meiotic division resulting in a linear tetrad of megaspores, the lowermost of which develops into a Polygonum-type of embryo sac. An interesting phenomenon is the occurrence of twin embryo sacs (Fig. 4). The two embryo sacs are similar in size and development. It is presumed that they

would have developed from two distinct megaspores with positional changes so as to lie side by side and can be placed under 'false polyembryony'². The mature embryo sac is pear-shaped. Its chalazal pole after fertilisation elongates and pushes deeper into the nucellar tissue. The three antipods, probably stimulated by pollination and fertilisation, undergo divisions resulting in a group of conspicuous densely stained cells that remain persistent even at the globular stage of the proembryo. Endosperm is of the nuclear type. Cell wall formation proceeds in a centripetal pattern and finally it becomes cellular and occupies the entire area of the embryo sac. The endosperm cells immediately around the embryo are with dense cytoplasm and distinct boundary (Fig. 6). In the chalazal region, the peripheral endosperm cells are rectangular in shape and appear to be meristematic. Laterally, along one side, a distinct pouch-like organisation with a central small, haustorial outgrowth is clearly recognised (Fig. 5). Its exact origin, and its haustorial nature, if any, are to be traced.

The zygote embarks upon its first division only after the primary endosperm nucleus has undergone few divisions. The transverse division of the zygote results in a terminal cell and a basal cell. Both the cells undergo transverse divisions to form a linear row of 5 or 6 cells. Further development could be traced to a globular proembryo with a massive suspensor (Fig. 7).

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1. Davis, G. L., *Systematic Embryology of Angiosperms*, John Wiley and Sons, London, 1966.
2. Narayanaswami, S., *Bot. Gaz.*, 1956, 118, 111.
3. Maheswari, P. and Sachar, R. S., "Polyembryony," In: *Recent Advances in the Embryology of Angiosperms* (Ed. Maheswari, P.), International Society of Plant Morphologists, University of Delhi, Delhi, 1963, p. 265.

DEVELOPMENT OF TOMATO GENOTYPES WITH EXSERTED STIGMA AND A SEEDLING MARKER FOR USE AS FEMALE PARENTS TO EXPLOIT HETEROSIS

THE detection of a mutant IHR 7-1 with exserted stigma (*ex*) was reported earlier³. Since exserted stigma provides ready accessibility for hand pollination without emasculation, it has a potential use in

hybrid seed production. Incorporation of suitable recessive marker gene/s into this mutant for detection of chance selfing was considered desirable. Potato leaved (*c/c*) character (a recessive seedling marker) was successfully incorporated in this mutant through hybridization, using IHR 174 as a donor parent. IHR 174 is also characterised by positional sterility conditioned by the recessive gene *ps*. This gene causes fusion of anthers and petals, preventing dehiscence and thereby fruit-set, in nature.

Adopting pedigree selection in the cross IHR 174 × IHR 7-1, two lines in F_2 generation with exserted stigma and potato leaves were isolated. They were provisionally designated as Ex-1, having normal flowers, and Ex-3, having positional sterility (Fig. 1). On progeny testing over two seasons, these lines were observed to be breeding true for the exsertion of stigma, and hence were genetically stable for this character. Exsertion of stigma in tomato has been reported by many workers, to be genetically governed^{1, 2}.

The extent of natural fruit set was assessed both in Ex-1 and Ex-3. Under open pollination Ex-1 (with normal flowers) had high fruit-set of 39%. Of the 255 seedlings raised from the open pollinated seeds of Ex-1, cut-leaved (*c*⁺) plants resulting from out-crossing were as low as 5.6%. Obviously the exserted stigma does not prevent natural selfing. The drooping nature of the floral disposition probably permits adequate quantities of pollen to drop on the stigma, following anthesis. On the other hand natural fruit-set in Ex-3 was as low as 3.0%. Of 106 seedlings of Ex-3 raised from its open pollinated seeds 99.05% were potato leaved, indicating predominant selfing. Since all the open pollinated potato leaved seedlings from Ex-3 were observed to have the positional sterile (*ps*) gene, the possibility of its natural crossing with Ex-1 was ruled out. The low fruit-set was obviously attributable to the breakdown of the non-dehiscent mechanism in a few anthers resulting in self-pollination.

Ex-1 was crossed with six promising high yielding collections using the latter as male parents. The crosses were effected by bud pollination of Ex-1 without emasculation. A high percentage of hybrid plants were observed in the resultant seedlings as evidenced by 94% cut-leaved plants among a total of 923 plants raised in the nursery. The hybrid plants obtained from these crosses were evaluated along with their parents for yield and other attributes. Heterotic expression for yield and several other characters was observed in all F_1 hybrids. Heterosis for yield ranged from 14.0 to 48.8%.

These results show that Ex-1 has a good general combining ability which deserves to be exploited. Since the step of emasculation can be avoided, these