**European Journal of Agricultural and Rural Education (EJARE)**
Available Online at: https://www.scholarzest.com
Vol. 3 No. 10, October 2022
ISSN: 2660-5643

# MORPHOLOGICAL STUDY OF POLLEN GRAINS OF THE GENUS *TORILIS* ADANS. FROM THE FAMILY APIACEAE WILD GROWING IN IRAQ.

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**Article history:**

**Received:** 11th August 2022
**Accepted:** 11th September 2022
**Published:** 24th October 2022

**Abstract:**

The current research aims to study a morphological taxonomic study of the pollen grains of the taxa *Torilis* genus wild growing in Iraq. Nine taxonomic taxa belonging to the genus were diagnosed and separated *T. arvensis, T. chrysocarpa, T. heterophylla, T. leptocarpa, T. leptophylla, T. leptophylla* var*. erythrotricha, T. nodosa, T. stocksiana and T. tenella,* the mattresses were all of the same poles and isopolar with simple apertures in the form of colpate or Porate grooves. All taxa were three holes or grooves Tricolpate. Pollen grain was of the type Zono colpate as the grooves of pollen do not extend from the pole to the second pole and do not connect the grooves end with each other. The pollen grains differed in their shapes, dimensions and the nature of their surfaces, and there is a discrepancy between the nature of the surface decoration of the studied genus taxa. It is concluded from the foregoing that all these variations are taxonomic evidence to isolate the studied genus taxa.

**Keywords:** Pollen, Genus *Torilis* Adans, Apiaceae Family

## INTRODUCTION

The phenotypic and structural characteristics of pollen grains are an additional tool to solve many problems. Hyde and Williams (1945) were the first to use the term Palynological, which means the science of pollen or spores. The type of surface decoration of the pollen grain, its grooves and holes and its size provides more information and taxonomic evidence than that of the study of the cross-sections of the pollen grain and the structure of its wall (Erdtman, 1943). the taxon and evolutionary importance of the external appearance of the pollen grain may be at the level of Species, Genus or a higher order, and the taxon is called Stenopalynous, if its pollen grains have fixed characteristics and these specifications may be limited to that botanical group only (Davis and Heywood, 1973). Punt and Clarke (1984) indicated that the pollen of the family Apiaceae is very distinctive with its external and internal lines and the external shape with semi-pits and broad ribs. This family consists of 300 genera and 3000 species spread in the warm regions of the world (Willis, 1973; Mabberley, 1987). In Pakistan, pollen grain of 167 species belonging to 56 genera were studied (Perveen and Qaiser, 2006). Regina and Lujan (2011) mentioned that the family Umbelliverea (=Apiaceae, Ammiaceae) is one of the families that has the largest number of genera from 300 to 450 and about 3500 species, and the genus Torilis has about 15 species, which is a relatively small number and is considered among the few genera in terms of species for the family. Family Apiaceae is located within the Order Apiales, and its genera amounted to 66 genera and 144 species in Iraq. For other regions of the world, researchers differed in enumerating the orders of the family. The family was described for the first time by Lindley 1830 which consists of 418 genera and 3257 species (Ghazanfar and Edmondson 2013).

Ghazanfer and Mc Daniel (2016) noted that there are 3300 species distributed over 980 genera belonging to 136 families of flowering plants, and 5 major families were included in terms of the number of species among them is the Apiacea family, which contains 155 species spread in different regions and environments of Iraq. Halbritter et al. (2018) showed that pollen grains characteristics of a number of families, including the umbrella family, were tricolporate, and in polar view triangular to semi-ovate (Subovate Baldemir et al., 2018). BACZYŃSKI et al. study

(2021) mentioned that the order Apiales consists of about 6000 species belonging to 522 genera. According to the results of Bittrich and Kadereit's studies (2018), there are four subfamily of Apiaceae: Apioideae, Azorelloideae, Mackinlayoideae and Saniculoideae.

