IV. DISCUSSION AND CONCLUSION

I. CAPSICUMS

The greatest confusion exists in Indian literature as to the cultivated species of Capsicum but popularly the larger fruits are usually designated as capsicums, and the smaller ones as chillies; and much remains still to be done in order to clear up the ambiguities which exist in the literature of the Indian capsicums (Watt, 1972). The capsicums may be variously and almost endlessly ranged into varieties. The most practical classification is on the fruits, as to position, size and shape (Bailey, 1957).

The berries become dry at maturity but do not dehisce to expose the seeds. The fruit is 2-locular or sometimes 3-4 locular in the basal and middle regions and unilocular in the terminal region. The placentation is typically axile in the basal and middle regions but it becomes anatomically parietal in the terminal region of the ovary or fruit. This is due to the splitting apart of the placentae in the terminal region of the ovary or the fruit. In the extreme tip region again the placentae may get merged with the tissues of the pericarp. So the transection of such tip will be seen as loculeless and seedless. Sometimes the whole pericarp is lobed and depressed at the tip in such a way that in transection of the tip a pore lined by the outer epidermal layer is seen in C. frutescens (var. Long Red).

Epicarp : The outer epidermal cells of the ovary wall or young and developing pericarp are very small, polygonal or rectangular and with dense cytoplasm, mostly centrally placed distinct nucleus and with the presence of protein. No stomata or trichomes are observed. The ventilating clefts are often found in the epicarps of C. frutescens (var. Long Red), C. annuum var. acuminata, C. annuum var. grossa, C. annuum var. abbreviata and in C. annuum (var. Hungarian Wax) but only in the basal region of C. frutescens var. baccata.

A thin cuticle is always present on the outer tangential walls of the outer epidermis of ovary wall. Later the cuticle develops and thickens as the fruit matures. Some fragments of the fruit show the strongly striated cuticle but on others striations are not visible (Jackson and Snowden, 1968). In seeds a cuticle can develop between the testa and the remains of the nucellus or endosperm. (Martin and Juniper, 1970). The cuticle of the epicarpic cells of chilli sometimes extends inbetween the outer epidermis and the subepidermal layers and even occlude the lumen with cuticular substance or form a cuticular net. The cuticle is also found splitted. The cuticular plugs extend over the radial walls of the outer epidermal cells.

The epicarp is uniseriate or 2-3 seriate at some places in the sections. The developing or mature epicarp shows more or less beaded cell walls and the presence of protein and/or oil in its cells. Jackson and Snowden (1968) reported that the fragments from near the base of the fruit showed the epicarpic cell walls considerably thickened and with distinct pits. In my observations the epicarpic cell walls are found much thickened in the basal and terminal regions of the fruit.

<u>Outer Hypodermis</u> : It is a 2-4 layered zone of periclinally divided cells just beneath the outer epidermis of the ovary

wall. In the later stages the outer hypodermal cells divide anticlinally and periclinally both and become collenchymatous mostly with the presence of chloroplasts. It is 3-4 layered chlorenchymatous in C. annuum var. acuminata.

Mesocarp : The mesoderm or the middle region of the ovary wall is the future mesocarp present inbetween the outer hypodermis and the inner hypodermis. The mesocarp remains parenchymatous and possesses chloroplasts. Sometimes the outer and inner mesocarpic regions can be distinguished. The outer mesocarp is made up of small parenchyma with or without chloroplasts and the inner mesocarp is made up of larger parenchyma embedding the vascular bundles which are placed more towards the inner hypodermal layer of giant cells. In the later stages of fruit development the mesocarpic cells become more vacuolated and enlarged. The inner mesocarpic cells may often show the presence of insoluble carbohydrates.

Inner Hypodermis : The largely vacuolated giant cells of the inner hypodermis increase very much in their size towards the maturity of the pericarp. Kaiser (1935) in his genetic and developmental analysis of the factors governing shape and size in Capsicum fruits studied particularly the epidermal cells and the cells of the inner hypodermis, called "Riesenzeilen" by Augustin (1907).

According to Kaiser, "these interesting cells begin as meristematic cells equal in size and similar in shape to the others but grew at a tremendously accelerated rate, so that in the ripe fruits they attain a size several thousand times their original volume". The greatest increment in size of the giant cells of C. frutescens (var. Long Red) is found between stage 2 and stage 3 (Fig. 1.23E).

