Comparative Studies on Sub-Family Maloideae (Rosaceae) Plants in Egypt.

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ABSTRACT

This present study covered 8 species (7genera) belonging to the subfamily Maloideae (Rosaceae). These plant samples were collected from 5 different Egyptian sites. The study includes morphological and anatomical studies for all the plant organs both vegetative or reproductive. The 68 recorded characters put in data matrix and these results were analyzed numerically using the (MVSP) program to determine the similarity between these studied species. The program classified the studied plant samples into two clusters, the first cluster includes 3 species (No.1-3), the highest similarity was 72.956 between *Cydonia* sp. and *Crataegus* sp., while the lowest similarity was 64.052 between *Cydonia* sp. and *Cotoneaster* sp. The second cluster includes the remainder 5 species; from (No. 4 to 8), The highest similarity was 73.054 between species *Pyrus calleryana* and *P. communis*, while the lowest similarity was 59.740 between *Rhiphiolepis* sp. and the other 4 samples in the same cluster (*Eriobotrya* sp., *Malus* sp., *Pyrus calleryana* and *P. communis*.). Also, the results used in the constructing of an indented key to identified and to easily the distinguish the eight studied samples.

Keywords: Morphology; Anatomy; pollen grains; flowers; fruits; (MVSP).

INTRODUCTION

The Rosaceae is one of the large families with an estimated 85 genera and 2000 sexual species (Kalkman 2004). Maloideae is a very important and intensively studied sub-family of Rosaceae. Most of the genera are from temperate regions of the Northern Hemisphere, also there is an extension into southern Asia, Hesperomeles grow in South America, and Osteomeles reach several South Pacific islands. The most significant character state of the subfamily are the pome fruits and the basic chromosome number (X = 17), Maloideae was formerly treated as a separate family, under the name Pomaceae, a position that has had little support. This group should be considered as a subfamily of Rosaceae and the name Pomoideae replaced by Maloideae after a thorough study of this group (AL-Dasoro, *et al.* 2005). Rosaceous plants are trees, shrubs or herbs; deciduous or evergreen. stems erect, scandent, prostrate or creeping, armed or unarmed. Most specifically, their leaves are alternate, rarely opposite, simple or compound; stipules paired, free or adnate to petiole, persistent or deciduous and rarely absent; leaf blade often serrates at margin, rarely entire (Lingdi *et al.* 2003) and (Al-Rubaie *et al*. 2022).

On the other side, its flowers are actinomorphic, bisexual, rarely unisexual and plants dioecious. Hypanthium (formed from basal parts of sepals, petals, and stamens) are free from or adnate to the ovary. Sepals usually 5, rarely fewer or more, imbricate; epicalyx segments sometimes also present. Petals as many as sepals and stamens usually numerous, rarely few, and always in a complete ring at margin of or above disk. Further, filaments usually free, very rarely connate; anthers small, didymous. Carpels 1 to many, also free or connate; ovary inferior, semi-inferior, or superior (Lingdi *et al.* 2003) and (Ruter 2018). Rosacea inflorescences range from single flowers to umbellate, corymbose, racemose, or cymose-paniculate (Lingdi *et al.* 2003). Moreover, Rosaceae pollen grains are monads, more or less spheroidal, and tricolporate in general and the colpi usually relatively long. In some Rosaceae the ectoapertures were operculate (Kalkman, 2004). Rosaceae fruits include achene, follicle, pome, and drupe (Bailey 1924), (Nagy 2011), and (Ruter 2018).

The anatomical characteristics of the stem of *Crataegus* species were studied, and it was discovered that the pith iscomposed of parenchymatous cells (Demiray 2006). In this respect, the anatomical characteristics of Crataegus leaf revealed that the upper and lower epidermis were comprised of single-layered cells with a thin cuticle layer. Furthermore, upper epidermal cells were larger than lower epidermal cells. Under the upper epidermis, the mesophyll was made up of 1-2 layers of palisade cells and spongy cells with large intercellular spaces (Demiray 2006, Erarsian and Kultur 2019), (Awad& Hameed 2021) and (Al-Rubaie *et al.* 2022).

In this context, the present study aims at comparing some economic species of sub-

family Maloideae growing in Egypt morphologically and anatomically then analyzed the data, in order to know the relationships and the similarity between these samples of plants to know the suitable taxonomic system for those species.

MATERIALS AND METHODS

Collection and identification: -

The samples contain eight species belonging to seven genera of sub-family Maloideae collected from various regions in Egypt. The identification of the collected species was achieved by comparing their morphological characters with the characters of the previously identified plants as published by (Bailey 1951), (Tackholm 1974), and (Boulos 2002). Different parts from the studied plant samples were fixed in (F.A.A) for a minimum period of 48 hours. The preparation of stems and leaves sections were done according to (Sass 1958, Nassar and El-Sahar 1998). All photomicrographs were prepared by Pentacon Camera on Olympus microscope. For the investigations of pollen grains morphology with scanning electron microscopy (SEM) the method of Bahadur *et al*. (2019) was followed, and examined by SEM (JEOL JSM-5200LV) in the Applied Center for Entomo-nematodes, Department of Zoology and Agricultural Nematology, Faculty of Agriculture Experiment Station, Cairo University, Egypt.

RESULTS AND DISCUSSION

Morphological characters

Habit:

The studied samples were mostly shrubs as in *Malus domestica* (fig.1), or trees as in *Pyrus calleryana* (fig.2). These results were in agreement with the finding of (Lingdi *et al.* 2003), (Dar *et al*. 2015), (Ruter 2018) and (Al-Rubaie *et al*. 2022).

Stems:

Most of the studied samples had tall stems e.g., *Eriobotrya japonica* (fig.3), except a few of samples e.g., *Malus domestica* (fig.4) which had dwarf and tall stem (on the same plant). The stems of all examined samples were mostly aerial-erect. The stems were often glabrous as in *Pyrus calleryana* (fig.5), hairy e.g., *Eriobotrya japonica* (fig.3), or spiny as in *Crataegus sinaica* (fig.6). Stems were usually brown in colors e.g., *Pyrus calleryana* (fig.5), green in *Malus domestica* (fig.4) or gray as in *Eriobotrya japonica* (fig.3). These results were strengthened by the findings of (Lingdi *et al.* 2003), (Dar *et al*. 2015), (Ruter 2018), and Al-Rubaie *et al*. (2022).

