

COMPARATIVE STUDIES ON SOME WILD PAPILIONACEAE

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Abstract: This investigation includes 18 species representing 8 genera of wild papilionaceae collected from various regions in Egypt. Macro and micro-morphological features were studied. The macro-morphological features include habit, stems, leaves and flowers, while the micro-morphological features include epidermal cell wall, hairs, stomata, crystals and the features of pollen grains. All these features are recorded comparatively for all examined species. The results showed that the plants are mostly annual herbs or perennial shrubs. The stem is erect or weak. The modified stem into spines is recorded only in *Alhagi maurorum*. Flowers are mostly in groups or inflorescence sometimes they are solitary as in *Vicia spp*. Pollen grains are rounded or globular or rectangular; smooth or granulose and apertures are tricolpate or tricolpate.

INTRODUCTION

Papilionaceae is a large family includes about 400-500 genera and 10000 species (Heywood,1993). The plants are mostly herbs or sometimes shrubs rarely trees. The seeds and pods of many herbaceous species used as a source of food for human and animal. The plants are of particular value in the protein deficient of the world because they are rich in protein as well as mineral contents (Heywood 1993). The vegetative and floral parts were described by many authors such as Bailey (1951), Hickey and King (1981), Singh and Jain (1985), Heemstra, et al (1990) and Stace (1997) they diagnostic the Papilionaceous plants as follow:

leaves are usually alternate, pinnately compound and stipulate. Flowers are solitary or variously grouped, bisexual, hypogynous and zygomorphic. Calyx is usually consists of 5 sepals, fused into tube often differentiated into upper lip of 2 sepals and lower lip of 3 sepals. Corolla of 5 petals, the upper called the standard, 2 free lateral called wings and 2 fused lower called keel. Stamens 10 usually fused into tube below or the uppermost free and 9 lower fused rarely all 10 free. Carpel 1 with many ovules in eow, style 1 and stigma capitate. According to Hassan et al (2005) the pollen grains of *Astragalus* were tricolpate or porlate. Epidermal morphology of the leaf has been extensively used recently in

emphasizing the relation ship and ontogeny of different taxa, Chandra et al (1969), Dilicher (1974), Thompson (1991) Perveen et al (2000) and Arpitra et al (2004).

MATERIALS AND METHODS

Sample of plants are 18 species, 8 genera belonging to Papilionaceae collected from various floristic regions in Egypt. The identification of the collected plants was achieved by comparing the morphological, vegetative, floral and fruit characters with the characters of previously identified plants as published by Bailey (1951), Boulos and El-Hadidi (1967) , Tackholm (1974) , Migahid (1989) and Boulos (2002). Fresh samples were fixed in F.A.A(mixture from formalin , acetic acid and ethyle alcohol) for a minimum period of 48 hours (Ancibor, 1979). Epidermal peels of foliar and floral were obtained and cleared in warm lactic acid then examined microscopically. Pollen grains preparations were made according to the method of Franks and Watson (1963).

Table (1): Alphabetical list of (18) species representing 8 genera belonging to Papilionaceae , together with their sources .

Species	sources
1- <i>Alhagi maurorum</i> Medic. = <i>A.mannifera</i> (Javib) Spach	N
2- <i>Astragalus bombycinus</i> Boiss.	S
3- <i>A. corrugatus</i> Bertol	S
4- <i>A. kahiricus</i> DC.	S
5- <i>A. sieberi</i> DC.	S
6- <i>A. spinosus</i> (Torssk.)Nuschl.	S
7- <i>A. tribuloides</i> Delile.	S
8 - <i>Hippocrepis bicontorta</i> Loisel.	S
9 - <i>Medicago laciniata</i> (L.)Mill.	D
10- <i>M. polymorpha</i> L.	N
11- <i>Melilotus elegans</i> Ser.	D
12- <i>M.mdicus</i> (L)A\l	N
13- <i>M. siculus</i> (Vitman)B.D.Jacks.	S
14- <i>Sesbania aegyptica</i> Poir.	N
15- <i>Trigonella arabica</i> Delil.	N
16- <i>T. stellata</i> Forssk.	S
17- <i>Vicia peregrinate</i>	S
18- <i>V. sativa</i> L .	S

D = The Nile Delta, N = Nasr city, S = Sinai.

