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BOTANICAL STUDIES ON SOME GENERA OF MIMOSACEAE AND CAESALPINIACEAE

III- Morphological and anatomical features of sapling

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ABSTRACT

Morphological characters and anatomical investigations were used in this study as a taxonomic evidences to evaluate the relationships between 4 species representing 3 genera of Mimosaceae and Caesalpiniaceae. These species were; *Leucaena leucocephala* (Lam.) De Wit., *Bauhinia variegata* L., *Bauhinia alba* Buch-Ham and *Delonix regia* Bojor ex Hook. Morphological results indicated that, both species of genus *Bauhinia* were exceeded in most studied traits of the axis (stem and root) than other genera, where *D. regia* exhibited increment for most leaf characteristics (except leaves no.) over the other species. *L. leucocephala* showed remote values for most morphological traits than other genera.

Anatomical studies confirmed differences between the 4 species in most studied traits. Increase in plant height was mainly related to number of cells more than to lengths. Stem diameter increasing was mainly attributed to the increasing in secondary xylem thickness more than other tissues.

INTRODUCTION

Legumes have been classified as one family; Leguminosae or Fabaceae on the basis of the entomophilous flower; single superior carpel, generally compound (rarely simple) leaves, and the unique fruit type (the legume) which normally splits along two sutures or it may remain indehiscent (Cullen, 1997). As a single family, it was then divided into three sub families based mainly on floral morphology (Rendle, 1959 and Lawrence, 1967). It is felt by many that these three groups; Papilionoidae, Mimosoidae and Caesalpiniodae, are more consistent with the customary concepts of families of flowering plants (Hardian *et al.*, 2001), as shown in table (1) designed after work published by Cronquist 1981, Heywood, 1993 and Pandey, 2004.

However, the phylogenetic relationships are still not well resolved, and with additional investigation, it may be appropriate to again combine the three groups into one family (Judd *et al.*, 1999).

Legumes consist of 642 genera and about 17275 species of trees, shrubs, lianas and herbs widely scattered throughout the world. They are second only to the grasses in their economic importance. Among the herbaceous species are such important forage and food plants as clover, vetch, alfalfa, bean, peanut, resins, dyes and drugs. Several are important as crop weeds or poisonous to livestock. Legumes often have root nodules containing nitrogen fixing bacteria of great value in enriching the soil (Hardian *et al.*, 2001 and Spichiger *et al.*, 2002).

Table 1: Classification of the 3 leguminaceous families based on distinctive leaves and floral characteristics

Family	Leaves	Floral symmetry	Petals	Stamens
Mimosaceae	Bipinnate	Actinomorphic	Valvate connate	Much longer than petals (4-10 to many)
Caesalpiniaceae	Pinnate, bipinnate or unifoliate	Zygomorphic	Imbricate; upper petal inside laterals, 2 lower ones separate	10 with same length or shorter than petal, separate
Fabaceae	Pinnate or unifoliate	Zygomorphic	Imbricate; upper petal (standard) outside laterals (wings), 2 lower ones fused (keel)	10 with same length or shorter than petals, enclosed within keel; fused into filament tube, or 9 fused and 1 separate

Caesalpiniaceae:

This family has 153 genera and 2175 species of shrubs, lianas and herbs. Caesalpiniaceae are distinctive in having generally "Zygomorphic flowers" with usually 5 or 10 distinct stamens and a corolla (imbricate in bud) with typically 5 distinct petals (sometimes reduced or lacking), the posterior, median, petal inner to (overlapped by) the two lateral petals (Purseglove, 1977 and Simpson, 2006).

Plants of Caesalpiniaceae have many economic uses; pod contain about 40-45% tannin which use in manufacturing black ink, wood contains red dye, leaf extracts used as fuel or manure, the pod powder is considered a stringent and used as antiperiodic tonic and in treatment of bleeding piles, and the plants are valuable for pastures, hay and soil erosion control and improvement, and for increase soil fertility by adding nitrogen and organic matter (Duke, 1981). The family represented in this study by *Leucaena leucocephala*.

Mimosaceae:

This family has 64 genera and about 2950 species. Spiny trees and shrubs characteristic of desert and dry prairie landscapes. Mimosaceae are distinctive in having "Actinomorphic flowers" with a corolla of typically 5, distinct or basally fused petals (valvate in bud), a hypanthium sometimes present and usually numerous, distinct or basally fused stamens (Spichiger *et al.*, 2002).

Leaves and pods of the plant of Mimosaceae are edible and are most important to the existence of many species of wildlife. The wood is hard and durable and is used in outdoor cooking for its aromatic smoke. Although mainly entomophilous and an important source of honey, the wind blown pollen is allergenic. Many species are used extensively for such products as gums, tanning, wood, fuel, food, forage ,dyes, perfumes and as cultivated ornamentals (Allen and Allen, 1981). The family represented in this study by three species, namely; *Bauhinia variegata*, *B. alba* and *Delonix regia*.

MATERIALS AND METHODS

In this study, 4 species belong to two families of Fabales were studied as shown in Table (2), which designed after work published by Quattrocchi, 2000 and Bisby, 2006. These species were *Bauhinia variegata*, *B. alba* and

Delonix regia representing Caesalpiniaceae family, in addition to *Leucaena leucocephala* of Mimosaceae family. The study was carried out during seasons 2005 and 2006 on plants collected from the experimental field of Botany Department, Faculty of Agriculture, Cairo University, Giza.

Because there are some doubts about the identification of these studied species at the certain stage of juvenility, the present study was concentrated on the morphological and anatomical features of these saplings (7 months age).

Seeds of these species were personally collected, a year before sawing, from existing trees at Faculty of Agriculture, Cairo University, and Orman Botanical Garden, Ministry of Agriculture , Giza, Egypt. Seeds were sown after pretreated with boiled water to break seed dormancy (Baskin and Baskin, 1998). Sowing date was on March, of each season, on trays with numerous holes filled with plain sand. One month later, seedlings were transplanted to 30 cm pots, and the experimental design was Randomized Complete Block with 4 replicates each with 12 seedlings.