By reviewing the literature, it was found that studies in Iraq of pollen grains for the studied genus orders were not studied, but studies of different genus odres within the family only, including Bakr (2011), which dealt with four types: Scandix pectin-veneris, Scandix iberica, Scandix stellata, and Smyrnium cordifolium. A study of a number of phenotypic traits of pollen grains by light microscopy, and Al-Newani's study (2018) included a study of a number of phenotypic traits of pollen grains by light microscopy and scanning electron microscopy for 12 different species belonging to three genera: Anisosciadium, Bunium and Ergocarpom. In addition, the study of Altaie and Al-Ani (2020) used a light microscope to study the phenotypic characteristics of pollen grains for nine species belonging to different genera of the umbrella family Apiaceae. These genera are Bupleurum lancifolium var. heterophyllum (Link) Boiss., Malabaila secacul (Mill.) Boiss., Myrrhoides nodosa (L.) Cannon, Scandix pecten-veneris L., S.iberica M. Bieb., S. stellate Banks and Sol., Smyrnium cordifolium Boiss., Turgenia latifolia (L.) Hoffm., and T. lisaeoide.

## MATERIALS AND METHODS

Newly opened flowers or mature flower buds were fixed in the field directly during field trips with Carnoy's solution (3 volumes of ethyl alcohol: 1 volume of glacial acetic acid) for 24 hours, then washed with 70% ethyl alcohol and kept at the same alcohol concentration in the refrigerator until use. According to the method of Sass (1958), the ripe anthers were placed in a watch class and drops of safranin-glycerin were added to it. The anthers were opened with a fine dissection needle to extract pollen grains, Then pollen grains were transferred by a special dropper to glass slides, cover slides were placed and examined under the compound light microscope type Novel. Approximately 50-25 pollen grains were studied for each type, and measurements were taken of the polar view and the equatorial view of the pollen grain, and the value of P/E was calculated. The thickness of the grain wall was also measured by the ocullar micrometer of the eyepiece lens. Moreover, the shape of the pollen grain for polar and tropical views was described, as well as the decorations on the surfaces of the pollen grains. The data were arranged in Table (1) as well as pictures 1, 2, 3, 4 and 5 to illustrate the variations in the polar and equatorial axis of the studied genus orders. Pollen was photographed with an NSZ-606 under the lens 40 of the optical microscope.

## RESULTS AND DISCUSSION

Data for pollen are shown in Table 1 and pictures 1, 2, 3, 4 and 5.

The results of the current study show that the pollen grains of all the studied genera are single monads, that is, they are not united with each other, they are in the form of elongated perprolate or semi-elongated subprolate in the tropical view, and trigonal, triangular or circular in the polar view, symmetrical in poles Isopolar, and its openings were of simple apertures, and were in the form of tricolpate and tricolporate, except for the taxa T. heterophyll and *T. leptophylla* var .*erythrotricha* were 3-2 grooves. The distribution of the holes was regulated with its surface decoration cavities, and the lengths of the grooves were equal for one pollen grain within the same species. It was also noted that there are wart-like areas on both sides of the polar axis of the pollen grain, and the presence of small pits on the outer surface, as well as the presence of a ripple of the sexin envelope in the middle of the pollen grains in all the studied ordes (pictures 1 and 2).

It is noted the variation in the lengths of the furrows between the different species of the genus, and the pollen grains are of the type Zonocolpate. The end of the furrows do not meet with each other and do not extend from the pole to the second pole in all the studied orders. It is possible to divide the studied orders depending on their sizes on the polar and equatorial axes. Its diameters were measured in the polar axis, the minimum polar axis reached between 10-15 µm in the two species *T. leptophylla* and *T. tenella*, which included 11-17 µm in the species *T. chrysocarpa* and 12-17 µm in the variety *T. leptophylla* var.*erythrotricha*, 12-22 µm in *T. heterophylla*, 15-17 µm in *T. leptocarpa* and *T. stocksiana*, 15-20 µm in *T. arvensis*, while the maximum reached 18-25 µm in *T. nodosa*

The studied orders were divided according to their lengths on the measurement of the equatorial axis, and the minimum equatorial axis reached between 17-25 µm in the species *T. leptophylla* and 18-28 µm in the species *T. tenella* and 18-30 µm in the variety *T. leptophylla* var.*erythrotricha*, 20-25 µM in *T. stocksiana*, 20-30 µM in *T. arvensis*, 22-25 µM in *T. chrysocarpa*, 22-28 µM in *T. nodosa*, 23-30 µM in *T heterophylla* and the maximum is 25-30 µm recorded for *T. leptocarpa*.

The results showed that pollen grains for the orders of the genera studied in the polar and tropical views are different in terms of their shape in the polar view, and they were divided into four groups, namely the group in which pollen grain was circular - semi-circular and includes *T. arvensis*, *T. heterophylla* and *T. nodosa*, the triangular group in *T. leptophylla*, and the group that ranges in shape from ovoid - semi-ovate as in variety T. *leptophylla* var .*erythrotricha*, and the triangular-subovate group of *T. chrysocarpa*, *T. leptocarpa*, *T. stocksiana* and *T. tenella*.