RESULTS

I- Macromorphological features:

a -Vegetative features:

Data in table (3) showed that all the examined taxa are annual herbs except *Alhagi maurorum*, *Astragalus sieberi*, *A. spinosus* and *Sesbania aegyptica*, which are perennial shrubs . Some of the examined taxa have erect stems e.g *Alhagi maurorum*(VigA), while the others are weak as in *Trigonella stellata* (Fig.2). The stem is solid in all the examined taxa except in *Astragalus kahiricus*, *Melilotus elegans* and *Trigonella Arabica*. The stem texture is glabrous as in *Alhagi maurorum* or hairy as in *Astragalus bombycinus* and spiny stem is observed only in *Alhagi maurorum*. The weak stems are prostrate as in *Trigonella stellata* or tendrils as in *Vicia saliva*, *V. peregrina* (Fig.3). The stem is terete in most of the examined taxa as in *Astragalus bombycinus* or polygonal in few taxa as in *Vicia sativa*. The leaves are compound in all the examined taxa except *Alhagi maurorum* which has simple leaves. The leaves are in paripinnate in *Sesbania aegyptica* (Fig.4), imparipinnate as in *Astragalus bombycinus* (Fig. 5); trifoliolate as in *Melilotus indicus* (Fig.6); Obcordate as in *Alhagi maworMw*(Fig.1).

The leaf apex is acut as in *Astragalus tribuloides*; obtuse in *Vicia peregrine*; cleft as in *Astragalus bombycinus*; obcordate as in *Alhagi maurorum*; retuse in *Melilotus indicus*; and cuspidate in *Vicia sativa*. The leaf margin is mostly entire as in *Alhagi maurorum*; dentate in few taxa as in *Medicago laciniata*; and serrate in some taxa as in *Melilotus elegans*. Stipules are present in all the examined taxa as in *Astragalus bombycinus* (Fig.7) except in *Alhagi maurorum*. The leaves are modified into spines only in *Astragalus sieberi* and *A. spinosus* (Fig.8). While they are modified into tendrils in *Vicia peregrine* and *V. saliva*.

b- Flower features:

Flowers are often in an inflorescence, mostly simple panicle or rarely head as in *Hippocrepis bicontorta*. Solitary flowers are observed only in four taxa which are *Alhagi maurorum*, *Astragalus spinosus*, and *Vicia sativa* and *V. peregrine* (Fig. 15). The bracts are present in all the examined taxa except *Sesbania aegyptica*. They are mostly sessile as in *Alhagi maurorum*, or pedicelled in *Vicia peregrine* and *V. sativa*. Sepals are united in all the examined species as in *Sesbania aegyptica* (Fig. 16).

Petals are usually unequal in all the examined species as in *Sesbania aegyptica* (Fig. 17). The stamens are recorded in a diadelphous position in all the examined species as in *Sesbania aegyptica* (Fig. 18).

Table (2). List of 50 characters recorded comparatively for 18 species representing 8 genera belonging to Papilionaceae. The 50 characters are distinguished into 44 qualitative, 3 multistate and 3 quantitative.

