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Taxonomic Consequences of Seed Morphology and Anatomy in Three *Lupinus* Species (Fabaceae-Genisteae)

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ABSTRACT

The objective of this paper is to study seed coat morphological and anatomical features of three *Lupinus* species; *L. albus* L., *L. digitatus* Forssk. and *L. angustifolius* L., in order to reveal the taxonomic relationships among them. Among seed coat macromorphological characters used were seed dimensions, seed weight and testa color, while those of the hilum were lens and *macula raphalis*. Seed coat micromorphological features revealed a similarity between *L. digitatus* and *L. angustifolius* since the outer periclinal walls of the isodiametric epidermal cells are tuberculate. The summit of each tubercle takes the form of umbrella with a central elevation in the former species, while each tubercle possesses long and narrow tips in the latter one. However, in *L. albus* the outer periclinal walls of the isodiametric epidermal cells are combination between pusticulate and reticulate. The anatomy of seed coat of *Lupinus* species shows that it is formed of two layers, the exotesta and the mesotesta. The exotesta is distinguished into two sublayers; the outer epidermis which is formed of malpighian cellulosic thick-walled cells (macrosclereids) and the inner hypodermis of hourglass thick-walled cells with large intercellular spaces (osteosclereids). On the other hand the mesotesta layer is formed of parenchyma cells. *L. angustifolius*, *L. digitatus* and *L. albus* displayed the same intermediate cotyledon type with some specification for *L. albus.*

Key words: Cotyledon anatomy, Fabaceae, *Lupinus albus*, *Lupinus digitatus*, *Lupinus angustifolius*, seed macromorphology, seed coat, seed coat micromorphology.

INTRODUCTION

Lupinus L. (Fabaceae-Genisteae) comprises about 200 species distributed mainly in the New World, Mediterranean region and tropical highlands of Africa, elsewhere these are naturalized (Hickey and King, 1988; Boulos, 1999; Kirkbride *et al.*, 2003). Due to the economic importance of the species, they were extensively studied by many researchers (e.g., Heyn and Heranstadt, 1977; López *et al.*, 2000; Ainouche *et al*., 2003).

The seed surface pattern have yielded valuable taxonomic information and seemed to reflect genetic-phylogenetic differences in the plant (Barthlott, 1981 & 1984). Seed morphology and anatomy showed considerable coincidence between these attributes and the distinction of taxonomic entities (Al-Nowaihi and Mourad 1999; Al-Nowaihi *et al.*, 2002; Shaheen, 2002). It is important to emphasize that seed morphology usually shows little phenotypic plasticity for environmental conditions (Barthlott, 1984; Oliveira and Paiva, 2005). El-Magly (1998) claimed that there have been few comprehensive systematic surveys comparing seed anatomy among related taxa at or below the family level and also stated that it seems surprising when one notes the potential systematic utility of this type of data. Meanwhile, cotyledon anatomy is correlated with the physiological-biochemical approach and with the changes that occur during development or germination of the seeds of economically valuable species (Smith, 1981).

The objective of this study is to characterize seed macro- and micromorphological features of three *Lupinus* species (from the four species recorded in the Egyptian flora): *L. albus* L., *L. digitatus* Forssk. and *L. angustifolius* L., which might contribute to the taxonomic relationships among them and facilitate the investigation of their seed biology.

MATERIALS AND METHODS

Seeds of 21 accessions of three *Lupinus* species were obtained from the International Center for Agricultural Research in the Dry Areas (ICARDA) at Alleppo, Syria and the National Plant Germplasm System (NPGS) at Washington University (Table 1). The seed specimens are stocked at Alexandria University Herbarium (ALEX) as vouchers.

Seed macromorphological examinations were carried out by Stereomicroscope and drawn by Camera Lucida. For micromorphology of the seed coat surface, Scanning Electron Microscope "SEM" (JEOL at 25 Kv at the electron microscope unit, Faculty of Science, Alexandria University) was used. The micrographs on the central position and around the hilum were made. For anatomical examinations, seeds were boiled in water for 15 minutes, soaked up to 12 hours, and then hand sectioned and photographed, while cotyledon sections were drawn using Camera Lucida. The terminology adopted was that of Kirkbride *et al.* (2003) for macromorphological features, Barthlott (1984) for seed coat ornamentation and Corner (1976) and Smith (1981) for anatomical details. Statistical analyses were performed using one-way ANOVA and correlation coefficients, for inter- and intra-specific quantitative characters by using Costat program for Windows.

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Table (1): Sources and accession codes of seed samples of three *Lupinus* L. species.