Leaves:

Leaves of Rosaceae were often permanent (evergreen) in *Eriobotrya japonica* (fig.7) or have deciduous leaves most the examined species e.g. *Malus domestica* (fig.8), it had cauline leaves in all examined species. Number of leaves at node were varies from one as in *Rhiphiolepis umbellata* (fig.9), two leaves in *Pyrus communis* only (fig.10), or more than two as in *Crataegus sinaica* (fig.11). The leaves were mostly petiolated e.g. *Crataegus sinaica* (fig.12) mean while they were sessile or sub-sessile in some taxa e.g. *Eriobotrya japonica* (fig.15). The leaves were stipulate in *Crataegus sinaica* (fig.12) or exstipulate in *Cotoneaster orbicularis* (fig.14). Furthermore, the leaves were mostly alternate in all the examined species as in *Cydonia oblonga* (fig.16) except *Eriobotrya japonica* (fig.17) and *Rhiphiolepis umbellate* that were spiral. Heterophyllus observed in a few species e.g. *Pyrus calleryana* (fig.18). The Rosaceous leaves were simple in all examined species. leaves varied in shapes; ovate as in *Pyrus calleryana* (fig.13), obovate as in *Crataegus sinaica* (fig.12), elliptic as in *Eriobotrya japonica* (fig.15), or ovate to orbicular as in *Cotoneaster orbicularis* (fig.14). The laminal base was often rounded as in *Cotoneaster orbicularis* (fig.14), attenuate in a few species e.g., *Eriobotrya japonica* (fig.15). The leaf or leaflets margin was entire as in *Cotoneaster orbicularis* (fig.19), serrate as in *Pyrus calleryana* (fig.20), or loped as in *Crataegus sinaica* Boiss.(fig.21). Apex of the leaf or leaflets was often acute as in *Eriobotrya japonica* (fig.15), acuminate as in *Pyrus calleryana* (fig.13) or obtuse as in *Contoneaster orbicularis* (fig.22). The texture of leaf or leaflets was glabrous as in *Pyrus calleryana* (fig.13), hairy as in *Cotoneaster orbicularis* (fig.22). The leaves color was pale green e.g. *Pyrus calleryana* (fig.13), or dark green as in *Cotoneaster orbicularis* (fig.14). These results were in agreement with. (Elshihy *et al.* 2004), (Nagy 2011), (Chang *et al.* 2011), (Kocyigit *et al.* 2015), (Dar *et al*. 2015), And (Ruter 2018).

Flowers features:

Flowers of the examined taxa were mostly solitary e.g., *Cydonia oblonga* (fig.23) and a little in an inflorescences; panicle as in *Rhiphiolepis umbellata* (fig.24), simple raceme as in *Eriobotrya japonica* (fig.25), compound raceme as in e.g. *Rhiphiolepis umbellata* (fig.24), corymb in *Malus domestica* (fig.26) or umbellata e.g. *Pyrus calleryana* (fig.27). The inflorescences

were mostly terminal as in *Rhiphiolepis umbellata* (fig.24), or lateral in *Malus domestica* (fig.26). The flowers in the examined species were usually actinomorphic, pedicellate in all examined taxa.

Calyx:

consists of five sepals in all the examined species. These sepals either united as in *Eriobotrya japonica* (fig.28) or free as in *Cydonia oblonga* (fig.29). these sepals were mostly hairy e.g. *Cydonia oblonga* (fig.29).

Corolla:

consists of 5 petals arranged in one whorled, with white color in all the examined species. e.g. *Cydonia oblonga* (fig.23).

Androecium:

Number of stamens as many as lobes of corolla in all examined species. Stamens were mostly exerted from petals as in *Pyrus calleryana* (fig.30) and a few samples inserted in petals as in *Cotoneaster orbicularis* (fig.31). Filaments were smooth in all examined samples, cylindrical as in *Pyrus communis* (fig.32) or flattened as in *Eriobotrya japonica* (fig.33); mostly attached with the anthers medifixed e.g. *Malus domestica* (fig.34). Anthers were mostly 4-locular as in *Pyrus communis* (fig.35); anthers apex with an appendage only in *Pyrus communis* (fig.35). These results were in harmony with the findings of (Donmez 2004), (Elshihy *et al.* 2004) (Chang *et al.* 2011), (Nagy 2011), (Kaur and Arya 2012), and (Ruter 2018).

Pollen grains:

shape of pollen grains was spheroidal as in *Pyrus calleryana*. (fig.36), or prolate as in *Rhiphiolepis umbellata* (fig.37). Pollen grains apertures were mostly colporate e.g., *Pyrus calleryana* (fig.38) or colpate as in *Malus domestica* (fig.39). Numbers of apertures were three in all = the examined species. Exine sculpture was striate as in *Pyrus calleryana* (fig.40) or sub-pislate as in *Cotoneaster orbicularis* (fig.41). Such results were in accordance with those previously reported by (Zhou *et al.* 2000), (Chen *et al.* 2006), (Ianovici *et al.* 2010), and (Radovic2016).

Fruits:

Rosaceous fruits were succulent, pome, glabrous in all examined species, rounded as in *Pyrus calleryana* (fig.42), ovate as in *Eriobotrya japonica* (fig.43), or pear shaped as in *Pyrus communis* (fig.44). The color of mature fruits varies from red as in *Malus domestica* (fig.46), yellow as in *Eriobotrya japonica* (fig.43), black to brown as in *Pyrus calleryana* (fig.42), or black to blue as in *Rhiphiolepis umbellate* (fig.45), These results were in agreement with the results obtained by (Kalkman 2004), (Donmez 2004), (Elshihy *et al.* 2004), (Nagy 2011), and (Ruter 2018).

Anatomical characters: -

Stems:

consists of several layers ranged between 9.0 - 40.0 layers most of them paranchyma cells. The stem cross sections investigations showed that the outline was rounded in all examined species. e.g., *Crataegus sinaica* (fig.47).

Cuticle

layer was smooth, thin, in all examined species e.g., *Crataegus sinaica* (fig.48). Epidermis presented in one layer in most of examined species as in *Pyrus communis* (fig.49), except some samples this layer followed by hypodermal layer as in *Crataegus sinaica* (fig.48). The average thickness of the epidermis was from 10.25µ in *Pyrus calleryana* to 73.8µ in *Cotoneaster orbicularis*.