A-Qualitative characters

i- macromorphological characters:

a- Vegetative characters:

- 1-**Habit:** herbs +/ shrubs-
- 2 - annuals +/ perennial -
- 3- erect +/ weak -
- 4-**Stem:** solid +/hollow -
- 5- texture glabrous + / hairy -
- 6- spines present +/ absent -
- 7- weak prostrate + / tendrils -
- 8- outline:shapes terete + / polyangled -
- 9- **Leaf:** simple + / compound -
- 10- stipules present + / absent -
- 11 - spinies leaves present +/absent -
- 12- tendril of leaflets present +/absent

b- Flowers characters:

- 13- solitary + / in an inflorescence -
- 14- bract present + / absent -
- 15- bract pedicelled + / sessile

ii- micromorphological features:

- 16-**Leaf:** epidermal cell wall straight +/undulate -
- 17- prismatic crystals present+/ absent -
- 18- unicellular eglandular unbranched hairs present+/ absent-
- 19- anomocytic stomata present+/absent-
- 20- anisocytic stomata present+/ absent.
- 21 - tetracytic stomata present +/ absent-
- 22- staurocytic stomata present+/ absent-
- 23- associated stomata present+/ absent-
- 24-**Sepals:** epidermal cell wall of sepals straight + / undulate -
- 25- Prismatic crystals present+ / absent-

- 26- sandy crystals present +/- absent-
- 27- hairs present +/- absent-
- 28- **Petals:** epidermal cell wall straight + / undulate -
- 29- Prismatic crystals present+ / absent-
- 30- sandy crystals present+/absent -
- 31 - hairs present +/- absent -
- 32- stomata present +/- absent -
- 33-**Filament:** Prismatic crystals present+ / absent-
- 34- sandy crystals present +/- absent-
- 35- **Ovary:** cell wall straight + / undulate -
- 36- hairs on one side + / not so -
- 37- uniseriate hairs present +/-absent -
- 38- crystals present + / absent -
- 39-**Style:** hairs present + / absent -
- 40- Prismatic crystals present + / absent.
- 41 - sandy crystals present +/- absent -
- 42-**Pollen graine:** shape rounded (globular) +/- rectangular -
- 43- exine sculpture smooth +/- granules -
- 44- pollen apertures tricolpate +/- tricolporate -

B-Multistate characters:

- 45-Leaf shape (4 categories): parapinnate,1; imparipinnate, 2;
trifoliolate,3: obcordate,4
- 46-LeafApex (6 categories): acute,1; obtuse,2; cleft,3;
obcordate, 4; reflex, 5; cuspidate,6
- 47- LeafMargin(3 categories): entire,1; dentate,2; serrate,3

C-Quantitative characters:

- 48- Length of filament in mm
- 49-Length of style in mm
- 50- Pollen grain dimensions in u

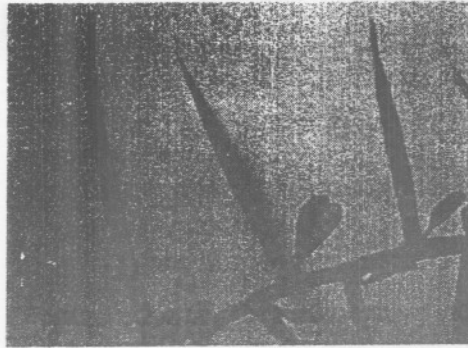


Fig.1: *Alhagi maurorum*.

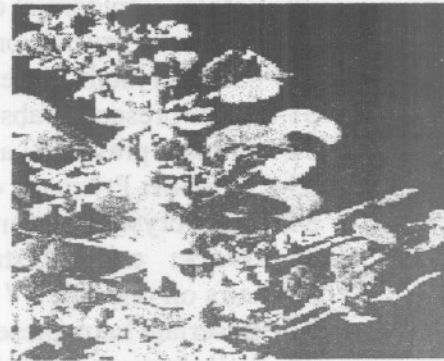


Fig. 2: *Trigonella stellata*.