Species	Source	Accession code
Lupinus albus L.	a	Pl 516624
Lupinus albus L.	a	Pl 481559
Lupinus albus L.	a	Pl 457930
Lupinus albus L.	b	IG 110552
Lupinus albus L.	a	Pl 483073
Lupinus albus L.	a	Pl 467349
Lupinus albus L.	a	Pl 467351
Lupinus digitatus Forssk.	a	W6 11995
Lupinus angustifolius L.	a	Pl 385078
Lupinus angustifolius L.	a	Pl 385111
Lupinus angustifolius L.	a	Pl 385093
Lupinus angustifolius L.	a	Pl 385092
Lupinus angustifolius L.	a	Pl 383249
Lupinus angustifolius L.	a	Pl 385082
Lupinus angustifolius L.	a	Pl 385080
Lupinus angustifolius L.	a	Pl 385100
Lupinus angustifolius L.	a	Pl 385119
Lupinus angustifolius L.	b	IG 109143
Lupinus angustifolius L.	b	IG 109150
Lupinus angustifolius L.	b	IG 109139
Lupinus angustifolius L.	a	Pl 491182

a: International Center for Agricultural Research in the Dry Areas at Alleppo, Syria, and **b:** National Plant Germplasm System NPGS at Washington University USA.

RESULTS

All quantitative measurements (macromorphological and anatomical) showed non-significant variations within accessions of each species (Tables 2 and 3). This reflects the stability of the recorded characters. Variations among the three species were highly significant that they might be used in species delimitation.

Macromorphological Characters

1. Seed Dimensions

Maximum seed dimensions were in *Lupinus digitatus* (L = 1.35 cm, W = 1.23 cm), while the minimum ones were found in *L. angustifolius* (L = 0.55 cm, W = 0.45 cm) (Table 2). High positive correlation exist between seed length and seed width (Table 4).

2. Shape

Seed shape was recognized in transection and in 3-dimensional. In *Lupinus albus* and *L. digitatus,* the seeds are flattened in cross-section and quadrangular, while in *L. angustifolius,* they are compressed and fusiform (Table 2).

3. Seed Weight

Seed weight is significantly different among species. These values vary from 0.56 g in *Lupinus digitatus*, through 0.22-0.4 g in *L. albus,* to 0.04-0.11g in *L. angustifolius* (Table 2).

4. Seed Color

Both *Lupinus albus* and *L. digitatus* are distinguished by specific testa color; the former is yellow to pale brown and the latter is yellowish brown marbled with brown and central brown blotch. *L. angustifolius* showed great variability in testa color (Table 2).

5. Hilum Characters

In all studied *Lupinus* spp., the hilum is visible, oval and with faboid split (hilar groove). In *L. albus*, the hilum was raised relative to testa, and the hilar rim color was the same as that of the testa. The other two species were characterized by recessed hilum and the hilar rim was darker in color than the rest of testa. Hilar groove ranged from a shallow depression in *L. angustifolius* to a deep depression in the rest of species. The hilum length varied from 0.1 cm in *L. angustifolius* to 0.36 cm in *L. albus* and is positively correlated with the seed length (Table 4). The hilum position is determined as a ratio between length from hilum to the end of radicular lobe (Hs) and length from hilum to the end of basal lobe (Hi); (Fig. 1). The recorded values of this ratio are easily recognizable into three categories: (i) nearly central with a ratio of *ca.* 1 in *L. albus*, (ii) sub-central with a ratio of *ca.* 4–5 in *L. digitatus*, and (iii) basal with a ratio of *ca.* 5-12 in *L. angustifolius*.

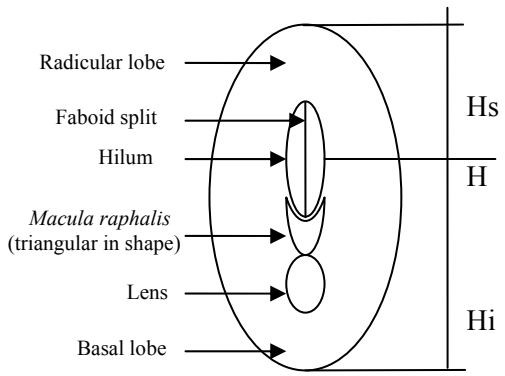

Figure (1): Diagrammatic representation of the descriptive macromorphological characters of leguminous seeds as defined by Kirkbride *et al.* (2003).

6. Lens Characters

In the examined *Lupinus* spp., the lens is discernible, elliptic with curved margins and is located adjacent to the hilum away from the hilar rim (Fig. 1). The lens color is either white in *L. albus* or yellow in the other two species. *L. digitatus* is characterized by a beak adjacent to the lens, which is relatively small or absent in *L. angustifolius* and completely absent in *L. albus* (Table 2).

