

**SOME SEED CHARACTERS AND IDENTIFICATION OF
SOME *CICER* SPECIES**

(Received : 22.3.2000)

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ABSTRACT

Seed morphology and testa structure of some *Cicer* species (*C.arietinum*, *C.echinospermum*, *C.judaicum*, *C.reticulatum* and *C.yamashitae*) were studied by Scanning Electron Microscope and Light Microscope. The following results were obtained:-

Seed shape and colour, spermoderm pattern, hilum and micropyle of seed coat as well as anatomical characters of both seed testa and seed testa at hilar region differed according to the studied *Cicer* species.

Brown to black seed colour, seed spermoderm pattern with spines, presence of spinelet on the spines, elliptical hilum and elliptical micropyle are characteristic for *C.echinospermum*. In addition, undulated papillose, bulged to spinose and crests with troughs spermoderm pattern are characteristic for *C.arietinum*, *C.judaicum*, *C.reticulatum* and *C.yamashitae*, respectively. Furthermore, the presence of light line in the palisade-like cells is characteristic for *C.reticulatum*. Also, the presence of two rows of palisade like cells is characteristic for *C. arietinum*. On the other hand, pear-shaped tracheid bar is characteristic for *C.judaicum*.

The highest values of average seed length, width, hilum length and width, thickness of the parenchymatous tissue, average length, average width of tracheid bar were observed in *C.arietinum*. Moreover, the highest values of average maximum length and

micropyle width, thickness of palisade like cells and hour glass cells were noticed in *C. echinospermum*. In addition, maximum values of average hilum width / length ratio were recorded in *C. yamashitae*. Also, maximum values of thickness of palisade layer at hilar region, counter palisade layer, summation of the the palisade layer + the counter palisade layer and aperture hilar groove were recorded in *C. reticulatum*.

Key words: *Cicer species, seed morphology, seed testa structure.*

1. INTRODUCTION

The genus *Cicer* L. belongs to the tribe Cicereae, family Fabaceae (Cronquist 1981).

As regards seed shape and colour, Van der Maesen (1972) showed that the *Cicer* seed shape was bilobular to subglobular, conspicuously beaked; the seed colour was brown, grey, black, white, yellowish, orange and green. Also, Lersten and Gunn (1981) found that the shape of *Cicer* seeds is circular to elliptical in shape.

Concerning the seed spermoderm pattern, Kondo (1913), Van der Maesen (1972) and Behl and Tiagi (1977) observed that *Cicer* seed surface was smooth, wrinkled, tuberculate and has echinate spinelets. Whereas, Lersten (1981) and Lersten and Gunn (1981 and 1982) examined the seed surface of some species of tribe Cicereae and recorded a large multicellular plates which bulge or protrude conically or as long spines and observed the conspicuous outgrowth of *Cicer* testa surface. Furthermore, Trivedi and Bagchi (1982) observed undulated spermoderm pattern testa in the seed of *Cicer arietinum*, crests and troughs with somewhat rough surface at regular intervals.

With respect to hilum and micropyle, Kupicha (1977) found that the *Cicer* seeds have uniformaly small elliptical or suborbicular hilum. In addition, Gunn (1981), Lersten (1981) and Lersten and Gunn (1981) noticed that rim arial was absent in *Cicer arietinum* and was present in *Cicer bijugum*. Moreover, they observed that the hilum shape was usually circular, slightly oval and elliptically sunken. Also, the funiculus was remnant in *Cicer arietinum*. In addition, they noticed that the micropyle was usually visible as a circular or deltoid

depression and adnate to the hilum.

Regarding to seed testa structure, Corner (1951), Lersten and Gunn (1981), Lersten (1982), Sanchez-Yelamo *et al.* (1992), Hassan (1997) and Sakr (2000) pointed out that the testa of both tribes Cicereae and Viciae consisted of single layer of thick slender, elongated malpighian cells, a subtending layer of columnar sclerieds (hour-glass cells) with prominent intercellular spaces and were uniformly thickened in all tribes and below this a poorly defined zone of partially or completely crushed. Malpighian cells in most species of these tribes are extended above the surface and give the testa a papillose and echinate spinelets. A definite counter palisade was present in seeds of most species of both Cicereae and Viciae at hilar region only. In addition, a tracheid bar was always present, extending the length of the hilum just beneath the hilar groove. This groove was presented in all the *Cicer* species seeds. Tracheid bar was always embedded in a mass of spongy parenchyma, which forms a thicker layer in the seed. Tracheid bar in transction was usually elliptical, which was narrow or broad; more rarely it appears circular and pear-shaped in all the tribe Cicereae.

The present research was carried out to study the seed shape, colour, testa structure of some *Cicer* species and their identification by structural characters.