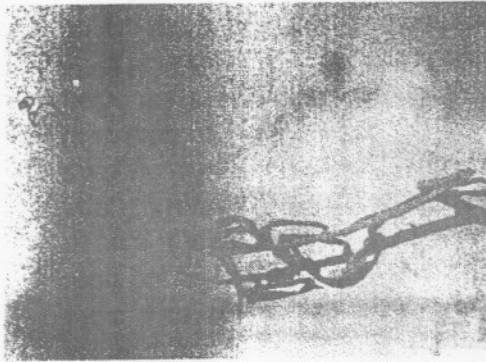


Fig.3: *Vicia peregrine*.

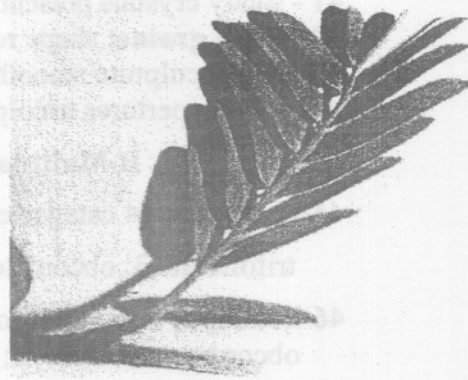


Fig.4: *Sesbania aegyptica*.

Figs (1&2): Stem types
Figs (3&4): Leaf types.

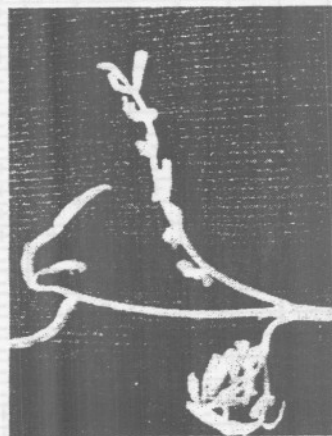


Fig.5: *Astragalus bombycinus*.



Fig.6: *Melilotus indicus*.

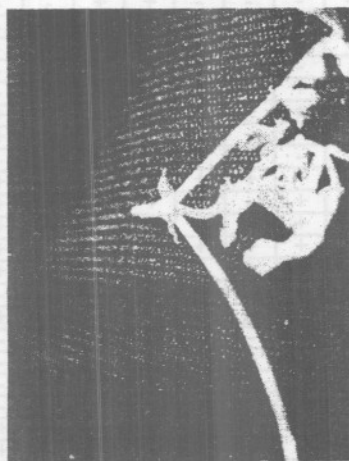


Fig.7 :*Astragalus bombycinus*.