The narrow and barrel shaped giant cells of C. annuum var. abbreviatum are elongated in the longitudinal direction of the fruit and their length being 2-3 mm. and their width 0.6-0.8 mm. (Fridvalszky and Nagy, 1966). The giant cells in the pericarp of mature fruit of C. frutescens (var. Long Red) 4-6 mm. in length and 0.6-0.8 mm. in breadth. They are bounded on their radial wall regions by the triangular wedge shaped groups of parenchyma upto certain depth. The giant cells are in direct touch with one another at the rest of their radial wall regions. The number of these parenchyma may differ in the various capsicums. Each giant cell is in contact with the inner epidermis or endocarp on its side facing the chamber of the fruit. To the side of the giant cell facing the interior of the pericarp, there are attached parenchyma of mesocarp. Fridvalszky and Nagy (1966) have recognized and described that the structure of the giant cells,-considering mainly its being foveolated - is different on the various sides of the cell depending on which tissue and cell type, respectively, it is in contact with. The numerous bristles seen on the inner surface of the pericarp are due to the presence of these giant cells and are characteristic of all the capsicum fruits (Fig. 1.1E). They may be absent in the terminal region of the fruit as in C. annuum var. longum, or at some places in the inner hypodermal layer, they do not differ in their size and shape from the mesocarpic cells as in C. annuum var. abbreviata and C. annuum (var. Hungarian Wax).

Endocarp : It is the innermost layer of the ovary wall which later becomes endocarp of the fruit. Konecsni (1971) contributed to the comparative anatomy of the endocarp of the fruit wall in various red pepper and food-paprika varieties examining two kinds of endocarp cells; the pitted thick walled sclereids and the parenchyma. The average size and shape of the sclereids and sclereid groups were also determined by him. The endocarpic cells in transection appear smaller than those of the outer epidermal layer. They contain starch and oil. These cells also contain protein and appear wavy and vertically elongated. The solitary or small groups of lignified and pitted cells, alternate with the parenchyma of the endocarp. The sclereids have sinuous and beaded walls. Mostly they are absent at the tip of the fruit, but their complete absence is observed only in the pericarp of C. annuum (var. Hungarian Wax). According to Jackson and Snowden (1968) the sclereids are polygonal to elongated and have moderately thickened walls and the middle lamella is strongly lignified but the remainder of the wall gives only a slight reaction for lignin.

Placentae : The placental epidermis of C. frutescens (var. Long Red) has also the solitary or scattered sclereids alternating with the parenchyma. The central placental parenchyma become more vacuolated and separated towards the maturity of the fruit. They contain starch or insoluble carbohydrates.

The study of growth patterns in the fruit of C. frutescens (var. Long Red) for the cells of its epicarp, the outer mesocarp, the inner mesocarp and the giant cells reveals that upto some stages the cells either, increase in area and/or, thickness. Ofcourse the placental cells show two periods of rapid growth increments with a period of slow growth inbetween them.

The basic vascular ring in the ovary consists of about 20-23 vascular strands at the extreme base of the ovary of C. frutescence (var. Long Red). Due to the branching and anastomosing in the basal and middle regions the numbers of vascular bundles is found to be 30-34 and

10-16 in the terminal region and 7-8 at the extreme terminal region because only few branches extend upto the tip. The ovarian and pericarpic vascular bundles are conjoint and collateral or bicollateral or hydrocentric and situated more towards the inner hypodermis of giant cells. The axial placental vascular bundles are 2-4 and mostly hydrocentric.

2. SOLANUMS

Brinjal (S. melongena) fruits and Potato (S. tuberosum) tubers of different varieties are popular vegetables of India and S. indicum fruit is of medicinal value.

(a) Brinjal (S. melongena) :

The whole pericarp of S. melongena which develops from 45-48 cells thick ovary wall, appears 60-70 cells thick at the third stage and 140-160 cells thick at the sixth stage of the fruit due to the rapid divisions of its cells. Later the cells may not increase much in number but show more enlargement.

Epicarp : The cells in 4-5 hypodermal layers of the ovary wall are divided anticlinally, periclinally and obliquely but periclinally divided cells are frequent which later form about 15-18 layers of peripherally elongated cells, out of which only 4-5 outer hypodermal layers contribute in the development of the epicarp. And the remaining layers add to the mesocarp of the fruit. The outer epidermis of the ovary wall and the pericarp possesses anomocytic and contiguous stomata. The outer tangential and the radial walls of outer epidermal cells appear highly cutinized.