2. MATERIALS AND METHODS

Seeds of five *Cicer* species (*Cicer arietinum*, *C.echinospermum*, *C.judaicum*, *C.reticulatum* and *C.yamashitae*) were imported from Washington State University, Regional Plant Introduction Station, United States, during October 1999 for studying the following characters:-

2.1. Average of seed dimentions, shape and colour.

2.1.1. Spermoderm pattern shape at the central region of seed coat, hilum and micropyle characters were studied by using Trivedi *et al.*, (1978) method which described as follow:-

A sample of air dried seeds was taken, adhesived on the stubs of the Scanning Electron Microscope (Cambridge S₄) and then coated with gold. The apparatus was supplied with aphotocopy unit .

2.1.2. For studying the anatomical structure of seed coat, the seed samples were taken before harvest time, killed and fixed in 70% FAA solution, dehydrated with n-butyl alcohol and embedded in pure paraffin wax (M.P. 56-58^o C) as described by Willey (1971). Using a rotary microtome, sections (12u) were obtained and stained with safranin and light green. Sections, in such cases were microscopically examined.

3.RESULTS AND DISCUSSION

3.1.Morphological studies of seeds

3.1.1.Shape, colour and dimensions

Data in Table (1) and Figure (1A) show that the shape of seed in outline was subcircular in *C.arietinum* (Figure 1A₁), elliptical in both *C.echinospermum* and *C.reticulatum* (Figures 1 A₂ and 1A₄) and deltoid in both *C.judaicum* and *C.yamashitae* (Figures 1 A₃ and 1 A₅). Seed colour was yellowish in *C.arietinum* (Figure 1 A₁), brown to black in *C. echinospermum* (Figure 1A₂), brown to grey in *C.judaicum* (Figure 1A₃), brown in *C. reticulatum* (Figure 1A₄) and black in *C.yamashitae* (Figure 1 A₅). Moreover, the highest values for both average seed length (8.8 mm) and average seed width (7.0 mm) were recorded in *C.arietinum* (Figure 1 A₁); while, the lowest ones were found in *C.judaicum* (3.5 and 2.9 mm) as given in Figure (1A₃). Such results are strengthened by Van der Maesen (1972) and Lerstern and Gunn (1981) who pointed out that *Cicer* seed species shapes were circular to elliptical and the seed colour was brown, grey, black, white, yellowish, orange and green .

Table (1): Seed morphological characters of some *Cicer* species .

Species → Characters ↓	<i>C.arietinum</i>	<i>C.echinospermum</i>	<i>C.judaicum</i>	<i>C.reticulatum</i>	<i>C.yamashitae</i>
Seed shape	Subcircular	Elliptical	deltoid	Elliptical	Deltoid
Seed colour	Yellowish	Brown to black	Brown to grey	Brown	Black
Average seed length (mm)	8.8	7.9	3.5	8.2	4.1
Average seed width (mm)	7.0	5.9	2.9	5.9	4.1