Cortex;

were consisted of several layers, the outer layers were often collenchymatous cells in most of studied species e.g. *Pyrus calleryana* (fig.50). Moreover, the average thickness of the cortex varied from 221.0 µ (narrow) in *Pyrus calleryana* (fig.50) to 905µ(borad) in *Eriobotrya japonica* (fig.51). The cortical vascular bundles recorded in *Eriobotrya japonica* only (fig.51), druses and prismatic crystals were recorded in some species as in *Pyrus communis* (fig.52) and *Crataegus sinaica* (fig.53) respectively. Secretory cell; secretory canals and parenchymatic cells observed in some species as in *Pyrus communis* (fig.50).

Vascular bundles;

were arranged in continuous ring in all examined taxa e.g., *Crataegus sinaica* (fig.47). Xylem vessels arranged in some plant's samples in arms e.g., *Rubus sanctus* (fig.54), while in the other samples arranged in clusters in *Crataegus sinaica* (fig.55), Tylosis also recorded in some species e.g., *Crataegus sinaica* (fig.55). The average dimensions of xylem vessels range from 12.3×8. 2µ in *Rhiphiolepis umbellata* to 28.7×20.5µ in *Pyrus communist.*

Pith region

was solid in all studied samples e.g., *Crataegus sinaica* (fig.47), The pith consisted of

sclerenchymatous, parenchymatous, secretory cells, secretory canals in *Pyrus calleryana* (fig.56), druses crystals present in *Pyrus calleryana* (fig.57) only. These results were in agreement with those of (Demiray 2006), (Chen *et al.* 2015), (Erarsian and Kultur 2019), and (Awad and Hameed 2021).

Leaves:

The investigation of leaves vertical sections showed that the cuticle layer was smooth in all examined species. Upper cuticle layer thickness varied from 4.1µ in *Malus domestica* (fig.58) to 8.2µ in *Rhiphiolepis umbellaae* (fig.59). Also, upper epidermis was simple in all examined species. The thickness of the upper epidermis varies from 12.3µ in *Cotoneaster orbicularis* to 20.5µ in *Rhiphiolepis umbellaae*, while lower epidermis varied from 8.2µ in *Cydonia oblonga* to 20.5µ in *Rhiphiolepis umbellata*.

Mesophyll;

was usually consisted of both palisade and spongy tissues in all examined species e.g., *Rhiphiolepis umbellata* (fig.59), number of palisade tissue layers either two layers as in *Pyrus calleryana* (fig.60) or three layers in *Malus domestica* (fig.58). Prismatic and druses oxalate crystals recorded in the mesophyll of many samples as in *Pyrus calleryana* and *Pyrus communis* (figs. 61and 62), respectively. Secretory cells and secretory canals were founded in the mesophyll of many species as in *Rhiphiolepis umbellata* (fig.63). The thickness of palisade tissue varied from 82.0µ in *Crataegus sinaica* to 143.5µ in *Cydonia oblonga* and consists of several layers ranged between 2.0-6.0 layers, while spongy tissue thickness varied from 73.8 µ in *Pyrus calleryana* Decne. to 143.5µ in *Eriobotrya japonica* and consists of several layers ranged between 4.0-12.0 layers.

Midrib region;

investigations showed the extended of palisade tissue above the midrib zone observed only in *Cotoneaster orbicularis* (fig.64), druses crystals recorded in *Cydonia oblonga* (fig.65), secretory cells, secretory canalsas in *Pyrus communis* (66). However, the upper epidermis above the midrib takes various shapes; often convex as in *Cotoneaster orbicularis* (fig.64), a few taxa concave as in *Pyrus communis* (fig.67), or straight in *Rhiphiolepis umbellata* (fig.68), while the lower epidermis midrib was concave in all examined species e.g. *Rhiphiolepis umbellata* (fig.68). Simple epidermis was mostly present in the studied samples except few species *Rhiphiollepis umbellata* and *Pyrus communis* which had hypodermal layer (figs. 68 and 67) repectivly.

Midvein;

All investigated taxa consist of a single collateral vascular bundle enclosed by a sclerenchymatious bundle sheath e.g., *Crataegus sinaica* (fig.69) or opened by a sclerenchymatous bundle sheath in *Cydonia oblonga* (fig.70). Shapes of vascular bundle were mostly crescent as in *Pyrus communis* (fig.67), or rounded as in *Rhiphiolepis umbellata* (fig.68), and collenchymatic cells occurs on both sides of the vascular bundle. Tylosis was recorded in xylem vessels in most examined samples as in *Pyrus communis* (fig.72). The average dimension of xylem vessels ranges from 4.1×8.2µ in *Cotoneaster orbicularis* to 20.5×16.4µ in *Cydonia oblonga*. These results were in agreement with the findings of (Elshihy *et al.* 2004), (Demiray 2006), (Raei *et al.* 2009), (Kocyigit *et al.* 2015), (Erarsian and Kultur 2019) and (Awad and Hameed 2021).

CONCLUSIONS:

Artificial indented key for the studied 8 species:

The results have been used in constructing the artificial key to differentiation between the 8 studied species of Maloideae (Rosaceae):

+ Flowers solitary:

Leaves were sessile or sub-sessile, fruit yellow in color, fruit and seed glabrous…. ***Cydonia oblonga***

++Flowers in an inflorescences:

I. Corymb infl.

* Leaves obovate, pale green, lobed, fruit red in color ***Crataegus sinaicus.***

** " orbiculate, dark green, entire margin, fruit red in color……..***Cotoneaster orbicularis.***

*** " ovate, pale green, serrate margin, fruit red and yellow color

Malus domestica.

II. Simple racemose infl.

Leaves elliptic, spirally, fruit yellow, seed oblong, glabrous ***Eriobotrya japonica.***

III. Compound racemose infl.

Leaves are ovate, spiral, hairy, fruit globular, whit black to blue color.***Rhiphiolepis umbellate.***

IV. Umbellata infl.

*Shrubs plants, fruit globular, blackish brown in color ***Pyrus calleryana.***

** tree plants, heterophyllus present, fruit pear shaped fragrant, yellow color. ***P. communis.***

The numerical analysis of the results:

The obtained results were analyzed numerically by using the program (MVSP), and the previous dendrogram showed that the studied plant samples were classified into 2 different clusters as the follows:

Cluster A: contain 3 species from 1- 3, the highest similarity was 72.956 between *Crataegus sinaica* and *Cydonia oblonga,* while the lowest similarity was 64.052 between species *Cotoneaster orbicularis* and *Cydonia oblonga*.

