IV. DISCUSSION

Maheshwari and Kapil (1963) in their review on Botanical researches in India visualised considerable scope for anatomical studies on tropical crop and drug plants. Carlquist (1969) pointed out that description of the histology of the fruit wall, sometimes called 'carpology', is scattered through the literature of various families. Such literature is often concerned with seed development and embryology and may be located under these topics. He emphasised that fruit morphology and anatomy have much to offer in aiding systems of fruit terminology. Behl and Tiagi (1977) in their review on
pericarp of angiosperm fruits aptly remark, "there are only a few investigations done exclusively on the pericarp of angiosperms. In India studies on morphology and development of pericarp have been contributed mainly by embryologists. The data, therefore, often occur as an adjunct to the investigation on embryology and seed anatomy". Therefore, in the present thesis, an attempt has been made to understand some of the developmental and structural changes which occur in the ovary during its development into a fruit in some members of the family Cucurbitaceae.

According to Müller (see Barber, 1909) fruits of Cucurbitaceae are all large berries with hard shells, soft fruit flesh and many seeds. I consider cucurbitaceous fruits to consist of skin and flesh on the basis of ontogeny and function.

Ontogenetically the skin is a part of the fruit developing from the peripheral ground tissue of the ovary. The rest of the ground tissue forms the flesh. Functionally the skin is the outermost protecting layer. Flesh is a site for food storage. Commonly the skin is peeled off and the flesh is used.

**SKIN**

The skin of *Luffa cylindrica, L. acutangula,*
Monordica dioica and Citrullus lanatus is a composite structure consisting of epicarp and outer mesocarp. Epicarp originates from the outer ground tissue of the ovary and differentiates into epidermis and hypodermis. The soft skin of Coccinia grandis consists of epidermis and hypodermis only. The make-up of outer mesocarp is mostly sclereids in all the fruits studied except in Coccinia grandis.

Epidermis

Epidermis in the cucurbitaceous fruits is single layered as no periclinal divisions occur during the fruit development. Epidermal cells divide anticlinally and grow in surface area. Epidermis and the hypodermis together form the characteristic colour design of the skin of some of the cucurbitaceous fruits. Degeneration of chlorophyll in certain groups of cells of epidermis and hypodermis leads to the formation of greenish-white patches in the skin of Luffa cylindrica and Coccinia grandis. The nature dry fruit of Luffa cylindrica and L. acutangula appears yellowish brown with white patches. This is because of gradual replacement of chlorophyll by the carotenoids in the cells of epidermis and hypodermis. Loechleben et al. (1950) reported the drop of chlorophyll content and formation of carotenoids during the ripening of banana fruit. According to Reid et al.
(1970) the chlorophyll content of musk-melon decreases throughout the fruit development but the carotenoid content increases. Recently Ljubšič (1977) studied the formation of chromoplasts in the developing fruit of Cucurbita maxima. I also observed the development of chromoplasts in the epicarp of Coccinia grandis and Momordica dioica.

The presence of plasmodesmata is common in the epidermal cells (Roelofsen, 1959). But it is first time reported in the fruit wall epidermis of Luffa cylindrica, L. acutangula, Momordica dioica, Citrullus lanatus and Coccinia grandis. Plasmodesmata between epidermal and subsidiary cells, between two adjacent subsidiary cells and between a subsidiary cell and a guard cell indicate cytoplasmic continuity among the various epidermal components of the fruit. Such cytoplasmic continuity is also reported by Kaufman et al. (1970) in Avena sativa with the help of the electron microscope.

Glandular and eglandular hairs of the skin may persist as in Momordica dioica or shed off during the development of the fruit as in Luffa cylindrica, L. acutangula, Citrullus lanatus and Coccinia grandis. In Cucurbita also hairs are shed off during the development of the fruit (Hayward, 1938). Glandular and eglandular hairs are present
in the family Cucurbitaceae (Matcalf and Chalk, 1950). The development of hairs observed in the cucurbitaceous fruits studied here is similar to that described in the leaves of Coccinia by Pant and Banerji (1964). Matcalf and Chalk (1950) reported "explosive hairs" with a two celled head in Cucurbita and Momordica. According to Zimmermann (see Matcalf and Chalk, 1950) the whole head of each hair is explosively cast off and the contents extruded through the pore thus formed. Such "explosive hairs" are absent in the fruit of Momordica dioica. The glandular hairs of Luffa cylindrica show the presence of insoluble polysachharides. They probably attract insects for the pollination as they are shed off during further development of the fruit. A few lipid bodies are also localised in the glandular hairs of Luffa cylindrica and L. acutangula. They are also found in the eglandular hairs of L. acutangula. In L. cylindrica branched glandular hairs are uniquely present.