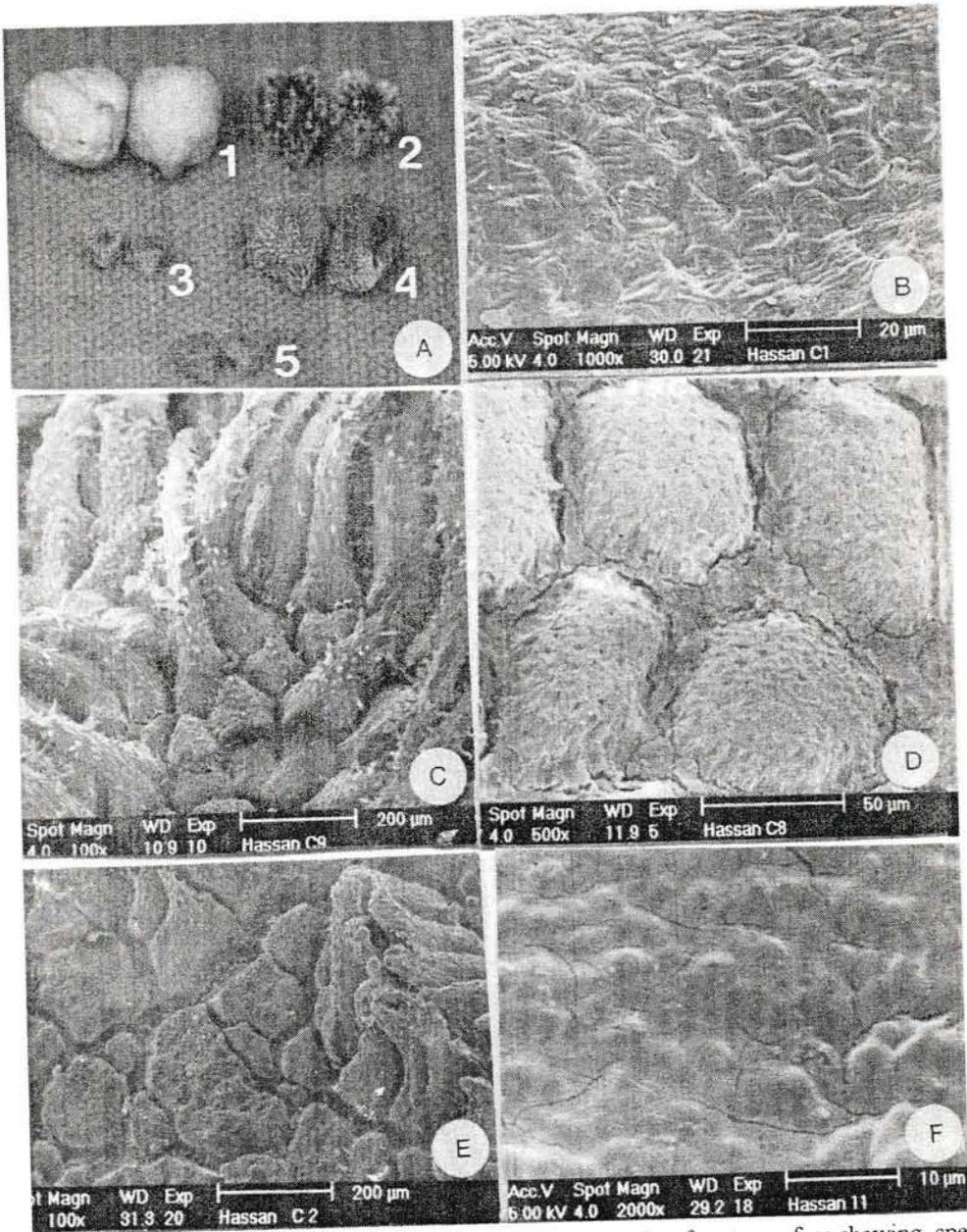


Figure (1):-Seed morphology (A) and scanning electron micrographs of testa surface showing spermoderm pattern (B - F) of:-
 A₁ and B-*C. arietinum* (x1000)
 A₃ and D-*C. judaicum* (x500)
 A₅ and F-*C. yamashitae* (x2000)
 A₂ and C-*C. echinospermum* (x100)
 A₄ and E-*C. reticulatum* (x100)

3.1.2.Spermoderm pattern

Table (2) and Figure (1B-F) show that seed spermoderm pattern with undulated, spinose, papillose, bulged to spinose and crests and troughs are characteristic for *C.arietinum*, *C.echinospermum*, *C.judaicum*, *C.reticulatum* and *C.yamashitae* (Figures 1B, C, D, E and F); respectively. Presence of the spinelets on the spines is characteristic for *C.echinospermum* only (Figure 1C). These results are in agreement with those obtained by Van der Maesen (1972), Trivedi and Bagchi (1982), Lersten (1981) and Lersten and Gunn (1981) who observed that the seed surface of some species of tribe Ciceraceae was a large multicellular plates which bulge or protrude conically or as long spines and also wrinkled, tuberculate, smooth and echinate spinelets. In *Cicer arietinum*, they showed undulated spermoderm pattern testa with crests and troughs with somewhat rough surface at regular intervals.

3.1.3. Hilum

Table (2) and Figure (2) show that the shape of hilum was circular in both *C.* and *C. judaicum* (Figures 2 A and C) respectively, elliptical in *C.echinospermum* (Figure 2 B), suborbicular in *C. reticulatum* (Figure 2 D) and deltoid in *C.yamashitae* (Figure 2 E). Moreover, the highest values of average hilum length (1.13 mm), average hilum width (1.10 mm) were recorded in *C.arietinum* (Figure 2 A). While, the highest value (2.10 mm) of average of width/length ratio was observed in *C.yamashitae* (Figure 2E). Whereas, the lowest values for both average hilum length (0.14 mm) and average hilum width (0.30 mm) were found in *C.yamashitae* (Figure 2 E). The minimal value of width/length ratio (0.66) was recorded in *C.echinospermum* (Figure 2 B). These results are similar to the data obtained by Behl and Tiagi (1977), Kupicha (1977) and Lersten (1981) who observed that the hilum shape in *Cicer* species was small elliptic to elliptic-suborbicular and circular or slightly oval.

