Proceeding Fifth Plant Breeding Conference May 27, 2007 (Giza)

Egypt. J. Plant Breed. 11(2): 693-715 (2007) Special Issue

MORPHOLOGICAL AND ANATOMICAL FEATURES OF SOME INTER- & INTRA-SPECIFIC COTTON HYBRIDS AND THEIR PARENTS

R.K. Harb[1], Sawsan M.A-E Abou Taleb[1] and Aziza M. Sultan[2]

1- Agric. Botany Dept., Faculty of Agriculture, Cairo University, Giza, Egypt.

2- Cotton Research Institute, Agric. Res., Center, Giza, Egypt.

ABSTRACT

An experiment was conducted at Giza Research Station during 2002, 2003 and 2004 to study some morphological & anatomical features of eight parental genotypes and twelve of their partial diallel F_1 crosses. Five Egyptian cotton cultivars (Giza 91, Giza 90, Giza 70, Giza88 and Suvin) of the species barbadense and three lines belonging to the species hirsutum (Frego bract, Okra leaf and Nectariless) were applied. The Egyptian parents surpassed those of the upland cotton with respect to main stem length, main stem diameter and the leaf thickness. Highest values of lobing index & central leaf lobe shape recorded for the Okra leaf and Nectariless lines. Leaves of both varied morphologically (drastically lobated & narrower lobes) from the wider leaves of the other parents. No specific anatomical variations were noted between both leaf types. Crossing between Okra leaf type with three Egyptian cultivars resulted F_1 hybrids with Okra leaf shape. Considerably, higher values of leaf nectaries length were recorded for Giza 90 and all of its crosses. Morphological study showed that most of the inter-specific hybrids performed better over parents and intra-specific ones which may be interpreted by hybrid vigour.

Wider anatomical differences were detected between the parental genotypes rather than that was noted between the resultant hybrids, especially regarding the petiole anatomy. Transverse sections made in the median leaf petiole of the main stem revealed three major anatomical types. The first was characterized by the presence of completely separated vascular bundles, thick walled cortical collenchyma cells, wider cortex and narrower pith. Cultivar Giza 88 and the upland lines (Frego bract, Okra leaf and Nectariless) belong to the first type. The second type, Egyptian cultivars (Giza 91, Giza 70 and Suvin) was characterized by nearly complete vascular cylinder, narrower cortex and wider pith. The third type exhibited by the parent Giza 90, in which collenchyma with thicker walled and radialy elongated cells were observed in cortex. The vascular bundles were separated by rays of thick walled parenchyma cells.

Transverse sections made in the lamina of all studied genotypes showed two main anatomical differences. Firstly, the palisade tissue extended beneath the adaxial leaf epidermis to be adjacent to adaxial collenchyma in the midrib. Giza 91 and its crosses with Suvin & Frego bract were free of this character,

while the others possessed it. Secondly, the presence of one or two small reverse oriented bundles (phloem towards the adaxial leaf side). The Egyptian parent Giza 70 and the upland lines are free of these bundles. Half-amphicribral main vascular bundle was exhibited by all genotypes under study.

Secondary thickening induced by the interfascicular cambium promotion was noted in most of the resultant hybrids. It could be considered as a sign of hybrid vigour. Most of studied hybrids exhibited petioles of nearly square shape. Leaf blades of most of them possessed extended palisade tissue and/or small reverse oriented collateral bundles.

Anatomical resemblance was detected between the upland cotton lines, as their petioles exhibited the first structural type, with completely separated vascular bundles. Their leaves showed palisade tissue extension. The midrib was free of small reverse oriented collateral bundles.

Specific anatomical features were detected in petioles and leaves of all studied genotypes. Idioblasts (varying in size, colour density and distribution) were observed across the transections made. Also, stellate crystals were noted.

Key words: ***Cotton, G. Barbadense, G. hirsutum, Hybrids, Anatomy and morphology***

INTRODUCTION

Cotton, *Gossypium spp.*, is the most important fiber crop of the world cultivated between 40° and 45° North & South of the equator, respectively (Kakani *et al.*, 2003). Worldwide cotton production was 120.4 million bales (218.2 kg/bale) in the 2004/2005 marketing year, the largest is record (FAS, 2005). It is considered as major source of national income of Egypt. Several commercial species belonged to the genus. The species *barbadense* is the most important represented in Egypt. It has a worldwide reputation because of its fiber length, fiber fineness and high yield. The species *hirsutum is* one of the most important species represented in the United States (Hayward 1938). Many investigations were done to explore new varieties by selection or crossing between the two species, Hayward (1938) and Chee *et al.* (2005). Davis (1978), from India, reported greatest degree of heterosis in net yield (138 %) of an intra-*hirsutum* F_1 hybrid over a commercial check. Davis (1979b) reported significant heterosis for yield of seed & lint cotton over the upland parent in two inter-specific hybrids between *G. hirsutum* and *G. barbadense*. When the two species are grown side-by-side in the field, *G. hirsutum* has higher photosynthetic and transpiration rates. (Lu *et al.*, 1997). Wise *et al.* (2000), by using scanning electron microscope, reported that the mature leaves of *G. barbadense* are larger and thinner with narrower palisade layer compared to the *hirsutum* ones. The authors reported also that the *G. barbadense* leaves exhibited significant curling which allow more absorption of insolation and much more light penetration into the canopy.

Senft (1986) reported that cotton plants having leaves with deeper indentation, than the normal, between the lobes are known as Okra-leaf type. He reported partial success in incorporation of this as a resistance factor into commercial cultivars. Ulloa (2006) pointed out that the genetic potential for improving agronomic and fiber traits may exist in populations with this alternative leaf morphology.

The current investigation was conducted 1) to study some morphological characters of eight parental genotypes belonging to two species of the genus *Gossypium* as well as some of their intra- & inter-specific F_1 hybrids, and 2) to identify possible anatomical variations between the parental genotypes. Possible anatomical relations between parents and some of their partial diallel F_1 hybrids.

MATERIALS AND METHODS

The present investigation was carried out at Giza Research Station, Agricultural Research Center, Giza, Egypt during 2002, 2003 and 2004 growing seasons to study some morphological & anatomical features of eight parental cotton genotypes & twelve of their F_1 hybrids. Five Egyptian cotton cultivars belonging to the species *barbadense* (Giza 91, 90, 70, 88 and Suvin) were used as well as three upland cotton lines of the species *hirsutum* (Frego bract, Okra leaf and Nectariless). Crosses were made in 2002 using a partial diallel mating design including the eight parents. In 2003 season, crossing was repeated to produce more F_1 seeds. In 2004, twelve F_1's & eight parental seeds were sown in a randomized complete block design with three replicates. The ridges were 4 m long and 60 cm apart. Hills were spaced 20 cm within ridges. At seedling stage, plants were thinned at two plants/hill. The agricultural practices were applied according to the recommendations in vicinity. The measurements were taken on ten guarded individual plants in each plot for morphological study. Three characters; lobing index (length of middle lobe in cm/leaf length in cm), length of leaf nectaries (mm) and central leaf lobe shapes (middle lobe length in cm/leaf width in cm) were measured at the age of 90 days, while main stem length was at picking.

Anatomical study

Specimens of the median leaf petiole (nearest part to the blade) and blade (the middle part) as well as the first apical internode (1 cm long) of the main stem were taken at the age of 79 days. Samples were killed and fixed for at least 48 hrs. in F.A.A. (10 ml. formalin, 5 ml. glacial acetic acid and 85 ml. ethyl alcohol 70 %). Fixed materials were washed in 50 % ethyl alcohol, dehydrated in a normal butyle alcohol series and embedded in paraffin wax, melting point 52-54 °C. Sections, 15 to 20 μ thick were cut. Safranin & fast green combination method (Sass, 1961) was used for staining. Stained sections were cleared in xylene and mounted in Canada balsam (Willey, 1971). Slides were examined and measurements were taken. Averages of 3 readings from 3 slides were calculated. Photomicrographs were taken.