Cluster B: includes 5 samples from No. 4-8. The highest similarity was 73.054 between *Pyrus calleryana* and *P. communis*, while the lowest similarity was 60.00 between *Rhiphiolepis umbellate* and the other species in the same cluster (*Eriobotrya* sp., *Malus* sp.; *Pyrus caleryana* and *P. communis).*

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Table 1: Alphabetical list of 8 studied spices representing 7 genera of Maloideae with their collection sites Orman garden Giza (Or), Zohrya garden Giza (Zo) Sant Catherins South Sainai (Sa), Beheira Governerate (Be) and Monufia Governerate (Mo)}.

No.	Species	Sites
1	*Cotoneaster orbicularis* Schltdl.	Sa.
2	*Crataegus sinaica* Boiss.	Sa.
3	*Cydonia oblonga* Mill.	Mo.
4	*Eriobotrya japonica* (Thunb.)Lindl.	Be.
5	*Malus domestica* Borkh.	Be.
6	*Pyrus calleryana* Decne.	Or.
7	*P. communis* L.	Be.
8	*Rhiphiolepis umbellata* Schneid	Zo.

Table 2: Data matrix of the observed 68 characters recorded for the 8 studied samples representing 7 genera all belonging to sub-family Maloideae (Rosaceae). The recorded characters are distinguished into (41) qualitative; (8) multi- state and (19) numerical characters. SP. = species, Ch. = characters

Sp / Ch		1	2	3	4	5	6	7	8
Qualitative characters									
1	Habit; shrubs+/ trees -	+	+	+	-	+	-	+	+
2	Stem; armed +/ unarmed -	-	+	-	-	-	-	-	-
3	" tall + / tall and dwarf -	+	+	+	+	-	+	-	+
4	Leaf; permanent + / deciduous -	+	-	-	+	-	-	-	+
5	" arrangement alternate +/ spirally -	+	+	+	-	+	+	+	-
6	" idumentum glabrous + / hairy -	+	+	-	-	-	+	+	-
7	" petiolate + / sessile or sub- sessile -	+	+	-	-	+	+	+	+
8	" stipulate + / exstipulate -	-	-	+	-	+	+	+	+
9	" laminal base, rounded + / attenuate -	+	+	+	-	+	+	+	+
10	" heterophyllus, present + / absent -	-	-	-	-	-	+	-	-
11	" number at node, one +/ more than one -	+	-	+	+	+	+	+-	+
12	" color: dark green+/ pale-green -	+	-	-	-	-	-	-	-
13	Flower: solitary +/ in an inflorescence -	-	-	+	-	-	-	-	-
14	" position, lateral + / terminal(apical) -	+	+	+	-	+	+	+	-
15	" sepals united + / free -	+	-	-	+	-	+	-	+
16	"androecium, stamens inserted + / exerted -	+	-	+	-	-	-	+	+
17	" filamen cylindrical + / flattened -	-	-	+	-	-	+	+	-
18	" anther bilocular + / 4-locular -	-	-	-	-	-	+	-	-
19	" " with appendage, present+/ absent -	-	-	-	-	-	-	+	-

20	"pollen grains shape prolate +/ spherodial-	+	+	+	-	+	+	-	+
21	" " " exine striate +/ sub-pislate -	-	-	+	+	+	+	+	+
22	" " apertures, tricolpate + / tricolporate -	-	+	+	-	+	-	-	-
23	Fruits shape rounded + / not so -	+	+	+	-	+	+	-	+
24	Stems epidermis, hypodermis, present + / absent -	+	+	-	+	+	-	-	+
25	" cortex, broad + / narrow -	-	-	-	+	-	-	-	+
26	" " sclerenchymatous cells present+/absent -	-	-	-	-	-	+	+	-
27	" cortical vascular bundles present + / absent -	-	-	-	+	-	-	-	-
28	" "druses oxalate crystals present + / absent -	-	-	+	-	+	+	-+	-
29	" vascular bundles, tylosis in xylem present + / absent -	+	+	+	+	-	+	+	-
30	" " xylem armed + / clusters -	+	-	+	+	+	+	+	+
31	" " druses oxalate crystals present+/absent -	-	-	-	-	-	+	-	-
32	Leaf: cuticle of upper epidermis, thin + / thick -	+	+	+	+	+	+	+	-
33	" palisade tissue, in 2 layers + / in 3 layers -	+	+	+	+	-	+	+	+
34	" druses crystals in mesophyll present+/absent -	-	+	+	-	+	-	+	-
35	" palisade tissue extended in midrib zone + / not so-	+	-	-	-	-	-	-	-
36	" " crystals oxalate, druses + / prismatic -	+	+	+	-	+	+	-	-
37	Vascular bundles, shape crescent + / rounded -	+	+	+	+	+	+	+	-
38	" " surrounded with sheath +/ not so -	+	+	+	+	-	-	-	-
39	" " bundle sheath open +/ closed -	+	-	+	-	*	*	*	*
40	" tylosis in xylem vesels, present + /absent-	+	+	+	-	-	+	+	-
41	" large cells in lower epidermis, present +/ absent -	-	+	-	-	-	-	-	-
	<u>Multi- state characters</u>								
42	Stem texture (3 categories): glabrous, 1; hairy, 2 and spiny, 3.	1	1,3	1	2	2	1	1	2
43	" color (3-categories) green, 1; gray, 2; and brown3	3	2	3	2	1	3	3	1
44	Leaf or leaflets shape (4 categories): eilliptic, 1; orbicular, 2; ovate, 3; and ob-ovate,4	2,3	4	3	1	3	3	3	3
45	" " apex (3 categories): acute, 1; acuminate, 2 and obtuse, 3.	3	1	1	1	2	1	1	3
46	" " margin (4 categories): entire, 1; ser rate,2 and lobed,3.	1	3	1	2	2	2	2	1
47	Inflorescences type (4 categories): simple racem, 1; compound racem, 2; corymb, 3; and umbellate, 4. If flower solitary*.	3	3	*	1	3	4	4	2
48	Epidermis above midrib: (3-categories) convex,1; concave,2 and straight,3	1	1	1	3	1	2	2	3
49	Fruits color: (6-categories) red,1; yellow,2; redish,3; black,4; blackish brrowen,5; and blackish blue,6	1	1	2	2	2,1	5	2	4,6
	<u>Numerical characters.</u>								
50	Stem, cuticle thickness in μ	4.1	8.2	4.1	8.2	4.1	2.05	4.1	4.1
51	" epidermis thickness in μ.	73.8	41.0	12.3	32.8	20.5	10.3	16.4	61.5
52	" cortex thickness in μ.	135.3	205.0	164.0	905.0	205.0	221.0	410.0	850.0
53	" " number of layers	9.0	15.0	11.0	40.0	13.0	12.0	20.0	30.0
54	" xylem vessels dimension in μ.	12.3	12.3	20.5	42.6	20.5	20.5	28.7	12.3