Fig.8: *Astragalus spinosus*

Figs (5&6): Leaf types

Fig.7:Stipules

Fig.8: Spinies leaves

Table (3).Data-matrix of observed characters in different taxa. The following data-Matrix comprises the observations recorded on 50 characters for 18 species representing 8 genera belonging to Papilionaceae. The species are recorded according to the symbolism used in Table 1, and the characters are recorded according to the symbolism used in Table 2. Missing attributes are denoted by*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	-	+	+	+	-	-	+	+	+	+	+	+	+	-	+	+	+	+
2	-	+	+	-	-	-	+	+	+	+	+	+	+	-	+	+	+	+
3	+	-	-	+	+	+	-	-	-	-	-	+	+	+	+	-	-	-
4	+	+	+	-	+	-	+	+	+	+	-	+	+	+	-	+	+	+
5	+	-	+	-	-	-	-	-	+	+	+	+	+	-	+	+	-	-
6	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	*	+	+	*	*	*	+	+	+	+	+	*	*	*	*	+	-	-
8	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	-	-
9	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+
11	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
13	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+
14	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
16	-	-	-	-	-	+	+	-	-	-	+	+	+	+	-	-	-	-
17	+	-	+	+	-	+	-	-	-	-	-	-	+	-	-	-	-	-
18	.	+	+	+	+	+	+	+	-	+	+	+	+	-	-	-	-	+
19	.	.	-	-	+	+	+	-	-	+	-	-	+	-	+	-	+	-
20	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+
21	-	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	-
22	-	-	-	-	+	-	-	-	+	-	+	-	+	-	-	-	-	-
23	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-
24	+	-	+	+	+	-	+	-	+	+	+	-	-	+	-	+	+	-
25	+	-	+	-	-	+	-	+	+	+	+	+	+	-	-	+	+	+
26	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+
27	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+
28	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
29	+	-	-	-	+	+	-	+	-	+	+	+	+	-	-	-	-	-
30	+	+	+	-	-	-	-	+	*	-	+	+	+	+	+	+	-	-
31	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
32	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-
34	+	+	+	-	-	-	-	+	-	-	+	+	+	+	+	+	-	-
35	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-
36	-	-	-	-	-	-	-	-	+	+	+	-	+	-	+	+	+	+
37	+	-	-	-	+	+	+	-	+	+	+	-	+	-	+	+	+	+
38	+	+	+	-	-	+	+	+	-	-	+	+	+	+	+	+	-	-
39	+	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	+
40	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
41	+	+	+	-	-	-	+	+	-	-	+	+	+	+	+	+	-	-
42	+	-	-	-	-	-	-	+	+	+	+	+	+	-	-	-	-	-
43	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	-	-
44	+	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-
45	4	2	2	2	2	2	2	2	3	3	3	3	3	1	3	3	2	2
46	4	3	3	4	4	1	1	1	4	4	4	5	4	5	4	4	2	6
47	1	1	1	1	1	1	1	1	2	2	3	3	3	1	3	3	1	1
48	9	7	5	24	23	17	7	5	5	4	2	3	5	2	7	4	10	9
49	5	5	2	13	12	12	3	4	2	1	1	2	3	11	5	2	2	2
50	22/22	42/30	27/21	42/37	36/30	36/29	37/29	21/21	51/51	26/26	27/27	27/27	33/33	38/29	31/23	23/18	41/32	39/29

II- Micromorphological features:

a- Leaf epidermal:

The epidermal cell wall are straight as in *Melilotus siculus* (Fig.9) or undulate as in *Astragalus sieberi*(Fig. 10) , prismatic crystals are observed in the leaf epidermal cell in few taxa as in *Melilotus siculus* (Fig.9). Unicellular eglandular unbranched hairs are noticed in some taxa as in *Melilotus elegans* (Fig. 11). Many types of stomata are observed :

anisocytic stomata observed in all most taxa as in *Medicago polymorpha* (Fig. 12), tetracytic stomata in most taxa as in *Melilotus siculus* (Fig. 13), anomocytic stomata in some taxa as in *Medicago polymorpha* (Fig. 14) and staurocytic stomata in few taxa as in *Astragalus sieberi*(Fig. 10) , and associated stomata in *Melilotus siculus*(Fig.9) .

B-Flower:

The epidermal cell walls of sepals are straight as in *Astragalus kahiricus* or undulate as in *Melilotus elegans*. Prismatic and sandy crystals are observed in the examined taxa as in Table (3). Hairs are present on the sepals of all the examined taxa in *Hippocrepis biconotorta* and *Sesbania aegyptica*. The epidermal cell walls of the petals are straight as in all of the examined taxa except in *Astragalus sieberi*. Prismatic and sandy crystals are observed on the examined taxa either together or alone. Hairs are observed only on the petals of *Astragalus spinosus*. Stomata are observed only on the petals of *Alhagi maurorum*. Prismatic and sandy crystals are recorded on the filament of *Hippocrepis biconotorta*; sandy crystals are recorded on some examined taxa Table (3). Filament length is varied from 2 to 24mm in the examined taxa. Pollen grains are rounded as in *Alhagi maurorum* or rectangular as in *Astragalus bombycinus*. Pollen grains apertures are colpate as in *Medicago polymorpha*. The exine sculpture is smooth in most of the examined taxa as in *Trigonella stellata*, or granulose in few taxa as in *Melilotus elegans*. The pollen grains in the examined taxa have average diameters of 12 to 51 x 18 to 37 μ . Cell walls of the ovaries in all the examined taxa except in *Vicia peregrina* and *V. sativa*. Hairs and prismatic are recorded on the ovary of many taxa as in Table (2).Hairs are found on the style of few examined taxa. Prismatic crystals are rarely recorded on the style of *Astragalus bombycinus* and *A. sieberi*. Sandy crystals are observed on the style of many taxa as in *Alhagi maurorum*. The length of style is varied from 1 to 13mm.

