

ORIGINAL ARTICLE

A Comparative Systematic Study of the Genus *Fritillaria* L. (Liliaceae) in Iraqi Kurdistan Region

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ABSTRACT

A comparative systematic study was conducted of the taxa of genus *Fritillaria* L. family (Liliaceae) grows in Iraqi Kurdistan, concerning Morphological, Palynological, The morphological data were about bulbs, stems, leaves, flowers, inflorescence, fruit parts and seeds. The pollen grains of all the studied taxa were monads. The studied taxa were *Fritillaria imperialis*, *F. persica*, *F. assyriaca*, *F. uva-vulpis*, *F. crassifolia* subsp. *kurdica*, *F. crassifolia* subsp. *hakkarensis* and *F. alfreda* subsp. *glaucoviridis* which was recorded for the first time in Iraq.

Keywords: The taxa of genus *Fritillaria* L. family (Liliaceae), Morphological & Palynological Study.

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INTRODUCTION

The study of phenotypic traits of plants are considered as the base to describe and initial diagnosis the plants, which is the centerpiece of any advanced taxonomic study and it cannot be dispensed, and used in the development of key taxonomic hierarchy. Through identifying minute phenotypic qualities that became necessary in the field of classification, especially after the discovery of a scanning electron microscope (SEM) and techniques that have helped to solve a lot of problems of taxonomic for being illustrating wider manifestations of the plant [1,2]. The current study examined phenotypic characteristics of all the plant organs in detail based on what was stated in terms of each of [3-13]. The basic objectives of this study are to select the obvious phenotypic traits and confirm them to be used in isolation of the studied taxa, and avoid overlaps between species.

The palynology information has contributed to solve many complex problems facing the taxonomic studies. Al-Maadhid [14] and Abdul-Razaq [2] found that the study of pollen is important as the morphological characters of plant organs. Erdtman [15] indicated that the family Liliaceae is monocolpate, while Nair (1971) confirmed the existence of one pore with 1-3 farrows and Franchi and Pacini [16] indicated that the pollen grains of the this family are monads and for species of the genus *Fritillaria* are heteropolar agreed with each of [17,18].

MATERIALS AND METHODS

MORPHOLOGICAL STUDY: The specimens of different taxa under study growing in Iraqi Kurdistan region were directly collected from the field, this sample collecting completed in 20 trips throughout 2012 seasons. Each site were visited more than twice, the trips were in Spring and Summer, it was due to the plants in growth stages, and revealed different (floral bud stage, vegetative growth stage, flowers and fruits), the trip covered all mountain regions within provinces of Iraqi Kurdistan (Jabal Sinjar District MJS, Amadiyah District MAM, Rawanduz District MRO, Sulaymaniyah District MSU, Erbil District FAR, and Kirkuk District FKI). Plant growth study in those areas is wide spread, those trips identified plant environment and what is associated with. The specimens were studied in detail and all plant parts by Dissecting Microscope and the Compound Microscope and diagnosed correctly in the laboratory, each

sample were given an identity label indicating the scientific name, number and date and place of collection, soil type and height above sea level measured by (GPS) Global positioning system of the type (Garmin Rino 110) and recorded some environmental observations as well as the name of the collector. Through what has collected during field trips as well as on installed on herbarium samples, some Iraqi herbarium installations of flower period growth were set to study. And most of the species were photographed in the field during trips so as to indicate the type of environment in which they live for the General Authority for plants.

PALYNOLOGICAL STUDY: The pollen grains obtained from anthers of mature floral buds preserved in ethanol 70%, which have been collected in the field during the field trips in which all species under the study were taken. Anthers were set in a watch glass and added into it some drops of Glycerin Safrannin pigment [2]. Then has been opened by two minute anatomical needles and crushed to extract the pollen and exposed to the pigment. The pollens have been crushed by dropper for each species and put on a clean glass slide, put the cover gently and then examined under the power zoom (40X) of a compound light microscope type Olympus. This study used samples collected previously from different locations of the districts of Iraqi Kurdistan in order to take in the consideration the variations resulting from environmental differences, (25-30) pollen grains were studied for each species and the dimensions of each grain in the (P) Polar view and the (E) Equatorial view, and exine thickness were measured and range value was recorded for each

RESULTS AND DISCUSSION

MORPHOLOGICAL STUDY

Habit and duration

All taxa of the genus *Fritillaria* are wild in Iraqi Kurdistan Region, perennial herbs and propagation is by bulbs. Often they grow on limestone substrates or serpentine soils, stony and clay soils on rocky mountain sides.

