



COMPARATIVE TAXONOMICAL STUDY OF THREE DIFFERENT WILD SPECIES FROM THE FAMILY BRASSICACEAE IN IRAQ

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Abstract

This research paper deals with studying the morphological characters and the pollen grains of the three different wild species, *Diplotoxis erucooides* L, *Rapistrum rugosum* L and *Sinapis arvensis* L, which belong to three different genera from the family Brassicaceae. Comparative study for the plant parts of the studied three species was performed, starting from the root, stem, leaf, and flower including calyx, petal, the female reproductive system (Pistil). The male reproductive system (Stamen) and the fruit regarding their shape, arrangement, dimensions, color and number. The study showed the taxonomical importance of the pollen grains, their shapes, dimensions and the nature of their surfaces were different. All species were isopolar and they have simple apertures which are in the form of colpate or porate all of which are tricolpate or tricolporate, pollen grains, however were zonocolpate, whose their colpate do not extend from pole to the second pole, the ends of the colpate never join each other in both species *D. erucooides* and *S. arvensis*, whilst in *R. rugosum*, the colpate of the pollen

grain extend from one pole to the second pole and their ends joined together, the size of the pollen grain differs within certain range from small grain to gigantic one. The obtained data were important from plant classification point of view to separate the three species.

Key words : Morphological study, pollen grains, some species of Brassicaceae.

Introduction

The family Cruciferae includes 380 genus and 3000 species world widely distributed specially in the Mediterranean sea (Hywood, 1978 and Perveen *et al.*, 2004), Al-Shahbaz *et al.* (2006) reported that cruciferae consists of 340 genus and 3350 species in the world. In Iraq, however, it comprises of 80 genus (Townsend and Guset, 1980; Al-Moussawi, 1987). Al-kateb (1988) stated that it contains 75 wild species and 18 cultivated species, some of which are medicinal plants which are sources of siliques, some are ornament plants and many of them grow in the Iraq fields. Linnaeus (1753) identified and classified species belong to different genera of Brassicaceae of which are the three wild species, *Diplotoxis erucooides* L., *Rapistrum rugosum* L and *Sinapis arvensis* L.

The scientific name of the genus *Diplotaxis* is derived from the Greek word: *diplous* which means double and: *taxis* which refers to the presence of two seeds in each chamber allied *Gargir* and *Rapistrum* which is the scientific name for the genus is derived from the old Latin name of the Lift which is *rapa* and form suffix *aster* and *astrum*, which means false (Fake). These are wild plants have no Arabic name or ancient name and *R. rugosum* which means rough from *cruciferae*. However, the scientific name of the genus *Sinapis* is the ancient Latin name of these plants specially applied for siliques (Nahal, 2009). Brassicaceae is characterized that its plant species contain many active chemical compounds (functional compounds) like alkaloids, tannins and glycosides (Al-Rajab *et al.*, 2014). Due to the importance of pollen grains in many plant studies which depend on the morphological and structural characteristics of the pollen grains, which resolve many problems of those studies. Hyde and Williams (1945) were the first scientists who used the term Palynological, which means the science that deals with pollen or spores and he said that the exine ornamentation of pollen, the presence of spines, grooves and holes in the pollen grains and their size provide taxonomical information and evidences more than the study of the cross section of the

pollen and its wall structure (Erdtman, 1943). The classification and developmental importance of the external morphology of pollen may be on the species or genus level or higher than that the taxonomical grade. Taxon is called Stenopalynous.

If their pollen grains have fixed characters, which many be in clusive for that group of plants (Davis and Heywood, 1973). This what characterise of the family (Khardliya) Brassicaceae. In contrast of some plant families that are called Eurypalynous families, which can be identified by depending on the apertures and Exin ornamentation. Therefore, depending on the studying plant morphology and pollen, do not provide comprehensive study for the above three species according to the references availability. Regarding Brassicaceae, there are many researchers, who performed studies on some genera that belong to this family in Iraq of which the research carried by Al-Neftaji(2000) on the pollen grains and the seeds of three families among which is Brassicaceae. Al- Shammary (2001) studied pollen 27 species belong to 6 tribes in the province of the lowr island (Al-Jazera Al-sufla). Al-Ablish (2007) reported morphological and anatomical study for som species of the genus *Brassica* L. However, Al-whab (2010) showed anatomical study of eight species belong to seven different genera of Cruciferae, while, the study performed by Al-Abide (2012) indumentum and crystals characters of 12 species belong to 10 genera of the tribe Brassicaceae (Cruciferae) than a study carried by Al-Kaliby (2012) which reported study of pollen of 12 species of the genus *Erysimum* L. The aim of this work is to study in details the morphological characters and pollen grains of three species belong to three different genera from this family in order to find enough evidences to separate these species involved in this study.