Morphological features were measured using meter ruler, vernier (clipper) and portable area meter model LI-3050 made in USA. Samples for the anatomical study were taken from roots (at primary and secondary growth stages), stems (apical meristem, median and terminal internodes), leaf petiole and lamina. All specimens were killed and fixed for at least 48 hours in F.A.A. (10 ml formalin, 5 ml glacial acetic acid, 50 ml alcohol 95%, 35 ml distilled water), then washed in 50% ethyl alcohol and dehydrated in a normal butyl alcohol series before being embedded in paraffin wax (Melting point 52-54 ºC). Transverse and longitudinal sections (20µ-thick) were cut using a rotary microtome, then double stained with Safranin/Fast green in successive to obtain cell walls/cytoplasm contradicting colouring, and mounted in Canada balsam (Nassar and Sahhar, 1998). Sections were examined; counts and the measurements of different tissues were recorded using a micrometer eye piece and micrometer stage. The average of 5 readings was calculated. Photographs of sections were taken using Microscope Olympus AX70 made in Japan.

Table (2): Botanical, English and Synonyms of the studied species.

Genera	Botanical names	English names	Synonyms
Bauhinia	*B. variegata* L.	Mountain ebony or Butterfly tree	*B. variegata* L.
	B. alba Buch-Ham.	White orchid tree	*B. variegata* var. *candida* Roxbg.
Delonix	*D. regia* Bojor ex Hook	Peacock flower	*Poinciana regia* Boj.
Leucaena	*L. leucocephala* Lam. De Wit.	Leadtree	*L. glauca* (L.) Benth.

RESULTS AND DISCUSSION

I- Morphological results:

1- Plant height:

Data in Table (3) clear that, plant height of the two species of genus *Bauhinia* was quite similar by recording 39.96 and 40.75 cm for *B. variegata* and *B. alba*, respectively. Whereas, *L. leucocephala* exhibited the lowest plant height value; 24.64 cm. On the other hand, plant height of *D. regia*; 28.75 cm was intermediate between those of *Bauhinia* and *Leucaena* (Fig.1).

The highest value of plant height of *B. alba* exceeded over all other species by 65.38%, 41.74% and 1.98% for *L. Leucocephala*, *D. regia* and *B. variegata*, respectively.

2- Number of internodes on the main stem:

It is clear from data in Table (3) that, the species represented genera *Bauhinia* and *Leucaena* exhibited nearly the same values of internodes number, which narrowerly ranged from 12.75 for *L. leucocephala* to 14.29 for *B. variegata* and 13.29 for *B. alba*. The lowest number of internodes was 8.75 in *D. regia*.

The highest value was recorded in *B. variegata* over all species by 63.31%, 12.08% and 7.52% for *D. regia*, *L. leucocephala* and *B. alba*, respectively.

3- Length of internode on the main stem:

It is obvious from data in Table (3) that, both species of genus *Bauhinia* and *D. regia* were nearly equal, by recording 2.81, 3.12 and 3.32 cm in *B. variegata*, *B. alba* and *D. regia*, respectively. Whereas, *L. leucocephala* exhibited the lowest length of internode; 1.93 cm.

The tallest internode was verified in *D. regia* over all studied species by 72.02%, 24.29% and 6.41% for *L. leucocephala*, *B. variegata* and *B. alba*, respectively.

Number of internodes and average length of internode were shared in increment of the plant height. Since the number of internodes was higher in *B. variegata* than *B. alba*, whereas the length of internode of *B. alba* exceeded that of the *B. variegata*. This explains that plant height related to average internode length (11.03% above *B. variegata*) more than number of internodes, as shown in Table (3). The same trend was observed between *D. regia* and *L. leucocephala*, where the average length of internode shared in increasing plant height more than number of internodes. So, average length of internode was responsible for increasing the plant height of *B. alba* and *D. regia* over *B. variegata* and *L. leucocephala*, respectively.

Table (3): Measurements and counts of external morphological features of the stem and root of the four studied species.

Characters / Species		*B. variegata*	*B. alba*	*D. regia*	*L. leucocephala*
1. Plant height (cm)		39.96	40.75	28.75	24.64
2. Number of internodes on the main stem		14.29	13.29	8.75	12.75
3. Length of internode on the main stem (cm)		2.81	3.12	3.32	1.93
4.Stem thickness (mm)	**Median internode**	2.5	2.1	2.3	1.3
	Basal internode	6.0	4.5	4.5	2.5
5. Root length (cm)		40.08	41.5	12.08	16.04

Fig.(1): A photograph of the external morphological features of the four studied species.

4- Stem thickness:

It is obvious from Table (3) that, both basal and median internodes of *B. variegata* exhibited the highest values (6 mm and 2.5 mm, respectively) in thickness over all species. The lowest value was recoreded in *L. leucocephala*; 2.5 mm and 1.3 mm in the same order. Whereas, *B. alba* and *D. regia* were similar in thickness of basal internode (4.5 mm), the median internode of *D. regia* was thicker (2.3 mm) than *B. alba* (2.1 mm).

Generally, it is clear that, *B. variegata* has the thickest stem (both basal and median internodes). The basal stem thickness of *B. variegata* was increased by 140%, 33.33% and 33.33% over *L. leucocephala*, *B. alba* and *D. regia*, respectively. Also, *B. variegata* median stem thickness showed an increment by 92.3%, 19.05% and 8.7% over *L. leucocephala*, *B. alba* and *D. regia*, respectively.

It could be concluded that, thickness of median internode go side by side with that of the basal internode, where *B. variegata* exhibited highest records than others, and *L. leucocephala* records the lowest value.

5- Root length:

Data in Table (3) indicated that, the root length of two species of *Bauhinia* was nearly the same; 40.08 cm and 41.50 cm in *B. variegata* and *B. alba*, respectively. The root length of *D. regia* was the shortest, which measured 12.08 cm. Whereas, *L. leucocephala* root was intermediate in length by recording 16.04 cm (Fig.1).