Mesocarp : The parenchymatous mesocarp develops from the mesoderm as well as partly from the inner and outer hypodermal regions of the ovary wall. The parenchyma of the inner mesocarpic zone start their enlargement earlier than those of the outer mesocarpic zone which is evident from the graphs B and C (Fig. 2.11). The mesocarp shows the presence of starch and the separation of its parenchyma towards the maturity of the fruit.

A ring of vascular bundles in the mesoderm of the ovary wall and in the mesocarp of third stage of the fruit is placed more towards the inner epidermis or the endocarp. At the third stage small procambial strands are also found towards the epicarp and in the later stages more vascular bundles and developing strands are found scattered throughout the mesocarp revealing further branching and anastomosing of the vascular system and the capacity of the mesocarpic cells which divide and differentiate into procambial strands. This is also evident from the various stages of the developing vascular bundles in the mesocarp. Some large vascular bundles of the mesocarp show the presence of 3-4 celled thick cambium which seems to indicate the possibility of the origin of secondary tissue as in the fruit wall of Datura (Nhã and Danert, 1973) but the details of the cambium and the results of its activity are not studied by me.

Endocarp : The cells of the inner epidermis and 5-6 inner hypodermal layers of the ovary wall multiply after the fertilization and the endocarp of the young fruit is seen 11-13 cells thick including the inner epidermis. The endocarpic cells show the presence of insoluble carbohydrates. The cells beneath the deeply situated compressed strata of the endocarp contribute to the inner mesocarpic zone.

At the extreme basal region of the fruit no locule is seen in its transection. From the base upward the fruit locules appear narrow and without placentae and seeds. Then the placentae with seeds are observed in the locules. There are 2 or more locules and the lobed placentae in the middle region of the fruit. The multichambered condition of the fruit locules is caused by the meristematic activity of the innermost layers of the endocarp and the peripheral cell layers of the placentae which give rise to the outgrowths. The endocarpic and placental outgrowths join each other in the locule and form chambers enclosing the individual seeds.

<u>Placentae</u> : The gross increment of the placentae is due to the meristematic activity of their peripheral cells and the considerable enlargement of their parenchyma.

<u>Growth patterns</u> : Many fruits have growth patterns of the simple sigmoid type common to most cells, tissues, and organisms, starting with an exponential increase in size and then slowing in a sigmoid fashion and this kind of growth curve is common to the apple, pineapple, strawberry, pea, tomato and many other fruits (Leopold and Kriedemann, 1964). The growth of the fruit of <u>Withania somnifera</u> as measured by fresh and dry weight increment also showed a sigmoid curve (Mohan Ram and Kamini, 1964). The cell areas of the different zones of the pericarp and the placentae calculated at various stages of the developing fruit, reveal the largest size of the inner mesocarpic cells and the placental cells. The slow growth of the outer mesocarpic cells is evident during the second to sixth stage period and that of the inner mesocarpic cells is evident during the first to third stage period. The inner mesocarpic cells grow rapidly from stage eighth to ninth and the placental cells, show their rapid growth from the stage three onward. The outer and inner epidermal cells show maximum growth from the sixth stage.

(b) Potato (S. tuberosum) :

The rare fruit of potato plant is a globose berry and often referred to as a potato "apple", potato "ball", or "seed ball" (Hayward, 1938). The 30-40 cells thick pericarp of mature fruit is the product of 17-22 cells thick ovary wall. The two loculed many seeded berry is without seeds and placentae in its terminal region.

Epicarp : It is a multilayered zone of the fruit consisting of collenchymatous tissue whose origin is from the outer epidermis and the periclinally divided cells of the outer hypodermal layers.

Mesocarp : The origin of this zone in the fruit is from the middle layers and partly from the thin walled outer hypodermal cell layers of the ovary wall. The food is stored in the form of starch in the mesocarp.

The vascular bundles at their different stages of development indicate the continuous differentiation and branching. The absence of any vascular strand at the tip of the fruit reveals that the whole vascular system ends beneath the tip and not a single vascular branch is extending upto the extreme tip.