Bulbs:

One bulb or more with few tightly-packed scales and thin, translucent tunic which disappears when increasing bulb-size. Often with bulblets, sometimes stoloniferous. Plant grows in limestone substrates or serpentine soils, stony and clay soils on rocky mountain sides. The bulb shapes of all taxa of the genus *Fritillaria* are globose except the *F. persica* which is spindle. The bulb colours of all taxa of the genus under the study are light yellow except the *F. imperialis* which is white. The minimum length of bulb was in *F. crassifolia* subsp. *hakkarensis* (13.55) mm as average and the maximum length of bulb was in *F. persica* (56.86) mm as average, while the rest of taxa are between the two values as shown in (Figure 1).

Stems:The stem is simple, erect and smooth in all species except in *F. assyriaca* which is often papillose, the stem colour of all taxa are green except in the species *Fritillaria imperialis* which is dark-reddish brown on the top. The stem's dimensions are the most characters variable, the maximum length of stem in *F. imperialis* as average was (91.13)cm, while the minimum value was in *F. crassifolia* subsp. *kurdica* (5.0) cm as average and the rest of taxa are between the two values.

Leaves:

The leaves of all taxa of the genus *Fritillaria* are simple, sessile and alternate arrangement in all species except *F. imperialis* which the arrangement of its leaves is whorled. The leaf shape is lanceolatus in *F. imperialis*, *F. assyriaca*, *F. uva-vulpis* and *F. alfreda* subsp. *glaucoviridis* but taplike in both *F. persica* and *F. crassifolia* subsp. *kurdica* and narrow elliptic in *F. crassifolia* subsp. *hakkarensis*. In all species the blade base is rounded in shape, parallel-veined, the leaf margin is entire and the apex of terminal leaf is acute except the *F. persica* which is acuminate. The leaf's dimensions are the most characters variable. The maximum length of leaf blade as average was (17.1) cm in *F. imperialis*, while the minimum value was (5.00) cm as average in *F. crassifolia* subsp. *kurdica*, and the rest of taxa are between the two values.

Flowers:

The flowers of all studied taxa of this genus are perfect, bisexual and actionomorphic symmetry. The flowers usually are bright, perianth with (6) tepals, inflorescence are on scape usually umbel as in the species *F. imperialis*, raceme in *F. persica* and solitary flower in the others. Peduncles are green in all the studied taxa except in *F. imperialis* which is with brown pedicle. The length of pedicles are varied in of the studied genus, the minimum length of the pedicle is (21.6) mm as average in the *F. persica* and the maximum value is (32.5) mm as average in the species *F. imperialis*, while the others species are located between the two values as shown in (Figure 2). Regarding the flower colour, the following variations were mentioned:

1: In *Fritillaria imperialis*:has three coloures:Red flower (Rubra), Yellow flower (Lutea) and Brownish orange flower (Aurora).

2: In *F. persica*: have two colours: Dark plum -purple and Yellow.

3: In *F. assyriaca*, tepals greenish or purplish-brown colour with green stripes outside, greenish or yellow inside.

4: In *F. uva-vulpis*, tepals purplish-grey edged yellow outside, deep yellow inside.

5: In *F. crassifolia* subsp. *kurdica*, tepals outer and inner tessellated on a greenish or yellow ground with green strips.

6: In *F. crassifolia* subsp. *hakkarensis*, the outer surface greenish, brownish or much reddish tessellated with broad greenish-yellow stripes tessellated inside.

7: In *F. alfredae* subsp. *glaucoviridis*, outside glaucous green, inside yellowish-green.

The margin of tepals in all species the genus *Fritillaria* is entire which apex of tepal in *F. imperialis*, *F. persica*, *F. assyriaca*, *F. uva-vulpis* and *F. alfredae* subsp. *glaucoviridis* is rounded but in both subsp. of species *F. crassifolia* which are *kurdica* and *hakkarensis* is acute. The base of tepals is rounded in *F. imperialis*, *F. persica*, *F. assyriaca* and *F. alfredae* subsp. *glaucoviridis* but tend wide in *F. uva-vulpis* and acute in both subsp. of species *F. crassifolia* which are *kurdica* and *hakkarensis*.