		x16.4	x8.2	x28.7	x20.5	x20.5	x20.5	x20.5	x8.2
55	Leaf, upper epidermis thickness in µ.	12,3	12.3	12.3	20.5	12,3	16.4	12.3	20.5
56	" " cuticle thickness in µ.	4.1	4.1	4.1	4.1	4.1	4.1	4.1	8.2
57	" palisade tissue thickness in µ.	82.0	82.0	143.5	61.5	135.5	82.0	61.5	123.0
58	" " number of layers.	2.0	2.0	3.0	3.0	3.0	2.0	2.0	2.0
59	" spongy tissue thickness in µ.	82.0	82.0	123.0	143.5	123.0	73.8	123.0	246.0
60	" " number of layers.	6.0	4.0	7.0	7.0	8.0	7.0	10.0	12.0
61	" xylem vessels dimension in µ.	4.1 x8.2	12.3 x12.3	20.5 x16.4	12.3 x8.2	8.2 x12.3	16.4 x12.3	20.5 x16.4	12.3 x8.2
62	Leaf , lower epidermis thickness in µ.	8.2	12.2	8.2	12.3	8.2	10.25	12.3	20.5
63	" " cuticle thickness in u.	2.05	2.05	2.05	2.05	2.05	2.05	2.05	4.1
64	Stamens, filament length in mm.	4,8	3,5	4,8	5.0	5.0	4.0	4.0	4.0
65	Pollen grains, polar diameter in µ.	9.52	10.1	10.8	4.29	9.69	4.54	4.39	5.11
66	" " equatorial diameter in u.	9.17	5.95	5.05	3.70	6.93	4.43	4.10	2.79
67	Stamen, filament length in mm.	1.83	1.69	2.13	1.16	1.39	1.02	1.07	1.83
68	Style, length in mm.	2.5	3.4	3.9	2.3	3.2	2.8	2.5	2.8

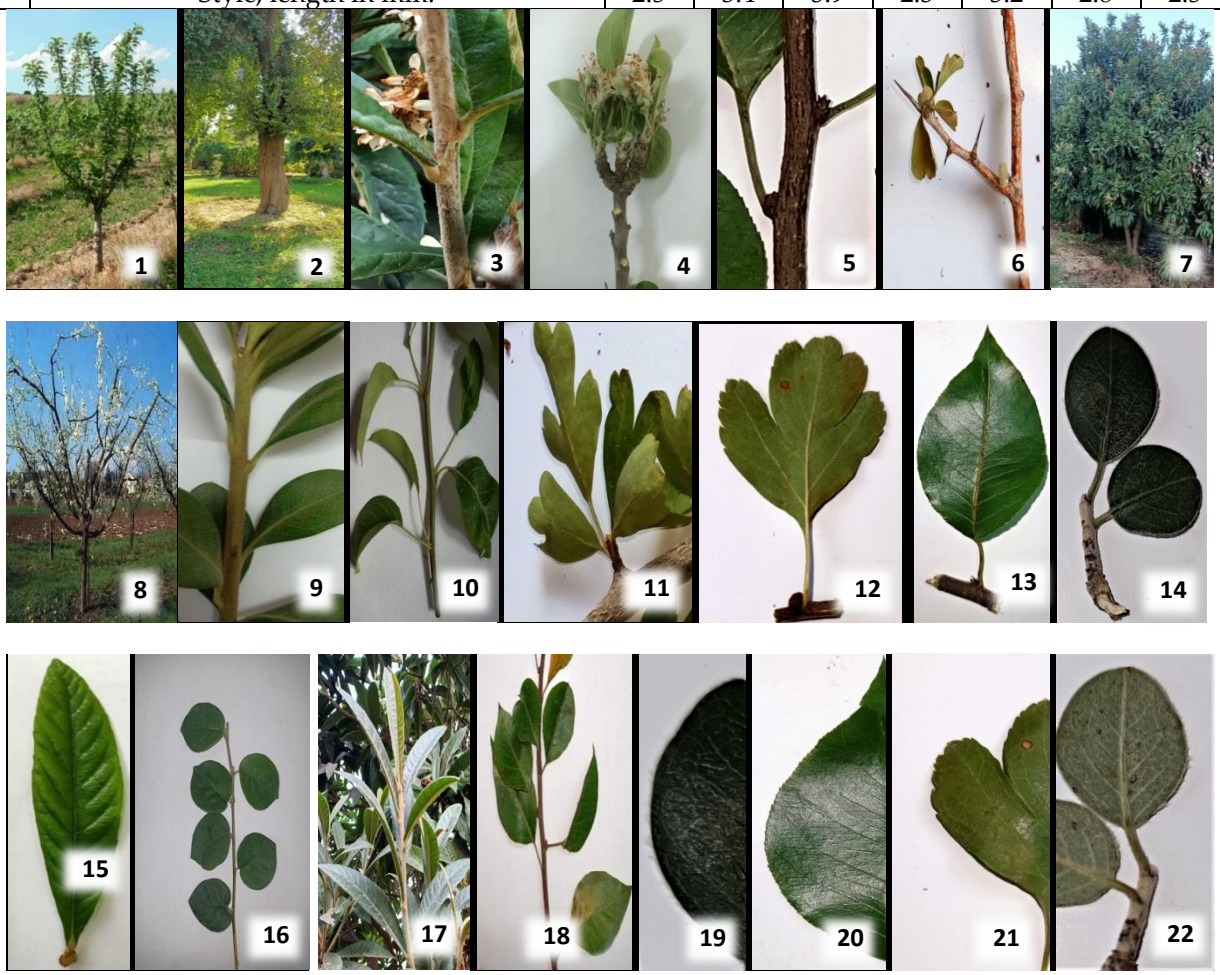


Plate 1: (Figs. 1-22) Show habit, stems and leaf in Maloideae:
1-Shrubs in *Malus domestica.*
2-Trees with *Pyrus calleryana.*
3-Stem indumentum, hairy with aerial-erect stem and gray stem in *Eriobotrya japonica.*
4-Dwarf stems and green stem in *Malus domestica.*
5-Glabrous and brown stems in *Pyrus calleryana.*
6-Spiny stems in *Crataegus sinaica.*
7-Permanent leaves (evergreen) in *Eriobotrya japonica.*
8-Deciduous leaves in *Malus domestica.*
9-One leaf at node in *Rhiphiolepis umbellate.*
10-Two leaves at node leaves in *Pyrus communis.*
11-More than leaves at node leaves in *Crataegus sinaica.*