The tallest root exhibited in *B. alba*, which enhanced above all other species (*D. regia*, *L. leucocephala* and *B. variegata*) by 243.54%, 158.73% and 3.54%, respectively.

It is clear that, root length was taller in species of genus *Bauhinia* than *D. regia* and *L. leucocephala*, and that may be correlated with plant height.

6- Phyllotaxy of leaves:

Data presented in Table (4) and Fig. (1) indicated that most studied species distinguished by distichous alternate leaves (180˚), except *D. regia* which showed spiral alternating leaves (120˚) along its main stem.

7- Leaves number on the main stem:

As a reflection to number of internode (where a leaf per node is systemizing the stem appearance), the same trend of intrnode number between species was noticed also for leaves number.

It is worthy to mention that, because of its deciduous habit, *D. regia* showed the least number of leaves at the beginning of fall season.

Table (4): Measurements and counts of external morphological features of the leaves of the four studied species.

Species / Characters	***B. variegata***	***B. alba***	***D. regia***	***L. leucocephala***
1. Phyllotaxy of leaves	180˚ Distichous alternate	180˚	120˚ Spirally alternating	180˚ Distichous alternate
2. Leaves number on the main stem	14.29	13.29	8.75	12.75
3. leaflets number/leaf	-	-	7.58	4.33
4. Pinna number/leaflet	-	-	20.33	16.00
5. Total Leaves area (cm^2)	517.72	309.78	723.45	221.34
6. Average leaf area (cm^2)	36.23	23.31	82.68	17.36
7. Total leaf length (cm)	7.38	6.06	12.10	4.38
8. Leaf petiole length (cm)	2.04	2.19	4.96	2.40

8- leaflets number per leaf:

Both species; *D. regia* and *L. leucocephala* could be distinguished from the other studied species of *Bauhinia* by dividing of their leaves (compound leaves), and it is clear from Table (4) that leaflets of *D. regia* exceeded those of *L. leucocephala* in number by 75.06% (7.58 leaflets and 4.33 leaflets for *D. regia* and *L. leucocephala*, respectively).

9- Pinna number per leaflet:

Compound bipinnate leaves of *D. regia* and *L. leucocephala* showed variation in number of pinna (20.33 and 16.00 pinna in *D. regia* and *L. leucocephala*, respectively). So, it is clear that *D. regia* excel over *L. leucocephala* for pinna number by 27.06 %. This match the same trend for leaflets number.

10- Total leaves area:

According to data in Table (4) it is evident that, total leaves area recorded the highest value in *D. regia* (723.45 cm^2) followed by *B. variegata* (517.72 cm^2), whereas the lowest values exhibited in *B. alba* and *L. leucocephala* (309.78 cm^2 and 221.34 cm^2, respectively).

D. regia exceeded by 226.25%, 133.54% and 39.74% the other studied species; *L. leucocephala*, *B. alba* and *B. variegata*, respectively.

11- Average leaf area:

Data presented in Table (4) indicated that, *D. regia* showed the largest average leaf area (82.68 cm^2), whereas, *L. leucocephala* showed the lowest value (17.36 cm^2) for this trait, and both species of *Bauhinia* exhibited intermediate values; 36.23 cm^2 and 23.31 cm^2 for *B. variegata* and *B. alba*, respectively.

So, it could stated that *D. regia* (as so in the forementioned character) exceeded *L. leucocephala*, *B. alba* and *B. variegata* in average leaf area by 376.27%, 254.70% and 128.21%, respectively.

12- Total leaf length:

D. regia showed the maximum leaf length (12.10 cm) over all studied species, whereas, *L. leucocephala* showed the minimum value (4.38 cm), and both *Bauhinia* species occupied intermediate posts; 7.38 cm and 6.06 cm for *B. variegata* and *B. alba*, respectively.

It is clear that *D. regia* excel all other species by 176.26%, 99.76% and 63.96 % for *L. leucocephala*, *B. a*lba and *B. variegata*, respectively.

So, it could be concluded that leaf length contributed in the size of leaf or expansion of leaf area.

13- Leaf petiole length:

It is evident from data shown in Table (4) that, *D. regia* has tallest leaf petiole (4.96 cm) over all other studied species, whereas, both species of *Bauhinia* are quite similar with their lowest values (2.04 cm and 2.19 cm for *B. variegata* and *B. alba*, respectively). *L. leucocephala* had intermediate petiole length (2.40 cm) biased toward *Bauhinia* species.

It is clear that *D. regia* leaf petiole length exceed *B. variegata*, *B. alba* and *L. leucocephala* by 143.14%, 126.48 % and 106.67%, respectively.

II- Anatomical results:

1- The root:

A- Primary growth stage:

Data presented in Table (5) and Fig. (2) confirmed that epiblem thickness was equal at all species under study. Whereas, according to cortex thickness, *D. regia* recorded the highest thickness (488 µ) over all species, and minimal thickness (375 µ) exhibited in *B. variegata*. Also, *D. regia* kept the highest increase in cortex layers number (14 layers), but the lowest number (9 layers) recorded in *L. leucocephala*. Dimensions of vascular cylinder for *D. regia* recorded highest values (1050 x 975 µ) compared with other species, whereas the lowest values noticed in *B. variegata* (525x450µ). Number of vascular bundles was equal in all species under studied (4 vascular bundles). Both pith dimensions and cross section dimensions of primary root for *D. regia* exhibited the highest values (638 x 600 µ and 2025 x 1875 µ, respectively) over all studied species, whereas the lowest values (150 x 150 µ and 1350 x 1313 µ in the same order) were verified in *B. variegata*.

It is obvious from data mentioned before that, increment in primary root diameter is related to the increase in dimensions of both pith and vascular cylinder, in addition to the increase of cortex thickness and number of layers. On the other hand, the decrease occurred in dimensions of both pith and vascular cylinder shared to the decrease in diameter of primary root.

Table (5): Measurements (µ) and counts of different tissues of the four studied species (average of 5 readings).

