

Comparative Botanical Studies on Some Trifoliolate Plants Belonging to the Subfamily Faboideae in Egypt

Hamza, M.K.⁽¹⁾, Sahar, F. El-Hefnawy⁽²⁾, El-Taher, A. M.⁽¹⁾ and Shahinaz, El-Shahat⁽¹⁾

⁽¹⁾Dept. of Agricultural Botany, Fac. of Agric., Al-Azhar Univ., Cairo, Egypt.

⁽²⁾Dept. of Biological and Environmental Science, Fac. of Home Economic Al-Azhar Univ., Tanta.

Corresponding author: shmariam69@yahoo.com

Abstract

Papilionoideae (Faboideae) is the largest subfamily in the family Leguminosae. The study occurs on some trifoliolate species belonging to this subfamily. The investigations include the morphological characters of the vegetative organs (stems and leaves) beside the micromorphological features obtained from the examinations of the leaflets epidermis (cell walls shape, trichomes forms, stomatal types and the presence or absence of oxalate crystals). Also the study includes floral aspects and the type and shapes of fruits and seeds.

Keywords: Stem, leaves, flowers, stomata, fruits, seeds, Faboideae, morphology

Introduction

The subfamily Papilionoideae (Faboideae) is the largest subfamily in the Leguminosae which comprises over 13,800 species, many of which are important as food crops Miller *et al.* (2011). Habit of *Psoralea* is perennial herbs and subshrubs; habit of *Phaseolus vulgaris* is annual herbs, Meikle (1985). Habit of *Cajanus cajan* is shrub habit of *Melilotus indica* is herb with pubescent biennial, habit of *Trigonella foenum-graecum* is annual herb, Gupta (2010). Habit of *Melilotus* was annual or biennial herbs, sparse to glabrescent. Stems erect, terete, stipules falcate, entire. Leaves trifoliolate; petiole slender, usually leaflets obovate, margins shallowly serrated. And important family Papilionaceae were eaten as vegetable as in *Phaseolus vulgaris* and *Cajanus cajan*, *Dolichos lablab* and *Cyamopsis tetragonoloba*, *Trigonella foenum-graecum*, *Vigna sinensis* and used as fodder as in *Cyamopsis tetragonoloba*, *Melilotus indica*, *Medicago sativa*, *Trifolium alexandrinum* and *Trifolium resupinatum* and used oil for cooking and. Pandey 2004.

Stomata were anomocytic and the guard cells were surrounded by 3, 4 or rarely 5 subsidiary cells. They were found on both surfaces, but the upper epidermis had fewer stomata Özbek *et al.* (2014). Anomocytic stomata in *Phaseolus vulgaris* bears anisocytic stomata, *Erythrina indica*, *Phaseolus mungo*, lineate bears only paracytic stomata. *Melilotus alba*, *Melilotus indica*, bear both anisocytic and anomocytic stomata. Leaf of *Erythrina* is -blade, in front view, epidermis with predominance of branched and glandular trichomes and paracytic and anisocytic stomata on both surfaces. In the adaxial surface, epidermal cells on the veins had prismatic crystals on their interior. The anticlinal walls of epidermal cells are sinuous on both surfaces leaf-blade presented branched trichomes with uniseriate stems Tripathi and Mondal (2012)

Leaf of *Erythrina* is -blade, in front view, epidermis with predominance of branched and glandular trichomes and paracytic and anisocytic stomata on both surfaces. In the adaxial surface, epidermal cells on the veins had prismatic crystals on their interior. The anticlinal walls of epidermal cells are sinuous on both surfaces leaf-blade presented branched trichomes with uniseriate stems Márcia *et al.* (2013).

Iflorescence of *Melilotus* is racemes white with bluish-purple tipped wings and keel, 3-6 mm. Ovary narrowly ovate with two ovules. Legume ovoid, 3-5 mm, puberulent, with longitudinal ridges. The seed-surface ornamentation was smooth in *M. albus*, papillate in *M. sulcatus*, granulate in *M. elegans* and striate in *M. indicus*. The hilum was elliptic. The seed coat ornamentation was tuberculate-rugose. Seeds 2, dark brown to dark green in color, globose to obovoid, papillate. The pollen grains of *M. bicolor* were 98% tricolporate, 2% syncolporate and were isopolar and radially symmetrical. Their shape was subprolate. The colpi were long and narrow with clear margins. Pores are elongate or circular. The aperture membrane was granulate. The pollen in *M. indicus* is tricolporate, subprolate-prolate and the sculpture was micro reticulate. Pollen grains in *M. albus*, *M. sulcatus*, *M. siculus* Begum *et al.* (2014). Pollen grains of *Coronilla scorpiodes* are colporate and striate-rugulate ornamentation Diez and Ferguson (1996). Pollen grains of Papilionoideae are in monads Takhtajan (2009). Pollen grains of *Ebenus* had tricolporate apertures, circular in polar view, with shallow colpi, and lumina of the reticulum sharply Ghanavatiet *et al.* (2011).

The present study occurs on 19 genera with 37 species are trifoliolate plants belonging to the subfamily Faboideae (Papilionoideae). The investigations including stems, leaves, flowers, fruits, and seeds the characters of these organs recorded comparatively for each species.

Aim of the work

This study aims to clear the inter relationships of between these studied samples, by using a numerical analysis program to reach to this purpose.