12-Ob ovate leaves, with winged petiolate and stipulate as in *Crataegus sinaica.*
13-Ovate leaf, green color, glabrous leaf, with acuminate apex in *Pyrus calleryana.*
14- Ovate to orbicularis leaf, ex stipulate with dark green color and rounded truncate base in *Cotoneaster orbicularis.*
15-Blade elliptic and sessile or sub-sessile with acute apex and attenuate truncate base in *Eriobotrya japonica.*
16-Alternate arrangement in *Cydonia oblonga.*
17-Spirally arrangement leaves in *Eriobotrya japonica.*
18-Heterophyllus in *Pyrus calleryana.*
19-Entire margin in *Cotoneaster orbicularis.*
20-Serrate margin in *Pyrus calleryana.*
21-leaf margin loped as in *Crataegus sinaica.*
22-Hairy leaf with obtuse apex in *Cotoneaster orbicularis*.

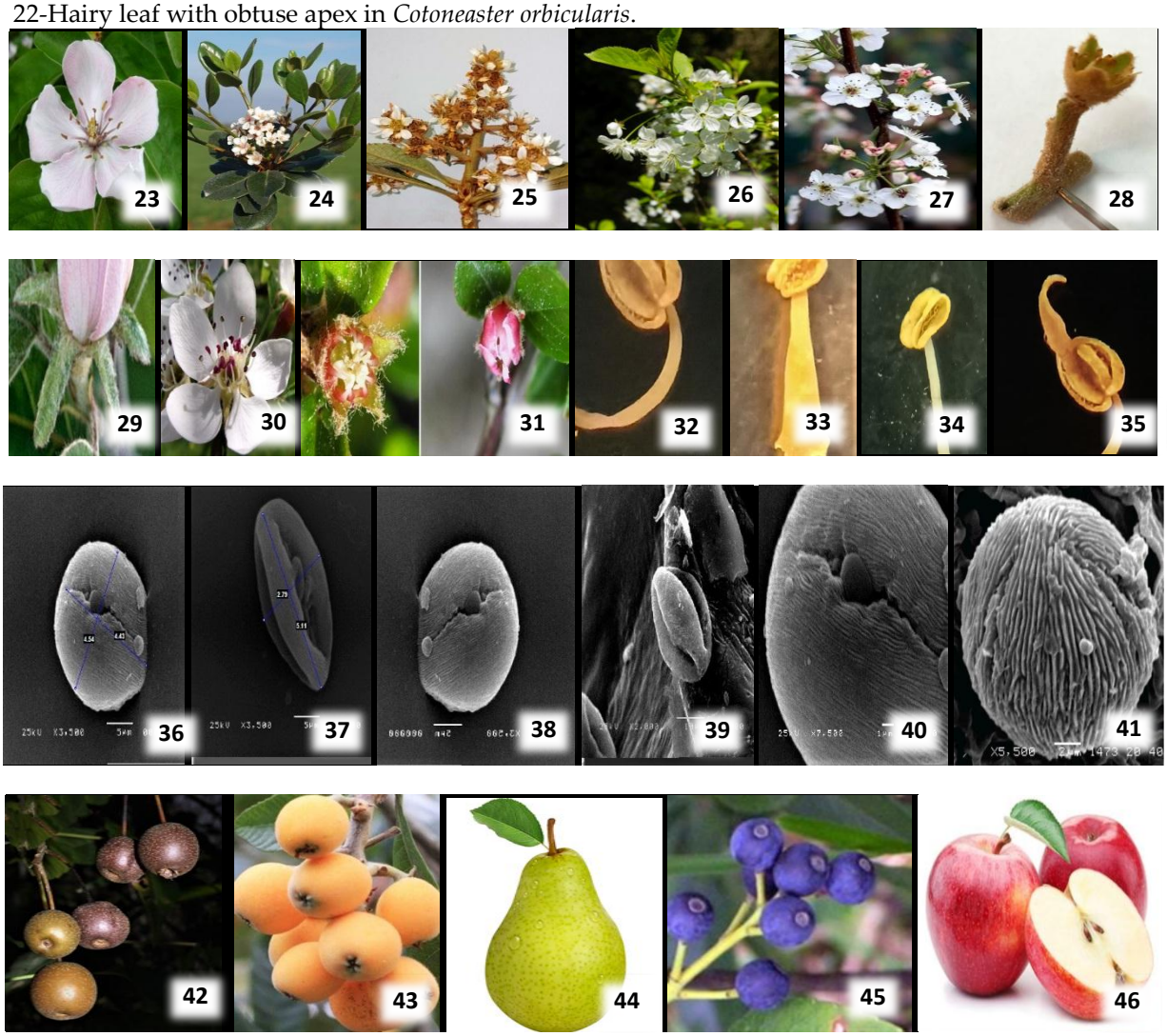
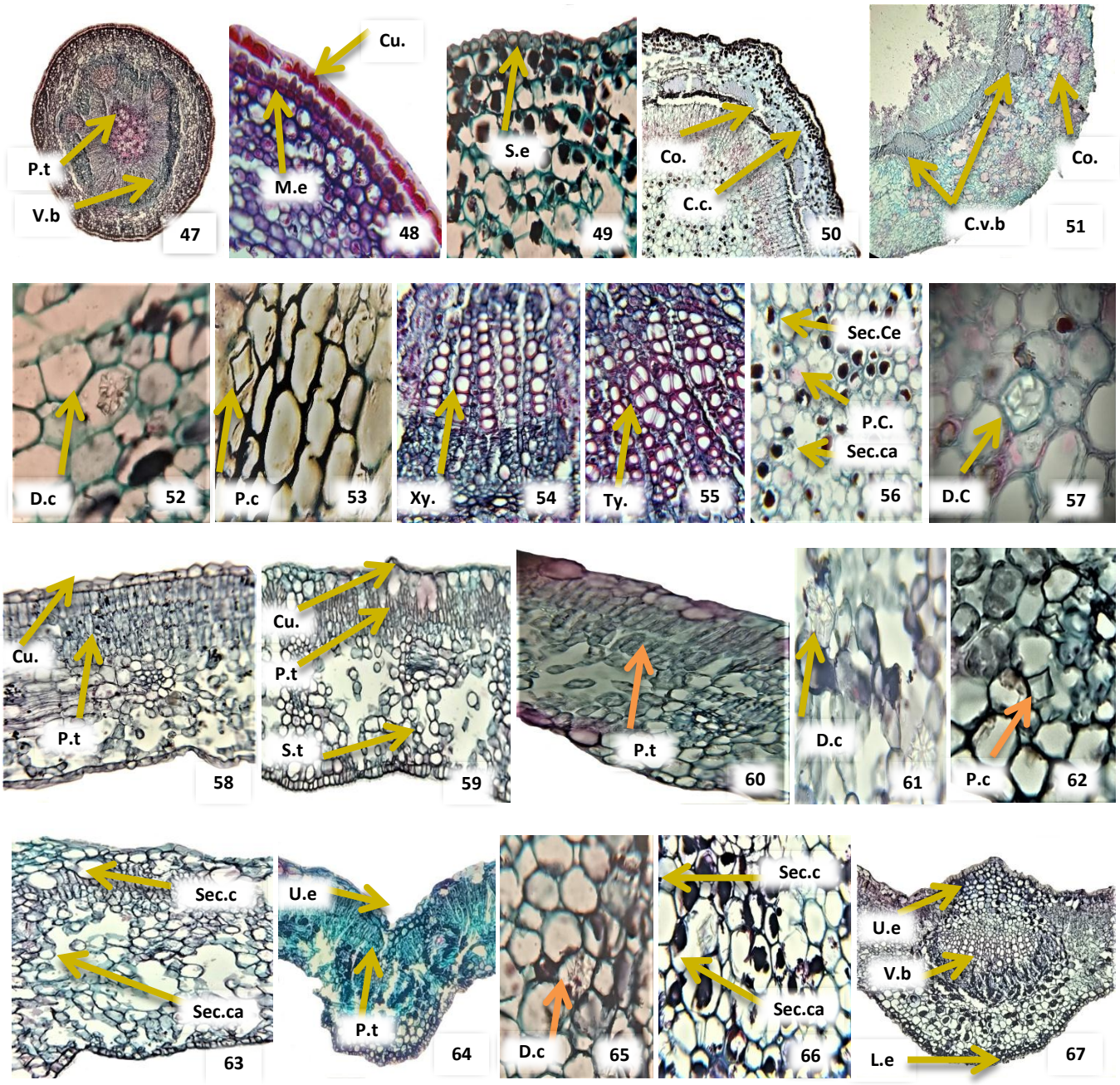