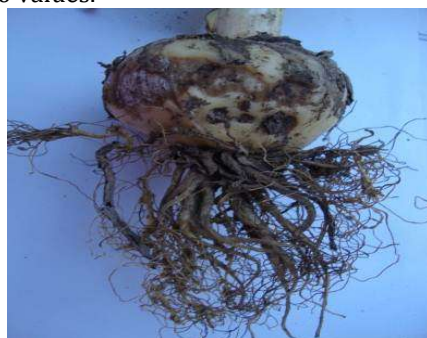
Nectaries are a sweet liquid secreted by plants as food to attract animals that will benefit them. Many flowers produce nectar to attract pollinating insects, birds, and bats. Bees collect nectar to make into honey. Nectar is produced in structures these provide a food source for animals such as ants which in turn defence the plant from harmful insects. Nectar consists primarily of water and varying concentrations of many different sugars, including fructose, glucose, and sucrose. In most of the material investigated, nectary cells were smaller and narrower and less irregular in shape than those of the neighboring. The nectaries shape were circular except the *F. persica* was triangular, the nectar's colour are black in the all taxa except the *F. imperialis* which is white and green usually with a black spot at the base in *F. crassifolia* subsp. *hakkarensis* but green in *F. alfredae* subsp. *glaucoviridis*. called nectaries. Some plants have nectaries located elsewhere, outside the flower.

Androecium

Androecium in the taxa of this genus consists of (6) fertile stamens, each stamen usually consists of filament and anther.

Filament:

Filament is characterized by filliform shape in *F. imperialis*, *F. persica* and *F. uva-vulpis* but papillose shape in *F. assyriaca*, *F. crassifolia* subsp. *hakkarensis* and *F. crassifolia* subsp. *kurdica* and in *F. alfredae* subsp. *glaucoviridis* is stout, papillose above glabrous in the all taxa. The filaments of taxa of the studied genus are basifixed innation with yellow colour. Which they varied in the length of their filaments, as the minimum length of filament is (6.0) mm as average in the *F. crassifolia* subsp. *hakkarensis* and the maximum length of filament is (55.5) mm as average in the *F. imperialis* and the rest of taxa are varied between the two values.



Fritillaria imperialis



F. persica



F. assyriaca



F. uva-vulpis

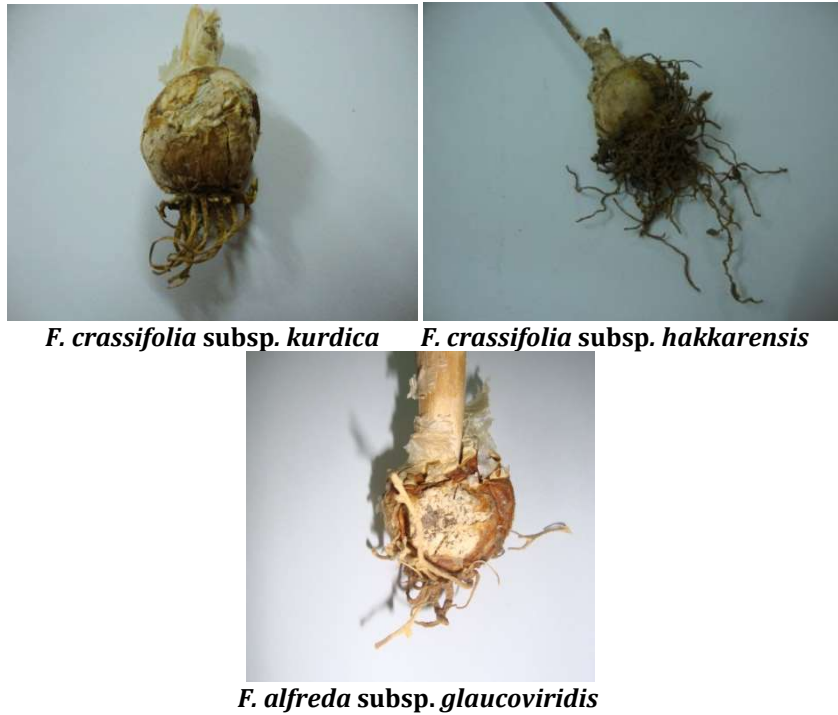


Figure (1): Variations in the shapes and dimensions of bulb of the genus *Fritillaria* taxa.