7. Macula Raphalis Characters

In both *Lupinus albus* and *L. digitatus*, the shape of *macula raphalis* is linear and similar in color to the testa, however, in *L. angustifolius* its shape is triangular and color is different from that of the testa (Fig. 1). Thus, the *macula raphalis* characters are of limited use in species differentiation.

Micomorphological Characters

Lupinus digitatus epidermal cells are isodiametric and tuberculate. The summit of each tubercle takes the form of an umbrella with a central elevation (Plate 1). The ornamentation on the tubercle surface diversifies according to the color of testa regions. At the yellow to pale brown region, the tubercle top is radiating-striate sculptures, those on its lateral sides are striate-ribbed,

Table (2): Macromorphological seed characters of the investigated *Lupinus* species with different accessions.

Species	Accessions	Seed Length (cm)	Seed Width (cm)	Seed Shape (T.S.)	Seed Shape (3-D)	Seed Weight (g)	Seed Color	Hilum Elevation (relative to testa)	Hilar Rim color (relative to testa)	Hilar Groove depression	Hilum Length (H)	Hilum Position	Lens Color	Lens Beak	*Macula Raphalis* Shape	*Macula Raphalis* Color	Length from Hilum to Radicular Lobe (Hs) (cm)	Length from Hilum to Basal Lobe (Hi)(cm)	Hs:Hi ratio
L. albus	1	1.03±	1.03±0.16	Fl	Qd	0.22	A	Ras	Sim	Dep	0.35±0.00	Cen	Wh	Ab	Lin	Sim	0.55±0.09	0.48±0.08	1.1
	2	1.03±0.1	1.03±0.16	Fl	Qd	0.25	A	Ras	Sim	Dep	0.33±0.03	Cen	Wh	Ab	Lin	Sim	0.55±0.1	0.48±0.08	1.1
	3	1.02±0.1	1.02±0.1	Fl	Qd	0.22	A	Ras	Sim	Dep	0.33±0.03	Cen	Wh	Ab	Lin	Sim	0.53±0.08	0.5±0.05	1.2
	4	1.08±0.1	1.15±0.13	Fl	Qd	0.4	A	Ras	Sim	Dep	0.33±0.03	Cen	Wh	Ab	Lin	Sim	0.63±0.1	0.45±0.05	1.5
	5	1.1±0.15	1.1±0.13	Fl	Qd	0.32	A	Ras	Sim	Dep	0.37±0.03	Cen	Wh	Ab	Lin	Sim	0.6±0.1	0.5±0.05	1.3
	6	1.02±0.1	0.91±0.1	Fl	Qd	0.26	A	Ras	Sim	Dep	0.35±0.00	Cen	Wh	Ab	Lin	Sim	0.55±0.05	0.47±0.06	1.2
	7	0.89±0.1	0.86±0.1	Fl	Qd	0.26	A	Ras	Sim	Dep	0.32±0.06	Cen	Wh	Ab	Lin	Sim	0.48±0.08	0.41±0.04	1.1
	Mean	*1.02±0.0*	*1.01±0.09***			*0.28±0.*					*0.34±0.02*						*0.55±0.04***	*0.47±0.03**	*1.2±0.1*
L. digitatus	8	1.2	1.0	Fl	Qd	0.56	G	Rec	Dar	Dep	0.27	Shb	Yel	Rl	Lin	Sim	0.95	0.21	4.7
	Mean	*1.2±0.18**	*1.0±0.18***			*0.56±0.*					*0.28±0.02*						*0.95±0.1****	*0.21±0.05**	*4.6±0.0*
L. angustifolius	9	0.64±0.0	0.53±0.06	Com	Fus	0.11	B	Rec	Dar	Sha	0.12±0.03	Bas	Yel	Ab	Tri	Dis	0.56±0.07	0.08±0.03	9.2
	10	0.48±0.0	0.37±0.05	Com	Fus	0.04	B	Rec	Dar	Sha	0.1±0.005	Bas	Yel	Ab	Tri	Dis	0.45±0.05	0.04±0.02	10.5
	11	0.64±0.1	0.51±0.1	Com	Fus	0.1	B	Rec	Dar	Sha	0.12±0.03	Bas	Yel	Ab	Tri	Dis	0.54±0.1	0.1±0.05	8.8
	12	0.62±0.0	0.53±0.04	Com	Fus	0.12	B	Rec	Dar	Sha	0.1±0.005	Bas	Yel	Sml	Tri	Dis	0.53±0.08	0.09±0.01	10.7
	13	0.57±0.0	0.45±0.04	Com	Fus	0.08	B	Rec	Dar	Sha	0.1±0.005	Bas	Yel	Sml	Tri	Dis	0.52±0.06	0.05±0.005	10
	14	0.6±0.09	0.5±0.05	Com	Fus	0.1	C	Rec	Dar	Sha	0.1±0.005	Bas	Yel	Sml	Tri	Dis	0.52±0.07	0.08±0.03	6.3
	15	0.62±0.1	0.5±0.06	Com	Fus	0.11	C	Rec	Dar	Sha	0.13±0.03	Bas	Yel	Sml	Tri	Dis	0.52±0.1	0.1±0.005	5.2
	16	0.63±0.0	0.56±0.09	Com	Fus	0.11	D	Rec	Dar	Sha	0.1±0.0	Bas	Yel	Abs	Tri	Dis	0.57±0.03	0.07±0.03	8.6
	17	0.53±0.0	0.39±0.04	Com	Fus	0.05	F	Rec	Dar	Sha	0.14±0.02	Bas	Yel	Abs	Tri	Dis	0.46±0.02	0.06±0.03	7.3
	18	0.65±0.0	0.52±0.04	Com	Fus	0.1	E	Rec	Dar	Sha	0.1±0.0	Bas	Yel	Sml	Tri	Dis.	0.55±0.05	0.1±0.0	6.9
	19	0.61±0.0	0.52±0.03	Com	Fus	0.11	B	Rec	Dar	Sha	0.12±0.03	Bas	Yel	Sml	Tri	Dis	0.52±0.04	0.09±0.01	8.7
	20	0.68±0.0	0.52±0.03	Com	Fus	0.1	B	Rec	Dar	Sha	0.1±0.005	Bas	Yel	Abs	Tri	Dis	0.58±0.03	0.1±0.005	5.8
	21	0.57±0.0	0.480.06	Com	Fus	0.09	B	Rec	Dar	Sha	0.12±0.03	Bas	Yel	Sml	Tri	Dis	0.52±0.07	0.05±0.005	13.3
	Mean	*0.6±0.05**	*0.49±0.05***			*0.09±0.*					*0.11±0.01*						*0.53±0.04***	*0.08±0.02**	*7.7±3.6*

