

POLLEN MORPHOLOGY OF *THALICTRUM* L., SPECIES (RANUNCULACEAE) IN TURKEY

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Abstract

In this study, the pollen morphology of 11 taxa of the *Thalictrum* L. (Ranunculaceae) viz., *T. orientale* Boiss., *T. aquilegifolium* L., *T. sultanabadense* Stapf., *T. foetidum* L., *T. isophyroides* C.A.Mey., *T. minus* L., var. *minus* Boiss., *T. minus* var. *majus* (Crantz) Crepin, *T. minus* L. var. *microphyllum* Boiss., *T. lucidum* L., *T. flavum* L. and *T. simplex* L., from Turkey was investigated with light microscope and scanning electron microscope. LM observations reveal that pollen grains of the taxa are periporate with operculum, spheroidal, ornamentation microechinate. The numbers of pores are between 6 and 17. This palynological investigation is the first one which has been done on *Thalictrum* L., distributed in Turkey.

Introduction

The genus *Thalictrum* L., of the family Ranunculaceae comprises of approximately 150 species in the world (Hickey and King, 1965) of which and 11 taxa of the genus are found in Turkey (Davis, 1965). The genus *Thalictrum* L., has shown the highest complexity.

Data on the pollen morphology of individual species of *Thalictrum* were obtained primarily by light microscopy (Kumazawa, 1936; Erdtman, 1943,1952; Erdtman *et al.*, 1961; Kapp 1969; Petrow and Borrissova - Ivonova, 1975; Faegri and Iversen, 1992). Nilsson *et al.*, (1977) studied pollen morphology of *Thalictrum flavum* L. using SEM. Moore and Webb (1978) have published a key including *Thalictrum* pollen. Pollen morphology of some *Thalictrum* species was studied by Punt *et al.*, (1991) using LM and SEM.

The present study aims to survey the pollen morphology of the Turkish representatives of *Thalictrum* using light and scanning electron microscopes and to discuss its significance in the taxonomy of the genus. The present study has been undertaken in order to provide further information which prove helpful in elucidating the taxonomy of the genus.

Materials and Methods

All the pollen samples were taken from herbarium specimens. Fig. 1 shows the distribution map of *Thalictrum* L., species in Turkey. For light microscopy, pollen grains were prepared by Erdtman's KOH-acetolysis technique; unstained residues were mounted in glycerin jelly (Erdtman, 1952). A Zeiss microscope with an apochromate oil immersion objective and periplan eyepiece was used for measuring the pollen diameter, exine thickness, pores shapes and mesopodium (Table 1). Measurements have been made with apiece micrometer (interval between two marks 0.62µm). At least 50 grains of each species were measured. Measure means (M) and standard deviation (S) were calculated. For this purpose the Excel 4.0 program for Windows was used.