Materials and Methods

The present study depends on fresh samples collected via different field visits during the growth season of 2016-2017. The dimensions of roots, shoot reproductive parts ,fruits and seeds were recorded by using different metric rulers in addition to graph papers to measure the minute parts of flowers regarding the morphological study ,whilst the study of pollen was dependant on the fresh samples, the fresh flowers and flower buds fixed immediately in the field during the field trips by using carnoi solution (3 volumes ethyl alcohol : 1 volume glacial acetic acid) for 24 hour fridge be using the some ethyl alcohol solution (70%) the ripe anther was kept in bottle to which few drops of safranin-glycerin stain swas added, the anther then opened by minute anatomical needle to

obtain the pollen grains , the other parts of anther the rest of anther were removed , the pollen then transfered by using special pipet to glass slides and were covered by cover slidas and examined under light compound microscope (type novel) supplied with digital camera type (nsz-606). The measure ments were taken by using ocular eyepiece micrometer to measure the dimensions, 25-50 pollen grain from each species were studied , their polar voew was measured together with their equatorial view for each pollen grain. The thickness of pollen wall was measured , the shape of pollen for both polar and equatorial view were described in addition to the exin ornamentation that present on the pollen surface,the data were presented in table (3) and plate (4) to explain the variations in the polar and aquatorial axis for the three studied specied . Pollen grain were photographed by camera type (nsz-606) from the light cmmpond microscope under (40x).

Results and Discussion

First : The Morphological study

Roots

The data of morphological styudy showed that the plants of belong to the Brassicaceae genera that the studied in this study all annual herbs have tap roots whose colors are white to pale white color their average dimensions were 15-55× 0.5-3 cm.

Stem

The roots are connected to herbal cylindrical stems growing upwards mostly group initiated from the roots base, sometimes contain only one branch which were semi- wooden in nature at the base due to the secondary growth, the stems of all species are dichotomousiy, regarding stem dimensions, the average dimensions in the species *D. eruroides* were 65-80 × 0.5-1.5 cm. with green to pale green in colour, however, dimensions of *R. rugosum* were 85-90 × 0.5-2 cm with green to reddish-green,the surface cover for all species covered with hairs that have moderate to low density. The present study revealed a clear variations in the colour and dimensions.

Leaves

There are two types of the first leaves (the simple basal leaves), which are arranged circulary around the stem base of the lobular (2-7). Large lobes compared with the stem leaves having a serrated edge, the shortest arvearge dimension was 5 - 18 × 4 - 11 cm belong to type *D. eruroides*, were as in *S. arvensis*, the arvearge dimension was 7-35 × 2-13 cm, the longest 5-50 × 2-14 cm, was recorded in *R. rugosum* second (The simple stem laeves) which arranged spirally or alternate on the stem which were variabl in the shape and size and

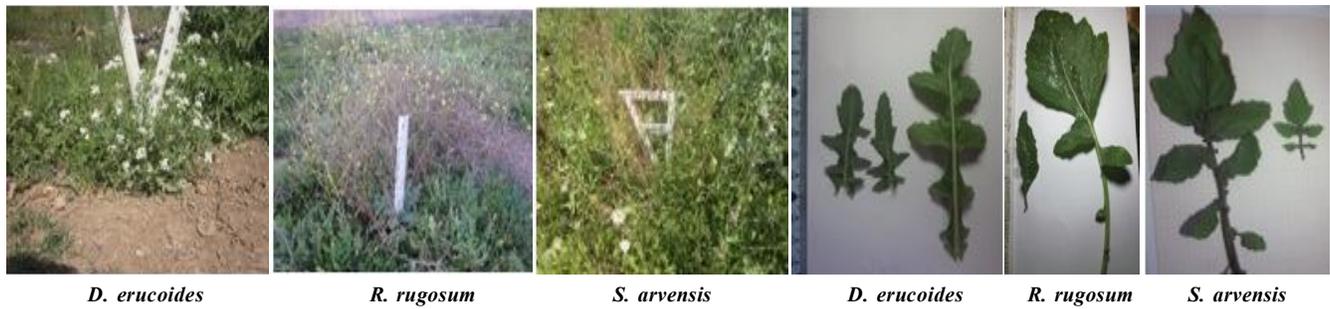


Plate 1 : The variations in the dimensions, leaves shape and field photographs for the studied species in their natural habitats.