Fl: flattened; **Com:** compressed; **Qd:** quadrangular; **Fus:** fusiform; **A:** yellow to pale brown; **B:** grey-brown mottled with pale yellow; **C:** brown mottled with pale yellow; **D:** grey marbled with dark brown; **E:** pale yellow marbled with greenish-brown; **F:** grey to pale brown marbled with brown and with yellow blotches; **G:** yellowish-brown marbled with brown and with one large brown central blotch; **Ras:** raised; **Rec:** recessed; **Sim:** similar to testa color; **Dar:** darker than testa color; **Dep:** deep depression; **Sha:** shallow depression; **Cen:** nearly central; **Shb:** shifting towards the basal lobe; **Bas:** nearly basal; **Wh:** white; **Yel:** yellow; **Ab:** absent; **Sml:** small; **Rl:** relatively large; **Lin:** linear; **Tri:** triangular; **Dis:** dissimilar to testa color. **Significant characters; ***highly significant characters.

Table (3): Micromorphological and anatomical seed characters of the investigated *Lupinus* species.

Characters	*L. albus*		*L. digitatus*						*L. angustifolius*	
Curvature of the outer periclinal walls	On hilum sides	On central position	Tuberculate take the form of umbrella with central elevation						Tuberculate with long and narrow tip	
	Pusticulate	Reticulate								
Fine relief of the cell wall	Rugose	Rugose-ruminate muri	Yellow to pale brown region			Brown-colored blotch region			Tubercle top	Tubercle lateral sides
			Tubercle top	Tubercle lateral sides	Umbrella elevation	Tubercle top	Tubercle lateral sides	Umbrella elevation	Ruminate	Rugose-striate
			Radiating-striate	Stiate-ribbed	Faveolate	Radiating-striate	Inconspicuous	Faveolate		
Malpighian layers number	2		2-3						2	
Thickness of malpighian layer mm.	0.118±0.01**		0.325±0.01**						0.117±**	
Thickness of hypodermis layer mm.	0.053±0.001***		0.145±0.002***						0.035±0.007***	
Thickness of parenchyma layer mm.	0.254±0.005***		0.298±0.004***						0.14±0.016***	

**Significant characters; ***highly significant characters.

Table (4): Correlation values among seed quantitative measurements of the three *Lupinus* species