In terms of pollen grains forms in the equatorial landscape, it was divided into five groups, the group that was Elongated - Constricted and included the species *T. heterophylla* and *T. leptophylla*, the group with Elongated - slightly shortened forms, Constricted Parum in the species *T. stocksiana*, either The elongated group in *T. leptophylla* var .*erythrotricha*, the group whose shapes were between the ovoid-wide ellipsoid of *T. arvensis* and the wide ellipsoid-narrowly ellipsoid of *T. chrysocarpa*, , *T. leptocarpa*, *T. nodosa*, and *T. tenella*.

With respect to the thickness of the outer wall Exine of the pollen grain, the mean of the smallest thickness ranged from 0.5 µm in the species *T. heterophylla*, *T. leptocarpa* and *T. tenella*, and it was 0.7 µm in the two species *T. nodosa* and *T. stocksiana*, and 0.8 µm in the taxa *T. arvensis T. chrysocarpa*, *T. leptophylla*, and T. *leptophylla* var .*erythrotricha*, as shown in Table (1).

The study also shows the contrast between the decorations of the outer surface of the pollen grain of different shapes and the taxa of decorations for its surfaces, which were divided into two groups; the smooth group which belongs to the taxa *T. chrysocarpa*, *T. heterophylla*, *T. leptophylla* var *erythrotricha*, *T. leptocarpa* and *T. nodosa*, and the subreticulat or Crled-shaped group in *T. arvensis*, *T. stocksiana*, *T. leptophylla* and *T. tenella*.

Regarding the diameter of the opening between the grooves of the pollen colpe in the polar view, it reached a minimum between 1.5-1 µm for *T. leptocarpa* and variety *T. leptophylla* var .*erythrotricha*, 1-2 µm for *T. chrysocarpa*, and 2.5-1.5 µm in The two species *T. nodosa* and *T. stocksiana*, 3-2 µm for both species and *T. leptophylla*, and the largest mean between 5-3 µm for *T. arvensis*, *T. heterophylla* and *T. tenella*.

Discussion

It is clear from all of the above the importance of pollen grains as micromorphological characters to separate the studied genus orders in general, and it gave good results for this purpose. The species showed clear variations in the polar and equatorial axes, their dimensions, the mean of wall thickness, the width of the openings between the grooves, as well as the surface decoration of pollen grains.

The current study proved that the pollen grains of all the orders of the genus studied are single, symmetrical, and their openings are of the simple type, and all the orders were tricolporate except for the orders of the genus *Torilis*, which are *T. heterophylla* and *T. leptophylla* var. *erythrotricha*, which are 3-2 grooves, and this is identical to what It was mentioned by Ting et al. (1964), Erditman (1986), Perveen and Qaiser (2006), and that the pollen grains of the genus orders are Stenopalynous, as their pollen grains have fixed specifications and those specifications may be limited to that botanical group only, and this is identical to what was mentioned by Volponi and Olivan (2011).

The shapes of pollen grain in the equatorial view are elongated - constricted, slightly constricted barum, ovoid, wide ellipsoid, and Narrowly ellipsoid. Their shapes ranged in polar view between Circular - Subcircular, Ovoid - Subovate, and Triangular - Subovate, and this is identical to what was mentioned by Baldemir et al. (2018), while between Özkök (2022) the pollen grains of most species The family is triangular in polar view.

The Taxa were divided according to their sizes on the polar and equatorial axes, and the minimum polar axis reached between 15-10 micrometers in the two species *T. leptophylla* and *T. tenella*, while the maximum was 18-25 µM in the type *T. nodosa*, and the orders ranged between these two limits.

The Taxa were also divided in terms of their lengths on the measurement of the equatorial axis, as the minimum equatorial axis reached between 25-17 µM in the species *T. leptophylla*, and the maximum was 25-30 µM in the species *T. leptocarpa*, and the orders ranged between these two limits.

The current study also shows the variation in the thickness of the outer wall Exine of the pollen grain, which averages the smallest thickness of 0.5 µm in the species *T. heterophylla*, *T. leptocarpa* and *T. tenella*, and 0.8 µm in the species *T. arvensis*, *T. chrysocarpa*, *T. leptophylla* and *T. leptophylla* var *erythrotricha*, and the rest of the species ranged between these two limits, the current study proved that the thickness of the wall is of importance for isolating the studied orders, and this is identical to what was found by Punt (1984).