Species / Characters	*B. variegata*	*B. alba*	*D. regia*	*L. leucocephala*
A- Root at primary growth stage:				
1. Epiblem thick.	19	19	19	19
2. Cortex thick.	375	450	488	450
3.Cortex layers no.	12	13	14	9
4. Vascular cylinder dimensions	525x450	900x863	1050x975	638x600
5. Vascular bundles no.	4	4	4	4
6. Pith dimensions	150x150	488x488	638x600	338x338
7. Cross section dimensions	1350x1313	1875x1875	2025x1875	1538x1538
B- Root at secondary growth stage:				
1. Periderm thick.	75	38	75	94
2. Phloem thick.	225	188	188	188
3. Xylem cylinder dimensions	2925x2813	1388x1350	1425x1425	1575x1538
4. Cross section dimensions	3600x3488	1913x1875	2025x2025	2400x2363

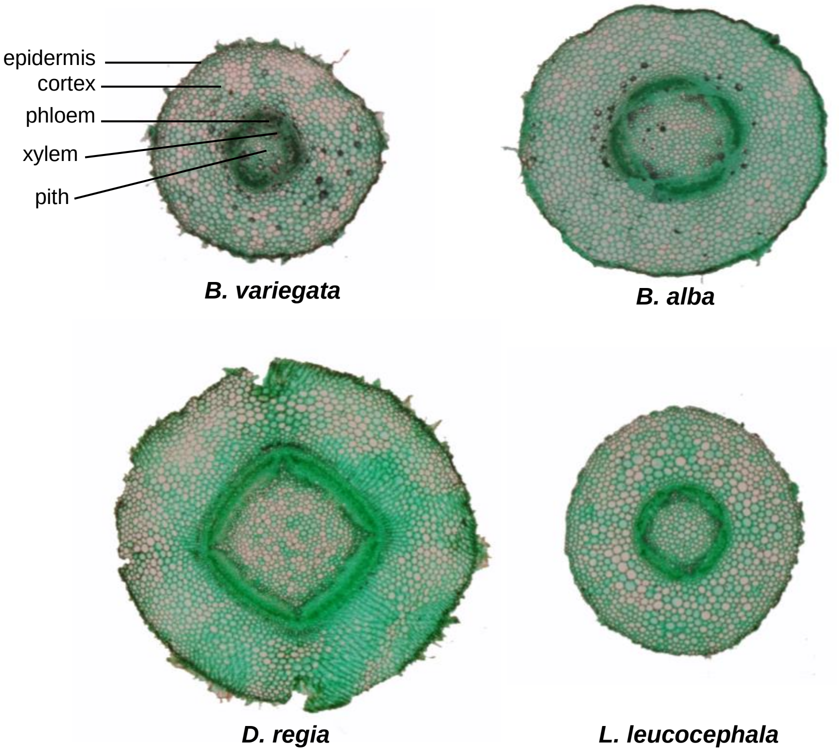


Fig. (2): Transverse sections of the main root at primary growth stage of the four studied species. (X= 17)

B- Secondary growth stage:

It is obvious from data in Table (5) and Fig. (3), that dimensions of both cross section and xylem cylinder for *B. variegata* recorded the highest values (3600 x 3488 µ and 2925 x 2813 µ, respectively) over all species under study, whereas the lowest values recorded in *B. alba* (1913 x 1875 µ and 1388 x 1350 µ, respectively). Periderm thickness of *L. leucocephala* exhibited the highest value (94 µ), whereas lowest value (38µ) verified in *B. alba*, where *B. veriegata* and *D. regia* recorded the same intermediate value (75 µ). According to phloem thickness, *B. variegata* recorded the only increase (225 µ) over all other studied species which exhibited the same value (188 µ).

These results confirmed that, the increase of secondary root diameter was mainly due to xylem cylinder dimensions, which exhibited sharp increase than primary growth. On the other hand, reduction occurred in cross section dimensions is mainly due to the decrease in xylem cylinder dimensions and periderm thickness.

2- Stem:

A- Longitudinal section of stem apical meristem:

As shown in Table (6) and Fig. (4), the dome height and width recorded the highest values (60 µ and 160 µ, respectively) for *D. regia*, whereas the lowest values exhibited in *L. leucocephala* (40 µ and 68 µ in the same order). On the other hand, highest value of tunica thickness was recorded for *L. leucocephala* (24 µ), whereas the lowest value (12 µ) exhibited in *B. variegate.* Number of tunica layers was equal at all studied species.

B- Terminal internode:

It is clear from data in Table (6) and Fig. (5) that, dimensions of both terminal internode cross section and vascular cylinder recorded the highest values for *B. variegata* (1350x1350µ and 1320x1245µ, respectively), whereas lowest values exhibited in *B. alba* (1005 x 990 µ and 945 x 915 µ, respectively). Epidermis thickness exhibited equal values (15 µ) for all species under study, except for *D. regia* which recorded the lowest value (8 µ). Cortex thickness recorded high increase in *L. leucocephala* (90 µ) over all studied species, while *B. alba* exhibited the lowest one (45 µ). All species under study recorded equal values for cortex layers number (5 layers), except *L. leucocephala* which recorded the lowest number (4 layers). Thickness of fibers was equal in all species under study (30 µ) phloem thickness recorded highest value (60 µ) in *B. alba*, whereas other species exhibited low and equal values (45 µ) for this trait. *B. variegata* recorded highest value for xylem thickness (173 µ), whereas the lowest one (105µ) was verified in *B. alba*. Pith dimensions were high at *D. regia* (750 x 735 µ), but *B. alba* recorded the lowest value (555 x 525 µ).