Anther:

Anther of the studied taxa is bilobed, longitudinal dehiscence, yellow in all taxa except *F. persica* brown, oblong shape in all taxa except the *F. persica* is elliptic. The minimum length of anther is (2.6) mm as average in the taxa *F. persica* and the maximum length of anther is (8.9) mm in the *F. imperialis* as average and the others of taxa are located between the two values and the minimum width of anther is (1.6) mm as average in the taxa *F. persica* and the maximum width of anther is (3.4) mm in the *F. imperialis* as average and the others of taxa are located between the two values.

Gynoecium: Gynoecium of the studied taxa of the genus *Fritillaria* consists of a polycarpous pistil, each with ovary, style and stigma.



Fritillaria imperialis



F. Persia



F. assyriaca



F. uva-vulpis



F. crassifolia subsp. *kurdica*



F. crassifolia subsp. *hakkarensis*



F. alfredae subsp. *glaucoviridis*

Figure (3): Inflorescence of all investigated species.

Stigma:

Stigma in the genus *Fritillaria* is consists of three lobes with yellow colours .

Style:

Style in the studied genus is single, filiform except in *F. alfredae* subsp. *glaucoviridis* is densely papillose, glabrous and light yellow. The minimum length of style is (6.3) mm as average in the taxa *F. crassifolia* subsp. *hakkarensis* and *F. crassifolia* subsp. *kurdica* and the maximum length of style is (46.5) mm as average in the taxa *F. imperialis* and the others taxa are varied between the two values,

Ovary:

Ovary of the taxa of genus *Fritillaria* is superior, ovoid shape and sessile in most of the taxa. The ovary colour is green in all studied taxa. Placentation is axile. The ovary dimensions (length and width) are varied from their minimum value (6.2X2.4) mm as average in the species *F. persica* and maximum value (17.2X3.6) mm as average in the species *F. imperialis* and the others taxa are located between the two values.

Fruit:

The fruit is regarded as a mature or ripened ovary; fruit of the studied taxa of genus *Fritillaria* are capsule. With regard of the fruit shape it can be distinguished the following shapes:

- A. Fruit is oblong-cylindrical in the taxa *F. imperialis*.
- B. Fruit is cylindrical in the both taxa *F. crassifolia* subsp. *kurdica*,
- C. *F. crassifolia* subsp. *hakkarensis* and *F. alfredae* subsp. *glaucoviridis*.
- D. Fruit is obconical in the species *F. persica*.
- E. Fruit is oblong-ellipsoid in the both taxa *F. uva-vulpis* and *F. assyriaca*.

At the base the fruit is narrowed to thick in *F. imperialis*, but obtuse angles in *F. persica* and *F. assyriaca* oblong-ellipsoid not winged. The fruit colour is yellowish-green in the all species except *F. imperialis* which is dark yellow and *F. persica* is yellow.

The maximum length is (37.5) mm as average in *F. imperialis* and the minimum length of fruit is (26.5) mm as average in the *F. crassifolia* subsp. *kurdica* and the others taxa are varied between the two values. This study indicates obvious variations in the shape and dimensions of fruit as shown in (Figure 3). The maximum width of fruit is (28.5) mm as average in *F. imperialis*, while the minimum value is (7.9) mm as average in *F. persica* and the result values are within the both, (Figure 3).

Seed:

There was obvious variation in the dimensions of seeds found in the results of this study among the studied species. Seed shapes are ovate in all taxa except the *F. imperialis* their seed shapes is ovate-oblong.

Regarding the seed colour, the following variations were mentioned:

- 1. Dark brown in *F. imperialis*.
- 2. Yellow in *F. persica*.
- 3. Light brown in *F. uva-vulpis* and *F. crassifolia* subsp. *hakkarensis*.
- 4. Brown to dark brown in *F. crassifolia* subsp. *kurdica* and *F. alfredae* subsp. *glaucoviridis*

Regarding seed dimension as shown in (Figure 4), the maximum length of seed is (8.7) mm as average in the species *F. imperialis* and the minimum length of seed is (5.1) mm as average in the *F. uva-vulpis* and the other taxa are ranged between the two values and the maximum width of seeds is (6.8) mm as

average in *F. imperialis* and the minimum values (4.9) in *F. crassifolia* subsp. *kurdica*, while the other value are within the two values, (Figure 4) .