Materials and Methods**Materials:**

This work was carried out in the Department of Agricultural Botany, Faculty of Agriculture, Al-

Azhar University, Nasr city, Cairo, Egypt. The plant samples were obtained from eight different locations as shown in (Table1). The plant contained 37 species, representing 19 genera belonging to the subfamily Faboideae , all with trifoliate leaves. The identification of the collected plants were achieved by comparing their morphological characters with those of the previously identified plants as published by Täckholm (1974) and Boulos (1999)

Table 1. Alphabetical list of (37) species, representing (19) genera belong to subfamily Faboideae. The studied samples were obtained from eight Egyptian places from various locations. These locations are: C. = Cairo university herbarium; I.= Ismaalia Governorate; N.= Nasr city Cairo; Q.= Qalubia Governorate; R.= Orman Garden (Giza); and S.= Areysh North Sainai .

No.	Species	Source
1	<i>Argyrolobium abyssinicum</i> Jaub. & Spach.	C
2	<i>Cajanus cajan</i> (L.) Millsp.	N
3	<i>Coronilla scorpiodes</i> (L.)W.D. J. Koch.	C
4	<i>Cyamopsis tetragonoloba</i> (L.) Taub.	N
5	<i>Dolichos lablab</i> L.	R
6	<i>Ebenus armitagei</i> Schweinf. & Taub.	C
7	<i>Erythrina caffra</i> Thunb.	G
8	<i>E. corallodendron</i> L.	R
9	<i>Glycine max</i> (L.) Merr.	I
10	<i>Medicago arabica</i> (L.) Huds.	C
11	<i>M. constricta</i> (Durieu) Ponert	C
12	<i>M. intertexta</i> (L.) Miller	C
13	<i>M. littoralis</i> Rohde ex.Lois.	C
14	<i>M. minima</i> (L.) Bart	C
15	<i>M. orbicularis</i> (L.) Bartal	S
16	<i>M. polymorpha</i> L.	C
17	<i>M. sativa</i> L.	Q
18	<i>Melilotus elegans</i> Salzm ex.Ser.	S
19	<i>M. indica</i> (L.) All.	I
20	<i>M. siculus</i> (Turra)B.D.Jacks	S
21	<i>M.sulcatus</i> Desf.	S
22	<i>Onomis serrate</i> Forssk	M
23	<i>O. vaginalis</i> M.Vahl.	M
24	<i>Phaseolus vulgaris</i> L.	Q
25	<i>Pseudarthia hookeri</i> Wight& Arn	N
26	<i>Psoralea plicata</i> Delile	N
27	<i>Rhynchosia minima</i> (L.) DC.	N
28	<i>Tetragonolobus purpureus</i> L.	N
29	<i>Trifolium alexandrinum</i> L.	Q
30	<i>T. respinatum</i> L.	C
31	<i>T.stellatum</i> L.	C
32	<i>Trigonella arabica</i> Delile	C
33	<i>T. hamosa</i> L.	C
34	<i>T. foenum-graecum</i> L.	C
35	<i>T.maritime</i> Poir.	C
36	<i>T. monspelica</i> L.	C
37	<i>Vigna sinensis</i> L.	I

Methods:

Parts of fresh materials were fixed in F.A.A. solution for a minimum period of 48 hours and then

samples were taken from various parts of plant organs to study different aspects. The dry specimens parts were resuscitated by boiling with a few drops of

the detergent "misrol" then treated as fresh materials. Epidermal peels of mature foliage leaves and stems were cleared in warm lactic acid, then they were examined microscopically to study the structure of mature stomata, types of trichomes, cell walls shaped and cell surface ornamentations.

The floral parts were dissected under stereomicroscope into their different parts and spread over slides. The sample parts were cleared by worming in lactic acid to study the macro- and micro- morphological features of the floral parts. Semi-permanent pollen preparations were made according to the method of **Franks and Watson (1963)**. Pollen dimensions have been measured using a calibrated ocular micrometer.

Results and Discussions

Morphological aspects have been recorded for stem, leaves, flowers, fruits and seeds for 37 species belonging to Faboideae. They consist of 83 characteristic covering both the vegetative and floral organs. These characteristics are described in details as follows:

Habit : The plants are mostly annual herbs as in *Phaseolus vulgaris* and *Glycine max* (Fig. 1) but they are perennial shrubs as in *Psoralea plicata* and *Cajanus cajan* (Fig. 2) or perennial trees as in *Erythrina spp.* (Fig. 3). All the studied *Medicago* species are annual herbs except *Medicago sativa* which has perennial herbs. This is in harmony with **Meikle (1985)** and **Gupta (2010)**.

Stem : It is usually erect except some studied samples such as *Dolichos lablab* *Medicago constricta* *Vigna sinensis* (Fig. 4) which has climbing stems and *Medicago littoralis* (Fig. 5) which has prostrate stems. The stem is mostly angular, herbaceous and hollow as in *Medicago spp.* and *Melilotus spp.*, while some plant samples have cylindrical woody and solid stems specially in shrubs and trees samples. Most examined samples with hairy stems such as *Vigna sinensis*, in few samples stem is smooth such as *Medicago constricta*, while rough stem observed only in *Erythrina spp.*