Plate 2: (Figs. 23-45) Show flower, inflorescences, pollen grains and fruits in Maloideae:
23-Solitary flower, 5 petals arranged in one whorled, white color in *Cydonia oblonga.*
24-Compound raceme inflorescences panicle as helicoid, terminal in *Rhiphiolepis umbellate.*
25-Simple raceme as in *Eriobotrya japonica.*
26-Corymb lateral polychasial lateral inflorescence in *Malus domestica*
27-Umbellate inflorescences in *Pyrus calleryana.*
28- United sepals in *Eriobotrya japonica.*
29- Free sepals whit hairy indumentum in *Cydonia oblonga.*
30-Stamens exerted petalous in *Pyrus calleryana.*
31-Stamens inserted in petalous in *Cotoneaster orbicularis.*
32-Cylindrical filaments in *Pyrus communis.*
33-Flattened filaments in *Eriobotrya japonica.*
34-Anther connected madifixed with filament in *Malus domestica.*

35-Anther with apical appendages and 4-locular in *Pyrus communis.*
36-Spheroida pollen in *Pyrus calleryana.*
37-Prolate pollen in *Rhiphiolepis umbellate.*
38-Pollen apertures colporate in *Pyrus calleryana.*
39-Pollen apertures colpate in *Malus domestica.*
40- Exine sculpture striate in *Pyrus calleryana.*
41- Exine sculpture sub-pislate in *Cotoneaster orbicularis.*
42- Rounded fruit black to brown color in *Pyrus calleryana.*
43- Ovate fruit with yellow color in *Eriobotrya japonica.*
44- Pear shaped fruit in *Pyrus communis.*
45- Black to blue fruit in *Rhiphiolepis umbellate.*
46- Red fruit in *Malus domestica.*