RESULTS AND DISCUSSION

Morphological study

Table (1) represents the mean performance of four morphological traits of eight parental genotypes and F_1 hybrids at the age of 90 days. The local parents significantly surpassed those belonging to the upland cotton with respect to main stem length. The same observation was recorded in main stem diameter and laminar thickness measured at 79 days (Table 2). The highest values of lobing index and central leaf lobe shape were recorded for parents Okra-leaf and Nectariless. They differed significantly from all parents under study, while recording the lowest values of main stem length and length of leaf nectaries. Max (2004) reported lower leaf area of Nectariless and Okra-leaf parents compared to Egyptian genotype Giza 83. Line Frego bract, recorded the lowest values of all morphological traits and stem diameters. Regarding the lobing index & central leaf lobe shape, no significant differences were detected between the five Egyptian cultivars. The highest values of leaf nectaries length were recorded on Giza 70 and Giza 90 (2.72 and 2.41 mm, respectively). Crosses of Giza 90 exhibited relatively higher values of such trait.

Table (1) showed that the inter-specific hybrids performed better than the intra-specific ones, as the means of lobing index, main stem length and central leaf lobe shape surpassed those of the intra-specific ones & vice versa with the mean length of leaf nectaries. Furthermore, they increased over the parents. It is worthy to note that the main stem diameter measured at 79-day old plants, of most inter-specific F_1 hybrids surpassed the corresponding parents or one of them. Increase recorded for F_1 hybrids over parents could be interpreted by the hybrid vigour. This result is in agreement with Davis (1974, 1979a, 1979b) and Davis and Palomo (1980) who stated that the hybrid vigour in *G. hirsutum* x *G. barbadense* is usually associated with excessive vegetative growth. Abo-Sen (1995) found insignificant differences between cotton genotypes, parents and F_1 hybrids in dry matter % of leaves at two growth stages (60 and 120 day-old).

Table 1. Mean performance of four morphological traits of eight parents & twelve of their parental diallel crosses.

Trait / Genotype	Main stem length (cm)	Lobing index	Length of leaf nectaries (mm)	Central leaf lobe shape
G. 91	175.67	75.61	1.81	1.73
G. 90	160.33	75.50	2.41	1.83
G. 70	171.67	76.86	2.72	1.85
G. 88	176.67	76.49	1.65	1.74
Suvin	148.33	78.83	1.62	1.79
Frego bract	111.67	67.91	1.61	1.35
Okra leaf	121.50	94.02	1.48	4.36
Nectariless	114.67	93.63	1.00	3.82
G. 91 x G.88	163.33	76.81	1.75	1.82
G. 91 x Suivin	108.60	74.97	2.11	1.82
G. 91 x Frego	149.33	73.81	1.51	1.56
G. 90 x Suivin	123.77	75.59	2.04	1.89
G. 90 x Frego	174.67	73.07	2.15	1.68
G. 90 x Okra	147.00	81.17	1.64	2.13
G. 70 x Frego	174.00	75.88	1.47	1.66
G. 70 x Okra	178.50	86.92	1.53	2.53
G. 70 x Nect.	165.17	86.00	1.54	2.34
G. 88 x Okra	177.00	84.04	1.60	2.21
G. 88 x Nect.	166.50	84.98	1.47	2.28
Suvin x Nect.	168.00	85.44	1.50	2.22
$LSD_{0.05}$	11.20	3.46	0.25	0.36
Mean of parents	147.56	79.86	1.79	2.31
Mean of crosses	157.99	79.89	1.69	2.01

Blades of lines Okra-leaf & Nectariless exhibited specific morphological feature compared to wider blades of the other parents. As the leaves are drastically lobated and the leaf lobes appeared narrower. Wise *et al.* (2000) pointed out that the mature leaves of *G. barbadense* are larger than those of *G. hirsutum.* Crossing three Egyptian parents (Giza 90, 70 and 88) with Okra-leaf type resulted in hybrids with Okra leaf shape. Gunaseelan and Krishnaswami (1987) crossed seven *G. hirsutum* cultivars with an Okra-leaf strain. They stated that Okra-leaf shape was dominant in F_1. This is confirmed in our crosses as shown in (Fig.1) where the hybrid G. 90 x Okra leaf possessed the Okra leaf type.

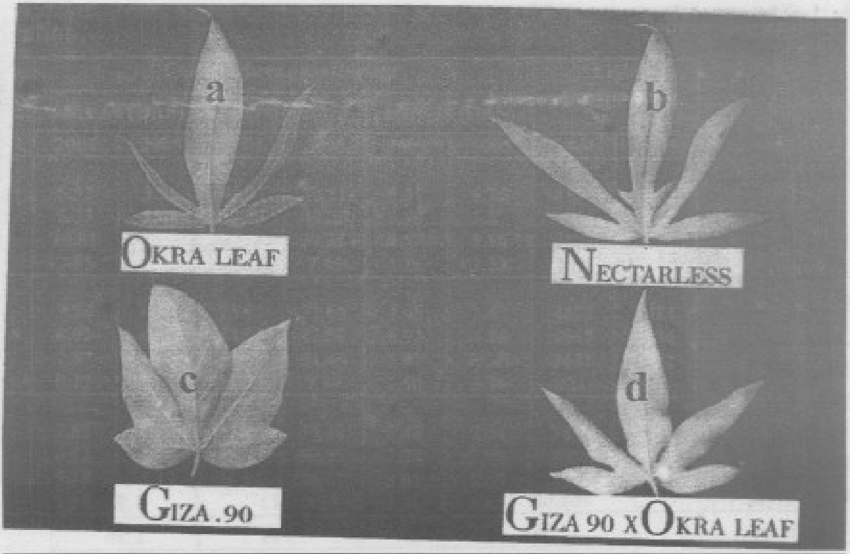


Fig. (1). Leaf shape:
a, b & D:- drastically lobated shape **c- wider leaf**

Anatomical study

(1) Anatomy of the petiole

General description

The epidermis underlay by layers of chlorenchyma, collenchyma and parenchyma, collectively termed the cortex. Collenchyma and/or chlorenchyma layers intercepted by severally distanced lysigenous glands. Hayward (1938) stated the presence of such lysigenous glands in cotton stem, developing in chlorenchyma. The cortex is followed by collateral vascular bundles in varying sizes. The central part of the petiole occupied by pith, composed of parenchymatous cells. Idioblasts in varying sizes, density of colour and distribution were observed. Stellate crystals scattered across the petiole section, rarely noted in cortex & pith in most cases. Crystals were observed mainly around the vascular bundles as well as contained in the phloem tissue. Neither idioblasts nor crystals were previously described in cotton anatomy.

Genotypes' characteristics

Transverse sections made in petioles of the studied genotypes at the age of 79 days revealed some differences. The mature petiole could be described as nearly oval, triangular, square or heart-shaped in cross sections. Slightly ridged outline was observed. Four major vascular bundles located in the angles of the square petiole. Each of the parents Giza 70, Giza 88, Frego bract, Okra leaf and the inter-specific hybrid Suvin x Nectariless were with nearly oval shaped petiole. The parent Giza 90 exhibited nearly triangular petiole. The parents Giza 91, Suvin and the majority of resultant hybrids are characterized by petioles with nearly square shape. Nectariless is the sole genotype possessed nearly heart shape petiole (Fig. 2).