3.1.4.Micropyle

It is noticed from Table (2) and Figure (2) that the shape of micropyle was deltoid in *C.arietinum* (Figure 2 A), elliptical in *C.echinospermum* (Figure 2 B), rectangular in *C.reticulatum* (Figure 2 D) and linear in both *C.judaicum* and *C.yamashitae* (Figure 2 C and

Table (2): Morphological studies of spermoderm pattern, hilum and micropyle of seed coat of some *Cicer* species.

Characters ↓	Species →					
	<i>C. arietinum</i>	<i>C. echinospermum</i>	<i>C. judaicum</i>	<i>C. reticulatum</i>		<i>C. yamashitae</i>
Spermoderm pattern	Undulated	+	-	-	-	
	Spinose	-	+	-	-	
	Papillose	-	-	+	-	
	Bulged to spinose	-	-	-	+	
	Crests and troughs	-	-	-	-	+
Presence of spinelets on the spines	-	+	-	-	-	
Hilum	Shape	Circular	Elliptical	Circular	Suborbicular	Deltoid
	Average length (mm)	1.13	0.88	0.43	1.07	0.14
	Average width (mm)	1.10	0.58	0.32	0.80	0.30
	Width/length ratio	0.97	0.66	0.74	0.75	2.10
Micropyle	Shape	Deltoid	Elliptical	Linear	Rectangular	Linear
	Micropyle aperture covered by a hilar rim	-	-	+	-	-
	Average maximum width (µm)	125	225	80	200	50
	Average length (µm)	150	275	110	120	150