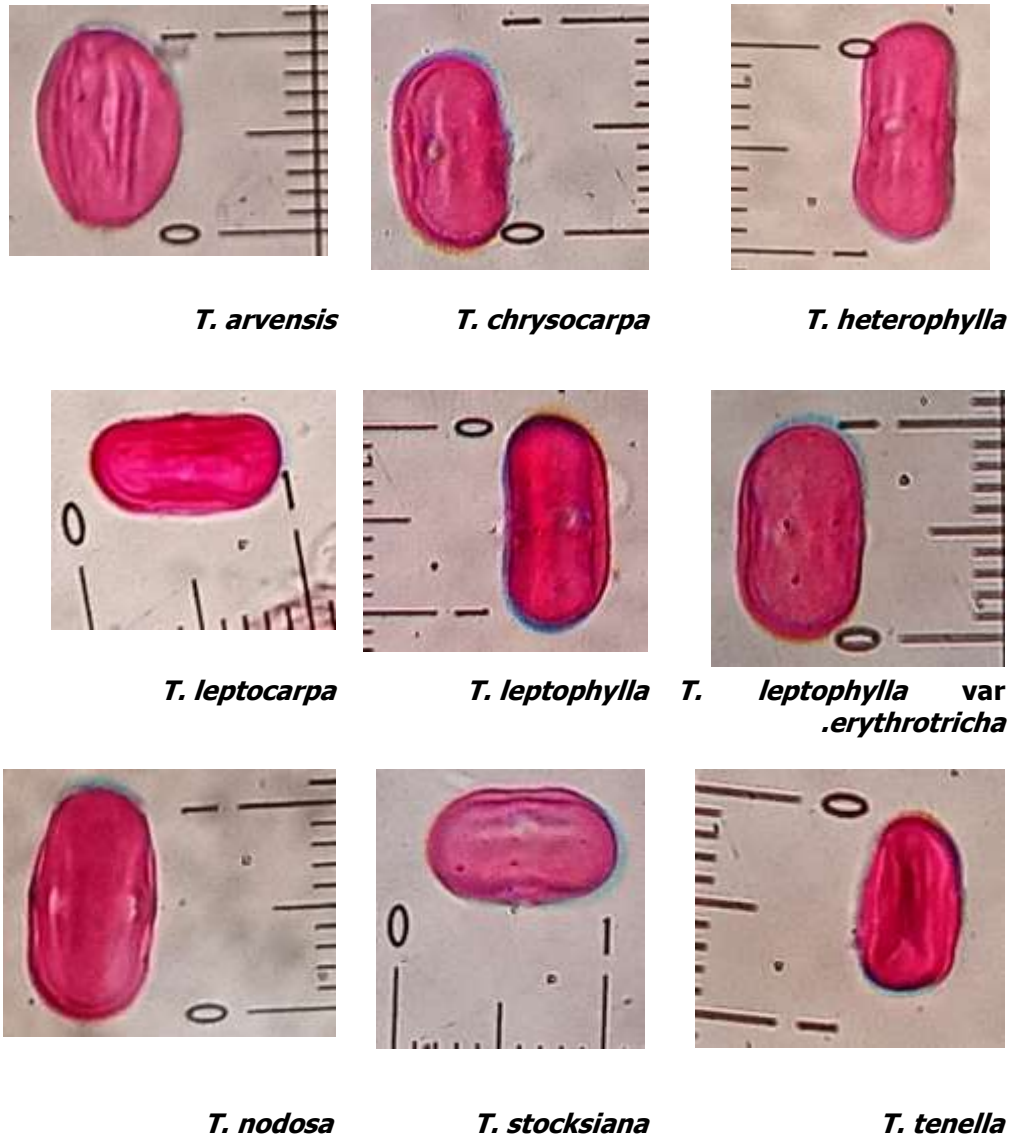
With regard to the width of the opening between the grooves Colpe, there was a discrepancy between the genus orders of the opening width between the grooves in its polar landscape. The minimum was between 1.5-1 µm for *T. leptocarpa* and *T. leptophylla* var. *erythrotricha*, and the maximum was between 5-3 µm which belongs to the species *T. arvensis*, *T. heterophylla* and *T. tenella*, and the rest of the species ranged between these two limits. The diameter of the opening between the grooves is of importance in isolating the studied genus orders.