Leaf: It is usually petiolate and stipulate as in *Cajanus cajan* (Fig. 6) except *Coronilla scorpiodes* which has sessile leaf (Fig. 7). Stipules are mostly leafy as in *Cajanus cajan*, while they are small appendages in few species such as *Dolichos lablab*. The leaflets are varies in shapes, they are ovate as in *Erythrina corallodendron* (Fig. 8), cordate as in *Dolichos lablab* (Fig. 9), lanceolate as in *Cajanus cajan* (Fig. 10), oblong as in *Melilotus sulcatus* (Fig. 11), obcordate as in *Medicago littoralis* and obovate as in *Medicago orbicularis* (Fig. 12). The apex of lamina is notched as in *Medicago littoralis*, acute as in *Cajanus cajan*, acuminate in *Dolichos lablab* and rounded as in *Melilotus elegans* (Figs. 12, 13, 14 and 15). The base of lamina is rounded as in *Erythrina corallodendron*, cuneate as in *Medicago*

orbicularis and cordate as in *Dolichos lablab* (Figs. 16, 17 and 18). The leaf margin is entire in *Melilotus sulcatus*, serrate in *Medicago littoralis* and wavy in *Psoralea plicata* (Figs. 19, 20 and 21 respectively) these results are in agreement with the finding of **Özbek et al. (2014)**.

The micromorphological studies on the leaflet epidermis showed:

a- **Hairs:** Several epidermal hair forms are recorded on the stem and leaflets adaxial and abaxial surfaces and also on the floral parts of the studied samples. These forms are distinguished into : Shaggy hairs with acute apex as in *Trifolium respinatum* (Fig. 22.), unicellular hairs unbranched with acute apex as in *Medicago sativa* (Fig. 23), unicellular hairs with glandular apex *Erythrina caffra* (Fig. 24), unicellular hairs branched with eglandular hair as in *Cymopsis tetragonolobus* (Fig. 25), multicellular hair branched with rounded apex as in *Melilotus elegans* (Fig. 26) and multicellular hair branched with glandular apex as in *Dolichos lablab* (Fig. 27).

b- **The epidermal cell walls** in surface view are mostly wavy or sinuate as in *Argyrolobium abyssinicum* (Fig. 28), but some investigated species have epidermis with straight cell walls as in *Coronilla scorpiodes* (Fig. 29), calcium oxalate crystals are observed in the epidermis in most examined sample as in *Melilotus sulcatus*, (Fig. 30). These observation are in accordance with **Tripathi and Mondal (2012)**.

c- **Stomata :** Five types of stomata are recorded the studied taxa these types are anisocytic as in *Trigonilla monspeliaca* (Fig.31), tricytic as in *Vigna sinensis* (Fig.32), paracytic as in *Glycine max* (Fig.33), tetracytic as in *Erythrina caffra*(Fig.34) and anomocytic as in *Trigonella maritime* (Fig.35), the common types of stomata are anisocytic and paracytic. Both associated and abnormal stomata are observed in few studied samples such as *Melilotus salcata*, *Melilotus indica* and *Ononis vaginalis* (Figs. 36, 37 and 38 respectively) These observations are in accordance with **Márcia et al.(2013)**.

Flowers: all the investigated samples have the flowers in clusters or inflorescences, they are in racemes as in *Melilotus elegans* (Fig. 39), capitate as in *Trifolium alexandrinum* (Fig. 40), umbel in *Erythrina caffra* (Fig. 41), head in *Trigonilla maritima* (Fig. 42) and spike as in *Pseudarthia hookeri*.

Calyx: Calyx is usually with five united sepals in most examined samples as in *Dolichos lablab*, but few samples contain only four sepals as in *Cajanus cajan*.

Sepals may be equal in length as in *Dolichos lablab* (Fig. 43) or unequal as in *Glycine max* (Fig. 44) Calyx is persistent in most of the examined species as in *Melilotus spp.* but it deciduous calyx recorded in few species as in *Medicago polymorpha*.

Sepals are often possess different shape of hairs , these hairs are unicellular or multicellular also they are glandular or eglandular. Average of sepals length of ranged between 0.3 mm.-1.7cm. while Average width are 0.3 mm .- 1.7cm. and number of veins per sepals varies from one to four.

Corolla: is usually polypetalous , it consists of 5 free petals with papilionate shape. The apex of standard is retuse in some plant samples as in *Argyrolobium abyssinicum* ,while they are obtuse-acute in *Cymopsis tetragonolobus*, and *Medicago constricta* . Standard is clawed in all examined samples, but not clawed in *Erythrina corallodendron* . This petal is mostly have dark veins, while in *Medicago constricta* and *M. littoralis* the color of blade as same as veins. Standard is glabrous in most of samples as in *Coronilla scorpiodes* but it is hairy in few samples as in *Argyrolobium abyssinicum*. Lateral petals were known as wings , the anterior pairs of united petals is termed keel this encloses two united petals contains both stamens and carples . keel is clawed in most samples while it is not clawed in few samples as *Phaseolus vulgaris*, keel with dark veins in all examined samples except in *Medicago constricta*, *M. littoralis* which have veins as same as blade. Average of petal length is. 0.2mm.-5 cm. Average of petals width is 0.2mm.-2.7cm. Number of veins are ranged between 4 and 28. Petals color varies from white as in *Trigonilla arabica*, yellow as in *Cajanus cajan*, *Trigonilla maritima* , red as in *Erythrina corallodendron*, rose in *Ebenus armitagei* orang in *Erythrina caffra* or move in *Dolichos lablab* and *Medicago sativa*.