Correlated Characters	Correlation Values
Seed Length and Seed Width	+ 0.961
Seed Length and Length from Hilum to Radicular Lobe	+ 0.714
Seed Length and Hilum Length	+ 0.834
Seed Width and Length from Hilum to Basal Lobe	+ 0.705
Seed Width and Hilum Length	+ 0.907
Length from Hilum to Basal Lobe and Hilum Length	+ 0.870
Thickness of Malpighian Layer and Hypodermis Layer	+ 0.988
Thickness of Malpighian Layer and Parenchyma Layer	+ 0.713
Thickness of Hypodermis Layer and Parenchyma Layer	+ 0.812

while the elevation on the umbrella is characterized by foveolate ornamentation (Plate 1; A & B). The brown-colored blotch region has the same appearance except that the contiguous umbrella-forms obscure the lateral sides of tubercles (Plate 1; C & D).

In *L. angustifolius*, the outer periclinal walls of the isodiametric epidermal cells are tuberculate, and each tubercle possesses long and narrow tips. The tubercle top embellishment is ruminate, but on its lateral sides it is rugose-striate (Plate 1; A & B).

The seed coat ornamentation in *L. albus* varied between the central position of the seed or around the hilum. On hilum sides, the outer periclinal walls of the isodiametric epidermal cells are pusticulate with rugose fine reliefs. On the other hand, the central seed region shows reticulate outer periclinal walls and rugulate-ruminate fine relief for the muri (Plate. 2; C & D).

Anatomical Characters

Seed coat of *Lupinus* spp. exhibites two layers: the exotesta and the mesotesta (Plate 3). The exotesta is distinguished into two sublayers; the outer epidermis is formed of malpighian cellulosic thick-walled cells (macrosclereids) and the inner hypodermis is formed of hourglass thick-walled cells with large intercellular spaces (osteosclereids). On the other hand, the mesotesta is formed of parenchyma cells. The macrosclereid layers vary in number and thickness where *L. digitatus* retains the maximum number (3 layers) and thickness (widest measure 0.325mm). These layers comprise about 42 % of the total seed coat thickness (Table 3). The macrosclereid layers in both *L. albus* and *L. angustifolius* showe the same layer numbers and thickness (2 layers and 0.117-0.118 mm thick). But the two species demonstrate variations in this layer percentage relative to total seed coat (51 % in *L. angustifolius* and 28 % in *L. albus*; Table 3). The percentage of osteosclereid layer, relative to the total seed coat, varies from 19 % in *L. digitatus* through 15 % in *L. angustifolius* to 12 % in *L. albus* (Table 3). The remnant parenchyma layers, as a percentage from total seed coat, exhibited the maximum thickness in *L. albus* (60 %) followed by *L. digitatus* (39 %) then the minimum in *L. angustifolius* (34 %) (Table 3).

DISCUSSION

The variation of seed dimension among the three species was significant at the species level in concordance with the opinion of Chaung and Heckard (1983). On the other hand the similarity of seed shape in both *Lupinus albus* and *L. digitatus* may support the view of El-Hadidy (2004) that seed shape has little value in the distinction between them.

Seed color is usually neglected in taxonomic considerations although in many cases it was of high diagnostic and systematic interest (Barthlott, 1984), as in tha case of both *L. albus* and *L. digitatus*. There is also a gradation in seed darkness from *L. albus* to *L. angustifolius* through *L. digitatus*. It is recognized that the gradation in seed darkness is accompanied with both the increment in seed hardness and the declination in water permeability. Oliveira and Paiva (2005) stated that: "testa with phenolic substances, in addition to