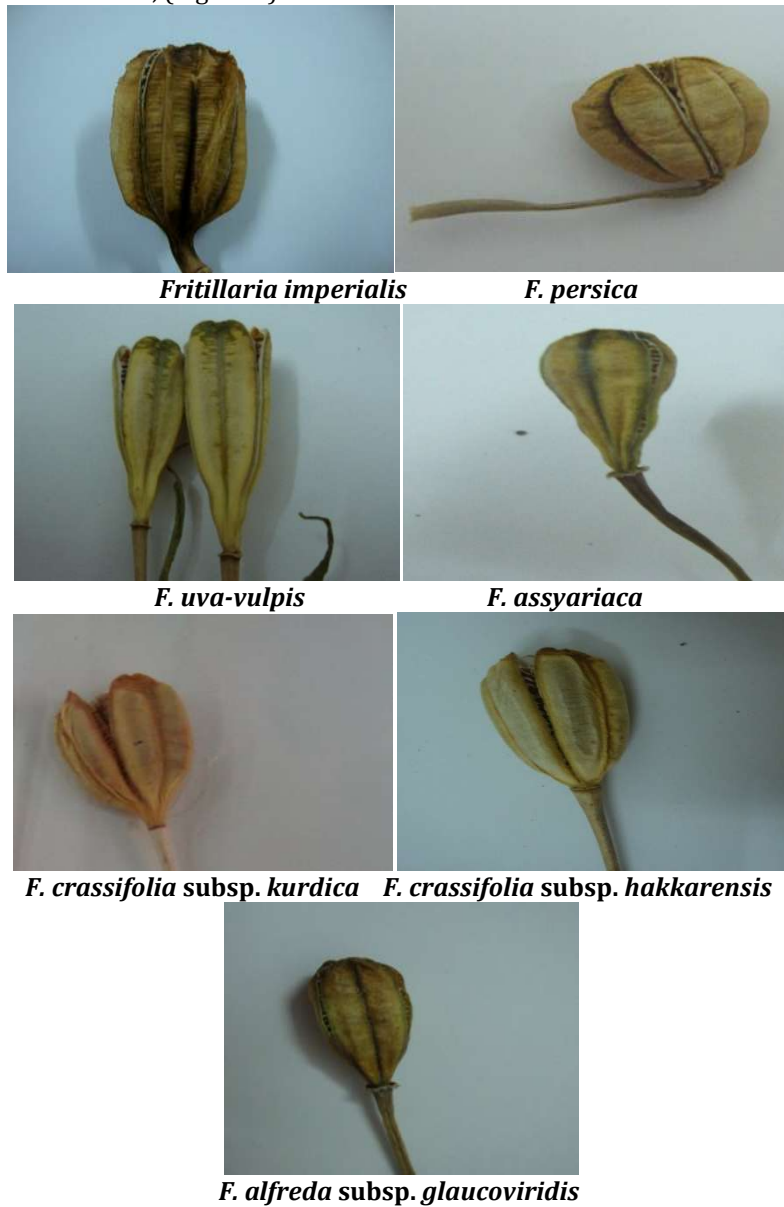
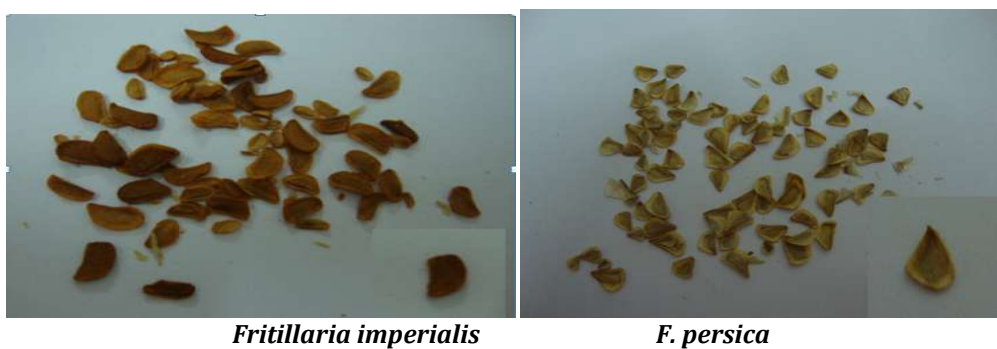


Figure (3): Variation in the shapes and dimensions of fruit of the genus *Fritillaria* taxa.