Androecium: stamens are united in all examined taxa, except in *Dolichos lablab* which have free stemens, the united stamens are mostly diadelphus as in *Glycine max*, *Phaseolus vulgaris*, and *Trigonilla hamosa* (Fig. 45), but some samples have monadelphus stamens such as *Coronilla scorpiodes*, (Fig. 46) Anther is mostly with elongate shape as in *Cajanus cajan* , while it is globular in some examined taxa as in *Medicago arabica*. The staminal filament is usually included in corolla in most examined samples, but it is excluded from corolla in the others as in *Trigonilla arabica* and *Melilotus indica* .The staminal filament is often glabrous ,while it is hairy in few species. The filament length varies from 2 mm. to 3.1cm. in most examined samples.

Pollen grains: The pollen grains are usually monads and globular to oblong in all examined plants, these grains have three apertures they may be 3-porate as in *Coronilla scorpiodes* (Fig. 47), 3-colpate as in *Medicago polymorpha* (Fig.48) or 3-colporate as in *Medicago minima* (Fig.49), Exine texture is mostly granulose in most examined species except some species which have reticulate or smooth exine. The equatorial dimensions of pollen grains ranged between 12 and 56 μ . in all examined

plants. These results are in agreement with **Diez and Ferguson (1996)**. **Takhtajan (2009)**. **Ghanavatiet et al. (2011)**. **Begum et al. (2014)**.

Gynoecium: ovary is hairy in most examined plants as in *Cymopsis tetragonoloba*, while it is glabrous in some samplless as in *Tetragonolobus purpureus*. Style is hairy in few plants as in *Coronilla scorpiodes* and *Erythrina*, while it is glabrous in most of samples as in *Medicago spp.* and *Trigonella spp.*. Stigma with glandular hairs in *Erythrina caffra*, *Glycine max*, *Medicago polymorpha* and *Phaseolus vulgaris* , but it eglandular hairs as in *Psoralea plicata*, *Trifolium stellatum* and *Vigna sinensis*.

Fruits: is pod or legume. Pod is flattened in most examined samples as in *Dolichos lablab* (Fig. 50) while it is terete in some plants as in *Erythrina caffra* (Fig. 51). The beak of pod is present in most examined plants as in *Erythrina caffra* (Fig. 51), but it is absent in the others as in *Onomis serrate* .The pod constricted between seeds in few plants as in *Erythrina caffra* (Fig. 51). The shapes of fruits are straight as in *Dolichos lablab* (Fig. 50), (Fig), curved in *Trigonilla hamosa* (Fig. 53) and spirrally in *Medicag intertexta*, (Fig. 52). The fruit exocarp is woody in *Erythrina caffra* (Fig. 51) herbaceous in *Medicago intertexta*, (Fig. 52) or papary in *Trigonilla hamosa* (Fig 53), leathery as in *Dolichos lablab* (Fig. 50). Fruit apex are varies in shapes it is rounded in few plants as in *Medicago littoralis* , acute or acuminate in most examined plants as in *Trigonella maritime*. Fruits are smooth in few samples as in *Erythrina caffra*, hairy in *Glycin max* (Fig. 54), spiny in *Medicago constricta* (Fig. 55). The average length of fruit is 2,2 cm. -14.5mm., while the average width of is 0.2 mm.-2.5cm.

Seeds: seed surface is usually smooth as in *Coronilla scorpiodes* but few samples have corrugated –grooved seeds as in *Ononis vaginalis*. Seeds are usually have hilum as in *Vigna sinensis* while some species their seeds without hilum as in *Ebenus armitagei* .

Seeds arranged in pod in one row in all studied samples except *Onomis serrate* the seeds arranged inside the pod into two rows. Seeds shapes varies from globular as in *Cymopsis tetragonolobus*, oblong in *Phaseolus vulgaris* (Fig. 57), kidney in *Medicago intertexta* (Fig. 56), obovate *Trigonilla arabica* (Fig. 58), ovate as in *Trifolium alexandrinum*. Seeds are also varies in color it is yellow in *Argyrolobium abyssinicum*, brown in *Medicago intertexta*, black in *Rhynchosia minima* , cream in *Vigna sinensis* orange in *Erythrina corallodendron*. Seeds length ranged between .02 mm.-1.5 cm., while the width ranged between 0.1mm. -0.7 mm. Number of seeds per pod varies from 1 to 23 seeds.

Table 2: List of the 83 different characters, recorded comparatively based on the morphological features of 37 species (19 genera) representing trifoliolate plants (Fabaceae). These characters are distinguished into 47 qualitative; 17 multistate and 19 numerical characters.

Qualitative characters:

Vegetative characters:

1. **Habit:** Annual (+) / perennial (-)
2. **Stem :** Cylindrical (+) / angular (-)
3. “ Herbaceous (+) / woody (-)
4. “ Solid (+) / hollow (-)
5. **Leaves:** Stipulate (+) / exstipulate (-)
6. “ Petiolate (+) / sessile or sub sessile (-)
7. “ Stipules, leafy (+) / small appendages (-)
8. “ leaflets, upper surface hairy (+) / glabrous (-)
9. “ “ lower “ “ (+) / “ (-)
10. “ “ hairs, unicellular (+) / multicellular (-)
11. “ “ glandular (+) / eglandular (-)
- 12- epidermal cell walls straight (+) / wavy or sinuate (-)
13. “ “ “ prismatic crystals present (+) / absent (-)
14. “ stomata paracytic present (+) / absent (-)
15. “ “ “ “ tricytic “ (+) / “ (-)
16. “ “ “ “ tetraparacytic “ (+) / “ (-)
17. “ “ “ “ anomocytic “ (+) / “ (-)
18. “ “ “ “ anisocytic “ (+) / “ (-)
19. “ associated stomata present (+) / absent (-)
20. “ abnormal “ “ (+) / “ (-)