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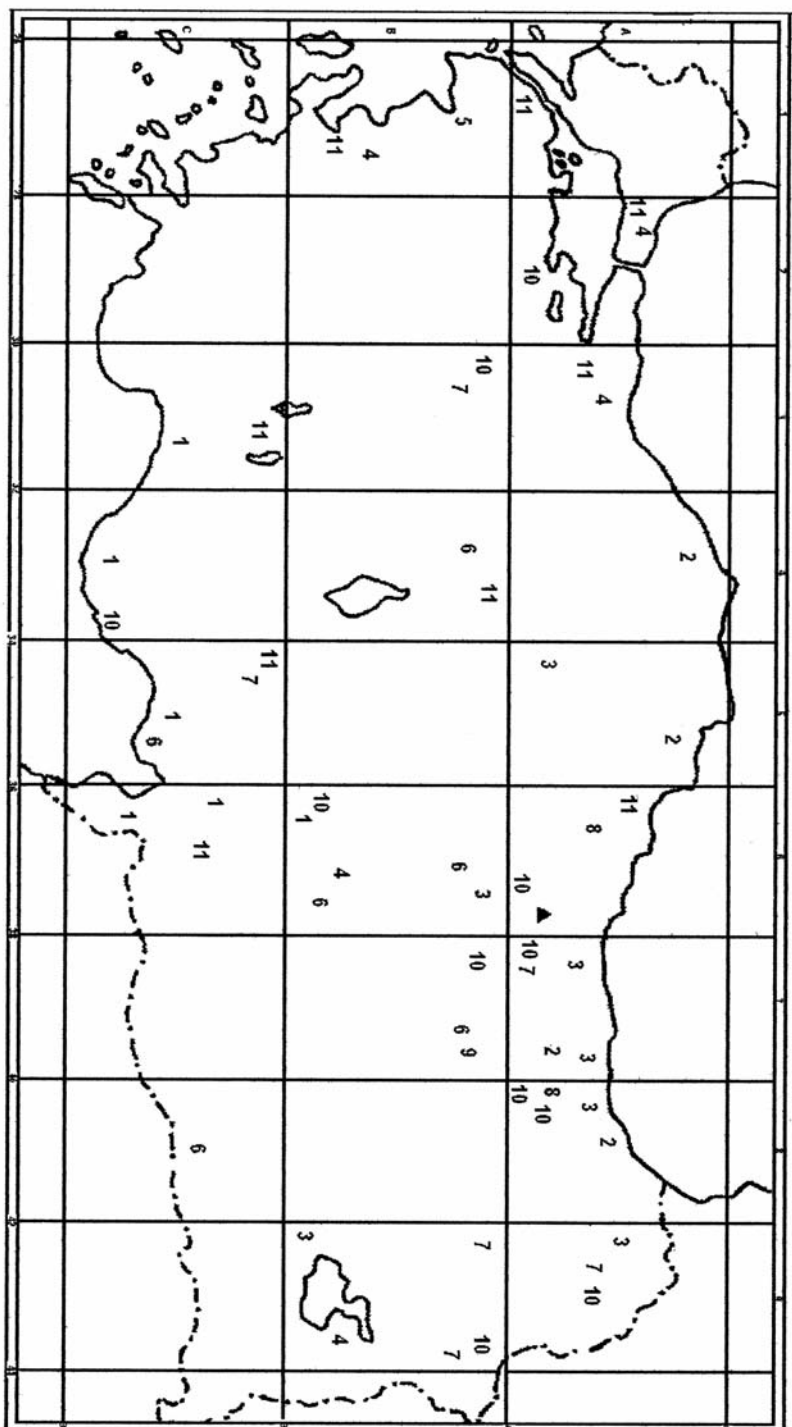


Fig. 1. Distribution map of *Thalictrum* L., species in Turkey: 1- *T. orientale*; 2- *T. foetidum*; 3- *T. minus* var. *majus*; 4- *T. flavum*; 5- *T. aquilegifolium*; 6- *T. isophyroides*; 7- *T. minus* var. *microphyllum*; 8- *T. simplex*; 9- *T. sultanabadense*; 10- *T. minus* var. *minus*; 11- *T. lucidum*.

Table 1. Pollen morphological data (with mean values and standard deviations) of *Thalictrum* L.

	1	2	3	4	5	6	7	8	9	10
<i>T. orientale</i> Boiss.		6-13	21.17±1.67	20.45±1.40	1.03	3.11±0.45	3.11±0.45	5.02±1.25	3120	ESSE
<i>T. aquilegifolium</i> L.		6-9	22.20±0.96	21.68±0.62	1.02	4.78±0.54	4.70±0.50	6.68±1.56	1268	ESSE
<i>T. sultanabadense</i> Stapf.		6-15	19.43±1.68	18.80±1.45	1.03	3.67±0.78	3.67±0.78	6.20±1.64	3333	ESSE
<i>T. foetidum</i> L.		6-13	21.20±1.81	21.02±1.73	1.00	3.42±0.55	3.42±0.55	6.45±0.96	2093	ESSE
<i>T. isophyroides</i> C.A. Mey.		6-11	19.04±1.82	18.49±1.75	1.03	4.25±0.96	3.43±0.49	7.02±1.13	6485	ESSE
<i>T. minus</i> L. var. <i>minus</i> Boiss.		11-17	28.24±2.90	26.87±1.97	1.05	3.32±0.54	3.32±0.54	5.97±0.85	7666	ESSE
<i>T. minus</i> L. var. <i>majus</i> (Crantz) Crepin		8-11	24.99±1.89	24.43±1.93	1.02	5.04±0.83	4.94±0.84	7.91±1.63	2100	ESSE
<i>T. minus</i> L. var. <i>microphyllum</i> Boiss.		6-12	20.21±1.38	19.70±1.24	1.02	3.05±0.49	3.05±0.49	6.34±0.71	50	ESSE
<i>T. lucidum</i> L.		8-11	21.18±1.38	20.64±1.44	1.02	4.43±0.68	4.43±0.68	5.76±1.20	290	ESSE
<i>T. flavum</i> L.		6-10	17.51±1.61	17.26±1.56	1.01	3.21±0.28	3.21±0.28	6.65±0.58	1043	BULU
<i>T. simplex</i> L.		9-15	19.37±1.66	18.80±1.44	1.03	3.64±0.79	3.63±0.78	6.20±1.64	8532	ESSE