Matcalf and Chalk (1950) and Pant and Banerji (1964) reported anomocytic stomata in the family Cucurbitaceae. Dave and Patel (1975) also reported anomocytic stomata in the fruit of Luffa cylindrica. But the cucurbitaceous fruits investigated here show anomocytic, cycloecytic, paracytic, tetracytic stomata and a stoma with one subsidiary cell (heplocytic). Inamdar and Gangadhara (1975) reported
anomocytic and haploecytic stomata in the cotyledon of *Lagenaria leucantha*. But anisocytic, paracytic, cyclocytic stomata with several abnormalities were observed in cotyledons treated with growth regulators. Degeneration of one or both guard cells is usually observed at the late stage of the fruit development. Rarely, a guard cell divides in *Luffa cylindrica*, a feature also reported in turmeric (Raju and Shah, 1975) and *Solanum melongena* (Patel and Shah, 1971). As in turmeric (Raju and Shah, 1975) the division of one guard cell forms a stoma with three guard cells in *Luffa cylindrica*. But in *S. melongena* a similar situation does not exist (Patel and Shah, 1971). On the basis of structure and development of stomata Pant and Banerji (1964) suggested that Cucurbitaceae appears a different family from the Passifloraceae and Begoniaceae. Because of wide diversity of stomatal types found in the fruit of a single species, I do not prefer to discuss any phylogenetic importance of stomata in the Cucurbitaceae.

**Hypodermis**

Hypodermis in the cucurbitaceous fruits is chlorenchymatous. Phenolic contents are present in the hypodermal cells of *Citrullus lanatus* and *Luffa acutangula*. They are also located in a few epidermal cells of *Luffa acutangula*, *Momordica dioica*, *Citrullus lanatus* and
Coccinia grandis.

The skin of some cucurbitaceous fruit has spiny projections. Their structure is described in *Sicyos angulatus* and *Echinocystis lobata* (Berber, 1909). I have studied their structure and development in *Homordica dioica*. In *Sicyos angulatus* and *Echinocystis lobata* the spine consists of a single layered epidermis enclosing thick walled pitted cells (Barber, 1909). In *Homordica dioica*, the spine has an epidermis of polygonal cells and chlorenchymatous ground tissue. Barber (1909) reported (1) unicellular conical hairs in *S. angulatus*, (2) a glandular capitate hair at the tip in *S. angulatus* and *E. lobata* and (3) short glandular hairs in *E. lobata*. But in *Homordica dioica* glandular filiform hair is at the tip and short glandular and e glandular hairs are on the surface of the spine. Epidermal hairs on the spines in fruits of *Baturia* (Patel, 1977) and *Anthemium* (Trivedi and Sharma, 1964) are also reported. Anomocytic, haploxytic and paracytic stomata are present in the spine epidermis of *Homordica dioica*. Trivedi and Sharma (1964) also reported stomata in the spine epidermis of *Anthemium* fruit.

Farr (1915), and Trivedi and Sharma (1964) consider *Anthemium* spines as the modified floral bracts. Patel (1977) supporting the view of Vish and Danert (1973), traced its
origin from a local active meristem in the outer hypodermal layers of the ovary wall. In the present investigation spine originates from a local active meristem (or "spine-meristem") in the outer hypodermal layers of the ovary/developing fruit.

The spine of *Momordica* is simple as compared to the heterogenous spine of *Xanthium* and *Datura*. In *Xanthium* three vascular traces are present in the spine. (Sharma and Trivedi, 1964). In *Datura* the branched and anastomosed vascular cylinder of the spine is broad and connected with the lateral vascular bundles in the mesocarp (Patel, 1977). The spine of *Momordica dioica* lacks any vascular supply. Thus, it can be considered as a superficial outgrowth of the fruit skin and so morphologically regarded as a prickle. According to Barber (1909) spines have important role in the dispersal of the seeds as spiny cucurbitaceous fruit can get attached to the skin of the passing animal.