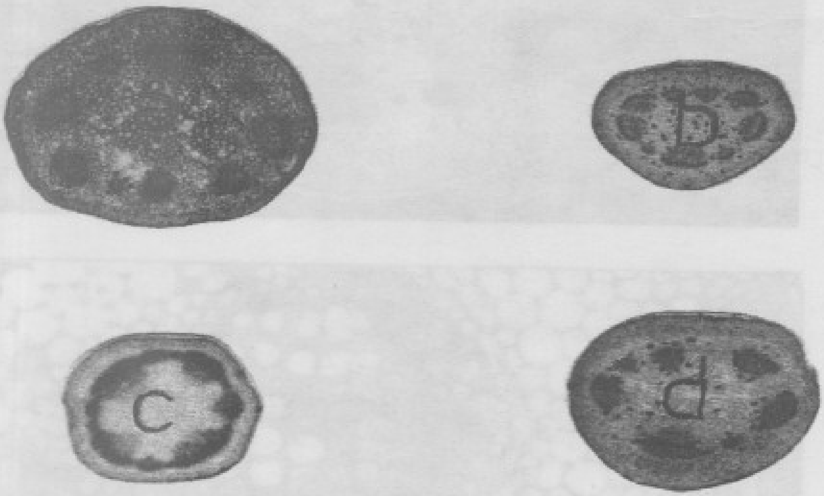


Fig. (2). Petiole shapes of studied genotypes

a- Oval shape **b- Triangular shape**

c- Square shape **d- Heart shape**

Hayward (1938) pointed out that the petiole of cotton leaf is circular to oval in shape. Three major internal structures could be recognized to differentiate between petioles of the studied genotypes. The first is characterized by more extended cortex, narrower pith and the presence of completely separated vascular bundles (Fig.3a). As the bundles were separated by wider rays (wider parenchyma regions). It is worthy to note those collenchyma layers which composed of thick-walled cells, the bundles contain poorly lignified secondary xylem vessels. Crystals & numerous of dense colour idioblasts distributed mainly around the bundles and included by the phloem.

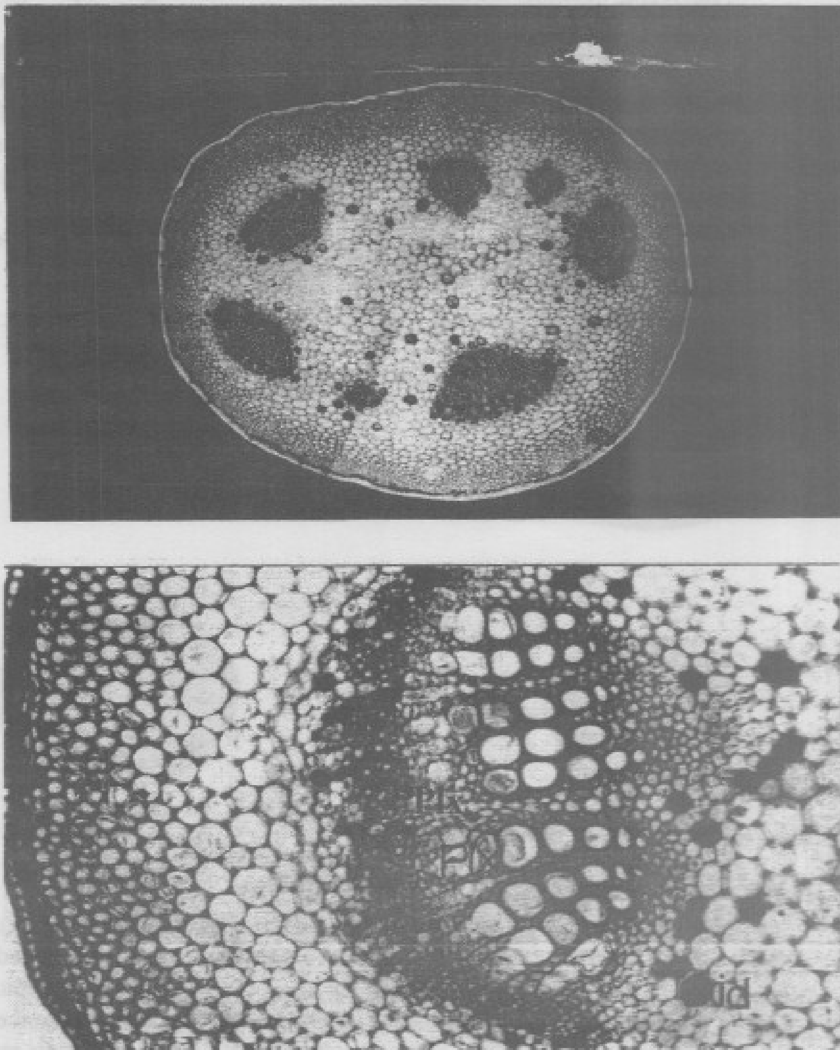


Fig. (3). T.S. of the median leaf petiole at the age of 79 days.

a- Aggregated photographs for the first type with separated vascular bundles in Nectariless line.

b- Magnified portion of Suvin x Nectariless showing

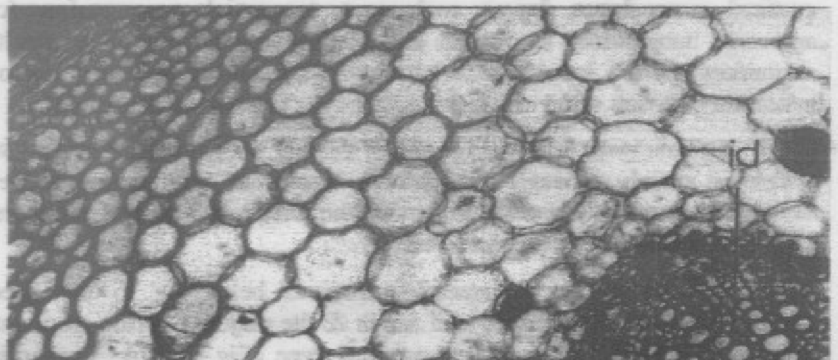
id . idioblasts . Plx. Poorly lignified secondary xylem vessels

c. thick-walled collenchyma cells

X 100

Petioles of Giza 88, the three lines belonging to the species *hirsutum* exhibited the structure described. The hybrid Suvin x Nectariless is the sole possessed separated vascular bundles' type. This may be interpreted by male parent effect. The later showed specific feature of poorly lignified wider secondary xylem vessels, thicker walled collenchyma and dark stained idioblasts spread across the petiole section (Fig.3b). Idioblasts were found occasionally between xylem rows as observed in Okra leaf petiole (Fig. 3 cont.a). The outer cortical layers of Giza 88 petiole contained higher density of stellate crystals compared to other genotypes (Fig. 3 cont.b).

c



d

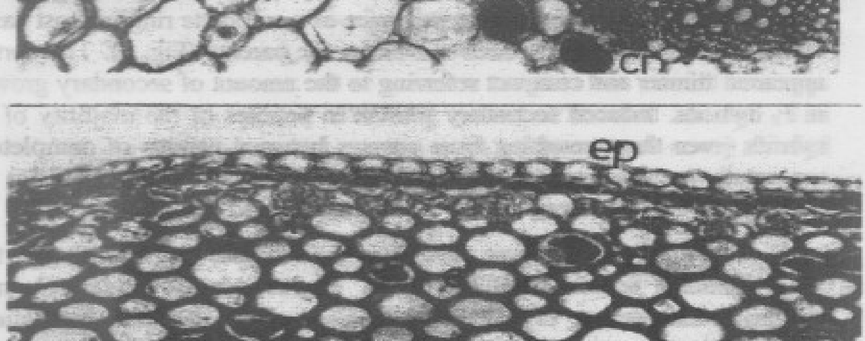


Fig.3 (Cont.).