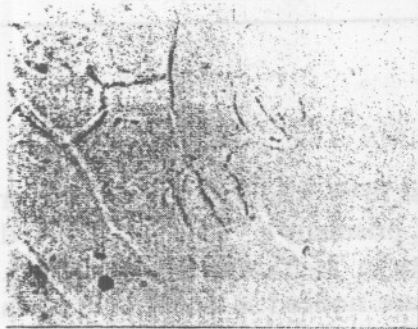


Fig.9: *Melilotus siculus*.(x=400)

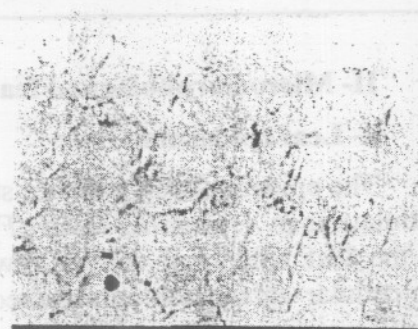


Fig.10: *Astragalus sieberi*. (x=400)

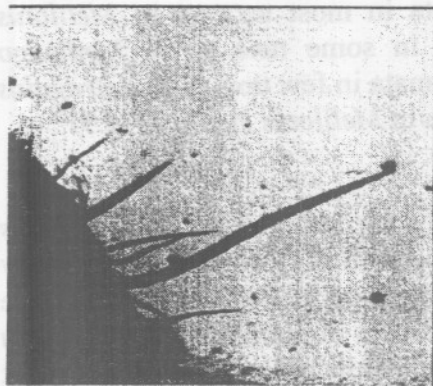


Fig.11: *Melilotus elegans*.(x=150)

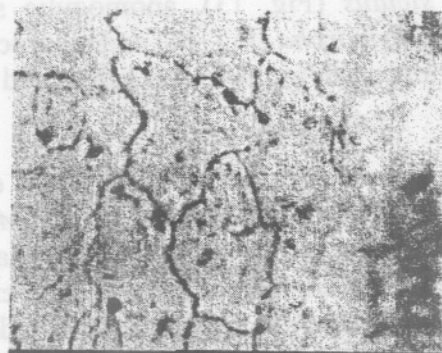


Fig.12: *Medicago polymorpha*. (x=400)

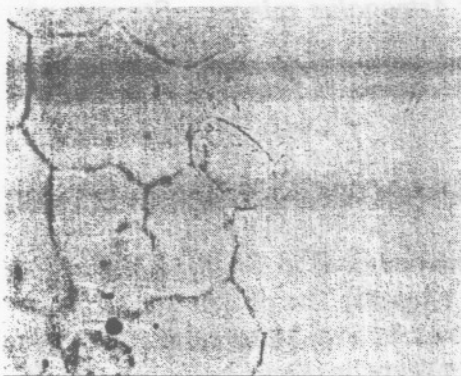


Fig .13: *Melilotus siculus*.(x=400)

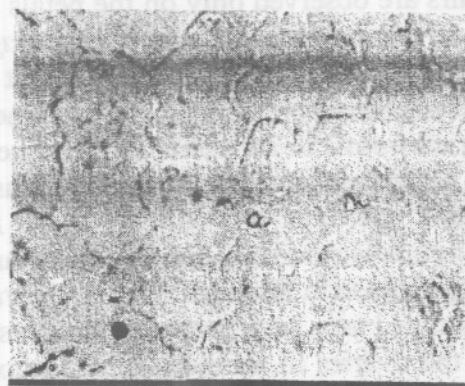


Fig.14: *Medicago polymorpha*. (x=400)

Figs (9&10&12&13&14): types of stomata.