Floral characters :

21. **Calyx,** sepals, five (+) / four (-)
22. “ equal in length (+) / unequal (-)
23. “ persistent (+) / deciduous (-)
24. “ hairy (+) / glabrous (-)
25. **Corolla,** hairy (+) / glabrous -
26. “ standard, apex retuse (+) / obtuse-acute (-)
27. “ clawed (+) / not clawed
28. “ with dark veins (+) / not so (-)
29. “ wings clawed (+) / not clawed (-)
30. “ with dark veins (+) / not so (-)
31. “ margin entire (+) / not so (-)
32. “ keel clawed (+) / not clawed (-)
33. “ with dark veins (+) / not so-
34. **Androecium,** stamens, united (+) / free (-)
35. “ -monodelphus (+) / diadelphus (-) / if free *
36. “ anther, elongate (+) / globular (-)
37. “ filament, inserted in corolla (+) / exerted from corolla (-)
38. “ hairy (+) / glabrous (-)
39. **Gynoecium,** ovary, hairy (+) / glabrous (-)
40. “ style, hairy (+) / glabrous (-)
- 41- stigma, glandular (+) / eglandular (-)
42. **Fruits,** pod, terete (+) / flattened (-)
43. “ “ with beak (+) / not so (-)
44. “ “ constricted between seeds (+) / not so (-)
45. “ “ seeds arrangement in one row (+) / in two rows (-)
46. “ “ - surface smooth (+) / corrugated or grooved (-)
47. “ seed with hilum (+) / without hilum (-)

II. Multistate character

48. **Habit:** (3 categories): herbs 1; shrubs 2 and trees 3.
49. **Stem:** (3 categories): erect 1; climbing 2 and prostrate 3.
50. “ touch: (3 categories): glabrous 1; hairy 2 and rough 3.
51. **Leaflet,** apex; (4 categories): acute 1, acuminate 2, rounded 3 and notched 4.
52. “ base; (3 categories): rounded 1, cuneate 2, and cordate 3.

53. " margin: (3 categories): entire 1; serrate 2 and wavy 3.
54. " blade shapes: (5 categories): ovate 1, cordate 2, lanceolate 3, oblong 4, and obovate 5 .
55. **Inflorescence** : (5 categories): raceme 1; capitate 2; umbel 3; head 4 and spike 5.
56. **Corolla color**: (6 categories): white 1; yellow 2; red 3; rose 4; orange 5 and move 6.
57. **Pollen grain aperatures** :(3 categories): porate 1; colpate 2 and colporate 3.
58. " " exine sculpture: (3 categories): smooth 1; granulose 2 and reticulate 3. 59. **Fruits** straightness: (4 categories): straight 1; curved 2; heliocoide 3 and spiraly 4.
60. " exocarp: (4 categories): woody 1; herbaceous 2, lathery 3 and papry 4.
61. " apex:(3 categories): rounded 1; acute 2 and acuminate 3.
62. " touch (3 categories): smooth 1; hairy 2 and spiny 3.
63. **Seed shapes**:(5 categories): globular 1; oblong 2; kidney 3, obovate 4 and ovate 5.
64. " colors: (6 categories): yellow 1; brown 2; black 3; white 4; cream 5 and orange 6.

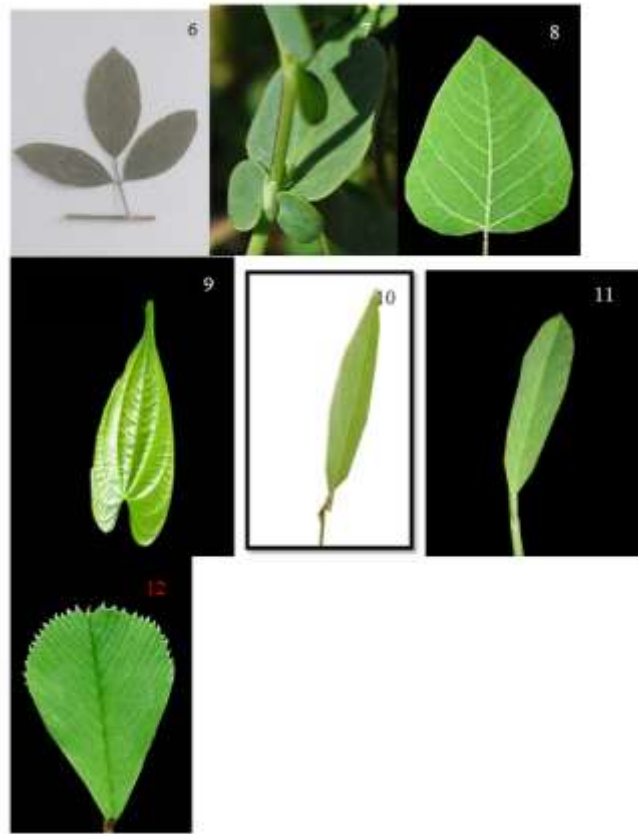
III. Numerical characters

65. Average of leaf length in cm.
66. " " " width
67. " " " leaflet length
68. " " " width
69. Average of sepals length in cm.
70. " " " " width "
71. " " " " number of sepal veins.
72. Average of petal length in cm,
73. " " petal width "
74. " " veins per petal .
75. " stamen length in cm.
76. " pollen grains polar dimension (P) in u.
77. " " " equatorial dimension (E) in u.
78. " P/E
79. " fruit pod length in cm.
80. " width "
81. seed length "
82. seed width "
83. Number of seed per pod.