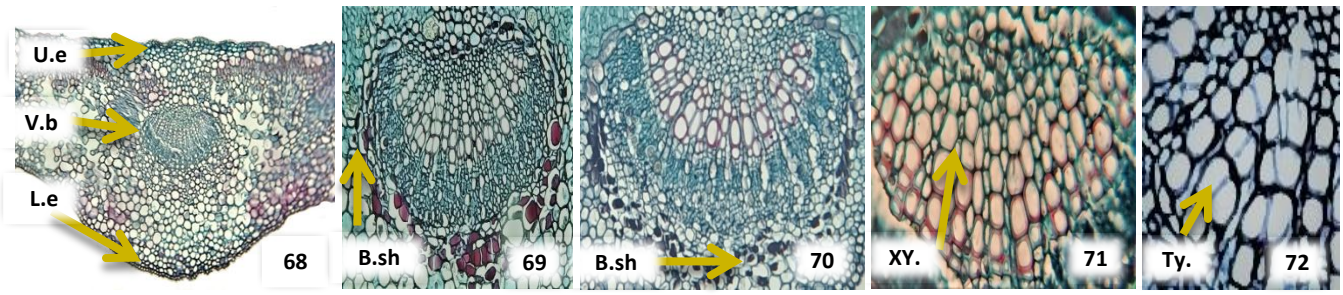


Plate 3: (Figs. 47- 72) Cross sections in the stems and leaf in Maloideae:
47-Outline rounded, Pith solid (Pt), vascular bundles arranged in continuous ring (V.b) in *Crataegus sinaica.* (X=40)
48-Multi-epidermis (Me) whit thin cuticle, (Cu) *Crataegus sinaica* . (X=160)
49- Simple epidermis, (Se) in *Pyrus communis*. (X=160)
50-Narrow cortex (Co.), with Collenchymatous cells (C.c) in *Pyrus calleryana*. (X=160), parenchymatous, (P.c) secretory cells, Cec.c) secretory canals, Sec.ca) in cortex.
51-Board cortex (Co.), with cortical vascular (C.v.b) bundle in *Eriobotrya japonica.* (X=160)
52-Druses crystals, (D.c) in *Pyrus communis*. (X=400)
53-Prismatic crystals, (P.c) as in *Crataegus sinaica*. (X=400)
54-Xylem vessels in armed (Xy) in *Rubus sanctus*. (X=400)
55-Xylem vessels in clusters (Xy) and Tylosis, (Ty) in *Crataegus sinaica*. (X=400)
56-parenchymatous, (P.c) secretory cells, (Cec.c) secretory canals, (Sec.ca) in pith e.g., *Pyrus calleryana.* (X=400)
57-Druses crystals (D.c) in pith e.g., *Pyrus calleryana*(X=400)
58-Palisade tissue (P.t), with three layers, whit thin cuticle, (Cu) in *Malus domestica*. (X=160).
59-Mesophyll consisted of palisade (P.t), and spongy (S.t), with thick cuticle (Cu) as in *Rhiphiolepis umbellate*. (X=160).
60-Palisade tissue (P.t), with two layers in *Pyrus calleryana.* (X=160)
61-Druses crystals (D.c), in mesophyll as in *Pyrus communis*. (X=400).
62-Prismatic crystals (P.c), in mesophyll e.g., *Pyrus calleryana.* (X=400)
63-Secretory cells (Cec.c), secretory canals (Cec.ca) in mesophyll as in *Rhiphiolepis umbellate* (X=160).
64-Upper epidermis (U.e) convex, and palisade tissue (P.t) above the midrib connected in. *Cotoneaster orbicularis* (X= 40).
65-Druses crystals (D.c), in midrib e.g *Cydonia oblonga* (X= 400).
66-Secretory cells (Sec.c), secretory canals (Sec.ca), in midrib e.g., *Pyrus communis*. (X= 400).
67-Upper epidermis (U.e) concave, above the midrib and vascular bundle (V.b) crescent, shaped and hypodermal lower epidermis (L.e) in *Pyrus communis*. (X=40).
68-Upper epidermis (U.e) striate, above the midrib and lower epidermis (L.e) concave,simple, vascular bundle (V.b) rounded, shaped in *Rhiphiolepis umbellate*.(X= 40).
69-Enclosed bundle sheath (B.sh) in *Crataegus sinaica* (X= 200).
70- Bundle sheath (B.sh) opened in *Cydonia oblonga*. (X= 200).
71-Xylem vessels (Xy) in *Crataegus sinaica*. (X= 400).
72-Tylosis (Ty) in *Pyrus communis* (X= 400).

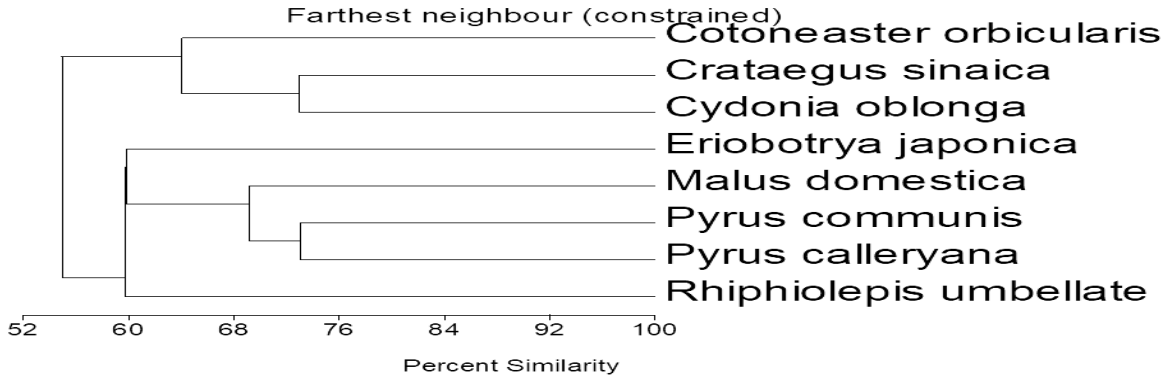


Figure 73: Dendrogram represent the relationships of similarity among 8 species (7 genera) from sub-family Maloideae (Rosaceae).

دراسات نباتية مقارنة علي بعض النباتات التفاحية (الوردية) في مصر

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الملخص العـربي

شملت هذه الدراسة 8 أنواع نباتية (7 أجناس) تتبع تحت الفصيلة التفاحية (الفصيلة الوردية) . هذه العينات النباتية جمعت من 5 مواقع مختلفة في جمهورية مصر العربية. واستخدمت في الدراسة كل أعضاء النباتات الخضرية (الساق والأوراق) والتكاثرية (الأزهار والثمار) وقد سجلت الصفات سواء مورفولوجية او تشريحية بطريقة مقارنة (بلغ عددها 68 صفة) في مجمع صفات ثم أخضعت النتائج لأحد برامج التحليل العددي وذلك لتحديد درجة التشابه بين هذه العينات النباتية والذي قسم هذه العينات الي مجموعتين : المجموعة الأولي ضمت ثلاث انواع (1-3) وكانت أعلي درجات التشابه 659. 72 بين كل من *Crataegus* sp. و *Cydonia* sp. بينما كانت االأقل درجات التشابه 052. 64 بين كل من *Cotoneaster* sp. و*Cydonia* sp. . أما المجموعة الثانية فقد شملت الأنواع الخمسة الأخرى (4-8) وكانت أعلي درجة التشابه 054. 73 بين *Pyrus calleryana* و*P. communis* بينما كانت أقل درجة تشابه هي 740. 59 بين *Rhiphiollepis* sp. والأنواع الأربعة الأخرى في نفس المجموعة *Eriobotrya* sp., *Pyrus calleryana* *Malus* sp., و *P. communis* .و يعتبر المفتاح التعريفي المسنن الذي صمم للعينات الثمانية محل الدراسة من أهم نتائج هذا العمل فهو يسهل تعريف وتمييز هذه الأنواع من خلال هذا المفتاح.

الكلمات الاسترشادية: مورفولوجى, تشريح، حبوب لقاح، زهرتن ثمار.