c- idioblasts (id) between xylem rows in Okra leaf line. X 100

d- outer cortical layers with stellate crystals (cr) in Giza 88. X 160

- ep-epidermis

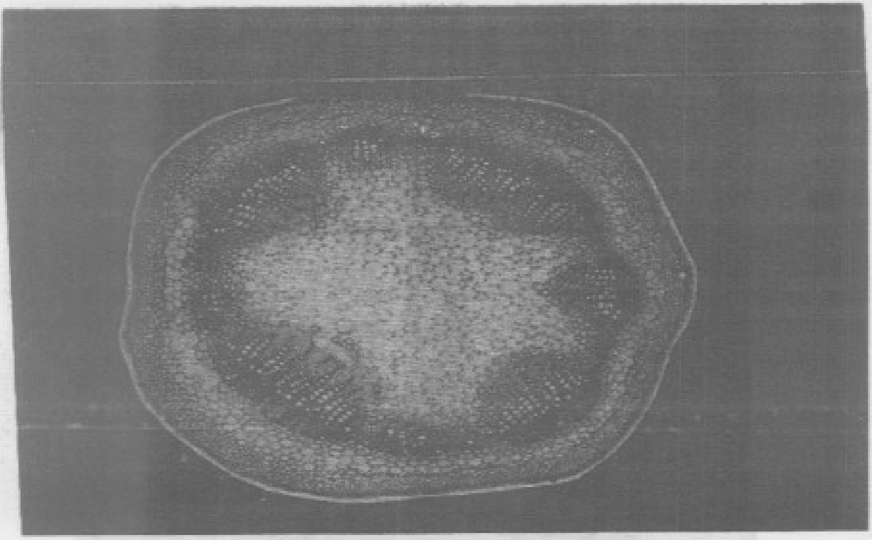
The second type exhibited nearly a complete vascular cylinder, newly developed bundles were observed between the major ones as a result of interfascicular cambium promotion. Therefore, the interfascicular region turned to small bundles and/or lignified cells. Fascicular cambium activation gave rise to secondary growth, adding secondary phloem & xylem elements within the bundles. Strands of highly lignified fiberous cells preceded the phloem of both major & minor bundles characterized this type. Poorly lignified cells occasionally terminated the bundles. The uppermost cortical parenchyma layers underwent tangential compression (cells appeared tangentially elongated and radialy comprised) as a result of secondary growth induction. Furthermore, the cortex appeared narrower while the pith was wider compared to the type previously described.

Collenchyma layer composed of thinner walled cells. Crystals were restricted mainly amongst the phloem tissues of both major & newly developed bundles. Contradicting with the first type reduced numbers of pale colour idioblasts were observed.

Petioles of three parental genotypes belonging to the species *barbadense* Giza 91, Giza 70 and Suvin & the majority of the resultant F_1 hybrids exhibited the second anatomical type (Fig.4 a&b). Tangentially elongated parenchyma gave an appearance of a complete ring in most cases compared to intercepted strands shown by the parents (Fig. 5). The cortex appeared thinner and compact referring to the amount of secondary growth in F_1 hybrids. Induced secondary growth in petioles of the majority of F_1 hybrids (even those resulting from crosses between parents of completely separated vascular bundles i.e. Giza 88 x Okra leaf type (Fig. 5c) & Nootarilcan) may be interpreted as a feature of hybrid vigour.

The Egyptian genotype Giza 90 is the sole one characterized by the third structural feature (Fig. 6 a & b). Higher density of dark stained idioblasts and stellate crystals were noticed across the petiole section, numerous were present in pith. Collenchyma with thicker walled, radialy elongated cells was observed. The vascular bundles contained numerous of poorly lignified secondary xylem vessels. The bundles appeared separated by medullary rays, occasionally thick walled parenchyma. It is worthy to note that types contain separated vascular bundles and/or their bundles induce poorly lignified secondary xylem vessels tended to be reinforced by thicker walled collenchyma cells instead of secondary thickening induction. Hayward (1938) pointed out that the petiole of cotton leaf had a ring of four or five large bundles and several smaller ones.

a



b

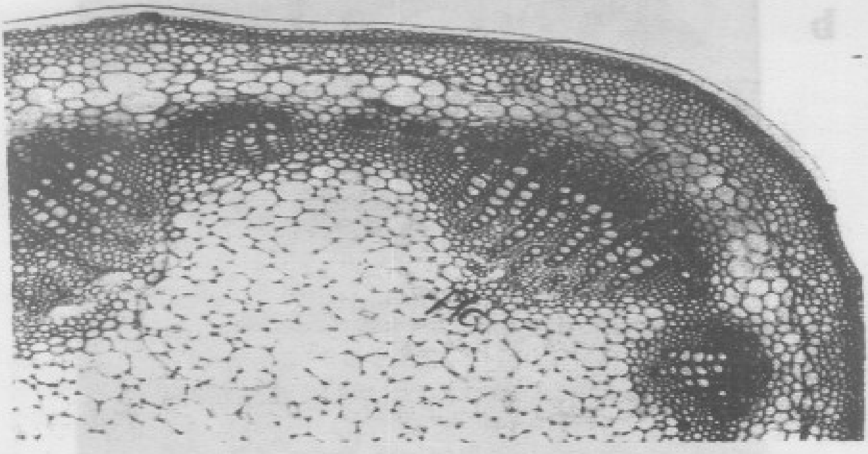


Fig. (4). T.S. of the median leaf petiole at the age of 79 days.

a- Aggregated photograph for the second type with complete vascular cylinder in Suvin cultivar.

b- Magnified portion of Suvin petiole. (X 40)

Notice: tangential compressed cortical parenchyma and thinner walled collenchyma.

lf. lignified fibers
plc. poorly lignified cells

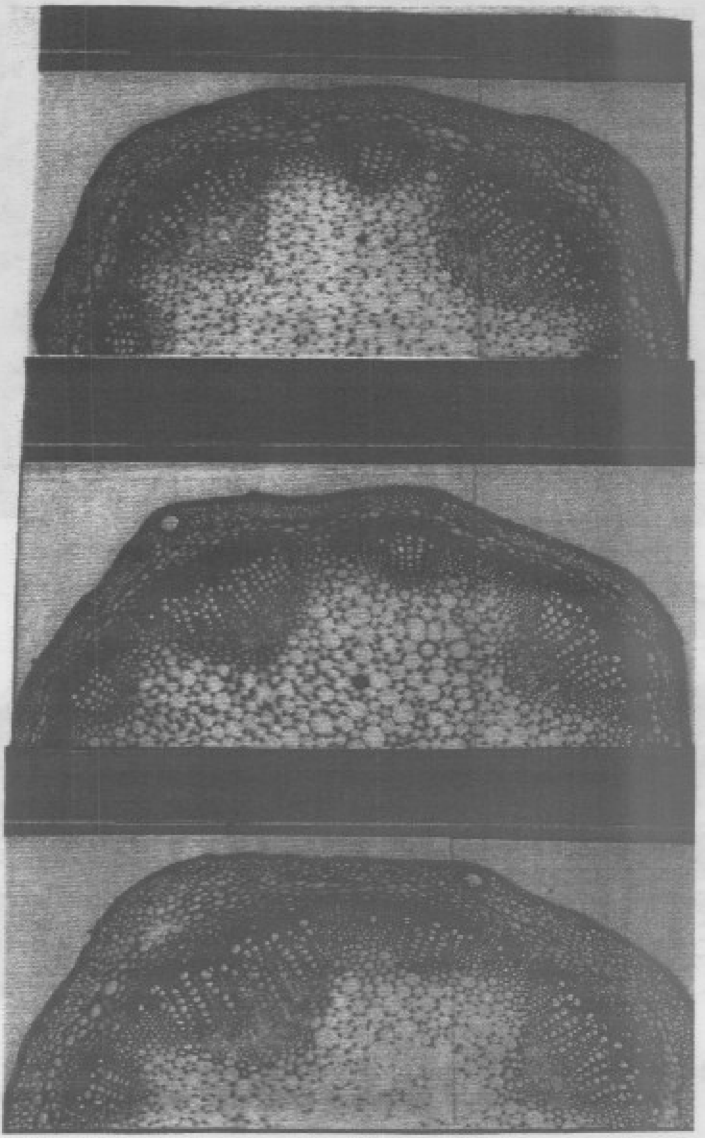


Fig. (5). T.S. of some hybrids at the age of 79 days. Aggregated photograph for:

- **a- Giza 91 x Frego bract.**
- **b- Giza 90 x Okra leaf type.**
- **c- Giza 88 x Okra leaf. Magnified portion of Suvin x Nectariless showing**

Notice thinner & compact cortex and tangentially elongated parenchyma.