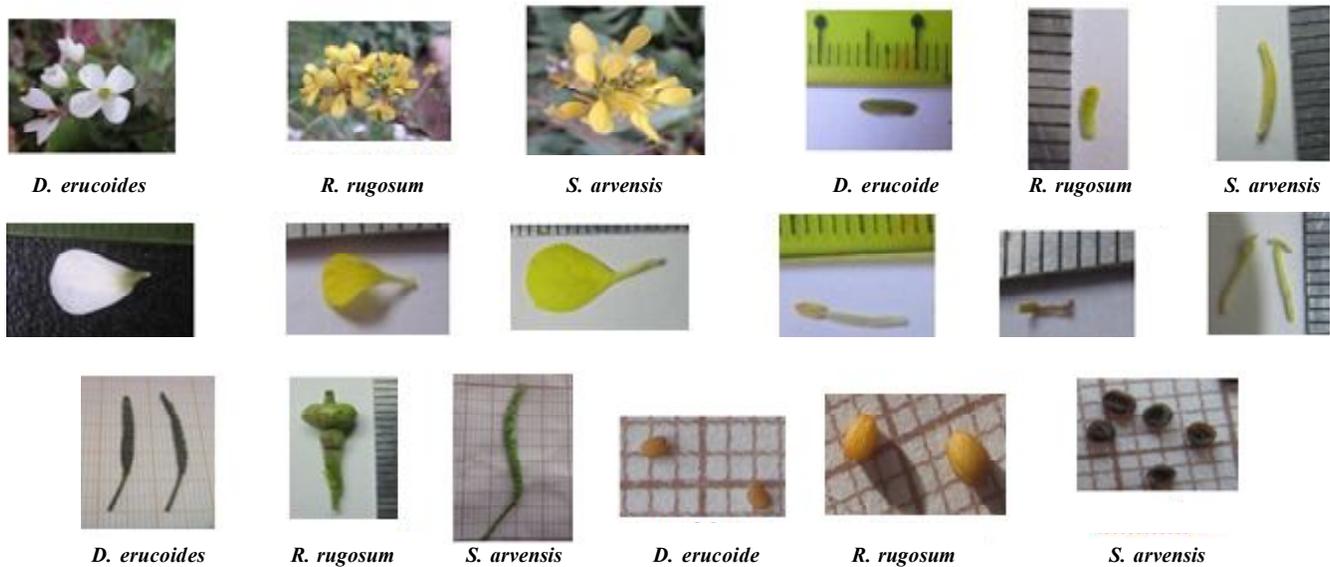


Plate 2 : The variations in the dimensions, shapes of fruits and the seed of the studied species.

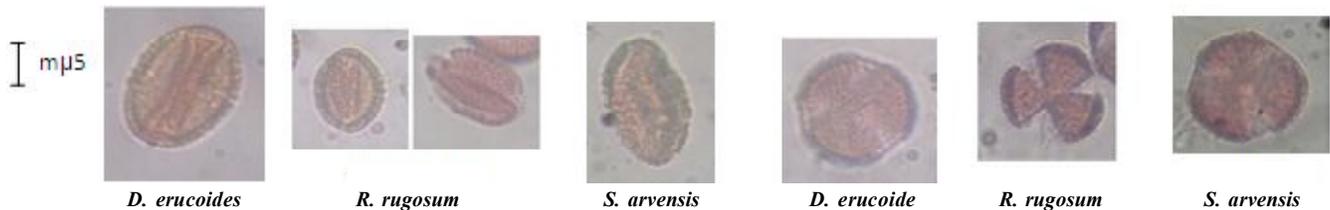


Plate 3 : The variations in the dimensions, shapes of pollen grains in the polar and equatorial view for the studied species.

composed of 1-2 lobed with saw edge, green to redish – green, its middle area covered by hairs with moderate to low density, it is important, however, to mention here that all leaves of the studied species were estipulate.