The increment in cross section dimensions is related to increase in vascular cylinder dimensions; mainly xylem thickness. Whereas, the reason for reduction in dimensions of cross section of terminal internode is the

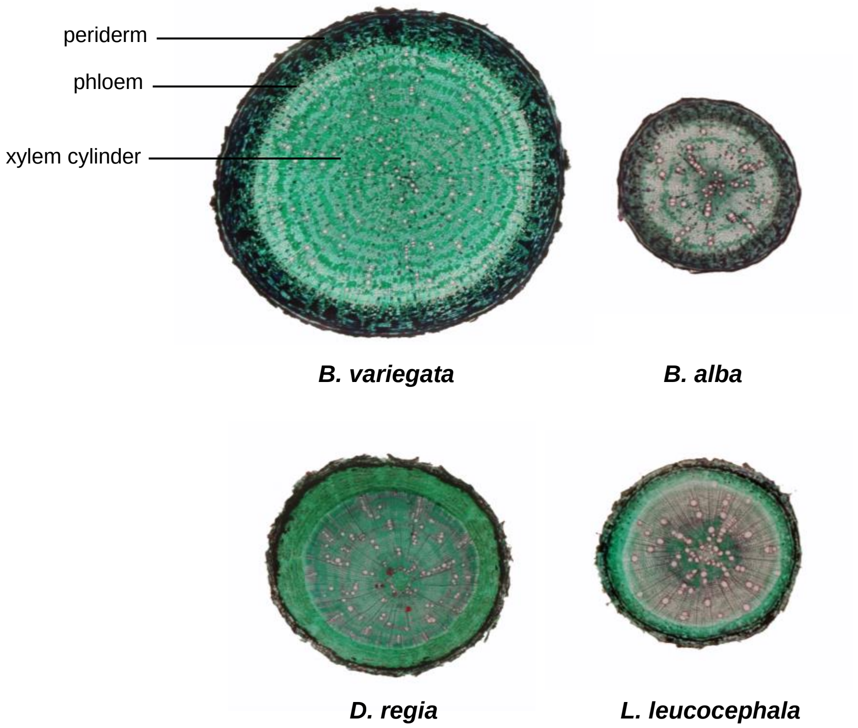


Fig. (3): Transverse sections of the main root at secondary growth stage of the four studied species. (X=17) decrease of vascular cylinder dimensions (mainly xylem thickness in addition to pith dimensions) and cortex thickness.

Table (6): Measurements (µ) and counts of different tissues of stem apical meristem and terminal internode of the main stem of the four studied species (average of 5 readings).

Species / Characters	*B. variegata*	*B. alba*	*D. regia*	*L. leucocephala*
A- Longitudinal section of stem apical meristem:				
1. Tunica thick.	12	16	20	24
2. Tunica layers no.	2	2	2	2
3. Dome height	48	56	60	40
4. Dome width	104	104	160	68
B- Cross section terminal internode:				
1. Epidermal thick.	15	15	8	15
2. Cortex thick.	75	45	75	90
3. Cortex layers no.	5	5	5	4
4. Fibers thick.	30	30	30	30
	(Fibers in circle surrounds vascular cylinder)			
5. Phloem thick.	45	60	45	45
6. Xylem thick.	173	105	135	120
7. Pith dimensions	720x705	555x525	750x735	735x735
8. Vascular cylinder dimensions	1320x1245	945x915	1170x1155	1125x1125
9. Cross section dimensions	1350x1350	1005x990	1320x1305	1245x1200

C- Median internode:

1- Cross section:

As shown in Table (7) and Fig. (6) it is clear that, periderm thickness was higher for *D. regia* (68 µ) over studied species, but *B. alba* showed lowest

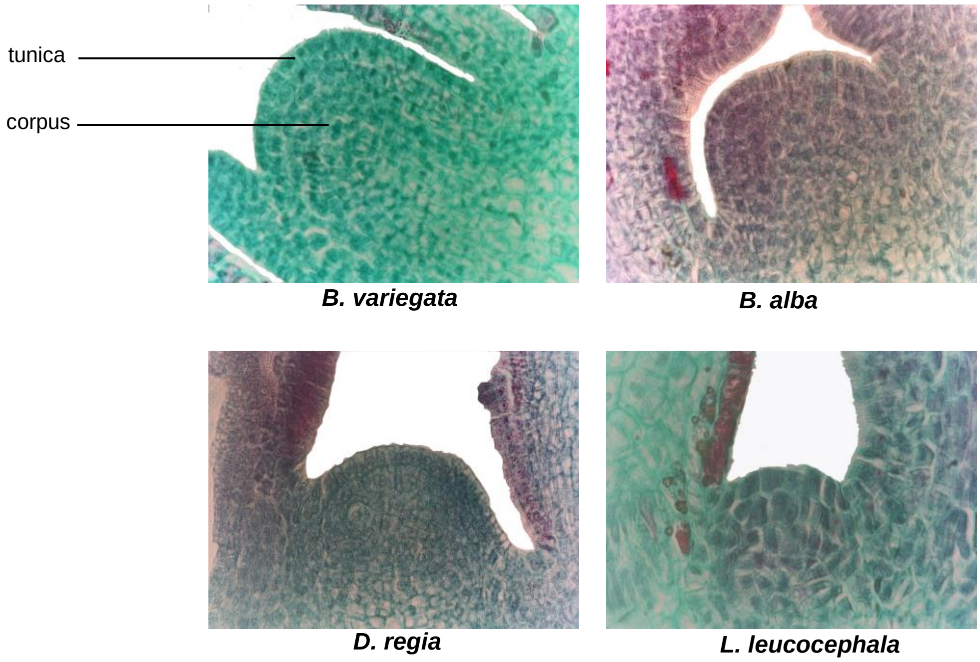


Fig. (4): Longitudinal sections of the stem apical meristem of the four studied species. (X= 430)