a

b

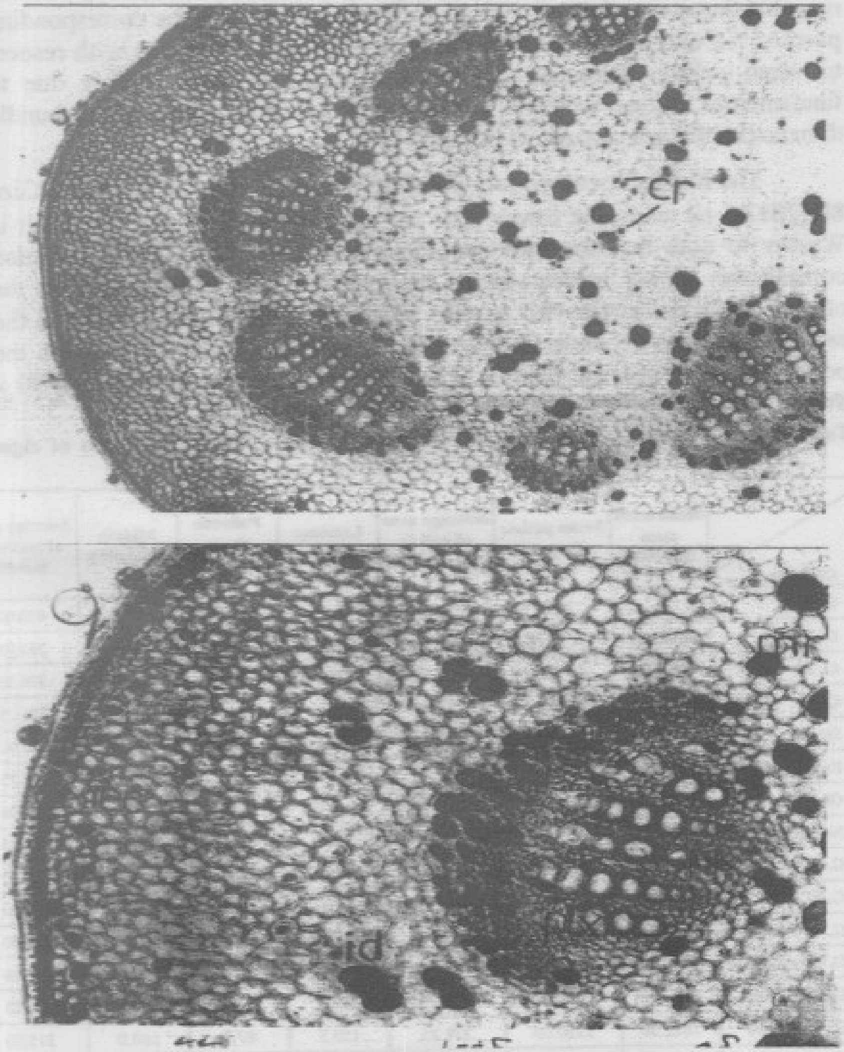


Fig. (6). T.S. of the median leaf petiole of Giza 90 at the age of 79 days.

a- The third type with:

- id . idioblasts **- cr. Stellate crystals**

Plx - poorly lignified secondary xylem vessels

- rec. radially elongated collenchyma X 40

b- Magnified portion of (a)

Notice: thicker walled parenchyma (medullary rays) between the bundles.

X 100

Measurements taken for petioles of studied genotypes (Table 2) revealed that most of the resultant hybrids did not surpass the corresponding parents. An exception was recorded by Giza 90 x Suvin cross with respect to mean petiole diameter. Increment over parents was mainly due to fundamental tissues, i.e thickness of cortex and pith, as the mean bundle dimensions did not surpass its parents.

The highest mean petiole diameter was recorded by the parent Giza 88 (2817.5 μ) while the lowest was recorded by Giza 90 (1522.5 μ). It is Worthy to note that the inter-specific hybrid Giza 91 x Suvin recorded considerably higher measurements taken for the petiole compared to the other F_1 hybrids, as the two parents involved in crossing belonged to the second type with secondary thickening. Differences recorded between the petioles of intra-specific hybrids (Giza 91 x both 88, Suvin and Giza 90 x Suvin) were narrower than those between the inter-specific ones.

Table 2. Some anatomical measurements (μ) for stems, petioles & leaves of eight parents & twelve of their partial diallel crosses at 79 day-old.

Trait / Genotype	Mean main stem diameter	Mean petiole diameter	Average area of petiole main bundle	Lamina thickness	Palisade tissue thickness	Midrib thickness	Average area of mid vein bundle
G. 91	2126.25	2283.75	463.75	175.0	87.5	857.5	490.00
G. 90	1645.00	1522.50	227.50	175.0	87.5	735.0	393.75
G. 70	1750.00	1636.25	328.50	140.0	70.0	630.0	376.25
G. 88	1837.50	2817.50	385.00	122.5	87.5	630.0	376.25
Suvin	1802.50	1855.00	428.75	157.5	87.5	700.0	385.00
Frego bract	1452.50	2607.50	402.50	140.0	87.5	700.0	376.25
Okra leaf	1540.00	2485.00	402.50	140.0	87.5	735.0	420.00
Nectariless	1540.00	2423.75	332.50	140.0	87.5	674.5	376.25
G. 91 x G.88	1837.50	2100.00	332.50	140.0	87.5	700.0	385.00
G. 91 x Suivin	1715.00	2143.75	341.25	140.0	87.5	700.0	367.50
G. 91 x Frego	1671.25	1723.75	332.50	140.0	87.5	700.0	385.00
G. 90 x Suivin	1645.00	2012.50	332.50	140.0	87.5	647.5	367.50
G. 90 x Frego	1872.50	1907.50	306.25	140.0	87.5	700.0	358.75
G. 90 x Okra	1802.50	1750.00	271.25	157.5	87.5	560.0	315.00
G. 70 x Frego	1802.50	2056.25	376.25	140.0	87.5	595.0	367.50
G. 70 x Okra	1968.75	1863.75	332.50	140.0	87.5	647.5	376.25
G. 70 x Nect.	1881.25	1846.25	271.25	122.5	87.5	647.5	332.50
G. 88 x Okra	1968.75	1933.75	227.50	175.0	105.0	647.5	358.75
G. 88 x Nect.	1505.00	1697.50	323.75	160.0	105.0	647.5	385.00
Suvin x Nect.	1617.75	1723.75	262.50	122.5	70.0	560.0	280.00

(2) Anatomy of the blade

General description

Upper and lower epidermis include the mesophyll in the flattened area of the blade, i.e. the laminar. Mesophyll composes of the palisade region, which comprises approximately one-half of the laminar thickness. The second part composes of loosely arranged cells with numerous intercellular spaces in between. Mesophyll is adjacent to enlarged mid vein. The upper & lower epidermis of the midrib was underlay by collenchyma, thicker walled collenchyma cells are present towards the abaxial leaf epidermis. The adaxial surface of the midvein gives an appearance of rib-like projection.

Genotypes' characteristics

Studied genotypes exhibited the presence of half-amphicribral vascular bundles in which the phloem tissue bounded partially xylem elements (Fig. 7). Stellate crystals, idioblasts in varying sizes were observed, especially around the main bundle and within the phloem tissue.

Table (2) represents the measurements taken for mature leaf transactions of all studied genotypes at the age of 79-days. Most of the resultant hybrids did not surpass the corresponding parents. The parents Giza 91 (Fig. 8) recorded the maximum blade measurements compared to the others. Furthermore, its crosses with Giza 88, Suvin (Fig. 8 cont.) and Frego bract recorded relatively higher measurements. The Egyptian cultivars recorded relatively thicker blades compared to the upland lines. Wise *et al.* (2000) reported that mature leaves of *G. barbadesne* were thinner with thin palisade tissue compared to those of *G. hirsutum*. Parental genotype Giza 88, its palisade tissue comprised approximately 3/4 the laminar thickness (87/122.5) (Fig. 9) Blades of its crosses with Okra leaf as well as Nectariless exhibited the same character.