+ = Present

- = Absent

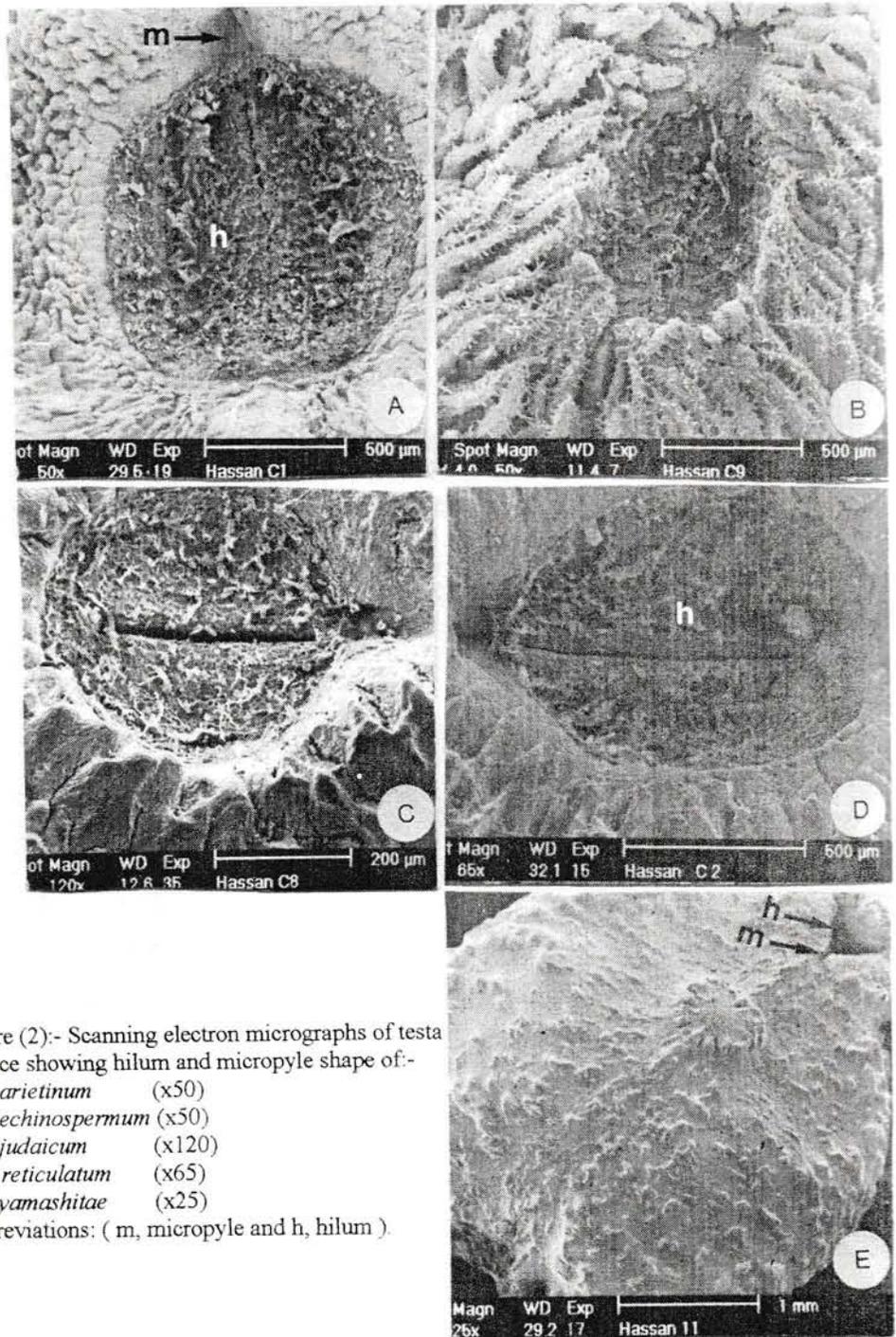


Figure (2):- Scanning electron micrographs of testa surface showing hilum and micropyle shape of:-
A-*C. arietinum* (x50)
B-*C. echinospermum* (x50)
C-*C. judaicum* (x120)
D-*C. reticulatum* (x65)
E-*C. yamashitae* (x25)
Abbreviations: (m, micropyle and h, hilum).

E, respectively). Micropyle aperture was covered by a hilar rim in *C.judaicum* only (Figure 2 C). Maximum average width (225 μ m) and average length (257 μ m) of micropyle were observed in *C.echinospermum* (Figure 2 B); but, minimal average width (50 μ m) and average length (110 μ m) of micropyle were noticed in both *C.yamashitae* and *C.judaicum* (Figure 2 E and C) respectively. These results are in harmony with those of Lersten (1982) who observed that micropyle shape in some *Cicer* species was circular or deltoid depression and adnate to the hilum .

3.2. Anatomical studies

3.2.1. Seed testa

Table (3) and Figure (3) indicated that the highest values for average thickness of the palisade like cells (400 μ) and average thickness of the hour glass cells (140 μ) were found in *C.echinospermum* (Figure 3 B). Furthermore, the highest value of average thickness of the parenchymatous tissue (700 μ) and number of palisade like cells row (2) were found in *C. arietinum*. (Figure 3 A). In addition, the lowest ones for the average thickness of the palisade-like cells (260 μ), average thickness of the hour glass cells (60 μ) and average thickness of the parenchymatous tissue (230 μ) were noticed in *C.judaicum*, *C.reticulatum* and *C.echinospermum* (Figure 3C, D and B); respectively. Hour glass cells were homogenous in *C.arietinum*, *C.judaicum* and *C.yamashitae* (Figure 3 A, C and E) respectively; whereas, they were heterogeneous in both *C.echinospermum* and *C.reticulatum* (Figure 3 B and D) respectively. Presence of light line in the palisade like cells, spinelets on the spines and papillae on the testa surface were characteristic for *C.reticulatum*, *C.echenospermum* and *C.judaicum* (Figure 3D, B and C) respectively. Moreover, the presence of spines on the testa surface was shown in both *C.echinospermum* and *C.reticulatum* (Figure 3 B and D). Presence of crests and troughs was recorded in *C. yamashitae* (Figure 3 E). These results are similar with the data obtained by Lersten and Gunn (1981) who reported that the testa of tribe Cicereae consisted of the single layer of thick slender elongated palisade cells, hour glass cells and defined zone of parenchymatous cells; the palisade cells in most *Cicer* species extend above the surface and give

Table (3): Anatomical characters of the five *Cicer* species seed testa .

Characters ↓	<i>C.arietinum</i>	<i>C.echinosperrum</i>	<i>C.judaicum</i>	<i>C.reticulatum</i>	<i>C.yamashitae</i>
Average thickness of the palisade like cells (μ)	360	400	260	380	355
Average thickness of the hour glass cells (μ)	100	140	80	60	120
Average thickness of the parenchymatous zone (μ)	700	230	490	310	440
Number of palisade like cells rows	2	1	1	1	1
Hour glass cells homogeneity	Homogeneous	Heterogeneous	Homogeneous	Heterogeneous	Homogeneous
Presence of light line in the palisade like cells	-	-	-	+	-
Presence of spines on the testa surface	-	+	-	+	-
Presence of spinelets on the spines	-	+	-	-	-
Presence of papillae on the testa surface	-	-	+	-	-
Presence of crests and troughs on the testa surface	-	-	-	-	+