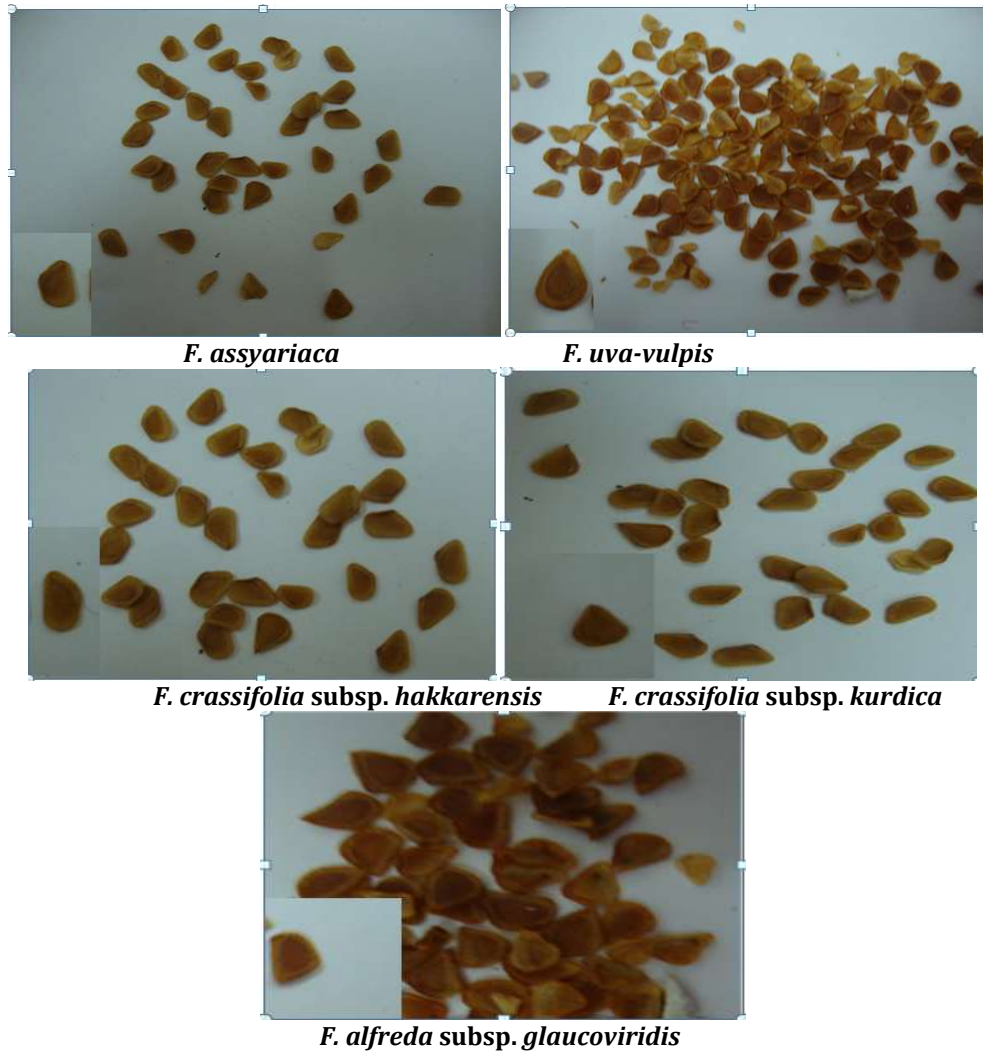


Figure (4): Variation in the shapes and dimensions of seed of the genus *Fritillaria* taxa.