The surface decorations were of different shapes between the orders of the genera, they were between smooth or semi-rough - wrinkled, and this is contrary to what was mentioned by Tseng (1980), William and Adam (1999) that the surface decoration in all Apiales is of the striped type.

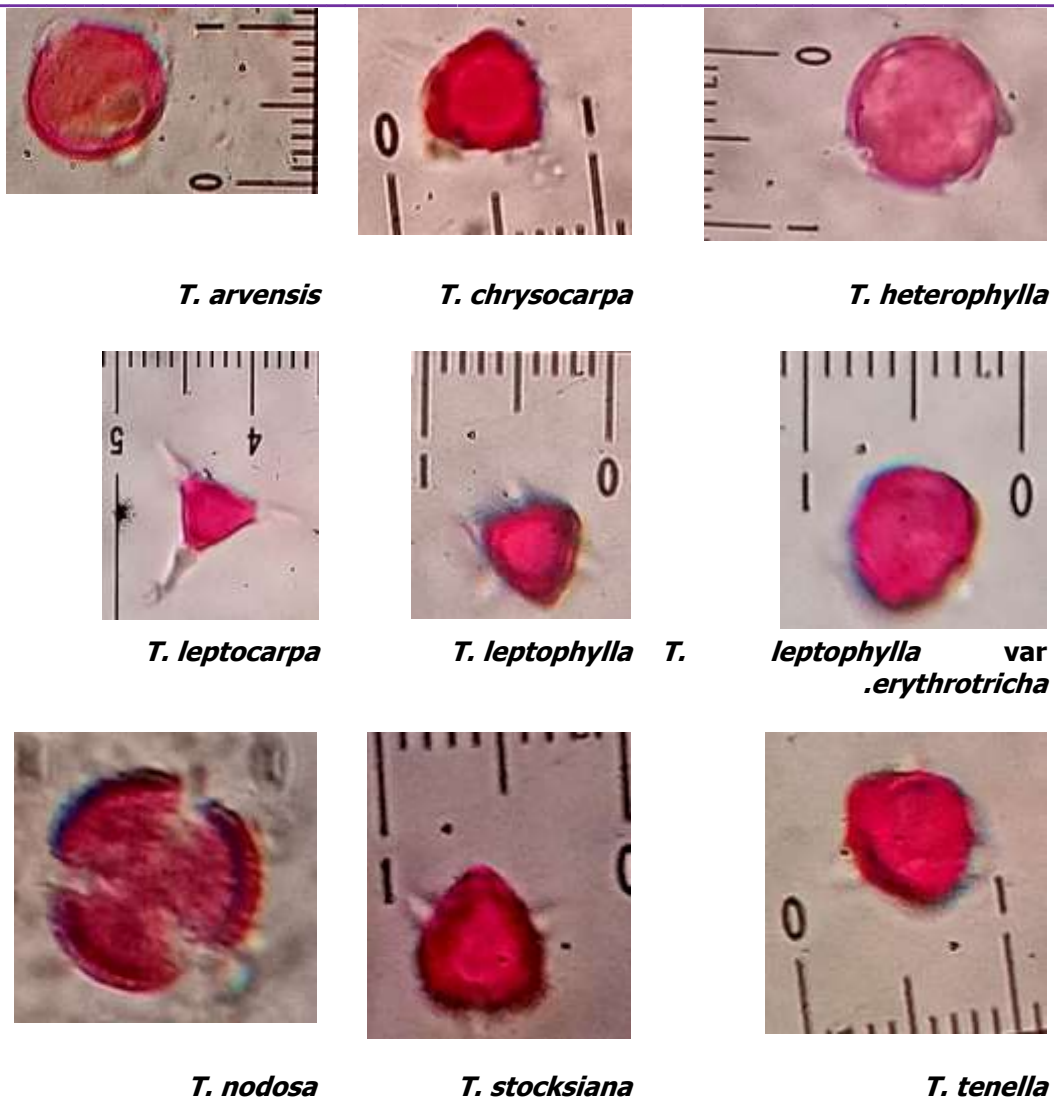
The current study agreed with the study of Hesse (2009) the presence of wart-like areas on both sides of the polar axis of the pollen grain, and the presence of small pits on the outer surface, as well as the presence of a ripple of the Sexin outer shell in the middle of the pollen grains in all studied species and this is consistent with what was concluded by Baczyński et al. (2021).