Figures: (1 - 5) Showed types of habit and stem of :

Fig. (1) *Glycine max*, Fig; (2) *Cajanus cajan*; Fig. (3) *Erythrina caffra*; , Fig. (4) *Vigna sinensis* and Fig. (5) *Medicago littoralis*



Figures : (6 — 12) Showed leaflet shapes :

Fig. (6) *Cajanus cajan*; Fig. (7) *Coronilla scorpiodes* ; Fig. (8) *Erythrina corallodendron*, Fig. (9) *Dolichos lablab*, Fig. (10) *Cajanus cajan*, Fig. (11) *Melilotus sulcatus* Fig. and (12) *Medicago orbicularis*.



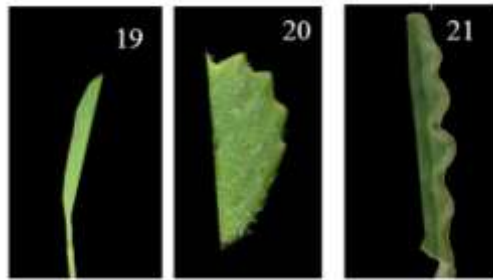
Figures : (13 — 15) Showed leaflet laminal apex shapes of:

Fig. (13) *Cajanus cajan*, Fig. (14) *Dolichos lablab*, Fig. and (15) *Melilotus elegans* Fig.



Figures : (16— 18) Showed leaflets laminal base shapes of:

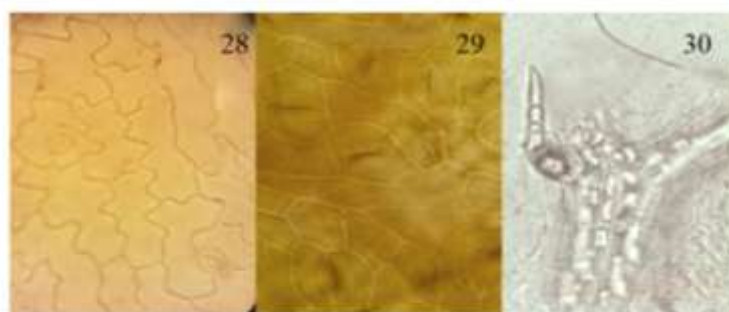
Fig. (16) *Erythrina corallodendron*, Fig. (17) *Medicago orbicularis* and Fig. (18) *Dolichos lablab*



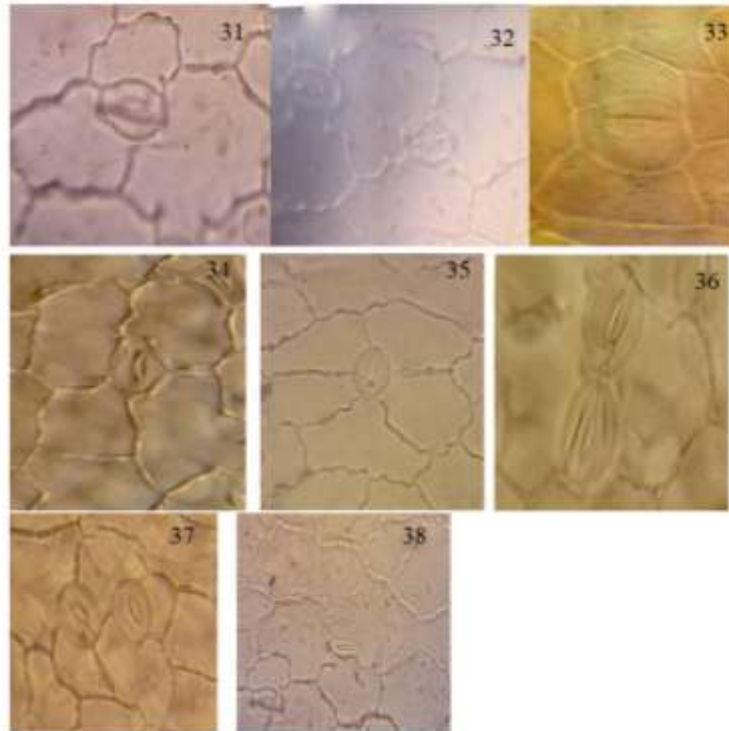
Figures : (19 — 21) Showed leaflets laminal margin shapes of: Fig. (19) *Melilotus salcatus* , Fig. (20) *Medicago littoralis* and Fig. (21) *Psoralea plicata*.