+ = Present
- = Absent

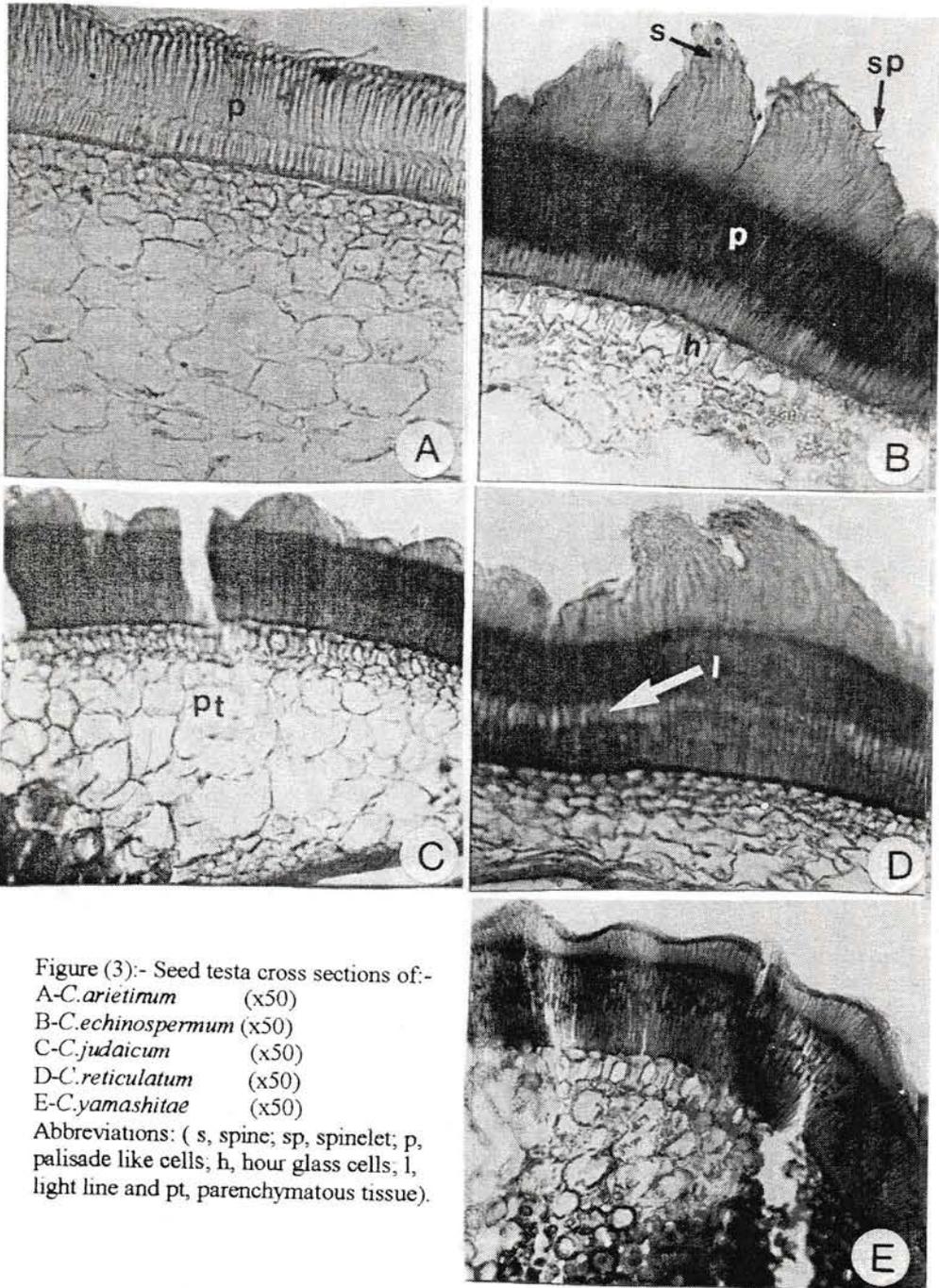


Figure (3):- Seed testa cross sections of:-
A-*C.arietinum* (x50)
B-*C.echinospermum* (x50)
C-*C.judaicum* (x50)
D-*C.reticulatum* (x50)
E-*C.yamashitae* (x50)

Abbreviations: (s, spine; sp, spinelet; p, palisade like cells; h, hour glass cells, l, light line and pt, parenchymatous tissue).

the testa a papillose and echinate spinelets.