PALYNOLOGICAL STUDY

It is clarified from this study that all studied species of the genus *Fritillaria* are monosulcate as shown in (Figures 5 and 6). According to [15] there are six sizes of pollen grains, it is very small when the size axis less than (10.0) micrometer, small with (10.0-25.0) micrometer, medium with (25.0-50.0) micrometer, large when the size axis reaches (50.0-100) micrometer, very large with (100-200) micrometer and it is Gigantic when the size axis more than (200) micrometer. The studied taxa medium except *F. imperialis* is large. The current study has indicated that pollen grains of the genus *Fritillaria* are single and heteropolar as one of the poles is narrower than the second one, and they are also unicolporate psilate. Obvious variations were found in pollen grains of the studied taxa for their polar and equatorial views. Regarding the shape of pollen grains in polar view (P), all the studied species have spherical to semi-spherical shape (Figure 6). While regarding their shape in Equatorial view (E), it can be divided to the following groups:

1. Species with ovoid to sub-ovoid shape of pollen grains in *F. imperialis*, *F. persica*, *F. crassifolia* subsp. *kurdica*, *F. crassifolia* subsp. *hakkarensis* and *F. alfreda* subsp. *glaucoviridis*.
2. Species with ellipsoid shape of pollen grains in both *F. assyriaca*, *F. uva-vulpis*.

The exine thickness of pollen grains are ranged from (1.7) micrometer as minimum value in the species *F. persica* to (1.9) micrometer as maximum value in *F. crassifolia* subsp. *kurdica*. The shape and size of pollen grains are the most variable characters in the taxa under study which agree with each [15].

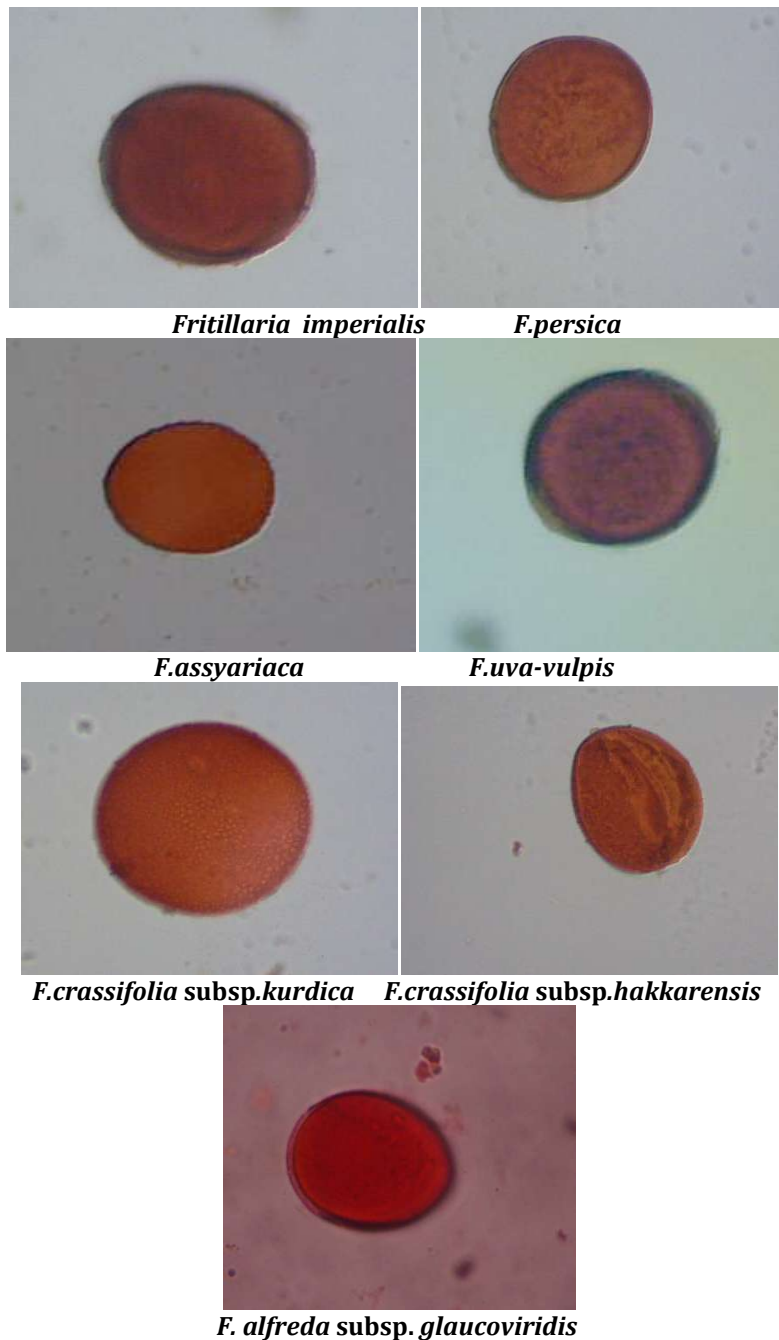
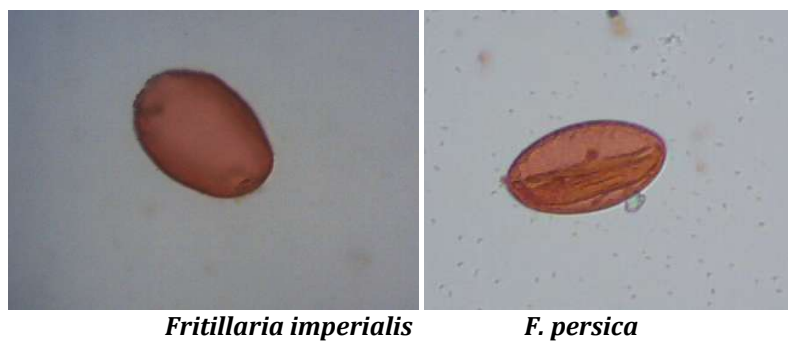