Endocarp : The cells of the inner hypodermal layers appear to divide and increase in number only upto the 3rd or 4th spaces (Eames and Mac Daniels, 1947). According to Leopold and Kriedemann (1964) the enlargement of fruit size may be due to the air spaces as in apple and the growth many be an expression of a wide variety of events, from the development of air spaces to the leading into the fruit of sugars without corresponding volume increments and from cell division to cell enlargement (and of course associated various types of tissue differentiation); and these may be preferential growth of any of several or successive morphological parts of the fruit. Sawhney and and Greyson (1972) showed that the fruits of tomato produced from GA_3 - induced multilocular ovaries were large both in size and fresh weight. According to Eames and Mac Daniels (1947) only the outer and inner epidermis and the fleshy layers are distinct in some berries such as fruits of the Solanaceae - tomato ... In the present investigation the multilayered epicarp, mesocarp and the single layered endocarp are histologically distinct in tomato. Dave et al (1975) also observed the distinct multilayered zones of epicarp, mesocarp and the endocarp in a fleshy berry of Averrhoa carambola.

Epicarp : The outer zone of pericarp possesses uniseriate eglandular and glandular types of trichomes in its epidermis. The epidermis develops unbranched 3-5 celled hairs and glands with unicellular basal stalk and a top of 2-4 cells (Hayward, 1938). The stomata are absent (Hayward, 1938; Rosenbaum and Sando, 1920), but the ventilating clefts and polymorphic patterns are formed due to the abnormal thickenings of the epidermal cell walls are present. Makemson (1919) found stomata and lenticels on the ovary. Cooper (1927) observed a few large stomata in the stylar epidermis, but found none in the epidermis of the ovary, agreeing in this regard with Groth (1910), Rosenbaum and Sando (1920) and Gardner (1925). Patel and Dave (1976) observed the anomocytic stomata in the basal region of the fruit of Physalis minima. It seemed to them that the aerating function of the stomata would have been taken up by the ventilating pores or ventilating clefts which are produced due to the splitting apart of the middle lamella of the epidermal cells. The number of outer epidermal cells does not increase greatly with growth of the fruit; and in consequence, the epidermal cells in mature fruit are much larger than those found in young ones (Hayward, 1938). The outer epidermal cells become very much thickened on their outer tangential walls and the radial walls. Rosenboum and Sando (1920) also observed in the tomato skin that the cuticular layer increased in thickness as the fruit aged. The thickening also extends on the cell walls of the first layer of outer hypodermis. According to Martin and Juniper (1970) the cuticle may not necessarily be on the outside of the seed or fruit and it develops and thickens as the fruit matures. They said that the tomato fruit has comparatively little surface wax, but a well developed cuticular membrane, and apart from Apples, little information is as yet available on the progressive development of the cuticles as the fruits increase in age.

Groth (1910) comparing the anatomy of fruit skins of numerous tomato varieties, found differences in the size and shape of epidermal cells, thickness of cuticle, and presence or absence of trichomes. He reported that the outer tissues of the pericarp of all varieties consisted of small, cutinized epidermal cells, 3 to 4 layers of collenchyma cells, and the remainder of parenchyma cells (Cotner et al, 1969; Hayward, 1938). The 'outer pericarp' or epicarp of Bonny Best tomato consists of outer epidermis and 3-4 collenchymatous hypodermal layers which develop from 2-3 layers of thin walled hypodermal parenchyma of the ovary wall. Mohr and Stein (1969) observed in their tomato plant var. Ailsa Craig, observed the parenchymatous outer pericarp (epicarp). According to Smith (1935), the cells next to the epidermis are small, thick walled parenchyma. Treshow (1955) found tannins in sub-epidermal layers of collenchyma and in the epidermis of tomato fruit tumor.

<u>Mesocarp</u> : The thick mesocarp of the mature fruit is the product of mesodermal and partly inner hypodermal cells of the ovary wall. The nuclei of the mesocarpic cells are larger than those of the outer and inner epidermal cells.

The mesocarpic cells, instead increasing much in number, enlarge more, lose their cytoplasm and become more vacuolated. There is widening of intercellular spaces and the separation of the cells towards the maturity of the fruit. Some of the mesocarpic cells appear crescent or arcuate.