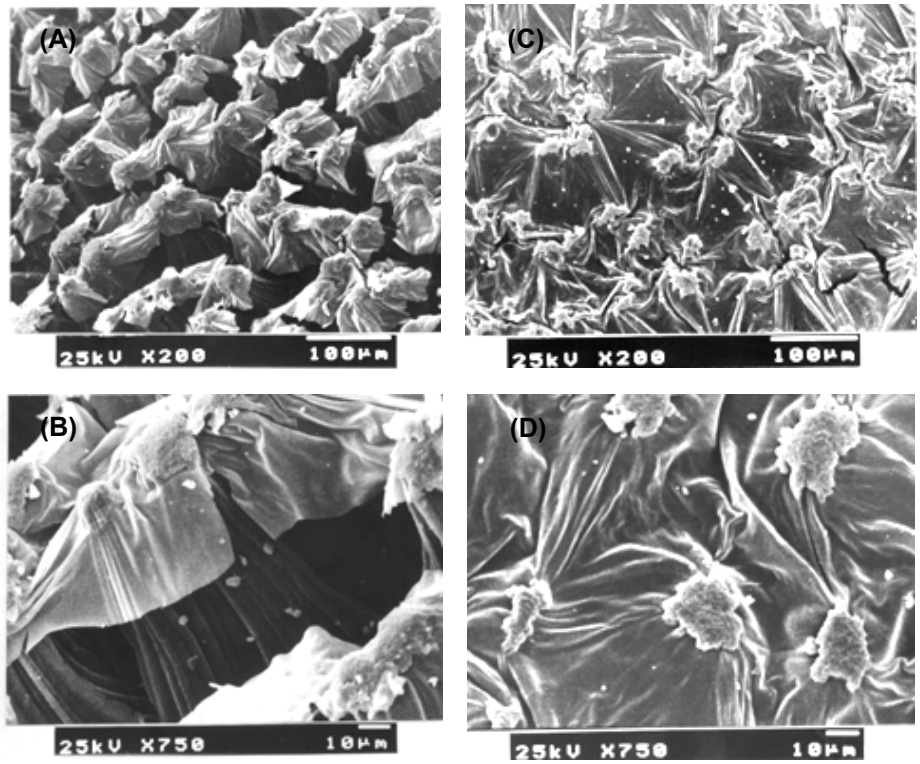

Plate (1): SEM micrograph of *L. digitatus* seed of the yellow to pale brown region (A & B); and the brown-coloured blotch region (C & D).

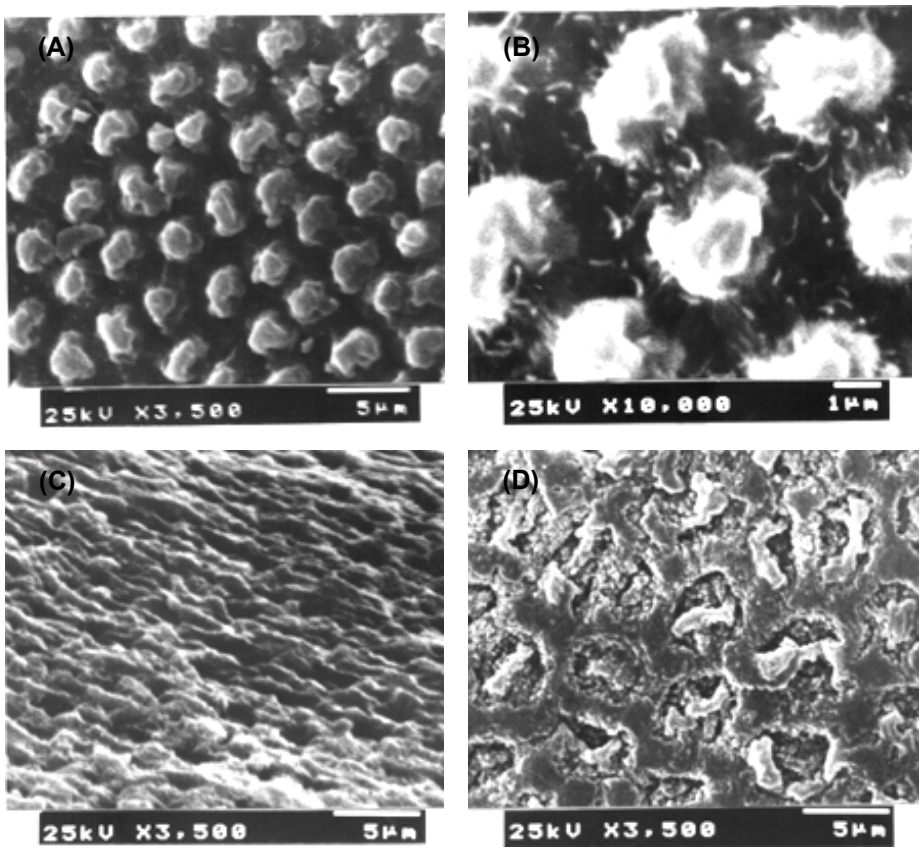

Plate (2): SEM micrograph of *L. angustifolius* seed (A & B); *L. albus* seed on hilum sides (C); and *L. albus* seed on central region (D).