All measurements are given in µm; **column 1**-taxon; **column 2**- pore number; **column 3** – largest diameter of pollen grains; **column 4**- smallest diameter of pollen grains ; **column 5**- A/B index; **column 6**- pore length; **column 7**- pore width; **column 8**- mesoporum; **column 9**- Herbarium number; **column 10**- Abbreviation of herbaria.

All taxa were examined using SEM except *T. sultanabadense* Stapf., for which polliniferous material was not enough. For scanning electron microscopy, the pollen grains were transferred directly to double-sided tape affixed stub and vacuum coated with gold. Photomicrographs were taken using JEOL 540 scanning electron microscope in Anadolu University, Turkey.

The descriptive terminology follows that of Faegri & Iversen (1992) and Punt *et al.*, (1991).

Results

Description of pollen grains

T. aquilegifolium L. (Table 1; Fig. 2, a-b)

Pollen grains are pantoporate (6-9 pores), apolar, spheroidal, 22 µm in diameter. Pore circular, 4.78 µm in diameter. Distance between pores 6.68 µm. Pore membrane with spaced varts and pores margin flattened. Exine thickness 1.2 µm. Ectexine slightly thicker than or same thickness as endexine. Ornamentation micro-echinate

T. flavum L. (Table 1; Fig. 2, c-d)

Pollen grains are pantoporate (6-10 pores), apolar, spheroidal, 17.51-µm in diameter. Pores circular, 3.21µm in diameter. Distance between pores 6.65 µm. Pore membrane with spaced varts and pores margin flattened. Exine thickness 1.2µm Ectexine slightly thicker than or same thickness as endexine. Ornamentation micro-echinate

T. foetidum L. (Table 1; Fig. 2, e-f)

Pollen grains are pantoporate, (6) 8 –10 (13 pores), apolar, spheroidal, 21.02 µm in diameter. Pore circular, 3.42 µm in diameter. Distance between pores 6.45 µm. Pore membrane with densely spaced granules, pores margin flattened or sunken. Exine thickness 1.22 µm. Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate.

T. isophyroides C.A. Mey. (Table 1; Fig. 3, a-b)

Pollen grains are pantoporate (6-11 pores), apolar, spheroidal, 19.04 µm in diameter. Pore circular, 4.25 µm in diameter. Distance between pores 7.02 µm. Pore membrane with spaced varts and pores margin flattened or sunken. Exine thickness 1.2µm. Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate

T. lucidum L. (Table 1; Fig. 4, g-h)

Pollen grains are pantoporate (8-11 pores), apolar, spheroidal, 21.18 µm in diameter. Pore circular, 4.43 µm in diameter. Distance between pores 5.76 µm. Pore membrane with densely spaced granules and pores margin flattened. Exine thickness 1.2 µm. Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate

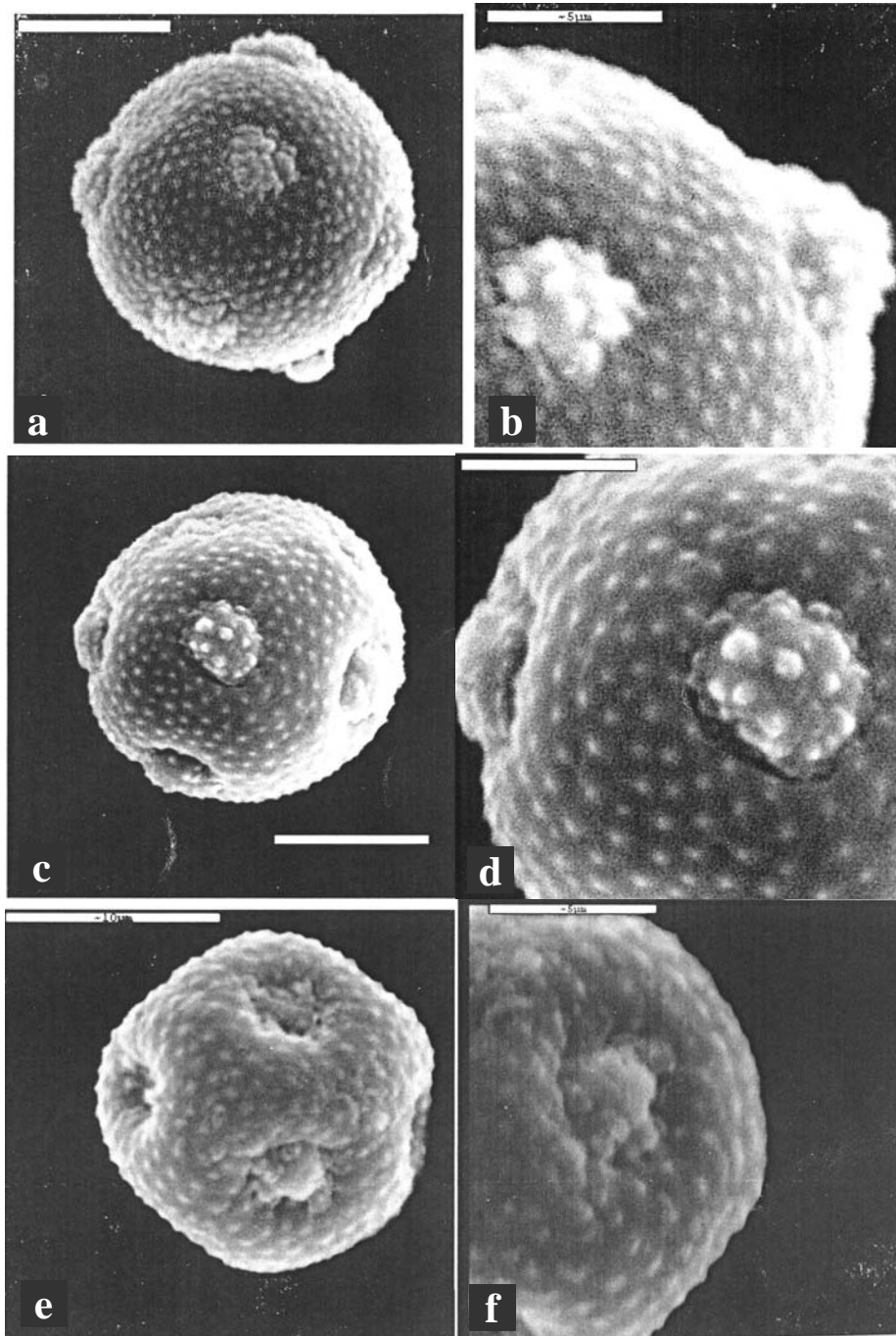


Fig. 2. Scanning electron micrographs of *Thalictrum* L.; *T. aguilegifolium* (a-b); *T. flavum* (c-d); *T. foetidum* (e-f); scale bar: a, c, e - 10μm; b, d, f - 5μm.