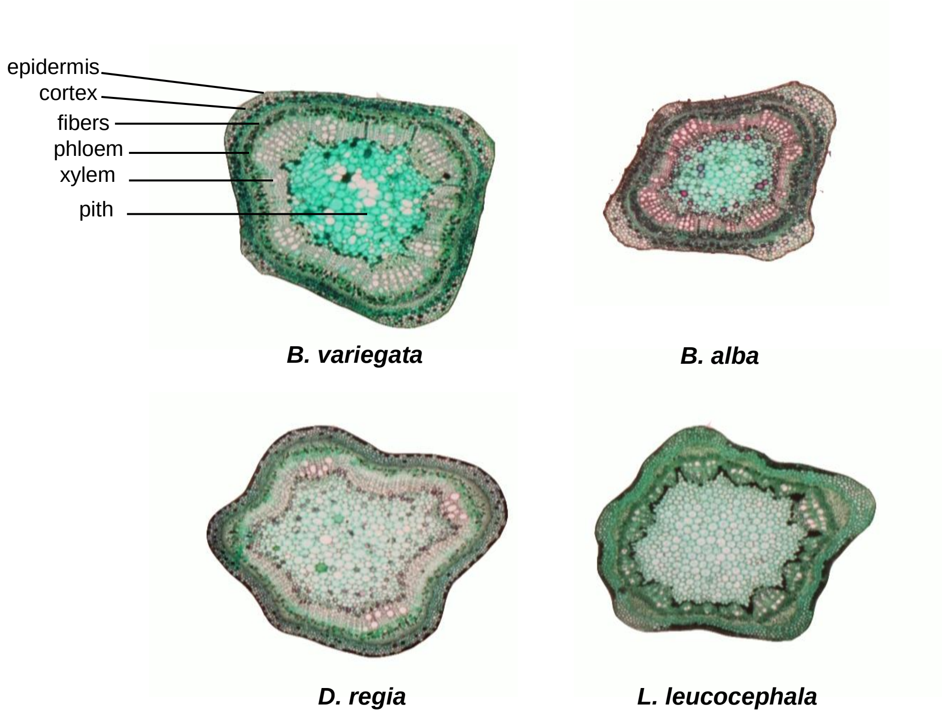


Fig. (5): Transverse sections on the terminal internode of the main stem of the four studied species. (X= 15.5) value (45 µ) for this trait. On the other hand, *D. regia* recorded the thinnest cortex remains (30 µ) equal to that of *L. leucocephala*, whereas *B. variegata* exhibited the highest value (90 µ) for this trait. The fibers form circle surrounded vascular cylinder, and recorded equal values for all studied species (30 µ), except *B. alba* which recorded the lowest thickness (23 µ).

According to phloem thickness, *B. variegata* recorded the highest increase (90 µ), while *B. alba* was the lowest (60 µ), whereas the rest of species exhibited equal and intermediate values (75 µ) for this trait. Both dimensions of median internode and xylem thickness were high for *D. regia* (2655 x 2580 µ and 750 µ, respectively), whereas the lowest cross section dimensions exhibited in *L. leucocephala* (1575 x 1395 µ), meanwhile, the thinnest xylem occurred in *B. alba* (240 µ). Pith dimensions exhibited the highest value for *B. variegata* (855 x 750 µ), but *L. leucocephala* recorded the lowest ones (405 x 405 µ). It is clear that the increase in median internode

Table (7): Measurements (µ) of different tissues of median internode of the main stem of the four studied species (average of 5 readings).

Species / Characters	***B. variegata***	***B. alba***	***D. regia***	***L. leucocephala***
A- Cross section of median internode:				
1. Periderm thick.	60	45	68	60
2. Cortex remains thick.	90	45	30	30
3. Fibers thick.	30	23	30	30
	(Fibers in circle surrounds vascular cylinder)			
4. Phloem thick.	90	60	75	75
5. Xylem thick.	300	240	750	300
6. Pith thick.	855x750	750x675	750x675	405x405
7. Cross section dimensions	2175x2145	1650x1575	2655x2580	1575x1395
B- Longitudinal section of median internode:				
1. Cortex cell length	30	15	38	45
2. Cortex cell width	26	15	23	15
3. Pith cell length	105	135	195	75
4. Pith cell width	45	38	45	105

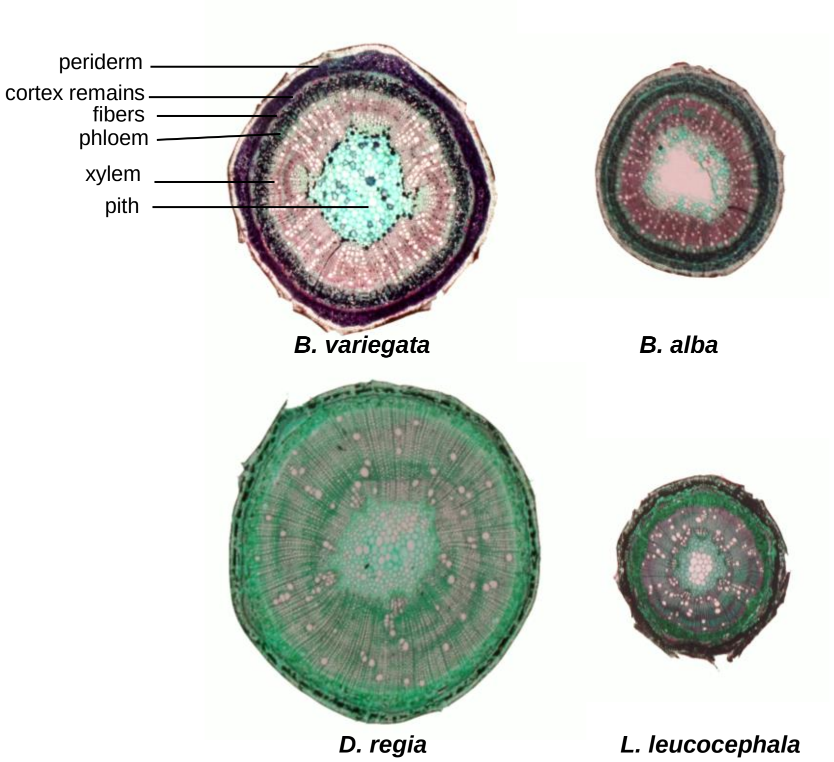


Fig. (6): Transverse sections on the median internode of the main stem of the four studied species. (X= 16.5) cross section dimensions related to increase in both xylem and periderm thickness. On the contrary, reduction in dimensions values of cross section mainly related to the decrease in pith dimensions more than other tissues.