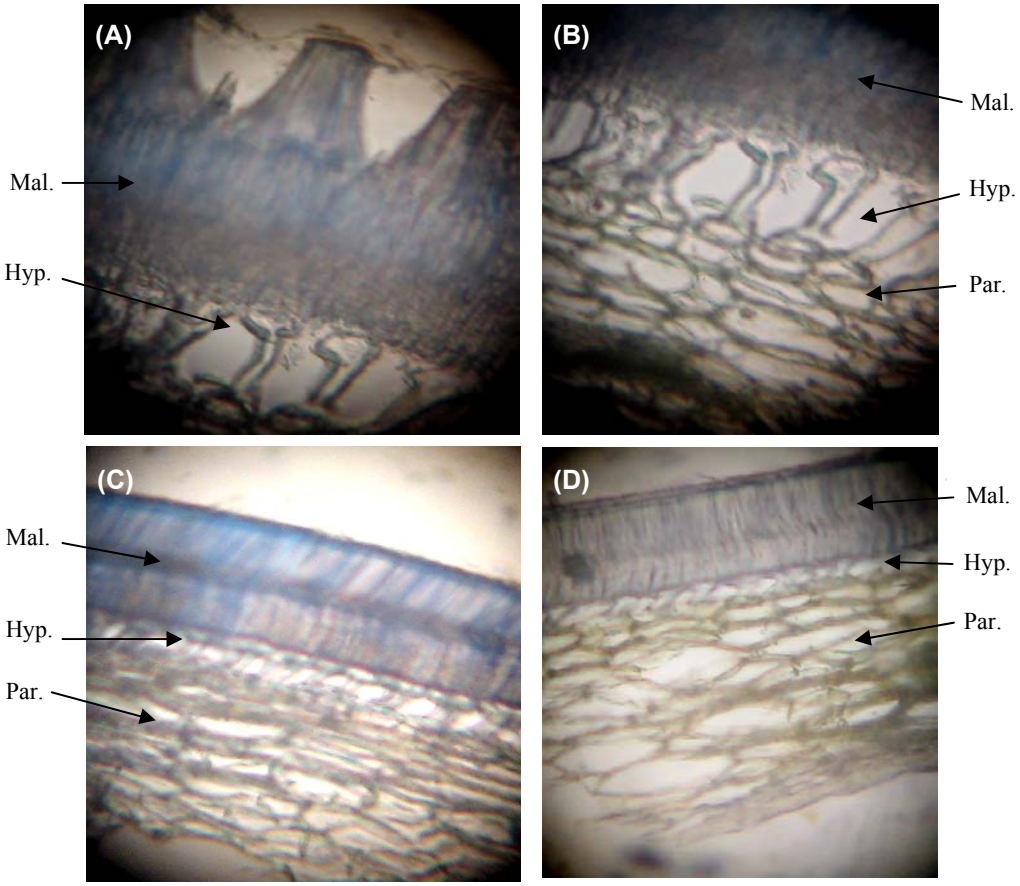

Plate (3): The seed coat transverse section of the studied *Lupinus* species: *L. digitatus* (A & B); *L. angustifolius* (C); and *L. albus* (D). **Mal**: Malpighian layer; **Hyp**: Hypodermis layer; **Par**: Parenchyma layer.

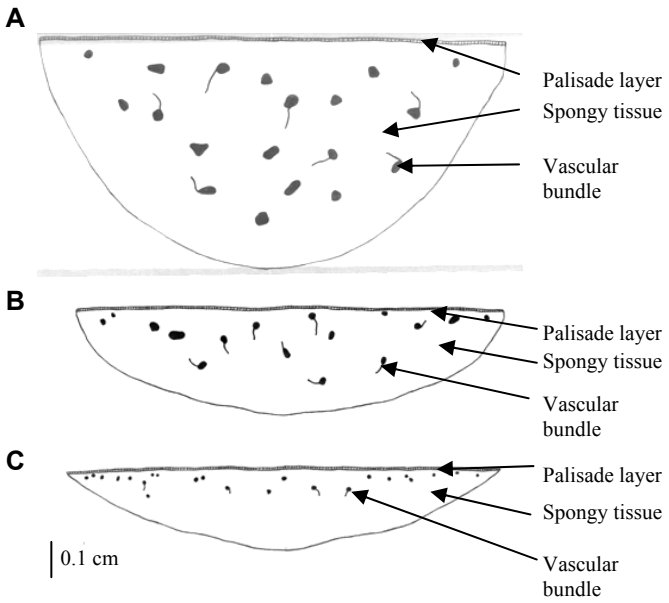

Figure (2): Camera Lucida drawings of transverse section in the cotyledons of *L. digitatus* (A); *L. angustifolius* (B); and *L. albus* (C).

producing a typical coloration presents greater seed coat hardness, low water permeability and more resistance to pathogen attack". The *macula raphalis* characters are of limited use in species differentiation. This is in agreement with El-Hadidy (2004) who suggested that in spite of the prominance of this character, its poor morphological differentiation limits its taxonomic value.

The seed coat micromorphological characters of the studied *Lupinus* species possess unique and characteristic features which as ascertained by Barthlott (1984), Sivarajan (1991) and Shaheen (2002), that SEM scrutiny on seed coat yields valuable diagnostic and taxonomic information at different ranks and especially for closely related species. Boesewinkel and Bouman (1984) concluded that the anticlinal walls are often of high taxonomic significance and mostly characterize taxa at genus or species level. That is inconsistent with the present *Lupinus* species which possess obscure anticlinal walls.