Flowering systems

The studied species of the genera belong to Brassicaceae that grow wild in Iraq are characterized by their flowers which were in the shape of (simple Racemose) in which the axis elongates and carry along it flowers on pedicels, the lower flower have long necks compared with the upper younger flowers, their flowers open from lower to higher successively in all the studied species.

Calyx

The calyx is composed from four sepals, 2- long and 2- short distributed in cruciform, their average dimension in the species *S. arvensis* (5-7) × (1-1.5mm) and *R. rugosum* (3-4) × (1-1.5mm) in *D. eruroides* (4-5) × (2-3mm), with elongated shape or sometimes curved shape, yellowish-green in all the studied species.

Corolla

It is composed of four palypetalous petals, there were variations in their dimensions, shapes and colour, the average dimensions in *S. arvensis* were 15-15 × 5-7 mm, in *R. rugosum* were (5-9) × (3-4mm), were as *D. eruroides* (7-10) × (3-5mm), the petals, however, were

varied in shape, they were spatulate in shape formed from claw, which is the thin basal part and the limp which is the wide part, the petals were varied in their colour from white in *D. erucoides* while in the other two species were yellow to pale yellow.

Androecium

Stamens

Stamens varied in their numbers which were in all the studied species six stamens, two are short in outer ring and four were tetradynamous, their average dimensions in *S. arvensis* (3-4)×(0.7-1mm), were as in *R. rugosum* (2-3)×(0.4-0.5mm) and in *D. rucoides* (4-5) × (0.7-1mm), their colour were also varied, they were white *D. rucoides* and yellow to pale yellow in the other two species the connection of filament with the anther was basal.

Gynoecium

Pistil

There is one pistil clearly characterized by its stigma, style and ovary its dimensions in *S. arvensis* (6-8)×(0.8-1mm) in *R. rugosum* (3-4)×(0.7-1mm) and *D. rucoides* (8-10)×(1-1.5mm), stigma composed of two lobes in all studied species. It is worth to mention from all described above that the flower properties including all its appendages between the studied species worth in comparison if the descriptive properties quantitatively or qualitatively were taken in consideration.

Fruit

Fruit was silique in all the three species, it was unopened *R. rugosum*, while it was opened in the other two species, fruits were varied in all the species in its shape and dimension. In *S. arvensis* cylindrical shape with pointed end having nodes in the middle. In *R. rugosum* the fruit was silique globose with style fixed with the fruit after ripe, however, *D. erucoides* it was elongated cylindrical slightly curved shape, their average dimensions in *S. arvensis* were (15-30)×(1.5-3)Mm, in *R. rugosum* it was (4-6)×(3-5) Mm and in *D. erucoides* (30-40)×(2-3mm), it was noted that there is significant differences in fruits characteristics both quantitatively or qualitatively on which we can depend on for the separation of the three species.

Seeds

All the data relate to seeds are given in table 2 and plate 3.

There are large differences between seeds in shape, dimensions, numbers and colour among the

Table 1 : The dimensions of the root, stem, leaf, sepal and petal of the studied species are measured in centimeters.

Species	Dimensions the root		Dimensions the stem		Dimensions the leaf		Dimensions the sepal		Dimensions the petal	
	Length the Root	Diameter the Root	Length the stem	Diameter the stem	Length the leaf	Width the leaf	Length the sepal	Width the sepal	Length the Petal	Width the petal
<i>D. rucoides</i>	(10-40) 30	(0.5-1.5)0.5	(65-80)70	(0.5-1.5)1	(5-18) 8	(4-11) 4	(0.4-0.5)0.4	(0.2-0.3)0.2	(0.7-0.10)0.8	(0.3-0.5)0.5
<i>R. rugosum</i>	(15-55) 50	(0.5-3) 1	(85-90)88	(1.5-2)1.5	(5-50) 9	(2-14) 4	(0.3-0.4)0.3	(0.1-0.12)0.1	(0.5-0.9)0.9	(0.3-0.4)0.4
<i>S. arvensis</i>	(10-40) 35	(0.5-2)0.5	(68-82)65	(0.5-1.2)0.8	(7-35)8	(2-13) 3	(0.5-0.7)0.7	(0.1-0.15)0.1	(0.10-0.15)0.13	(0.5-0.7)0.6

Values outside parentheses represent the average.

Table 2 : The dimensions of the stamens, the pistil, the fruit and the seed, measured in millimeters.