Some cucurbitaceous fruits develop periderm (Asam, 1965). According to Miller (see Barber 1909) cork cells occur below the epicarp in *Cucumis melo*. Periderm formation is not observed in the cucurbitaceous fruits studied by me. In *Coccinia grandis* and *Citrullus lanatus* wound cambium forms protecting layers in the epicarp.

Ridges and furrows in the fruit of *L. acutangula* develop because of unequal enlargement of the epicarp cells,
particular of the cells above the major vascular bundles. During the fruit development ridges become stiff because xylary and extraxylary fibers develop.

Hypodermis in *Citrullus* consists of thick-walled cells (Barber, 1909) but in material investigated by me thin-walled cells are present.

**Outer mesocarp**

In *Luffa cylindrica*, *L. acutangula*, *Momordica dioica* and *Citrullus lanatus* the development of outer mesocarp begins with the sclerosis of cells of the ground tissue of the ovary, situated above the ring of vascular bundles. This development occurs after the ovary is fertilized. The development of sclereids is gradual. Along with the fruit development the parenchyma cells between the adjacent groups of sclereides divide radially. Some of them differentiate into sclereids and others continue to divide. Later, the sclerosis of remaining cells occurs forming a complete ring of sclereids. This pattern of development is well adapted to circumferential growth of the fruit. Thus, the outer mesocarp of *Luffa cylindrica*, *L. acutangula*, *Citrullus lanatus* and *Momordica dioica* has a continuous ring of sclereides. In *Citrullus* the mesocarp has a discontinuous ring of sclereids (Barber, 1909). In the mature fruit, several sclereides retain their protoplast. According to Maau (1969) the causal
relationships in the development of sclereids constitute a challenging problem for the student of plant histogenesis. Al-Talib and Torry (1961) pointed out that auxin influences the development of sclereids.

Plasmodesmata are common between two adjacent sclereids in Luffa cylindrica, L. acutangula, Momordica dioica and Citrullus lanatus. The hardness of the fruit skin is due to this region.

**Flesh**

The flesh is soft and edible region of the fruit. In Luffa cylindrica, L. acutangula, Momordica dioica and Citrullus lanatus it consists of middle and inner mesocarp, endocarp and placental region. But in Cucumis grandis - a soft cucurbit, it is made up of outer and inner mesocarp, endocarp and placental region.

**Middle and inner mesocarp**

Middle mesocarp and inner mesocarp in Luffa cylindrica, L. acutangula, Momordica dioica, and Citrullus lanatus are parenchymatous. The cells in this region contain abundant starch grains. The middle mesocarp mostly originates from the ground tissue of the ovary below the ring of vascular bundles. Cell divisions and cell enlargement above the endocarp contribute to the formation of the inner mesocarp.
Periclinal divisions and subsequent cell enlargement above the endocarp are partly responsible for the circumferential growth of the fruit. Thus, the outer, middle and inner mesocarp have distinct sites of origin in the ovary. Similarly in Coccosia grandis the outer mesocarp is mostly derived from the ground tissue of the ovary adjacent to the ring of vascular bundles, while the inner mesocarp from the cells above the endocarp. Patel (1977) also pointed out that the mesocarp is derived from the mesoderm of the ovary in the solanaceous fruit.

Besides, middle mesocarp cells are comparatively thick walled, hence they are distinguished from the inner mesocarp cells in Momordica dioica. Though there is no sharp demarcation between the middle and inner mesocarp in Luffa cylindrica and L. acutangula the former has horizontally, and the latter vertically oriented fibro-vascular strands.

In Citrullus lanatus, on the other hand, the middle mesocarp has horizontal and vertical vascular strands and the inner mesocarp has vertical ones. Thus, the heterogeneous nature of the mesocarp of cucurbitaceous fruit is confirmed (Matienko, 1957).

**Endocarp**

Barber (1909) generalised that the endocarp cells of the cucurbitaceous fruit are thin walled and tangentially
elongated and they form a thin transparent layer firmly attached to the seed. Hayward (1958) also found similar endoarp in the fruit of Cucurbita. But till now the delimitation of the endoarp of cucurbitaceous fruit was not clear as the information given by Barber (1909) and Hayward (1958) is obscure. I furnish the following important features of the endoarp.

1. Topographically it is a single layer immediately below the inner mesoarp.

2. It is not a continuous layer, and is confined to three regions only. It bends towards the placental region and surrounds the seeds.