As described for the petiole (Fig.6), the parent Giza 90 exhibited thicker walled collenchyma cells underlying the upper & lower epidermis of the midrib (Fig. 7). The same feature showed by its crosses with Suvin and Frego bract. The same observation recorded for the parent Nectariless (Fig. 10 a) & its crosses with Giza 70 (Fig. 10b), Giza 88 and Suvin. Leaves of those hybrids seemed to be reinforced by such thick-walled collenchyma cells. As the secondary thickening induced in the main bundle give rise to numbers of immature secondary xylem vessels.

a

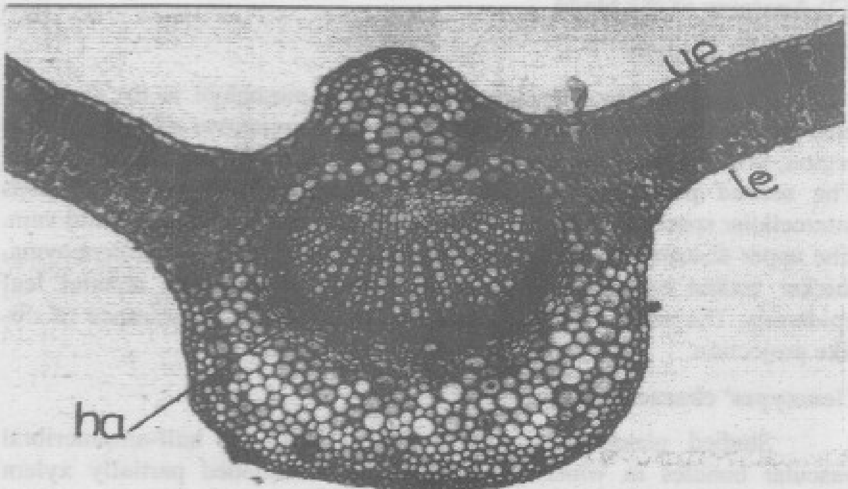


Fig. (7). T.S. of the lamina of Giza 90 at the age of 79 days showing half-amphicribral main vascular bundle (ha)
-ue . upper epidermis - le. Lower epidermis
- p. palisade tissue - s. spongy tissue
- c. collenchyma

b

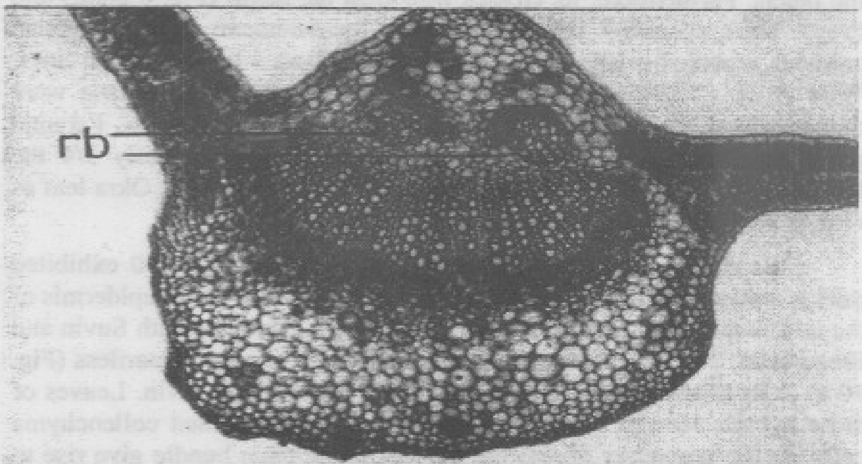


Fig. (8). Giza 91 leaf with 2 small reverse oriented collateral bundles (rb).

X 40

a

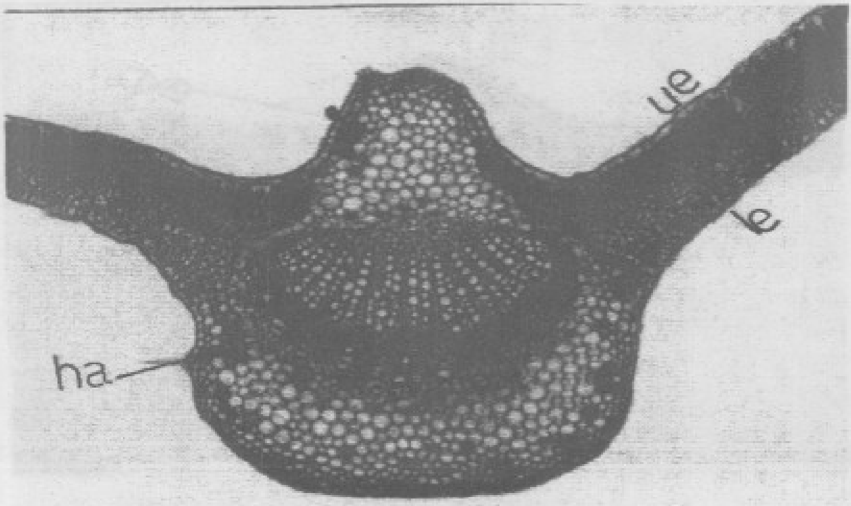


Fig. (8 cont.). Hybrid Giza 91 x Suvin. No., reverse oriented bundles.

b

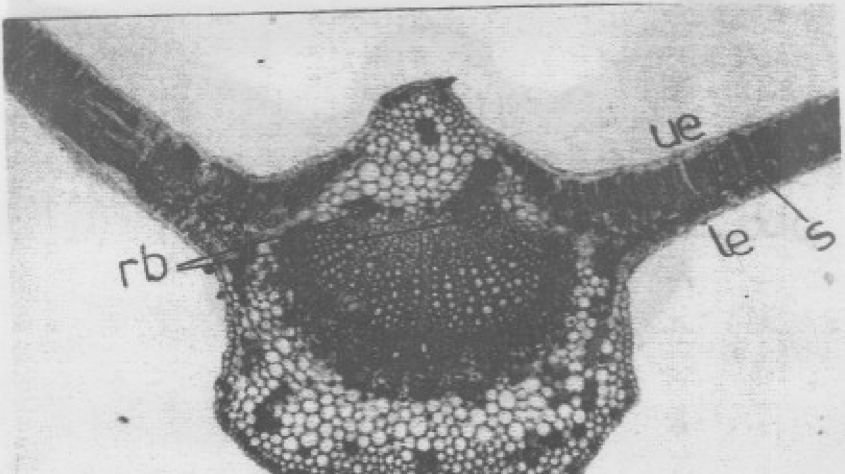
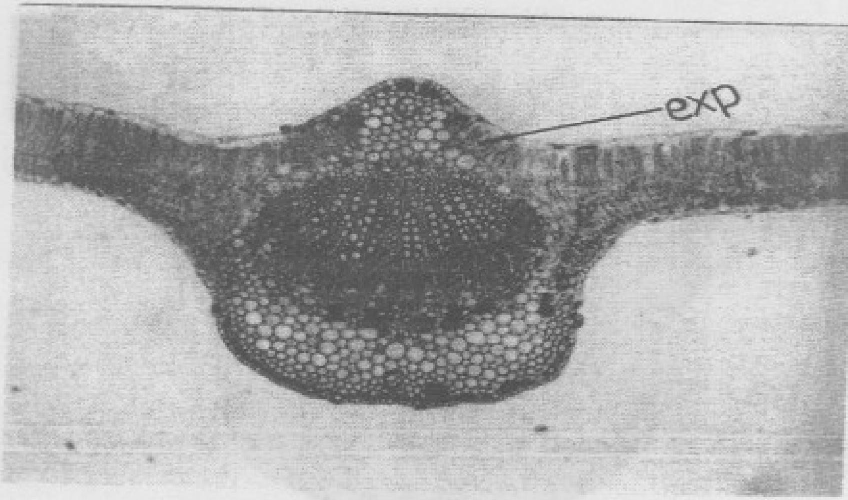


Fig. (9). Cultivar Giza 88 with palisade tissue ¾ of the laminar thickness.
Notice: 2 reverse bundles