The vascular skeleton is weakly supporting the whole fleshy fruit, as there is no much branching and anastomosing of the feebly developed vascular bundle embedded in the tissues of pericarp and the placentae.

Endocarp : A single layer of thin walled cells appear curved or pressed with the mesocarp which is due to the pressure acting upon them by the growing tissue of the placental outgrowths.

Placentae : The placental structure is largely cauline in origin; and the ovules may be regarded ~~the~~ as arising from cauline, axile placentae rather than foliar ones (Hayward, 1938). According to Hayward (1938) as the ovules develop, there is an outward growth of the parenchyma of the placenta which surround their bases. Esau (1953) also states that in contrast to the pericarp, each placenta shows active multiplication of cells and an increase in volume, so that the locule is filled with the fleshy tissue and the seed is completely embedded. This is due to the meristematic activity of the peripheral tissue of the placentae as in case of S. tuberosum. The parenchyma increases until it completely encloses the developing seeds in a homogeneous tissue of thin walled cells (Hayward, 1938). In the present investigation it is found that the outgrowths in their early stages are homogeneous in nature but later a multiseriate central core of elongated or columnar tissue in each placental outgrowth develops, and towards the subsequent development of the fruit when the individual seeds are enclosed within small chambers, the central strands appear interconnected. It seems that because of these strands the seeds remain supported within their small chamber as the tissue surrounding the central core become gelatinous and separated towards the maturity of the fruit. As Hayward (1938) also notes that at first the tissue is firm and compact; but as the fruit matures, the walls become thinner and the cells partially collapse, and large number of round starch grains are included in the gelatinous contents. These outgrown gelatinous tissue do not unite with the endocarp as in potato, but press against it and the seeds.

4. WITHANIA SOMNIFERA

Ovary is glabrous (Cooke, 1905). The chambers are narrow in the terminal region but broad at the basal and middle regions of the non-hairy ovary.

<u>Epicarp</u> : The epidermis and 4-6 outer hypodermal layers constitute the epicarp of the fruit which develops from the outer epidermis and 2-3 outer hypodermal layers of the ovary wall. The anomocytic stomata surrounded by 4-6 epidermal cells are present only in the basal region of the fruit. Towards the maturity of the fruit the outer epidermal cells become more vacuolated and cutinized on their outer tangential and radial walls. The whole epicarp of mature fruit can be peeled off as the hypodermis made up of compressed collenchymatous tissue easily separates on breaking of the lower parenchyma of the mesocarp.

<u>Mesocarp</u> : It is the product of the mesoderm of ovary wall which has not increased much in number of cell layers but its cells are enlarged, vacuolated and separated in the mature stage of the fruit.

<u>Endocarp</u> : Only 3-4 layered thick parenchymatous zone shows radial elongation of its cells which forms the endocarpic lobes. These lobes are found adhering with the placental false septa and form small chambers to enclose the individual seeds.

<u>Placentae</u> : The false placental septa are also produced due the limited meristematic activity and enlargement of the peripheral tissue of placenta. The cells of the septa in mature fruit become elongated, vacuolated and separated.

In some other berries like Physalis Alkekengi (Kraus, 1949) the locules are filled by proliferations of pericarp wall as well as of placentae.

5. DATURA INNOXIA

The hairy and densely spinous fruit of D. innoxia is 4-5 cm. long and 3.5-4.5 cm. broad. According to Nhâ and Danert (1973) the fruits in the genus Datura are capsules (sect. Datura) or dry berries (sect. Brugmansia) or the seeds are lost by bursting of the pericarp (sect. Datura which includes D. innoxia and sect. Ceratocaulis). The mature spines are 0.5-0.8 cm. long, weak and hairy. Sometimes they are forked.

The smooth walled ovary of the small flower bud is slightly lobed and four chambered at the base, two chambered in the middle and terminal regions but one chambered and without placenta or seeds beneath the style. The entire pericarp develops from 10-13 cells thick homogenous ovary wall.

Epicarp : The 5-7 layered thick epicarp which develops from the outer epidermis and 2-3 outer hypodermal layers of the smooth ovary wall, is ornamented with spines and trichomes which originate from the subhypodermal cells and the single outer epidermal initials of the ovary wall respectively. The outer and inner tangential walls of the outer epidermis gradually become thickened and as the fruit matures the epidermal cells and the collenchymatous hypodermal cells become separated.