2- Longitudinal section:

Data in Table (7) and Fig. (7) confirmed that *L. leucocephala* exhibited the highest length for cortex cell (45 µ), whereas the lowest one recorded for *B. alba* (15 µ). On the other hand, both of *L. leucocephala* and *B. alba* recorded the lowest values for cortex cell width (15 µ each), while the large width was verified in *B. variegata* (26 µ). According to length and width of pith cell, *L. leucocephala* exhibited the lowest length (75 µ) but the largest width (105 µ) for pith cell, also *D. regia* recorded the highest length of pith cell (195µ), where *B. alba* exhibited the lowest value (38 µ) for pith cell width.

From anatomical and morphological data previously represented in Tables (3,6 and 7) it could be indicated that, the increment in height for *B. alba* is related to increase in number of cortex cells and length of pith cells. On the other hand, the reduction of height for *L. leucocephala* mainly due to the decrease occurred in pith cell length more than cortex cell.

3- Leaf:

A- Lamina :

It could be from data presented in Table (8) and Fig. (8), mentioned that, *B. variegata* recorded the highest values for most characters under study, whereas both *D. regia* and *L. leucocephala* exhibited the lowest ones, where as *B. alba* recorded intermediate values for most studied characters. Collenchymatous tissue was investigated above and beneath midvein in *B. variegata* and *B. alba*, whereas for both *D. regia* and *L. leucocephala*, it was verified only at lower side of midrib.

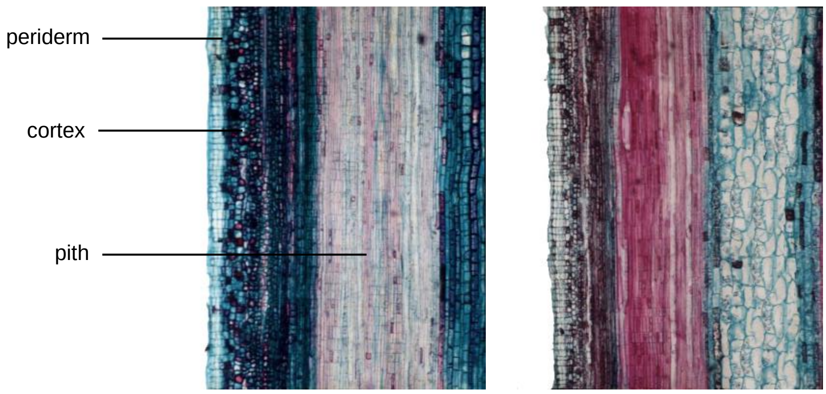
It could be concluded that, increment in lamina thickness is due to increase in spongy tissue more than in palisade tissue. Meanwhile, the increase in midrib thickness is related to increment in vascular bundle thickness; xylem, phloem and fiber thickness, and vise versa.

B- Leaf petiole :

Data showed in Table (8) and Fig. (9) confirmed that *D. regia* exhibited the highest values of most characters under study, whereas *B. alba* recorded the lowest values for most investigated characters. Pith existed only in *D. regia* leaf petiole.

It is clear from forementioned data that the increase in diameter of leaf petiole is related to increase of most tissues mainly vascular cylinder dimensions and pith dimensions, and vise versa.

The present anatomical studies on root, stem (including apical meristem) and leaf (lamina and petiole) were in harmony with that found by Metcalfe and Chalk, 1950, Esau,1953, Greulach, 1973, Fahn, 1985, Rudall, 1992 and Omran *et al.* ,2002 .



B. variegata ***B. alba***

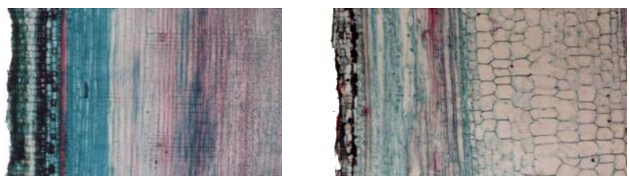


Table (8): Measurements (µ)and counts of different tissues of leaf lamina and petiole of the four studied species (average of 5 readings).

Species / Characters	*B. variegata*	*B. alba*	*D. regia*	*L. leucocephala*
A- Lamina :				
1. Upper epidermis thick.	15	15	8	15
2. Palisade tissue thick.	30	30	30	30
3. Spongy tissue thick.	38	23	30	38
4. Vascular bundle thick.	255	105	75	75
5. Xylem thick.	135	45	45	45
6. Phloem thick.	60	30	15	23
7. Fibers thick.	45	30	15	8
8. Main vein thick.	465	225	180	180
	Collenchyma above and below main vein		Collenchyma below main vein	
9. Lower epidermis thick.	8	8	8	8
10. Lamina thick.	90	75	75	90
B- Leaf petiole :				
1. Epidermis thick.	8	8	8	15
2. Cortex thick.	90	45	45	45
3. Fibers thick.	30	30	53	45
	(Fibers in circle surrounds vascular cylinder)			
4. Vascular bundles no.	4	4	9	4
	Plus 2 cortical vascular bundles in corners surrounded by fibers			
5. Vascular bundles thick.	150	120	180	165
6. Xylem thick.	105	90	135	90
7. Xylem column no.	11	6	5	7
8. Xylem vessel dimensions	38x30	23x15	53x38	30x23
9. Phloem thick.	45	30	45	75
10. Pith dimensions	-	-	525x480	-
11. Vascular cylinder dimensions	855x630	405x345	1020x945	555x526
12. Cross section dimensions	990x825	510x480	1095x1065	660x645