3. Anticlinal divisions and the subsequent enlargement of the cells lining the placental cavity form the endoarp. Insoluble polysachharides are present in the endoarp of Citrullus lanatus. Similar product is also reported in certain solanaceous fruits (Patel, 1977).

Patel and Dave (1976) found anomocytic stomata in the inner epidermis of Datura innoxia and Datura metel. Among the cucurbitaceous fruits anomocytic, haplo cytotic and para cytotic stomata in the endoarp are found in Momordica dioica. A wide spherical pore (20-26 micron in diameter) is the characteristic feature of the endoarp stomata. These stomata, probably, may have some role in the inner ventilating system. As far as I am
aware this is the first report of stomata in the endocarp in the family Cucurbitaceae.

**Placental region**

According to Eames and MacDenials (1972) the term "pericarp" refers only to the modified ovary wall, but in general usage it refers to the outer tissues of the fruit regardless of its morphology. If this view is accepted the placental region is not a part of the pericarp. But its study is essential along with the other parts of the fruit as the central theme of fruit growth seems to be the mobilisation of substrates into the various tissues associated with the ovule (Bollarad, 1970).

In cucurbitaceous fruits the placental region is the inner most parenchymatous part of the flesh, derived from divisions and subsequent enlargement of cells of the central ground tissue of the ovary.

In *Citrullus* the greater part of the flesh consists of placental region. It consists of (1) placental cavity, (2) funicular region, (3) interfunicular region, (4) ovular region, (5) interovular region, (6) ventral region and (7) radial region. The various planes of cell divisions and mode of cell enlargement contribute in developing the different parts of the placental region. There are no sharp limits among the different regions, but they gradually merge
with each other forming a large portion of the flesh. Though this distinction is based on topography it is essential for understanding the growth activity of placental region.

The fruit ripening may involve the separation of cells (Eames and MacDenials, 1972). Patel (1977) found the separation of cells in some solanaceous fruits. Among the cucurbitaceous fruits widening of the intercellular spaces and subsequent cell separation are observed in Coccinia grandis, Momordica dioica and Citrullus lanatus. Eames and MacDenials (1972) suggested that the dissolution of pectic substances occurs at the time of fruit ripening which causes cell separation. Leopold and Kriedemann (1975) also found the solubilisation of pectic substances from the middle lamellae during the fruit ripening.

Marked changes in the pigments at the time of the ripening of the fruit are common. In certain fruits pigments are restricted to the shell while in others they penetrate the entire fleshy part (Leopold and Kriedemann, 1975). Chromoplasts develop in the flesh of Momordica dioica, Citrullus lanatus and Coccinia grandis during the fruit ripening. Leopold and Kriedemann (1975) suggest that changes in enzyme components of the fruits during the ripening govern the mechanism of pigment formation.

Vascular tissue

In the cucurbitaceous fruits usually the major strands
are bicollateral and the minor ones are collateral.

Bicollateral strands are the extensions of those from the fruit-stalk. They are arranged in a ring towards the periphery below the skin.

The anastomosing minor strands develop from the vascular meristem - procambium, derived from parenchyma cells of the flesh. Barber (1909) generalised that in the cucurbitaceous fruits anastomosing bundles occurring throughout the mesocarp are bicollateral. In the present investigation the majority of the minor strands are collateral with the exception of very few small bicollateral strands found in *Momordica dioica* and *Citrullus lanatus*. Anastomosing strands have different orientations in various regions of the flesh. In *Cucumis graminis* they are horizontal, vertical and radial in the outer mesocarp, inner mesocarp and placental region respectively. In *Momordica dioica* and *Citrullus lanatus* majority of them are oriented horizontally and vertically in middle mesocarp, vertically in inner mesocarp and radially in placental region. Thus, I conclude that the vascular strands of the cucurbitaceous fruits investigated here have specific orientation. All the strands in the different parts are connected with each other, ultimately forming an irregular pattern of the vascular system.

The parenchyma cells of the flesh of cucurbitaceous
fruits show interesting behaviour. Some of them divide and form phloem cells. In Coccinia grandis and Momordica dioica parenchyma cells adjacent to outer and inner phloem of bicollateral strand divide and differentiate as phloem elements. Similarly in Citrullus lanatus more phloem elements are derived from parenchyma cells and added to outer and inner phloem of the minor strand. In Luffa cylindrica and L. acutangula parenchyma cells adjacent to only inner phloem contribute to the phloem.