Figure (5): Variations in the shapes and dimensions of pollen grain of polar view of the genus *Fritillaria* taxa



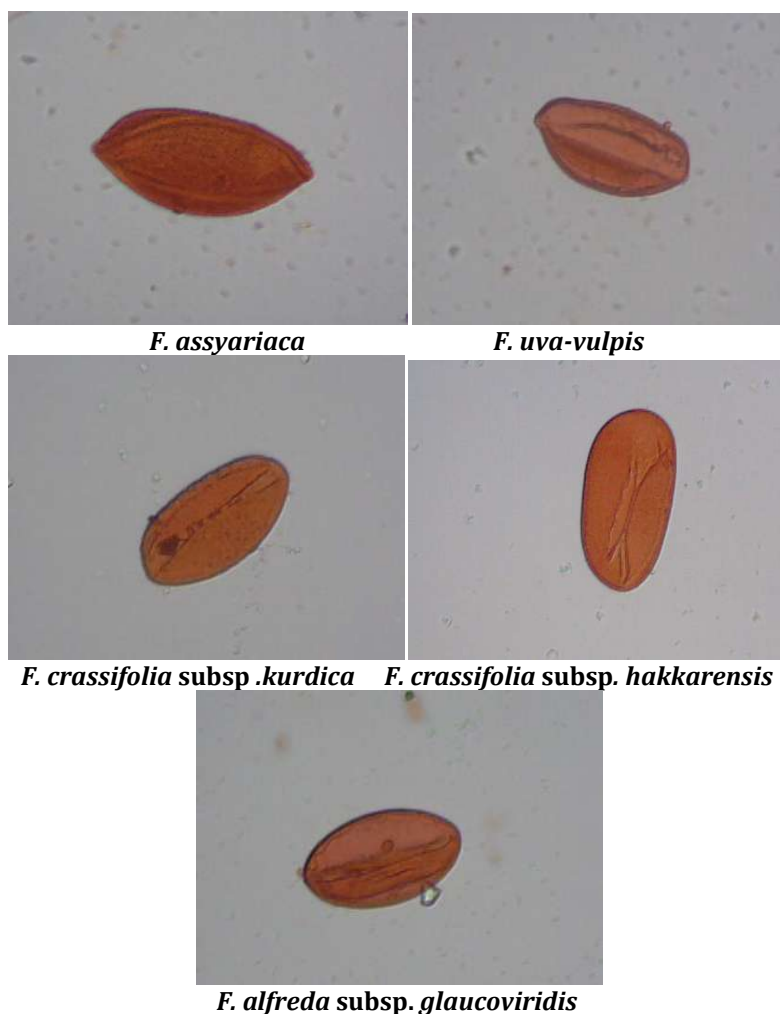


Figure (6): Variations in the shapes and dimensions of pollen grain of Equatorial view of The genus *Fritillaria* taxa.

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