Fig. 11: unicellular hairs.

DISCUSSION

All the studied taxa of Papilionaceae are mostly annual herbs, perennial shrubs as in some species or perennial herbs as in *Asystasia* *fabrifera*. Stems are erect or weak (mostly prostrate rarely tendrils).

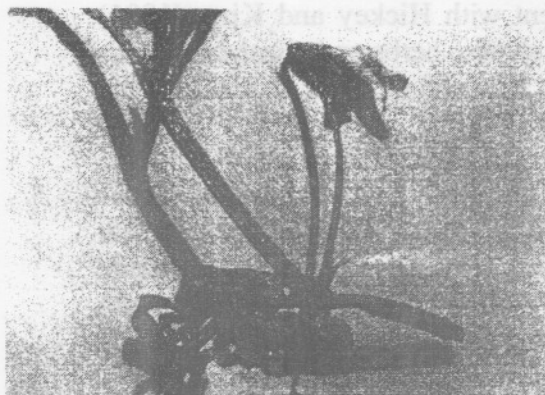


Fig.15: *Vicia peregrina*.

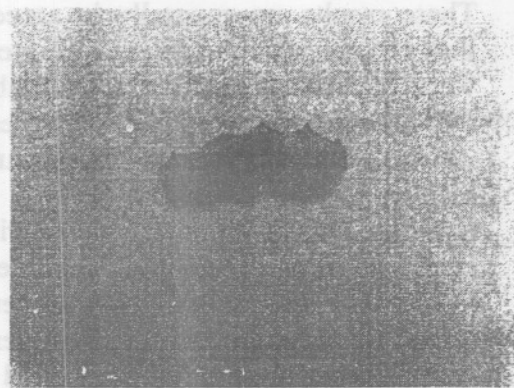


Fig.16: *Sesbania aegyptica*.

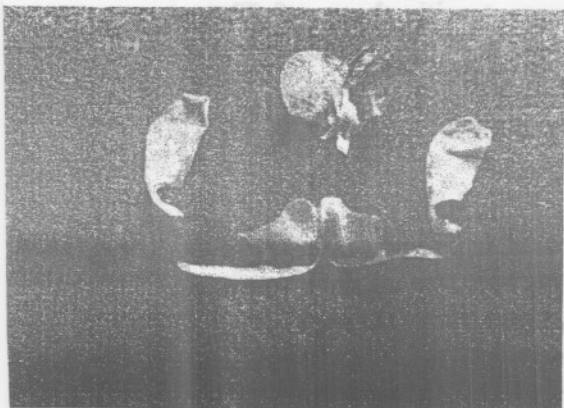


Fig.17: *Sesbania aegyptica*.

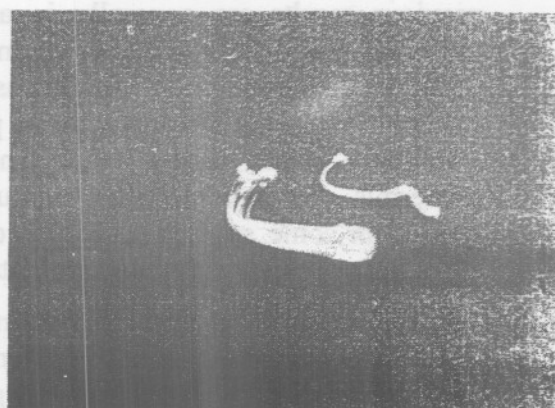


Fig.18: *Sesbania aegyptica*.

Fig. 15: Solitary flower.

Fig.16: Sepals united.

Fig. 17: Petals unequal.