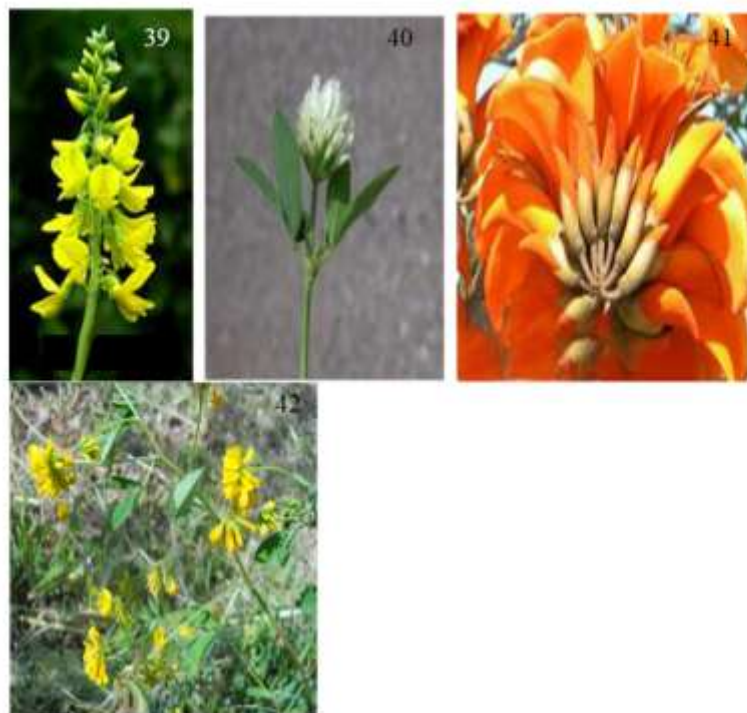
Figures: (22— 27) Showed hair forms on the leaflets: Fig. (22) *Trifolium resupinatum*, Fig. (23) *Medicago sativa* ,Fig. (24) *Erythrina caffra* Fig. (25) *Cymopsis tetragonolobus*, Fig.(26) *Melilotus elegans* and Fig(27) *Dolichos lablab*.



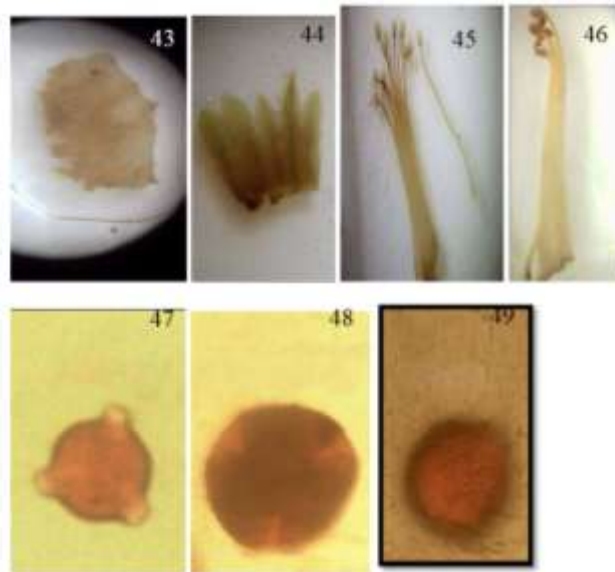
Figures : (28 — 30) Showed The epidermal cell walls and Calcium oxalate crystals ,Fig. (28) *Argyrolobium abyssinicum*, Fig. (29) *Coronilla scorpiode* and Fig. (30) *Melilotus sulcata*.



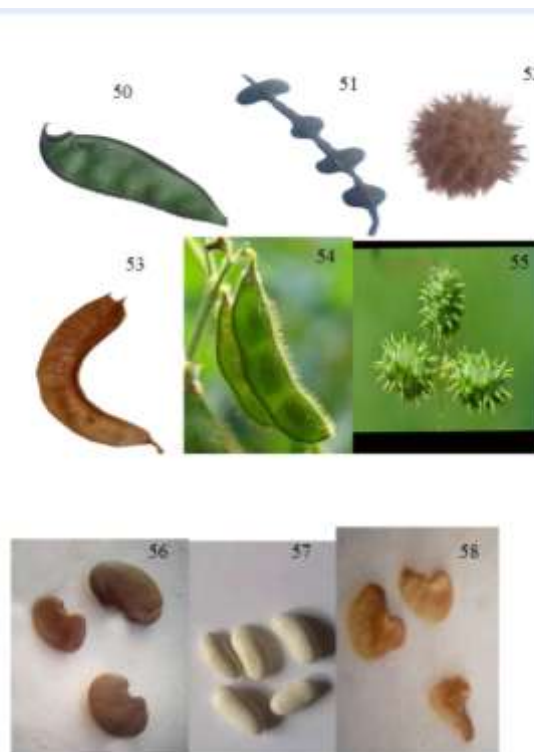
Figures : (31 — 38) Showed stomatal types , associated and abnormal stomata ,Fig. (31)*Trigoella monspeliaca*, Fig. (32) *Vigna sinensis* ,Fig. (33) *Glycine max*, Fig.(34) *Erythrina caffra*, Fig.(35) *Trigoella maritime*, Fig.(36) *Melilotus sulcata* ,Fig.(37) *Melilotus indica* and Fig.(38) *Ononis vaginalis*.