3.2.2. Seed testa at hilar region

It is clear from Table (4) and Figure (4) that the shape of tracheid bar was narrowly elliptical in *C.arietinum* (Figure 4 A); broadly elliptical in both *C.echinosperrum* and *C.reticulatum* (Figure 4 B and D); pear-shaped in *C.judaicum* (Figure 4 C) and small elliptical in *C.yamashitae* (Figure 4 E). Presence of funicle on the hilum was observed in *C.arietinum*, *C.reticulatum* and *C.yamashitae* (Figure 4 A, D and E); whereas, it was absent in other *Cicer* species (Figure 4 B and C). Also, the presence of amorphous inclusion in palisade like cells and counter palisade layer was found in both *C.echinosperrum* and *C.reticulatum* (Figure 4 B and D) and it was absent in the studied *Cicer* species. However, the presence of amorphous inclusion in parenchymatous tissue was shown in *C.echinosperrum*, *C.judaicum* and *C.reticulatum* (Figure 4 B, C and D) respectively; whereas, it was absent in both *C.arietinum* and *C.yamashitae* (Figure 4 A and E). Maximum values of thickness of palisade layer (300 μ), thickness of the counter palisade layer (200 μ), summation of the palisade layer + the counter palisade layer (560 μ) and thickness of aperture at hilar groove (480 μ) were recorded in *C.reticulatum* Figure (4 D). In addition, the maximum average length of tracheid bar (1750 μ) and the maximum average width of tracheid bar (900 μ) were observed in *C.arietinum* (Figure 4 A). The lowest values of both thickness of palisade layer (140 μ) and thickness of aperture hilar groove (200 μ) were found in *C.echinosperrum* (Figure 4 B). In addition, the lowest values of thickness of the counter palisade layer (160 μ), summation of the palisade layer + the counter palisade layer (360 μ) and the maximum width of tracheid bar (300 μ) were noticed in both *C.judaicum* and *C.yamashitae* (Figure 4 C and E). On the other hand, the lowest value of maximum average length of tracheid bar (400 μ) was observed in *C.yamashitae* (Figure 4 E). These results are in agreement with those obtained by Lersten (1981) and (1982) and Sakr (2000) who described the tracheid bar of some *Cicer* and *Vicia* species, where it was pear-shaped, small elliptical, narrowly elliptical and broadly elliptical shape. Also, they observed that the funiculus was remnant at hilar groove in some *Cicer* species .

Table (4): Anatomical characters of the five *Cicer* species seed testa at hilar region .

Characters ↓	Species →	<i>C. arictinum</i>	<i>C. echinospermum</i>	<i>C. judaicum</i>	<i>C. reticulatum</i>	<i>C. yamashitae</i>
Shape of tracheid bar		Narrowly elliptical	Broadly elliptical	Pear-shaped	Broadly elliptical	Small elliptical
Presence of funicle on the hilum		+	-	-	+	+
Presence of amorphous inclusion in palisade like cells and counter palisade layer		-	+	-	+	-
Presence of amorphous inclusion in parenchymatous zone		-	+	+	+	-
Thickness of palisade layer (μ)		200	140	200	300	200
Thickness of the counter palisade layer (μ)		250	240	160	260	160
Summation of the palisade layer + the counter palisade layer (μ)		450	380	360	560	360
Thickness of aperture hilar groove (μ)		400	200	220	480	220
Maximum average length of tracheid bar (μ)		1750	840	440	760	400
Maximum average width of tracheid bar (μ)		900	600	300	640	300