Fig. 18: Stamens diadelphous.

DISCUSSION

All the studied taxa of Papilionaceae are mostly annual herbs , perennial shrubs as in some species or perennial herbs as in *Astragalus kahiricus*. Stems are erect or weak (mostly prostrate rarely tendrils). These results are generally in agreement with Hickey and King (1981) they reported that the plants were trees, shrubs, herbs and climbers. Stems were commonly erect, many climbing by leaf or stem tendrils or by twining around other plants. Leaves are cauline , compound , except (*Alhagi sp.*) petiolate mostly stipulate , alternate , pinnately veined , margin mostly entire or serrate rarely dentate , compound leaves imparipinnate or trifoliolate rarely paripinnate . These are in agreement with Heemstra et al (1990) they recorded that leaves were usually alternate .compound with 3 leaflets or several pairs or leaflets sometimes with spines .Flowers are in an inflorescence or sometimes solitary (e.g. *Vicia spp.*). Flower are usually pedicelled and mostly bracteate. Stamens 10 in two whorls (diadelphous). Gynoecium is monocarpelate with marginal placentation, gynophore present. Stigma either capitate or lineate. The previous results are generally in agreement with those of Thompson (1991). The walls of the leaf epidermal cells in Papilionaceae are undulate or straight in some plant samples as in *Astragalus spinosus* . Prismatic oxalate crystals are showed in some plant samples as in *Alhagi mayrorum* . In hairy plants, unicellular eglandular hairs are widespread on leaf epidermis . Stomata are often mixture between anisocytic and tetracytic types , in some species anomocytic stomata are distinguished; besides these normal types associated stomata are recorded in few species.

These are in agreement with many authors such as El-Fiki (1975) who mentioned that the leaf epidermis possessing there three types of hairs unicellular, multicellular and glandular . He reported that the leaf stomata were paracytic , anomocytic and tetracytic . He recorded also the presence of druses and prismatic crystals in these cells . Ibrahim (1990) mentioned that the epidermal cell walls in papilionaceae were straight or slightly sinuous. He stated that anomocytic and anisocytic stomata were dominant in papilionaceous plants . He recorded the presence of prismatic crystals. He also recognized 5 shapes of hairs in these plants unicellular non glandular , multicellular glandular , multicellular non glandular uniseriate , multicellular glandular uniseriate and hooked hairs . Pollen grains are usually tricolpate or tricolporate , smooth or granulose . These are in agreement with El-Fiki (1975) and Ibrahim (1990) who mentioned

that the pollen grains in Papilionaceae were mostly colpate , sometimes porate or colporate , smooth pollen were widespread and granulose pollen observed in many species but the reticulate pollen were few observed .

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دراسات مقارنة على بعض النباتات البرية من الفصيلة الفراشية

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الملخص العربى

أجريت هذه الدراسة على ١٨ نوعا نباتيا تتبع الفصيلة الفراشية تم تجميعها من مناطق مختلفة فى مصر ، سجلت الدراسة ٥٠ صفة مورفولوجية وتشريحية وهذه الصفات شملت طبيعة نمو النبات وبعض الصفات المورفولوجية للسيقان والأوراق والأزهار كما اشتملت على صفات خلايا البشرة فى الأوراق والأزهار وأنواع الثغور والشعيرات وكذلك بعض صفات حبوب اللقاح ، كل هذه الصفات سجلت بطريقة مقارنة بين الأنواع المختلفة ، وأظهرت النتائج أن النباتات أحشاش حولية أو شجيرات ذات حولين ، السوق غالبا قوية وأحيانا ضعيفة بعضها زاحف وبعضها متسلق بالمحاليق ، كما سجلت وجود السيقان المتحورة إلى أشواك فى نبات اللقاح كانت مستديرة أو مضلعة وتحتوى على ثلاثة فتحات بسيطة فى صورة ثقب أو مركبة ثقب مع ثقب.