X 40

a



b

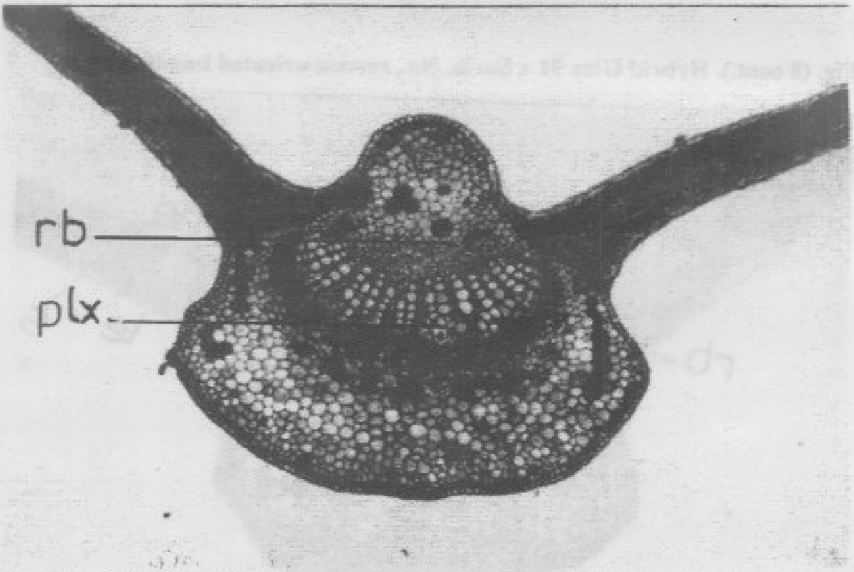


Fig. (10). a. T.S. of the Nectariless leaf with extended palisade tissue (exp) & no reverse bundles
b- Hybrid 70 x Nectariless.
Notice thick walled collenchyma (c), reverse bundles (rb) & poorly lignified secondary xylem vessels (plx) in (b)

X 40

Specific anatomical features were observed. Firstly, the extension of the palisade tissue, beneath the upper epidermis, to be adjacent to the adaxial collenchyma and parenchyma in the midvein. Most of studied genotypes exhibited palisade tissue extension except the parent Giza 91 (Fig. 8) & its crosses with Suvin and Frego bract (Fig. 8 cont.). Secondly, the presence of one or two small reverse collateral bundles, phloem towards the adaxial side, adjacent or separated from the main largest one. Genotypes of the species *Hirsutum* (Figs. 10 a and 11 b) as well as Giza 70 (Fig. 11 a), their blades were free of this character. Reverse oriented bundles were noted in most of F_1 crosses even in cases resulting from parents-free of this character, e.g. crosses of Giza 70 with both Nectariless & Okra leaf (Figs. 10 b & 11 c.). This may be attributed to complementary or modified genes in parental genotype(s) resulted in the appearance of such character. No explanation could be given to the presence of the reverse oriented bundles.

Although, they varied morphologically (Fig.1), no detectable differences were noted between the structural anatomy of Okra-leaf blades & Nectariless with those of the other parental genotypes. This is true also concerning the crosses including both lines. Generally, the upland cotton lines showed resemblance in their anatomical structure, as their petioles exhibited the first type with completely separated vascular bundles. Their leaves exhibited the extension of palisade tissue towards the midvein. The midrib is free of small reverse oriented collateral bundles (Figs. 10 a & 11 b).

From the previous anatomical results, it is worthy to conclude that the differences recorded between the parental genotypes were wider than those between the F_1 hybrids. This is in agreement with the results obtained by Harb *et al.* (2006). He estimated that the genetic relationship between the parental varieties were larger than its in F_1 generation by using cluster analysis method. He reported that the parental genotypes were distinct to two clusters while F_1 were not distinct to determined cluster.

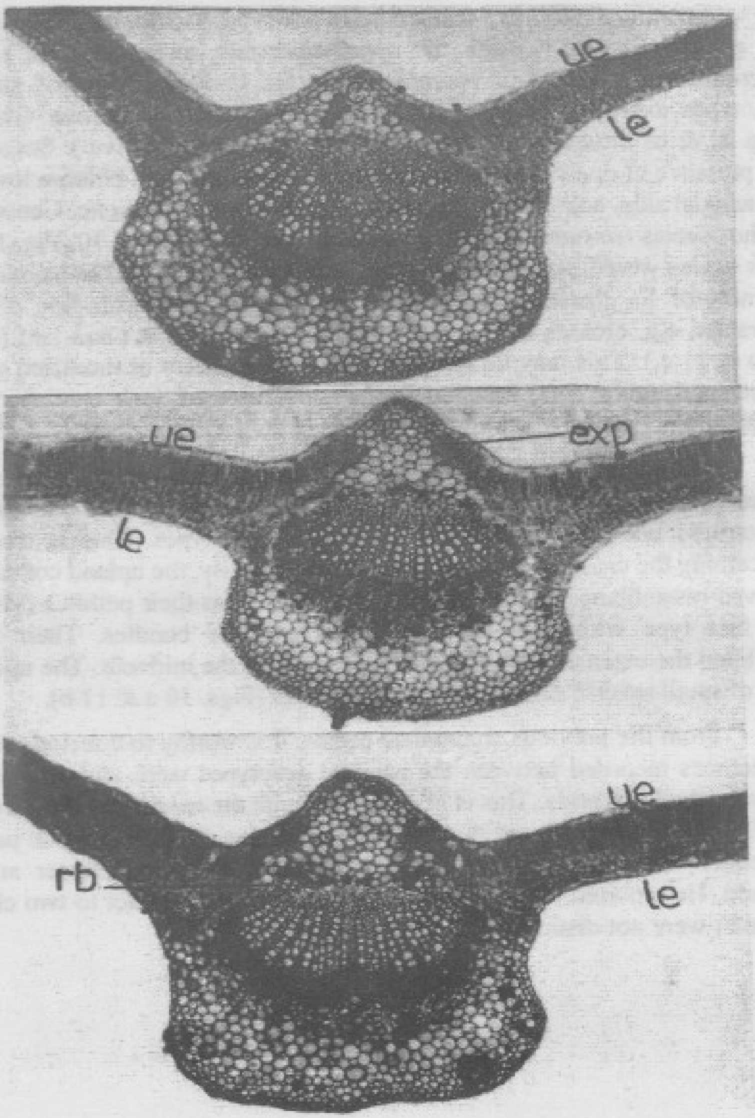


Fig. (11). a- Cultivar Giza 70.
b- Line Okra leaf
c- Hybrid Giza 70 x Okra leaf
Notice: no reverse oriented bundles in a & b and the presence of them in c.
X 40

REFERENCES

Abo-Sen, Z.F. (1995). Genetic studies on some plant characteristics related to aphid resistance in cotton. Ph.D. Thesis, Fac. Agric. Zagazig Univ.

Chee, P., X. Draye, C.X. Jiang, L. Decanini, T.A. Delmonte, R. Bredhauer, C.W. Smith and A.H,. Paterson (2005). Molecular dissension of inter-specific variation between *Gossypium hirsutum* and *Gossypium barbadense* (cotton) by a backcross-self approach: I. Fiber elongation. Theor. Appl. Genet. 111 (4): 757-763.

Davis, D.D. (1974). Synthesis of commercial F_1 hybrids in cotton. I. Genetic control of vegetative reproductive vigor in *Gossypium hirsutum* L. x *G. barbadense* L. crosses. Crop Sci. 14: 745-749.

Davis, D.D. (1978). Hybrids cotton: specific problems and potentials. Adv. Agron. 30: 129-157.

Davis, D.D. (1979a). Yield and fiber properties of selected F1 hybrids. P. 71-72. Proc. Beltwide Cotton prod. Res. Conf. Phoenix, Ariz.

Davis, D.D. (1979b). Synthesis of commercial F_1 hybrids in cotton II. Long, strong-fibered *G. hirsutum* L. x *G. barbadense* L. hybrids with superior agronomic properties. Crop Sci. 19: 115-116.

Davis, D.D. and A.P. Palomo (1980). Yield stability of interspecific hybrids, p. 81-82. Proc. Beltwide Cotton Prod. Res. Conf., St Louis, Mo.