+ = Present

- = Absent

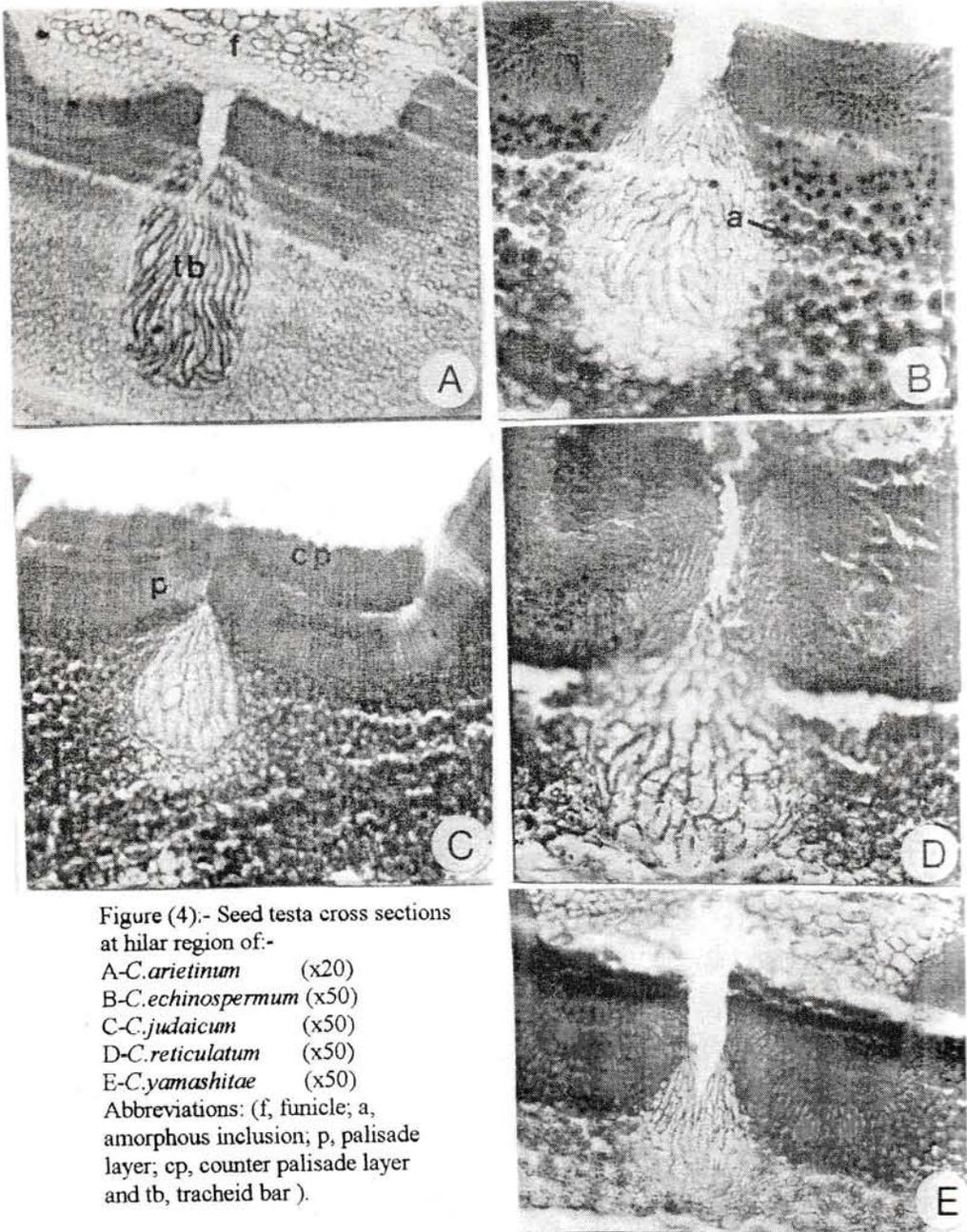


Figure (4):- Seed testa cross sections at hilar region of:-

A-*C. arietinum* (x20)

B-*C. echinospermum* (x50)

C-*C. judaicum* (x50)

D-*C. reticulatum* (x50)

E-*C. yamashitae* (x50)

Abbreviations: (f, funicle; a, amorphous inclusion; p, palisade layer; cp, counter palisade layer and tb, tracheid bar).

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بعض خصائص البذرة التي تميز بعض أنواع الحمص

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ملخص

درست مورفولوجيا البذرة وتركيب القصرة لبعض أنواع الحمص *C. reticulatum* ، *C. judaicum* ، *C. echinospermum* ، *C. arietinum* ، *C. yamashitae* ، بواسطة الميكروسكوب الإلكتروني الماسح والضوئي وقد أمكن التوصل للنتائج التالية:

أظهرت الصفات المورفولوجية للبذرة ولونها وتضاريس القصرة وشكل السرة والنقير اختلافات واضحة بين أنواع الحمص المدروسة. وقد اختلفت الأنواع في الصفات التشريحية لكل من قصرة البذرة والقصرة عند منطقة السرة. يعتبر لون البذرة البني المائل للأسود وتضاريس القصرة ذات الأشواك وكذلك وجود الشوكيات على هذه الأشواك والسرة والنقير الاهليجي مميزة للنوع *C. echinospermum* . بالإضافة لذلك فإن القصرة ذات التضاريس المتموجة والحلمية وذات النتوات الشوكية ووجود المنخفضات والمرتفعات تعتبر مميزة لكل من *C. yamashitae* ، *C. reticulatum* ، *C. judaicum* ، *C. arietinum* على التوالي. كذلك وجود الخط الأبيض في النسيج الشبيه بالعمادي صفة مميزة للنوع *C. reticulatum* . يكون النسيج الشبيه بالعمادي ذو الصفيين والشكل الكثرى للـ Tracheid bar مميزاً للنوع *C. arietinum* والنوع *C. judaicum* على التوالي.

سجلت أعلى القيم لمتوسط طول وعرض البذرة ومنتوسط طول السرة وعرضها وسمك النسيج البارانشيمي ومنتوسط طول وعرض الـ Tracheid bar في النوع *C. arietinum* . سجلت علاوة على ذلك أعلى القيم لمتوسط أقصى طول وعرض للنقير وسمك النسيج الشبيه بالعمادي وسمك الخلايا الشبيهة بزجاجات الساعة في النوع *C. echinospermum* . بالإضافة لذلك فلقد لوحظت أعلى قيمة لمتوسط نسبة العرض لطول السرة في النوع *C. yamashitae* . و سجلت أيضا أعلى القيم لسمك الطبقة العمادية عند منطقة السرة وكذلك سمك الطبقة العمادية المقابلة ومجموعهما وسمك فتحة اخدود السرة للنوع *C. reticulatum* .

المجلة العلمية لكلية الزراعة - جامعة القاهرة - المجلد (51) العدد الثالث
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