Trichomes : The trichomes which persist upto the last stage of the fruit are simple or eglandular, uniseriate glandular and glandular with multicellular heads.

Spines : Trivedi and Sharma (1964) gave anatomical support to Farr's view (1915) regarding the spines of *Xanthium* as modified floral bracts. The development of spines originates from a local high active meristem in the second subepidermal layer of the young pericarp, which produces parenchymatic cells in centripetal direction, (Nhâ and Danert, 1973). According to Nhâ and Danert (1973) in *D. metel* an extended parenchymatous tissue from the first subepidermal layer overlays the primordia of spines. In the present investigation it is found that the spine originates from a local active meristem in the outer hypodermal layers of the ovary wall. The spine primordia emerges out in the form of a more or less flattened or slightly convex meristematic spine apex as a result of anticlinal divisions in the outer epidermis and frequent periclinal divisions in the hypodermis. Due to the further meristematic activity of its hypodermal cells, and then due to their vacuolation and vertical elongation, the spine increases in its height.

The elongated polygonal cells of the mature spine epidermis have thick cuticle on their outer tangential walls. The glandular and eglandular trichomes are also present in the spine epidermis. Trivedi and Sharma (1964) reported three types of trichomes and the presence of stomata in the epidermis of Xanthium spine.

The next zone beneath the epidermis of spine is 2-3 layered collenchymatous cortex with intercellular spaces. In the spine of Xanthium this zone of 2-3 layers of parenchyma contains many chloroplasts. The cortex becomes narrow at the spine tip. The ring of sclerenchymatous vascular bundles initially develops from the ring of procambial strands and later due to the continued activity of the vascular cambium. The branched and anastomosed vascular cylinder of the spine is broad and connected with the lateral vascular bundles in the mesocarp at its base and narrowing with the decrease in number of bundles towards the tip. 1-3 vascular bundles extended in the tip are found fused forming a complete ring. In Xanthium spine there are three vascular traces present at the base but only one supplies the apical portion (Trivedi and Sharma, 1964).

The pith in the basal and middle regions of the spine is made up of thin walled elongated parenchyma containing starch but in the terminal region of mature spine it has become sclerenchymatous.

Mesocarp : It is the product of mesoderm in the ovary wall whose cells have undergone periclinal, anticlinal and oblique divisions. These cells towards the maturity of the pericarp become enlarged, more vacuolated, sinuous and later separated. The mesocarp embeds the conjoint, collateral, bicollateral and hydrocentric vascular bundles of which the latter show the meristematic activity of the cambium to produce secondary xlyem, phloem and the sclerenchymatic tissue. According to Nhâ and Danert (1973) the centric vascular bundles with secondary growth originate from bicollateral vascular bundles.

Kapoor (1973) observed that ascending towards the distal end of the *Papaver* capsule the amphicribal bundles bend and become progressively reduced from an amphicribal to a collateral type of vascular bundle. In the sections *Datura* (which include *D. innoxia*) and *Ceratocaulis* the primary phloem bundles are mainly arranged in centripetal and centrifugal direction of the primary xylem. In both these ways secondary growth is concentrated, laterally the production of secondary tissue is very low (radiocentric vascular bundles). The cells of secondary xylem are only low lignified and are similar to parenchymatic cells (Nhâ and Danert, 1973).

Endocarp : The 10-14 layered thick endocarp develops from an inner epidermis and 4-5 layers of the inner hypodermis of the ovary wall. The hypodermal cells divide transversely, obliquely and vertically to increase the thickness of the endocarp. Towards the maturity of the fruit the endocarpic cells become vacuolated, sinuous and separated and contain starch.

The ontogeny and structure of the anomocytic stomata are as described by Patel and Dave (1976) in the inner epidermis of the pericarps of D. innoxia and D. metel. They found that the stomata are absent in the inner epidermis of Physalis minima and in the outer epidermis of D. innoxia and D. metel.

Placentae : The thin walled parenchyma of the placentae and septa become separated towards the maturity of the fruit. The placental hydrocentric vascular bundles show secondary growth as described by Nhã and Danert (1973). They mentioned that in all sections of Datura the vascular bundles of the placenta coincide in the structure of secondary growth, it is a tissue of sclerenchymatic cells with high lignified walls.