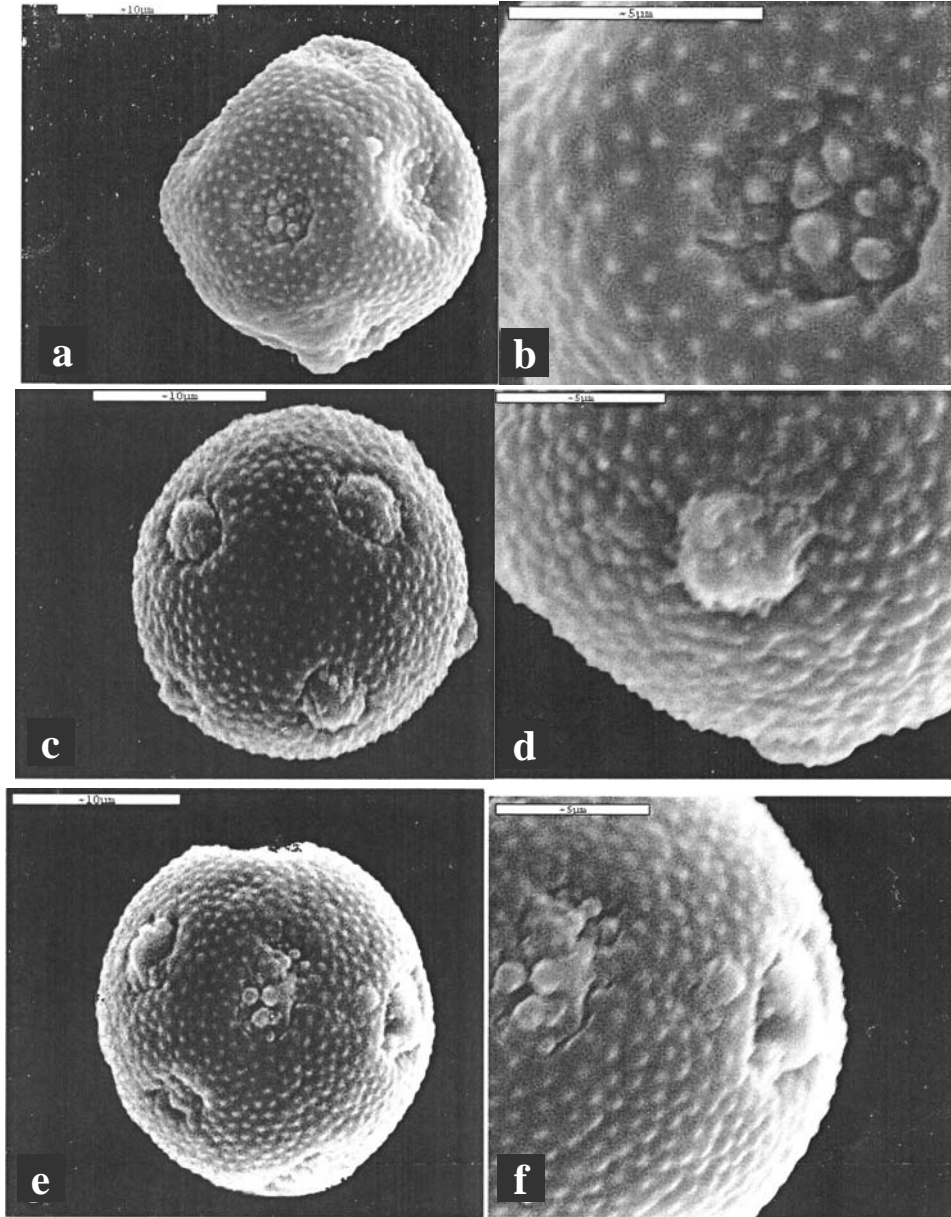


Fig. 3. Scanning electron micrographs of *Thalictum* L.; *T. Isophyroides* (a-b) *T. minus* var. *microphyllum* (c-d); *T. minus* var. *majus* (e-f); scale bar: a, c, e) 10µm; b, d, f - 5µm.

***T. minus* L.var. *minus* Boiss. (Table 1; Fig. 4, a-b)**

Pollen grains are pantoporate (11-17 pores), apolar, spheroidal, 28.24 μm in diameter. Pore circular, 3.32 μm in diameter. Distance between pores 5.97 μm . Pore membrane with spaced spinules and pores margin sunken. Exine thickness 1.2 μm . Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate

***T. minus* var. *majus* (Crantz) Crepin (Table 1; Fig. 3, e-f)**

Pollen grains are pantoporate (8-11 pores), apolar, spheroidal, 24.99 μm in diameter. Pores circular, 5.04 μm in diameter. Distance between pores 7.91 μm . Pore membrane with spaced gemma and pores margin flattened. Exine thickness 1.2 μm . Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate

***T. minus* var. *microphyllum* Boiss. (Table 1; Fig. 3, c-d)**

Pollen grains are pantoporate (6-12 pores), apolar, spheroidal, 20.21 μm in diameter. Pores circular, 3.05 μm in diameter. Distance between pores 6.34 μm . Pore membrane with spaced spinules and pores margin flattened. Exine thickness 1.2 μm . Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate

***T. orientale* Boiss. (Table 1; Fig. 4, c-d)**

Pollen grains are pantoporate (6-13 pores), apolar, spheroidal, 21 μm in diameter. Pore circular, 3.11 μm in diameter. Distance between pores 5.02 μm . Pore membrane with densely spaced granules and pores margin flattened. Exine thickness 1.2 μm . Ectexine slightly thicker than or same thickness as endexine. Ornamentation micro-echinate

***T. simplex* L. (Table 1; Fig. 4, e-f)**

Pollen grains are pantoporate (9-15 pores), apolar, spheroidal, 19.37 μm in diameter. Pore circular, 3.64 μm in diameter. Distance between pores 6.2 μm . Pore membrane with spaced varts and pores margin flattened. Exine thickness 1.2 μm . Ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate.

***T. sultanabadense* Stapf. (Table 1)**

Pollen grains are pantoporate (6-11 pores), apolar, spheroidal, 19.43 μm in diameter. Pore circular, 3.67 μm in diameter. Distance between pores 6.2 μm . Pore membrane with densely spaced granules. Exine thickness 1.2 μm . Ornamentation micro-echinate.

Discussion

Ranunculaceae is an europalynous family. Pollen grains (2-) 3 (4) colpate, 3 colporoidate, pantocolpate, pantoporate, nonaperturate; pollen shape oblat to spheroidae; ornamentation shows variety (echinate, reticulate etc.) (Erdtman, 1952).

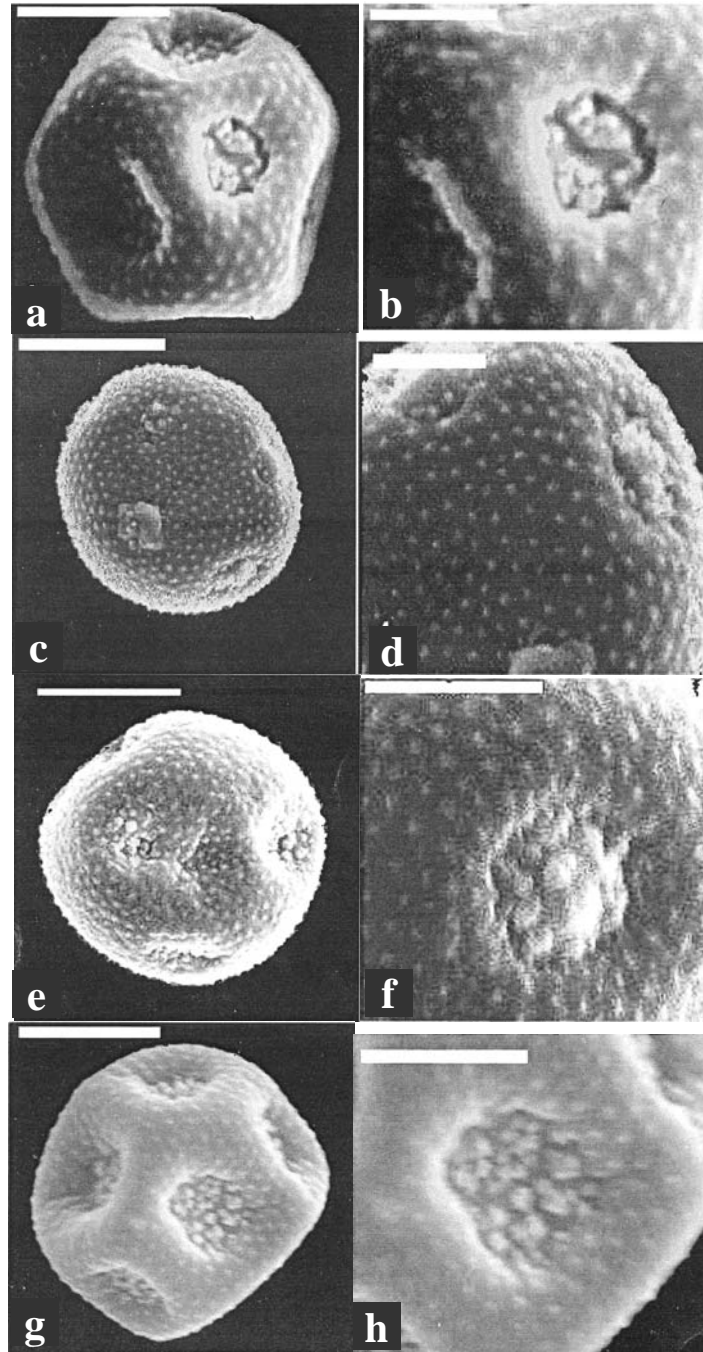


Fig. 4. Scanning electron micrographs of *Thalicttrum* L.; *T. minus* var. *minus* (a-b); *T. orientale* (c-d); *T. simplex* (e-f); *T. lucidum* L. (g-h); scale bar: a, c, e, g - 10 μ m; b, d, f, h - 5 μ m.