Species	Dimensions stamens		Dimensions pistil		Dimensions fruit			Seeds		
	Length the filament	Width the filament	Ovary length	Ovary diameter	Length the fruit	Fruit diameter	The shape	Dimensions	Number of seeds in one fruit	Color
<i>D. rucoides</i>	(4-8) 8	(0.7-1) 1	(8-10)10	(1-1.5) 1	(30-40)	(2-3)	Ovoid-Ellipsoid Oblong	0.5 × 0.8	14 - 34	Yellow
<i>R. rugosum</i>	(3-2) 3	(0.4-0.5)0.5	(3-4) 3	(0.7-1) 1	(4-6)	(3-5)	Ovoid-Ellipsoids Oblong	1 × 5.2	2	Yellow
<i>S. arvensis</i>	(3-6) 6	(0.7-1)0.7	(6-8) 7	(0.8-1)0.8	(1.5-30)	(1.5-3)	Irregular -Sinuate	1.5 × 1	3 - 10	Black-brown

Values outside parentheses represent the average.

Table 3 : The pollen dimensions of the studied species are measured by micrometer.

Species	Dimensions the pollen			
	Polar view P	Equatorial view E	Width the distance between the germinal furrows	Exine thickness
<i>D. erucooides</i>	(10-12.5) 10	(10-14) 14	(1-2.5) 1.5	(0.8-1) 1
<i>R. rugosum</i>	(10-13) 10	(13-20) 20	(1.5-5) 5	(0.5-1) 0.7
<i>S. arvensis</i>	(10-15) 12.5	(18-22) 22	(1.5-2.5) 1.5	(0.8-1) 1

Values outside parentheses represent the average.

three species. Seeds shapes were different among the studied species they were Ovoid – Oblong ellipsoid in both *D. erucooides* and *R. rugosum* and were Irregular – Sinuate in *S. arvensis*. The seeds differed in their dimensions , their average dimensions the lowest was (0.8×0.5mm) for *D. erucooides* and (2×1.5mm) for *R. rugosum*, which was the highest , the number of seed, fruit was different, the average was minimum 2 seeds for *R. rugosum* and the maximum number of seeds was (14-34) seed in *D. erucooides*, the colour of seeds during study also different, the Black-Brown was in *S. arvensis*, the yellow was prevalent in *D. erucooides* and *R. rugosum*. However, regarding surface configuration of seeds, they were smooth in all studied species. It was concluded that the seeds have large taxonomical importance due to the clear variations both quantitatively or qualitatively that are useful in the separation of the above three species.

Second: pollen grains

The data belong to pollen are in table 3 and plate 4.

All pollen seen in this study were isopola and their pores were simple apertures and they were colpate form (Tricolpate) or Tricolporate , the pollen were zonocolpate, because their groud did not extend from pole to the second pole, their ends were not joined together in both *D. erucooides* and *S. arvensis* in *R. rugosum* the pollen grooves extended from the first pole to the second pole and their end joined together, the pollen grains were varied in their size ranged between the small and Gigantic according to Erdtman (1971). The studied grades were divided according to their size to three groups.

First group : includes the species *D. erucooides* which have small pollen grains, the average equatorial diameter or the polar axes (10-14 µm).

Second group : which have pollen grains of medium size, whose average diameter length and axis is (10-20) µm as in *R. rugosum* .

Third group : which have large pollen grain whose their average length and axis (12.5-22) µm as in *S.*

arvensis.

Pollen grains of the studied three species were different in their polar and equatorial view, they were Ovoid-Triangular in the polar view , but in the equatorial view they were Ovoid-Wide ovoid in both *D. erucooides* and *R. rugosum*, however, in *S. arvensis* they were ellipsoid . The average thickness of Exine for the pollen grain range between 0.7 to 1.0 µm in the three species (table 3), the surface ornamentation were Reticulat.

It was concentrated on the comparative parameters of pollen specially the mean diameter of the between colpate of the pollen of polar view which was 1.5 µm for both *D. erucooides* and *S. arvensis* and 5.0 µm for *R. rugosum*. Therefore, it is important to study pollen grains as Micromorphological characters to separate the above three species, which gave good results the species showed clear variations in the dimensions of both polar and aquatorial axis together with the well thickness the wedith of the apertures between colpate and ornamentation of pollen.

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