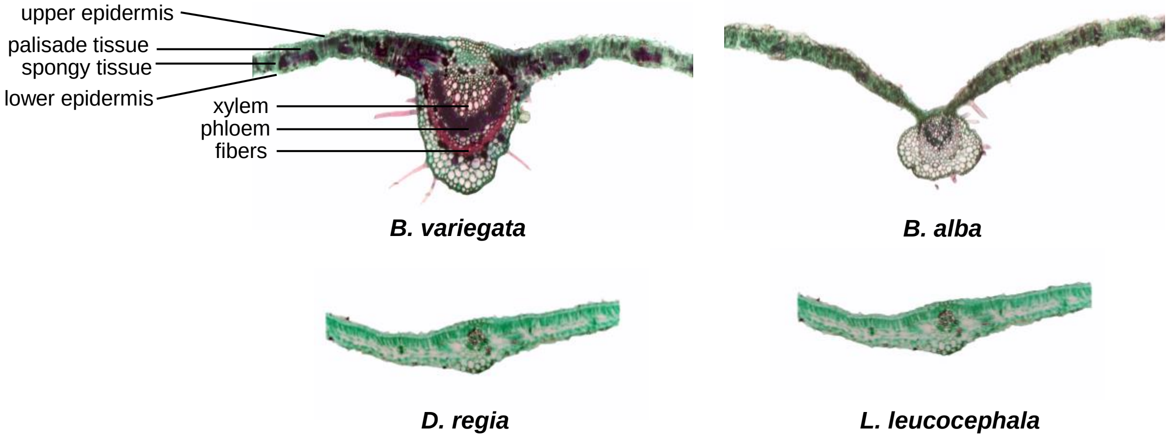


Fig. (8): Transverse sections of the lamina of the four studied species. (X= 50)

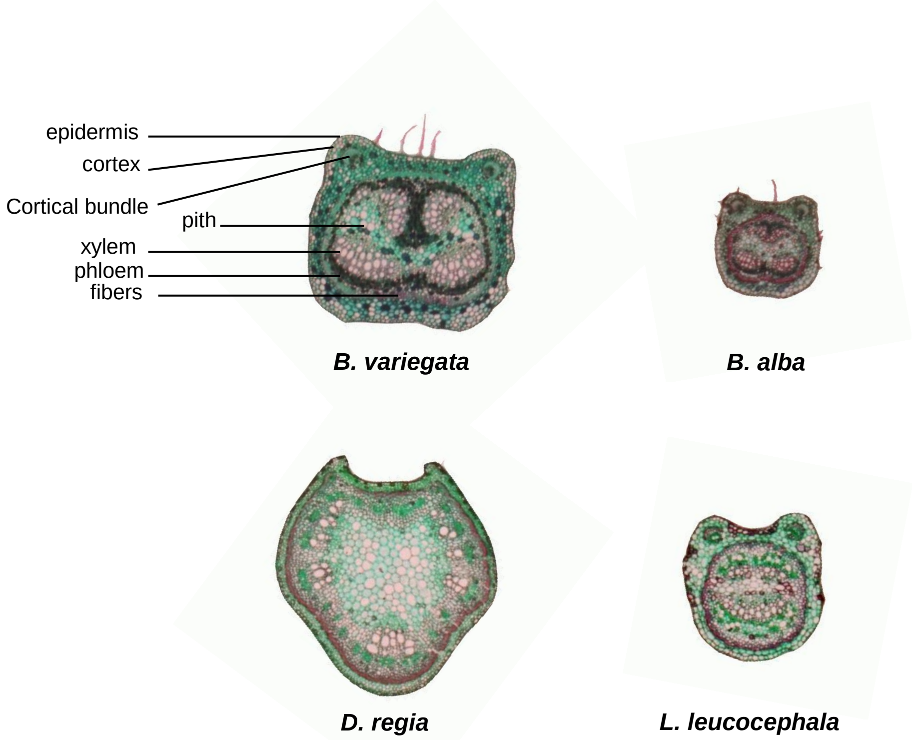


Fig. (9): Transverse sections of the leaf petiole of the four studied species. (X= 15)

CONCLUSION

The results obtained from studying sapling morphological characters could be concluded as follows:

- Both species of genus *Bauhinia* (*B. variegata* and *B. alba*) were more close to each other in most studied characters.
- Species of genus *Delonix* (*D. regia*) has quite number of characters varied from other studied species, but close to species of genus *Bauhinia* more than to that of *Leucaena*.
- Species of genus *Leucaena* (*L. leucocephala*) has mostly remote characters values from other species, either of genus *Bauhinia* or *Delonix*.
- Association between morphological characters and their explanatory anatomical traits showed contrasting due to variation in growth rate between species under studied through growth season.

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دراسات نباتية على بعض أجناس الفصيلة الطلحية والبقمية
ثالثا- الصفات المورفولوجية والتشريحية للشتلة:

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أجريت هذه الدراسة خلال عامي ٢٠٠٥-٢٠٠٦ على ٤ أنواع تنتمي إلى ٣ أجناس لفصيلتي الطلحية و البقمية، وكانت تلك الأنواع هي *Leucaena leucocephala* و *Bauhinia variegata* و *Bauhinia alba* و *Delonix regia* بغرض مقارنة الصفات المورفولوجية والتشريحية بين الأنواع تحت الدراسة لمعرفة درجة التشابه بينهما و تحديد العلاقة التقسيمية.

وأوضحت النتائج المتحصل عليها من القياسات والدراسات المورفولوجية أن كلا نوعي جنس *Bauhinia* تفوقا في معظم صفات محور النبات عن الأجناس الأخرى، بينما أظهرت *Delonix regia* زيادة في أغلب صفات الورقة (ما عدا صفة عدد الأوراق) وذلك مقارنة بالأنواع الأخرى. ولقد أظهرت *Leucaena leucocephala* قيم نائية عن الأجناس الأخرى في معظم الصفات المورفولوجية.

وأثبتت النتائج المتحصل عليها من الدراسة التشريحية وجود اختلافات بين الأربع أنواع تحت الدراسة. ولقد كانت الزيادة في ارتفاع النبات ترجع أساسا إلى الزيادة في عدد الخلايا عن طولها. أما الزيادة في سمك الساق فكانت ترجع أساسا إلى زيادة سمك نسيج الخشب الثانوي عن باقي الأنسجة.