Many isolated strands of phloem are also derived from the parenchyma cells of the flesh. Isolated phloem strands can be considered as additional food-conducting "canals" produced to cope up with increased distribution of food to the greater area as many cucurbitaceous fruits are large. The causal factor/s for divisions and differentiation of the flesh-parenchyma cells into phloem are not known. But Leopold and Kriedemann (1975) suggest that in the multicellular organism there must be regulatory systems through which cells mutually determine the location and type of growth.

Similar isolated sieve tubes are also found in the flesh in Luffa cylindrica, L. acutangula, Citrullus lanatus and Coccinia grandis. Some of the isolated sieve tubes join with the bundle sieve tube. These are called commisural sieve tubes by Fischer (see Barber, 1909). Isolated sieve tubes were first observed by Fischer (see Barber, 1909). He claimed
that there are no true late tubes. Those identified as latex tubes are nonfunctioning sieve tube elements. According to Barber (1909) perforated plates are present in some tubes while absent in others. Therefore, he considers that in the fruits both sieve tubes and latex tubes are present. In the present study the tubes have definite sieve plates and the lumen is filled with the proteinaceous material.

The presence of proteinaceous substance in the mature sieve tube elements is reported in the family Cucurbitaceae (Cronshaw and Esau, 1968; Shah et al., 1975). But its even distribution filling the entire lumen of the mature sieve tube element in the cucurbitaceous fruit not only reflects its varying behaviour but also complicates the determination of its role in translocation.

In Cucurbita maxima, proteinaceous bodies are present in the companion cells (Evert et. al., 1966; Cronshaw and Esau, 1968). I observed proteinaceous bodies in the companion cells in Coccinia grandis, and amorphous proteinaceous substance in Luffa acutangula. The role of the proteinaceous substance in the companion cell is not known.

**Fibrous skeletal net**

Sinnott and Bloach (1943) and Dave and Patel (1975) studied certain aspects of fibrous net of Luffa cylindrica. I have studied its development and structure in Luffa cylindrica.
and \textit{L. acutangula}. Dave and Patel (1975) consider these strands as fibrovascular. Each strand mostly consists of fibers associated with the other vascular tissues and hence it is termed fibrovascular. There are major and minor strands in the net. According to Sinnott and Bloach (1943) they are parallel to the circumference in the middle, and run chiefly longitudinally in the inner region of the fruit wall. I consider that on the basis of orientation of the major strands, the net consists of four definite systems. They are, (1) outer-vertical, (2) horizontal, (3) inner-vertical and (4) radial. The orientation of the strand is determined by the plane of divisions and the direction of differentiation of parenchyma cells of the flesh.

Sinnott and Bloach (1943) and Dave and Patel (1975) found that the net is not formed simultaneously but its structural complexity increases along with the fruit development. I find that initially scattered groups are formed in each system, but later they anastomose.

Sinnott and Bloach (1943) found that in the beginning the elongation of fibers and the fruit is more or less equal but later they elongate faster than the fruit. I also found that in \textit{Luffa cylindrica} and \textit{L. acutangula} during early fruit development the increase in the length of the fiber and fruit is almost equal. But, later fiber length increases faster than
the fruit size. This confirms the observations of Sinnott and Bloach (1943).

The morphological nature of the strands in the net is a matter of interest. Sinnott and Bloach (1943) observed that, each strand consists of fibers, phloem and few elements of xylem. I have also observed similar cell types in the strands of *Luffa cylindrica* and *L. acutangula*. In certain strands xylem may be absent. In the investigated plants the fibers are xylary or extraxylary. Xylary fibers are mostly found in the major strands of outer vertical system. In the other strands, usually, fibers are extraxylary.

The strands in the net show definite orientation in the different regions of the fruit similar to the vascular strands of other cucurbitaceous fruits. Horizontal system, inner vertical system and radial system of the fibrous net are present in the middle mesocarp, inner mesocarp, and placental region respectively. Thus, the skeletal net of *Luffa cylindrica* and *L. acutangula* is a modified vascular system functionally adapted to the mechanical support and seed dispersal. Sinnott and Bloach (1943) also consider the strands as modified vascular bundles where xylem and phloem are much reduced and the fibrous tissue is greatly developed.

**Mucilage sac**

Structure and development of mucilage sac are studied in
Luffa cylindrica, Citrullus lanatus and Cocinia grandis. In Luffa cylindrica it originates by enlargement or an intercellular space and disorganisation of cells, while in Citrullus lanatus and Cocinia grandis it is formed by the disorganisation of the cells. It is a result of pathological development. Its origin may be at any stage of the fruit development. The causal factor/s responsible for the formation of mucilage is/are obscure.