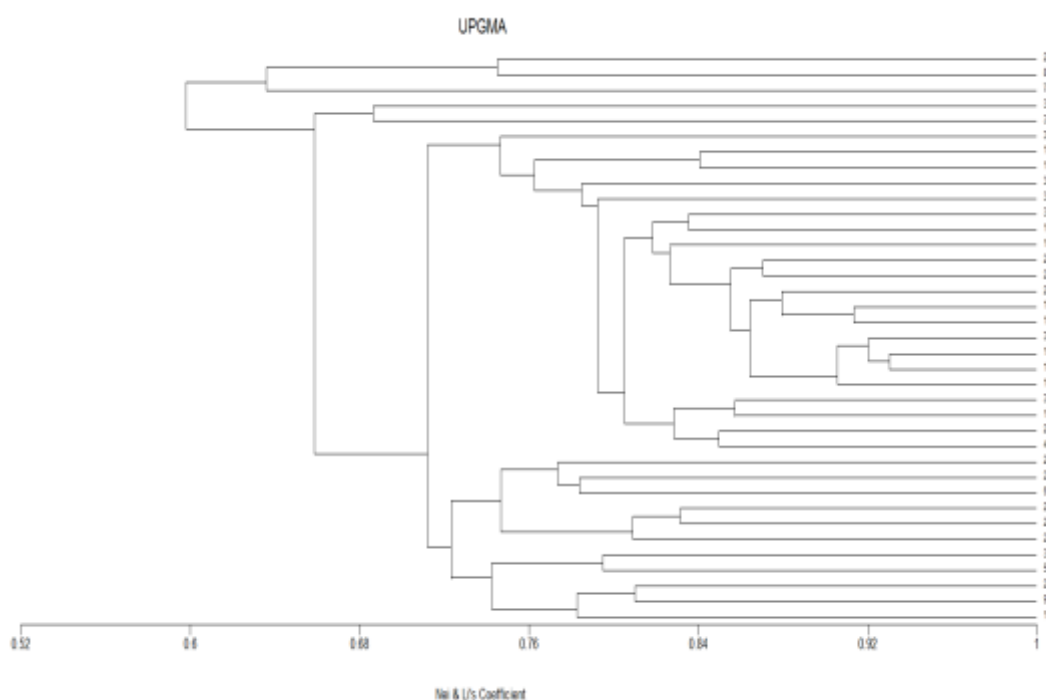
Figures : (39 — 42) Showed inflorescence types of, Fig.(39) *Melilotus elegans*, Fig.(40)*Trifolium alexandrinum* Fig.(41) *Erythrina caffra* and Fig.(42) *Trigonella maritime*.



Figures : (43— 49) Showed equals and unequals sepals ; monadelphous and diadelphous stamens . Types of pollen grains, Fig.(43) *Dolichos lablab*, Fig.(44) *Glycine max* Fig.(45) *Trigonella hamosa* Fig.(46) *Coronilla scorpiodes*, Fig .(47) *Coronilla scorpiodes*, Fig (48) *Medicago polymorpha* and Fig.(49) *Medicago minima*.



Figures : (50— 58) Showed Fruits and , seeds , Fig.(50) *Dolichos lablab*, Fig.(51) *Erythrina caffra* Fig.(52) *Medicago intertexta*, Fig .(53) *Trigonella hamosa*, Fig (54) *Glycine max* ,Fig.(55) *Medicago constricta*, Fig.(56) *Medicago intertexta* , Fig.(57) *Phaseolus vulgaris* and Fig.(59) *Trigonella arabica*.



The results recorded in the data-matrix (Table, 3) used in numerical analysis program to determine the relationships between the studied samples. The producing dendrogram showed many interpretations as follows:

- 1) The studied samples divided into clusters A and B, the smallest one A includes only two genera *Pseudarthia* (Desmodieae) and *Erythrina* (Phaseoleae).
- 2) The cluster B divided into two clusters C and D, the smallest one C includes *Trigonella arabica* and *Coronilla scopiodes* each belonging to the same tribe Trifolieae.
- 3) The cluster D divided into two large clusters E and F, the cluster E includes 6 different genera *Trifolium*, *Medicago*, *Melilotus* and *Trigonella* (all belonging to the same tribe Trifolieae); *Cyamopsis* (Indigofereae) and *Tetragonolobus* (Loteae).
- 4) The cluster F divided into two clusters G and H, the cluster G includes 5 genera belonging to 4 tribes, Phaseoleae (*Cajanus* and *Rhynchosia*); Hedisareae (*Ebinus*), Trifolieae (*Ononis*) and Psoraleae (*Psoralea*).
- 5) The cluster H includes 5 genera all belonging to tribe Phaseoleae (*Dolichos*, *Glycine*, *Phaseolus* and *Vigna*) except *Argyriolobium* belonging to tribe Genisteae.

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دراسات نباتية مقارنة على بعض النباتات الثلاثية الاوراق التي تنتمي لتحت الفصيلة الفراشية التي تنمو في مصر

محمد قدرى محمد حمزه⁽¹⁾، وسحر فتحى محمد الحفناوى⁽²⁾، احمد محمد الطاهر⁽¹⁾، شاهيناز الشحات أحمد⁽²⁾

⁽¹⁾ قسم النبات الزراعى - كلية الزراعة جامعة الازهر ، ⁽²⁾ قسم العلوم البيولوجية والبيئية - كلية الاقتصاد المنزلى - طنطا

الملخص العربى

اشتملت الدراسة على الصفات الظاهرية لكل اعضاء النبات الخضرية والزهرية والثمريه، كما تم تسجيل بعض الصفات الدقيقة المأخوذه من صفات البشره في الوريقات مثل شكل الجدر ووجود او غياب البلورات في طبقة البشره وكذلك نوع الثغور واشكال الزوائد المختلفه علي البشره. وتم عمل مصفوفه تضم النباتات وصفاتها، ومن خلال برنامج تحليل عددي لهذه البيانات لمعرفة درجات التشابه والقربه بين النباتات محل الدراسه، وتم تحليل نتائج هذا البرنامج والتي تمثلت في رسم بياني يبين العلاقات المختلفه بين أجناس النباتات التي خضعت للدراسه.