Few studies have been made on the pollen of some *Thalictrum* L., species. Faegri and Iversen (1992) have published a key including *Thalictrum* pollen and described as 10-25 μm in diameter and 4-12 pores.

T. aquilegifolium L., was described by Erdtman (1952) having 6-10 pores and 15-24 μm in diameter. In our study, pollen grain of *T. aquilegifolium* was 22.2 μm in diameter with 6-10 pores.

During investigation on pollen morphology of *Thalictrum flavum* L., Erdtman (1943) described that pollen of *T. flavum* is 16 μm in diameter, 8 pores and reticulate ornamentation. Petrov *et al.*, (1975) found pores number 20 in *T. flavum* Nilsson (1977) studied pollen morphology of *T. flavum* using SEM showing 15-20-24 μm in diameter, pores number 6-10, pores diameter 5-6 μm . Moore and Webb (1978) reported 9 or more pores in *T. flavum*. Punt *et al.*, (1991) found that pollen diameter was 18-(20)-24 μm , pores number 8-(12)-15 in *T. flavum*. In our study pollen of *T. flavum* are spheroidal, 17.51x 17.26 μm in diameter, 6-10 pores, pores diameter 3.21 μm . The pollen morphology of *T. flavum* correspond more closely to that reported by Nilsson (1977). Other studies are different from our studies especially in pores number. Kumazawa (1936) reported less than 10 pores in *T. simplex* L. In our study pores number of *T. simplex* was found between 9 and 15.

The most important information on the comparative pollen morphology of *Thalictrum* is given by Punt & Blackmore (1991). They have provided detailed palynomorphological description of six. The Northwest European species of *Thalictrum*. In the present study we found that, the pollen grains of 11 taxa of *Thalictrum* are pantoporate (6-17 pores), apolar, spheroidal. Pore membrane show different palynologic characters. Pores margin situated flattened or slightly sunken areas of the exine. Mezopodium 5.02-7.91 μm . Exine thickness 1.2 μm , ectexine slightly thicker than or of same thickness as endexine. Ornamentation micro-echinate.

Pollen morphological key to species of *Thalictrum* L., distributed in Turkey:

1. Operculum densely spaced granules or spinules
 2. Pores margin flattened
 3. Some pores margin flattened or some of them sunken *T. foetidum*
 3. All of pores margin flattened
 4. Largest diameter of grains > 20 μm *T. sultanabadense*
 4. Largest diameter of grains < 20 μm
 5. Mesopodium > 6 μm *T. orientale*
 5. Mesopodium < 6 μm *T. minus var. microphyllum*
 2. Pores margin flattened
 6. Operculum spaced granules *T. lucidum*
 6. Operculum spaced spinules *T. minus var. minus*
1. Operculum densely spaced varts or gemmae
 7. Pores margin flattened
 8. Some pores margin flattened or some of them sunken *T. isophyroides*
 8. All of pores margin flattened
 9. Operculum spaced gemmae *T. minus var. majus*
 9. Operculum spaced varts
 10. Largest diameter of grains > 20 μm *T. flavum*
 10. Largest diameter of grains < 20 μm *T. aquilegifolium*
 7. Pores margin sunken *T. simplex*

In the flora of Turkey, it is described that *T. simplex* L. and *T. flavum* are related to each other (Davis, 1965). We have found that these two species are different from each other in the terms of palynologic characters. According to Davis (1965), *T. minus* L., is complex species for Turkey. In our study, pollen grains of *T. minus* L., var. *minus* are different from other species it is 24 µm in diameter and pores are between 11 and 17.

This palynological investigation is the first one which has been done on *Thalictrum* species distributed in Turkey.

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