The relationship between cell size and fruit size

At the early fruit development, the fruit size increases rapidly than the cell size but later cell enlargement is prominent. This is in conformity with the observations of Sinnott (1939).

The growth of cucurbitaceous fruits is a result of two factors, (1) cell multiplication and (2) cell enlargement.

In the early development fruit growth is mostly due to more cell divisions and less cell enlargement. Later fruit growth takes place mainly by cell enlargement. The tomato - a solanaceous berry also follows a similar pattern of development (Haughtaling, 1938).

The parenchyma cells of the different parts of the developing fruit show varying behaviour in the cell multiplication and cell enlargement. Considerable size
variation exists in the cells of the various regions of the cucurbitaceous fruits. Cell enlargement is more prominent in the placental region, inner mesocarp and middle mesocarp in *Luffa cylindrica*, *L. acutangula*, *Momordica dioica* and *Citrullus lanatus*. It is also prominent in placental region, inner mesocarp and outer mesocarp in *Coccinia grandis*. The development of epidermis and hypodermis is due to more cell divisions. Exceptionally hypodermal cells in *Momordica dioica* enlarge similar to those of the inner regions.

It is obvious that the growth in volume of the fruit is due to more cell enlargement. But growth in surface predominantly takes place by cell divisions.

The early fruit development by cell divisions and later by cell enlargement must depend upon the physiological state of the cells of the developing fruit. Leopold and Kriedemann (1975) remark that, the story of fruiting is dominated by the physiological events in the pericarp and accessory tissues surrounding the ovules and later the seeds.

The higher rate of cell divisions during the early period of fruit development in cucurbitaceous fruits is presumably due to growth regulators. Leopold and Kriedemann (1975) are hopeful for the role of kinin especially in the
fruits with considerable amount of cell divisions occurring during their development. The presence of kinin in young fruit of banana (Steward and Simmonds, 1954), apple (Goldacre and Bottomly, 1959; Letham and Bollard, 1961) and tomato (Nitsch and Nitsch, 1961) is well known.

Increase in the cell size must depend upon the physiological processes of each region of the fruit. Higher concentration of auxin was found in the central region of squash fruit (Gustafson, 1939). Nitsch (1951) found 150 percent increase in fruit size of tomato by the treatment of auxins. Wright (1956) also reported three auxins from the developing fruits.

According to Leopold and Kriedemann (1975) there are many correlations between the number of seeds and fruit size which recognise the concept of seeds as a source of growth stimulating signals in the fruits. In strawberry (Nitsch, 1950) seeds provide factors for the conversion of tryptophan into auxin which stimulates the fruit growth. Many cucurbitaceous fruits have seeds in large numbers situated in the inner region of the flesh where prominent cell enlargement is observed.

Sinnott (1959) reported a gradient in the increase in cell size from inward to outward region of the cucurbitaceous fruits. According to him maximum cell enlargement is in the placental region and it gradually decreases towards the
peripheral region. In the present investigation hypodermal cells also show cell enlargement similar to those of the inner regions as in *Momordica dioica*. Sinnott (1959) did not study the cell divisions and cell enlargement in the endocarp. Endocarpic cells in the plants investigated by me show more cell enlargement. Thus, this observation does not support the idea of cell size gradient of Sinnott (1959). Also, the inner mesocarp which is external to the endocarp, in all the fruits studied here, shows more cell enlargement than the endocarp. The schematic representation of the development of cucurbitaceous fruits as I visualise is given in charts I, II and III.

Cucurbitaceous fruits may be divided into three types, (1) soft fruits - skin without sclereids as in *Cucinia grandis*, (2) hard fruit - skin with sclereids as in *Luffa cylindrica*, *L. acutangula* and *Citrullus lanatus*, and (3) spiny fruit - though the skin of *Momordica dioica* has sclereids, it has spiny projections (prickles). The schematic representations of development of these types of cucurbitaceous fruit are given in charts I, II and III. They are significant in the developmental anatomy of the fruit as they provide information about the proportional cell divisions and cell enlargement in the various parts of the fruit. They further indicate the histological contributions of the different regions of the ovary towards the development of the fruit.
Chart - I
Chart - II
Chart - III