Table (1) Quantitative and qualitative characteristics of pollen grains of the genus *Torilis*.

| Orders | Quantitative characteristics (µm) | | | | | Qualitative characteristics | | |
|---|---|---|---|---|---|---|---|---|
| | **Polar axis P** | **equatorial axis E** | **P/E** | **ediameter of the distance between the grooves** | **External wall thickness rating** | **Pollen shape in tropical view** | **Pollen shape in polar view** | **Exine surface** |
| ***T. arvensis*** | (15-20) 17 | (20-30) 27 | 0.63 | 3-5 | 0.8 | Ovoid- Wide ellipsoid | - Subcircular Circular | Subreticulat or Crled |
| ***T. chrysocarpa*** | (11-17) 15 | (22-25) 23 | 0.65 | 1-2 | 0.8 | Wide ellipsoid | Triangular-Subovate | Smooth |
| ***T. heterophylla*** | (12-22) 12 | (23-30) 25 | 0.48 | 3-5 | 0.5 | Elongated-Constricted | Circular-Subcircular | Smooth |
| ***T. leptocarpa*** | (15-17) 15 | (25-30) 25 | 0.60 | 1-1.5 | 0.5 | Wide - ellipsoid Narrowly ellipsoid | Triangular-Subovate | Smooth |
| ***T. leptophylla*** | (10-15) 13 | (17-25) 25 | 0.52 | 2-3 | 0.8 | - Constricted Elongated | Triangular | Subreticulat or Crled |
| ***T. leptophylla* var *.erythrotricha*** | (12-17) 15 | (18-30) 27 | 0.55 | 1-1.5 | 0.8 | Elongated | - Subovate Ovoid | Smooth |
| ***T. nodosa*** | 23 18-) (25 | (22-28) 27 | 0.85 | 1-.5-2.5 | 0.7 | Wide ellipsoid | Circular-Subcircular | Smoothl |
| ***T. stocksiana*** | (15-17) 15 | (20-25) 25 | 0.60 | 1.5-2.5 | 0.7 | Constricted - Parum Elongated | - Subovate Triangular | Subreticulat or crled |
| ***T. tenella*** | 15 -15) (10 | (18-28) 27 | 0.55 | 3-5 | 0.5 | Wide ellipsoid | Triangular-Subovate | Subreticula or Crled |




Picture (1) Dimensions and shapes of pollen grains in the tropical view of the studied Species of the genus *Torilis.*

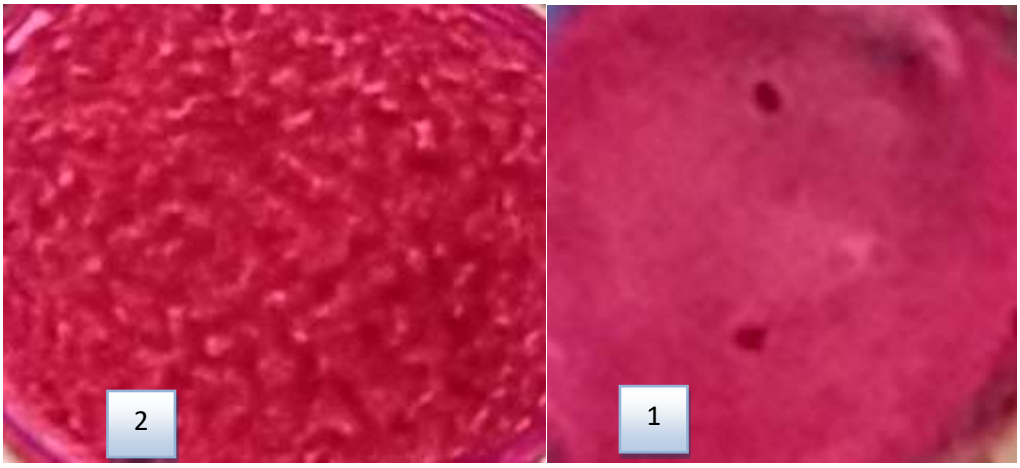


***T. arvensis*** ***T. chrysocarpa*** ***T. heterophylla***

***T. leptocarpa*** ***T. leptophylla*** ***T. leptophylla* var *.erythrotricha***

***T. nodosa*** ***T. stocksiana*** ***T. tenella***

Picture (2) Dimensions and shapes of pollen grains in the tropical view of the studied orders of the genus *Torilis.*




Picture (5) Decorations of the outer surface of pollen grains of the genus Torilis studied (×1000).
1- The decorations are not clear - semi-clear, not prominent and very smooth.
2- The decorations are clear, prominent and semi-rough.

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