Anonymous (2005) FAS. October. World Cotton Supply, Use and Trade, USDA, Foreign Agricultural Service, Washington, DC.

Gunaseelan, T. and R. Kirshnaswami (1987). Association of some polygenic characters with leaf morphology in inter racial crosses of *G. hirustum* L. Cotton et Fibers Tropicals, 42 (2): 127-131.

Harb, R.K., T.A. El-Feki and Aziza M. Sultan (2006). Genetic parameters and multivariate analysis for morphological and some boll anatomical traits of intra and inter-specific crosses of cotton. Ann. Agric. Sci., Ain Shams Univ., 51 (2): 385-399.

Hayward, H.E. (1938). The structure of economic plants, Macmillan New York.

Kakani, V.G., K.R. Reddy, D. Zhao and A.R. Mohammed (2003). Effects of ultraviolet B radiation on cotton (*Gossypium hirsutum* L.) morphology and anatomy. Ann. Bot. Comp. 91: 817-826.

Lu, Z., J. Chen, R.G. Percy and E. Zeiger (1997). Photosynthetic rate, stomatal conductance and leaf area in two cotton species (*Gossypium barbadense* and *Gossypium hirsutum*) and their relation with heat resistance and yield. Aust. J. Plant Physiol. 24 (5): 693-700.

Max, M.S. (2004). Genetic polymorphism for insect resistance attributes in some cotton genotypes. M. Sc. Thesis, Fac. Agric. Zagazig Univ.

Sass, J.E. (1961). Botanical Microtechnique (3rd Edit) Iowa State University Press Ames, 228 pp.

Senft, D. (1986). Bollworms find Okra-leaf cotton less tasty. Agric. Res., USA., 34 (3): 1.

Ulloa, M. (2006). Heritability and correlation of agronomic and fiber traits in an Okra-leaf upland cotton population. Crop Sci. 46: 1508-1514.

Willey, R.L. (1971). Microtechniques: A :laboratory Guide MacMillan Publishing Co., Inc., New York, 99 pp.

Wise, R.R., G.F. Sassenrath-Cole and R.G. Percy (2000). A comparison of leaf anatomy, in field grown *Gpossypium hirsutum* and *G. barbadense*., Ann. Bot. 86 (4): 731-738.

الخصائص المورفولوجية والتشريحية لبعض هجن القطن الصنفية والنوعية وآبائها

رمضان قرنى حرب [1]-سوسن محمود أبو العلا أبو طالب[1]-عزيزة محمد محمد سلطان[2]

١- قسم النبات الزراعى-كلية الزراعة-جامعة القاهرة-جيزة-مصر

٢- معهد بحوث القطن-مركز البحوث الزراعية-جيزة-مصر

أجريت هذه الدراسة فى مركز البحوث الزراعية خلال الأعوام ٢٠٠٢، ٢٠٠٣، ٢٠٠٤ لدراسة بعض الصفات المورفولوجية والتشريحية لثمانية آباء تتبع الجنس *Gossypium* . تضمنت الدراسة خمسة من الآباء التابعة للقطن المصرى *G. barbadense* وهى جيزة ٩١و ٩٠ و ٧٠ و ٨٨ وكذلك الصنف سيوفن والثلاثة التابعة للقطن الأمريكى *G. hirsutum* هى (Frego bract, Okra leaf & Nectariless).

أوضحت النتائج تفوق القطن المصرى عن القطن الأمريكي بالنسبة لصفة طول وسمك الساق الرئيسى وكذلك سمك الورقة. سجلت السلالتين Okra leaf & Nectariless أعلى قيم لكل من صفتى دليل التفصيص وشكل فص الورقة الأوسط. اختلف شكل الورقة فى كلاهما مورفولوجياً حيث تميزت أوراقهما بحدة التفصيص ونقص عرض الفصوص مقارنة بالأوراق العريضة فى بقية الآباء. أوضحت الدراسة عدم اختلاف كلا النمطين تشريحياً. تميزت النباتات الناتجة من التهجين بين السلالة Okra leaf والآباء المصرية بوجود أوراق حادة التفصيص كما فى السلالة Okra leaf . سجل الصنف جيزة ٩٠ وكل الهجن الناتجة عنه أعلى قيم لطول الغدة الورقية. أوضحت الدراسة المورفولوجية تفوق معظم الهجن النوعية عن تلك الصنفية وعن الآباء المستخدمة مم يفسر بقوة الهجين. أوضحت الدراسة اختلافات تشريحية أوسع ما بين الآباء عما هو موجود ما بين الهجن الناتجة وبخاصة بالنسبة للتركيب التشريحى للعنق حيث أوضحت قطاعات عنق الورقة المتوسطة على الساق الرئيسى ثلاثة تراكيب تشريحية مختلفة، تميزت أعناق النمط الأول بوجود حزم منفصلة عن بعضها تماماً بخلايا برانشيمية. واحتواء منطقة القشرة على خلايا كولنشيمية ذات جدر سميكة

بالإضافة الى اتساع منطقة القشرة وضيق منطقة النخاع وذلك كما فى الصنف جيزة ٨٨ وكذلك الثلاثة سلالات التابعة للقطن الأمريكي. تميزت أعناق الأصناف المصرية جيزة ٩١، ٧٠ وسيوفن بوجود اسطوانة وعائية شبه تامة الاتصال ، قشرة ضيقة ومنطقة نخاع أوسع مقارنة بالنمط الأول. لوحظ النمو الثانوى والناتج عن نشاط الكامبيوم البين حزمى (النمط الثانى) فى معظم الهجن الناتجة مما يفسر بظاهرة قوة الهجين. أظهرت القطاعات العرضية فى الهجن أن معظمها ذات شكل شبه مضلع. تميزت منطقة القشرة فى عنق الصنف جيزة ٩٠ بوجود خلايا كولنشيمية هى الاسمك جدراً على الإطلاق وتميزت تلك الخلايا بامتدادها فى الاتجاه القطرى للقطاع العرضى مع وجود خلايا برانشيمية ذات جدر سميكة تفصل ما بين الحزم الوعائية.

أوضحت القطاعات العرضية فى أوراق التراكيب تحت الدراسة وجود صفتين مميزتين:

أولهما امتداد النسيج العمادى تحت البشرة العليا للنصل حتى يصبح ملاصماً للكولنشيمة الموجودة بأعلى العرق الوسطى وقد ظهرت هذه الصفة فى معظم التراكيب التى تم دراستها وخلا منها الصنف جيزة ٩١ وهجنه مع كل من سيوفن ، Frego bract.

أما الصفة الآخرى فهى وجود حزمة أو حزمتين وعائيتين جانبيتين معكوستى الوضع (حيث اللحاء ناحية السطح العلوى للورقة) وتقعان ناحية السطح العلوى للورقة، وقد تميز الأب جيزة ٧٠ وكل السلالات التابعة للقطن الأمريكي بعدم وجود تلك الصفة.

احتوى العرق الوسطى لكل التراكيب المستخدمة على حزمة وعائية نصف مركزية الخشب حيث يحيط نسيج اللحاء جزئياً بصفوف من أوعية الخشب. أظهرت القطاعات مدى التشابه بين السلالات التابعة للنوع *hirsutum* حيث تشابهت أعناقها فى احتوائها على النمط ذو الحزم الوعائية المنفصلة وكذلك أظهرت أوراقها امتداد النسيج العمادى وعدم وجود الحزم الصغيرة المقلوبة الوضع.

أوضحت القطاعات العرضية وجود خصائص مميزة بكل من العنق والنصل حيث احتويا على ما يسمى بالخلايا الغريبة المختلفة فى الحجم ودرجة اللون وكثافة تواجدها بين الأنماط المذكورة. كما احتوت أيضاً قطاعات العنق والنصل على بللورات نجمية، يختلف نظام توزيعها تبعاً لأنماط الأعناق التى فحصت.

مجلد المؤتمر الخامس لتربيه النبات – الجيزه ٢٧ مايو ٢٠٠٧

المجله المصريه لتربية النبات ١١(٢): ٦٩٣-٧١٥ (عدد خاص)