The comparative anatomical studies of seed structures, especially in corporation with systematics and other related disciplines may elucidate many evolutionary relationships and also be very helpful at lower taxonomic levels (Boesewinkel and Bouman, 1984). The studied *Lupinus* species are typically testal, i.e. the outer integuments was significally participated in the seed coat, as other Papilionoideae examined by Corner (1976), Gunn (1981), Liwang and Grusak (2004) and Oliveira and Paiva (2005). The mature seeds of the three *Lupinus* species characterized by the presence of parenchyma layers of the mesotesta.

Van Dongen *et al*. (2003), studying the ontogeny of pea seeds, found that theses layers were differentiated into three sublayers: chlorenchyma, ground parenchyma and branched parenchyma. During storage phase, these parenchyma die and their cell wall remnants form the boundaries between the seed coat and the cotyledons.

The present investigation indicates that *L. angustifolius* species aquires the lowest permeability, since it exhibited the highest malpighian layer percentage and the darkest seed coat comparable to the other species. Mera *et al.* (2004) illustrated that the relatively high seed coat proportion of *L. angustifolius* is the reason for the reduction of its economic value.

The cotyledon anatomy provided several features that could be used in seed or seedling identification as well as having potential value in elucidating taxonomic or phylogenetic relationships. Smith (1981) found correlation between cotyledon anatomy and both seed size and taxonomic groupings in the classification of some genera of Papilionoideae. In the present study, *L. angustifolius* and *L. digitatus* displayed the same intermediate type between fleshy and leaf-like. This type is characterized by flat adaxial surface with palisade tissue not clearly demarcated from spongy tissue, the abaxial surface was strongly curved, and the main veins ramified through the cotyledon (Fig. 2; A & B). However, *L. albus* shares most of these characters except the main veins that extend mainly towards adaxial and central section of the cotyledon, meanwhile these main veins are less ramified than in the other two species (Fig. 2; C).

In conclusion, the seeds of the studied *Lupinus* species exhibite a vast diversity of taxonomically applicable morphological and anatomical characters and provide the needed understanding of the taxonomic relationships between them.

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التبعيات التصنيفية للصفات الظاهرية والتشريحية لبذور ثلاثة أنواع من الترمس .*Lupinus* sp (العائلة القرنية)

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الملخص العربـــى

يهـدف هـذا البحـث إلـي دراسـة الـصفات الظاهريـة والتـشريحية لبـذور ثلاثـة أنـواع مـن جـنس التـرمس وهـم: *L. albus* L. و *L. digitatus* Forssk. و *L. angustifolius* L. وذلك لتوضيح العلاقات التصنيفية فيما بينهم. ومن الصفات الظاهرية "macromorphological" التي تم قياسها: أبعاد البذور وحجمها ولون القصرة وبعض الصفات المرتبطة بكل من السرة "hilum" و العدسة "lens" و"macula raphalis". وقد أثبتت دراسة الصفات الظاهرية الدقيقة "micromorphological" التشابه بين نوعي *L. angustifolius* و*digitatus* في الشكل الأنبوبى "tuberculate" للجدر المماسية لخلايا البشرة. وقد اتخذت فى النوع الأول *L. digitatus* شكل الشمسية مع وجود إرتفاع مركزى"umbrella with a central elevation"، بينما في النوع الثانى *L. angustifolius* كانت طويلة وذات أطراف مدببة "long and narrow tips". أما عن *L. albus* فالجدر المماسية لخلايا البشرة كانت تجمع ما بين الشكلين المتموج والشبكى "pusticulate and reticulate".

وبدراسة الصفات التشريحية لبذور جنس الترمس وجد أنها تتميز بوجود طبقتين: القصرة الخارجية "exotesta" والقصرة المتوسطة "mesotesta". وقد تميزت الطبقة الخارجية "exotesta" إلى تحت طبقتين: الخارجية تتكون من خلايا ملبيجية ذات جدر سيليولوزية سميكة "macrosclereides" والداخلية تتكون من خلايا عظمية الشكل ذات جدر سيليولوزية سميكة "osteosclereides"، بينما تكونت الطبقة المتوسطة "mesotesta" من خلايا بارانشيمية. وبدراسة التركيب التشريحى لفلقات الأنواع الثلاثة *L. albus*, *L. digitatus* و*L. angustifolius* وجد أنها تتشابه مع بعض التميز للنوع الأول *L. albus*.