Dehiscence : Rethke (1946) wrote, "Comparatively little is known about the mechanism of dehiscence in dry fruits of the angiosperms ... and little of that is more than gross observation". A definite zone of dehiscence is found in the capsules of Moringa (Dave et al, 1974), Tecoma

(Kumar et al, 1975), Catharanthus (Zala et al, 1976), Mustard (Rao, 1976), and in some other fruits as described by Fahn (1967), Fahn and Zohary (1955), Patel et al (1976), ~~Rao (1976)~~, Rethke (1946), Subramanyam and Raju (1953) and Swamy (1976). According to Mac-lean and Ivimey Cooke (1967) in the capsule of Datura the dehiscence is truly septifragal but each carpel (valve) splits secondarily along its midrib, opposite the false septum formed by the placentae. They also state that the dehiscence of the fruits is generally brought about by the shrinkage of the pericarp in drying. In the absence of any definite zone of dehiscence in the mature fruit of D. innoxia, it is believed that the parenchyma of the pericarp, placentae and septa undergo shringkage so the septa and pericarp break irregularly to expose the seeds. The fruit hardly opens below the middle region as the parenchyma of basal region remain less separated. The exposure of seeds first from the terminal portion of the fruit is because of the presence of less mechanical tissue and short placentae which prove weak against the pressure exerted by the tightly enclosed growing seeds.

6. TOBACCO (NICOTIANA TABACUM)

According to Goodspeed (1954) all species normally exhibit dehiscent capsules; atleast three N. rustica, N.bigelovii and N. tabacum, also have indehiscent races. The fruit worked out in this thesis is indehiscent.

The ovary wall of N. rustica is composed of outer and inner epidermises enclosing inbetween a four layered mesocarp (mesoderm) composed of parenchymatous tissue, which is traversed by numerous vascular strands and scattered prisms of calcium oxalate (Karawya et al, 1973a, 1973b). The ovary wall of N. tabacum is found to be 8-12 layered thick including outer and inner epidermises. The 4-7 layered thick mesoderm beneath the outer epidermis, embeds about 30 vascular bundles in the basal region, 20-25 in the middle and 16-18 in the terminal regions of the ovary. No prisms of calcium oxalate are found in the ovary wall of N. tabacum. The anomocytic stomata are observed in the outer epidermis and epicarp of N. tabacum but in the inner epidermis of the ovary wall and pericarp they are found to be absent. In N. rustica stomata of both cruciferous and ranunculaceous types and prisms of calcium oxalate are present in both epidermises of the ovary wall and in the inner epidermis of the fruit but the epicarp shows only prisms and no stomata (Karawya et al, 1973a; 1973b). The pericarp of N. rustica is 8 layered thick while in N. tabacum there is no increase in the number of layers of the pericarp towards the maturity. Esau (1953) mentioned that an ovary wall maturing into the pericarp of a capsule may have but little increase in the number of cells, as in tobacco. According to Esau (1953) the pericarps of capsules have both sclerenchymatous and parenchymatous tissues in variable distributions, for example pericarp of Linum usitatissimum, has an exocarp of highly lignified cells and a mesocarp and an endocarp of parenchymatous cells but that of N. tabacum shows, in contrast, 2-3 layered thick lignified endocarp and parenchymatous lacunose exocarp and mesocarp.

Epicarp : It is a single layered epidermis of large polygonal cells. The anomocytic and the contiguous stomata are surrounded by 5 or 7 epicarpic cells. Sometimes a group of two mature stomata of which one is larger than the other, and a meristemoid adjacent to it is observed.

Mesocarp : The mesodermal cells of the ovary wall during the development of the fruit become enlarged, more vacuolated and separated.

Endocarp : The inner epidermis and the two inner hypodermal layers form the endocarp. Towards the maturity of the fruit the cell walls become sinuous, protruding and lignified but enclosing the cytoplasm and nuclei. The lignified endocarpic cells are simple and forked at one or two ends, or irregularly branched but fit in each other forming a compact multilayered endocarp of the mature fruit.

Placentae : The placentae are peculiarly lobed from base to the apex. In transection the broad and convex placentae with incurved margins, bearing ovules on their periphery are found borne on thick placental ridges. The placentae appear deeply notched in the terminal region. The enlargement of the placentae in the fruit is more due to the increase in size of their outer epidermal and the inner or central cells than the increase in number of cells. No outgrowths are present here.