

(Fumariaceae)



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Corydalis

Fumaria

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Corydalis

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: *C. haussknechtii* -
 : *C. angustifolia* -
 : *C. rupestris* -
 : *C. hyrcana* -
 : *C. aitchisonii* -
 : *C. aitchisonii* -
 : *C. seisumsiana* -
 : *C. oppositifolia* -
) : *C. chionophila* subsp. *firouzii* -
 (
 : *C. chionophila* subsp. *chionophila* -
 : *C. verticillaris* subsp. *boissieri* -
 : *C. verticillaris* subsp. *verticillaris* -
 : *C. cava* -
C. rupestris -
C. cava -
Corydalis -
Leonticoides -
C. rupestris -
C. cava -
Corydalis -
Leonticoides -
Leonticoides -

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Fumaria Corydalis

Corydalis

Corydalis

C. seisumsiana

(SEM)

C. rupestris Radix-cava

C. cava Corydalis

C. angustifolia

C. haussknechtii

C. hyrcana

C. seisumsiana

C. oppositifolia

C. verticillaris

C. aitchisonii

Strictae

.Leonticoides

C. chionophila

Corydalis

Corydalis

("IRAN")

Fumariaceae :

(Mabberley 1987)

(Fumariaceae)

.(Mabberley 1987)

Fumaria

Corydalis

(Wang *et al.* 2003; Ying-Wei & Liden 2006)

Corydalis

Corydalis

Corydalis

.(Liden 1996)

.(Liden 1997)

Corydalis

Corydalis

C. integra ()

(*C. angustifolia* *C. haussknechtii*)

C. haussknechtii

Corydalis

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Helicosyne

Leonticoides

C. aitchisonii)

(*C. chionophila* *C. hyrcana* *C. seisumsiana* *C. oppositifolia* *C. verticillaris*

.(Liden 1997)

Leonticoides

Leonticoides

C. cava

Radix-cava

(Liden *l.c.*)

()

Corydalis

Corydalis

(Wendelbo 1974) Flora Iranica

C. rupestris

Strictae

Chremnocapnos

.(Liden *l.c.*)

Chremnocapnos

DNA (Liden & Fukuhara 1995) *Corydalis*
(Liden *et al.*)
Corydalis

Corydalis *Corydalis Fasciculae*
(*Sophorocapnos Chremnocapnos*)
(*Bipapliata Strictae*) *Chremnocapnos*
() *Sophorocapnos*

Duplotuber
(*Corydalis Dactylotuber Leoniticoides Radix-cava*)
) (Liden & Zetterlund 1997)
(*Corydalis*) (

Corydalis

(Kilic *et al.* 2006)
C. conorhiza *C. solida* subsp. *solida*

(Perveen & Qaiser 2004)
Fumaria *Corydalis*
Kalis) *C. rupestris*
Corydalis Papaveraceae (1979)

Corydalis

Corydalis

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Corydalis

Corydalis

Corydalis

Bulbocapnin Protopin)

Corydalis .

Corydalis cava .

Corydalis

(Fumariaceae)

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Corydalis.....

Fumaria.....

Corydalis

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(*Fumaria Corydalis*)

Corydalis

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Corydalis

("IRAN")

(Zeiss)

Canon G-5

("IRAN")

SEM

(*C. seisumsiana*)

Corydalis

<i>Corydalis aitchisonii</i>	<i>Leonticoides</i>	(IRAN-43372)	:
<i>C. angustifolia</i>	<i>Corydalis</i>	IRAN-)	:
			(43377)
<i>C. angustifolia</i>	<i>Corydalis</i>	(IRAN-43363)	:
<i>C. cava</i>	<i>Radix-cava</i>		:
		(IRAN-43367)	
<i>C. chionophila</i>	<i>Leonticoides</i>		:
		(IRAN-43405)	
<i>C. hyrcana</i>	<i>Leonticoides</i>		:
		(IRAN-43365)	
<i>C. haussknechtii</i>	<i>Corydalis</i>		:
		(IRAN-44388)	
<i>C. haussknechtii</i>	<i>Corydalis</i>		:
		(IRAN-44387)	
<i>C. oppositifolia</i>	<i>Leonticoides</i>		:
		(IRAN-43376)	
<i>C. oppositifolia</i>	<i>Leonticoides</i>		:
		(IRAN-43375)	
<i>C. rupestris</i>	<i>Strictae</i>		:
			(IRAN-43357)
<i>C. seisumsiana</i>	<i>Leonticoides</i>		:
			(IRAN-44390)
<i>C. verticillaris</i>	<i>Leonticoides</i>	(IRAN-49681)	:

<i>Corydalis</i>	<i>Leonticoides</i>		:
<i>aitchisonii</i>			(IRAN-43372)
<i>C. angustifolia</i>	<i>Corydalis</i>		:
			(IRAN-43377)
<i>C. cava</i>	<i>Radix-cava</i>		:
		(IRAN-43367)	
<i>C. chionophila</i>	<i>Leonticoides</i>	(IRAN-18285)	:
<i>C. hyrcana</i>	<i>Leonticoides</i>		:
		(IRAN-43365)	
<i>C. haussknechtii</i>	<i>Corydalis</i>		:
		(IRAN-44388)	
<i>C. oppositifolia</i>	<i>Leonticoides</i>		:
			(IRAN-43375)
<i>C. rupestris</i>	<i>Strictae</i>	-	:
			(IRAN-43354)
<i>C. verticillaris</i>	<i>Leonticoides</i>		:
			(IRAN-52203)

(“IRAN”) (-))

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Sect. *Corydalis*

Corydalis haussknechii Liden

Corydalis angustifolia (M. Bieb.) DC.

Sect. *Radix-cava*

C. cava (L.) Schweigg. & Korte

Sect. *Strictae*

C. rupestris Ky.

Sect. *Leonticoides*

C. aitchisonii M. Pop.

C. verticillaris DC.

subsp. *verticillaris*

subsp. *boissieri* (Prain) Wendelbo

subsp. *parviflora* Liden

subsp. *grandiflora* (Bornm. & Gauba)

Wendelbo

C. oppositifolia DC.

subsp. *kurdica* (Cullen & P.H. Davis)

Liden

C. seisumsiana Liden

C. hyrcana Wendelbo

C. chionophila Czernjak

subsp. *Chionophila*

subsp. *Firouzii* (Wendelbo) Liden

Fumaria

F. densiflora DC.

F. bracteosa Pomel

F. officinalis L.

F. vaillantii Loisl.

F. schleicheri Soyer-Willemet

F. parviflora Lam.

F. asepala Boiss.
F. indica (Hauskn.) Pugsley

Corydalis

(Liden & Zetterlund 1997)

Corydalis

(Kilic *et al.* 2006)

Perveen & Qaiser)

.(2004

Corydalis

<i>C. haussknechtii</i>	<i>Corydalis</i>		:
		(IRAN-44388)	
			:
		(IRAN-44387)	
			:
		(IRAN-44389)	
<i>C. angustifolia</i>	<i>Corydalis</i>		:
			(IRAN-43377)
<i>C. cava</i>	<i>Radix-cava</i>		:
		(IRAN-43367)	
			:
		(IRAN-43366)	
			:
		(IRAN-43367)	
			:
		(IRAN-48417)	
<i>C. chionophila</i> subsp. <i>chionophila</i>	<i>Leonticoides</i>	(IRAN-43407)	:
			:
		(IRAN-43406)	
			:
		(IRAN-43408)	
			:
		(IRAN-43409)	
			:
		(IRAN-43408)	
			:

<i>C. chionophila</i> subsp. <i>firouzii</i>	<i>Leonticoides</i>	:
		(IRAN-44391)
<i>Corydalis</i> <i>aitchisonii</i>	<i>Leonticoides</i>	:
		(IRAN-43372)
		:
		(IRAN-43404)
		(IRAN-43374)
		:
		:
		(IRAN-43378)
<i>C. oppositifolia</i>	<i>Leonticoides</i>	:
		(IRAN-43375)
		:
		(IRAN-43376)
<i>C. verticillaris</i> subsp. <i>Boissieri</i>	<i>Leonticoides</i>	:
		(IRAN-52748)
		:
		(IRAN-52192)
		:
		(IRAN-52193)
<i>C. verticillaris</i> subsp. <i>verticillaris</i>	<i>Leonticoides</i>	:
		(IRAN-49681)
		:
		(IRAN-52745)
		:
		(IRAN-52747)

			:
		(IRAN-52743)	
			:
			:
			:
<i>C. verticillaris</i>	<i>Leonticoides</i>		:
subsp. <i>grandiflora</i>		(IRAN-52203)	
<i>C. verticillaris</i>			:
			:
		(IRAN-52203)	
			:
		(IRAN-52746)	
			:
<i>C. hyrcana</i>	<i>Leonticoides</i>		:
		(IRAN-43365)	
<i>C. seisumsiana</i>	<i>Leonticoides</i>		:
		(IRAN-44390)	
<i>C. rupestris</i>	<i>Strictae</i>		:
		(IRAN-48411)	



C. angustifolia -

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C. haussknechtii -

. :



C. hyrcana -

. :



C. rupestris -

. :



C. aitchisonii -

:



C. aitchisonii -

:



: *C. oppositifolia* -



: *C. seisumsiana* -



C. chionophila subsp. *chionophila* -

:



C. chionophila subsp. *firouzii* -

.() :



C. verticillaris subsp. *verticillaris* -

:



C. verticillaris subsp. *boissieri* -

:



: *C. cava* -

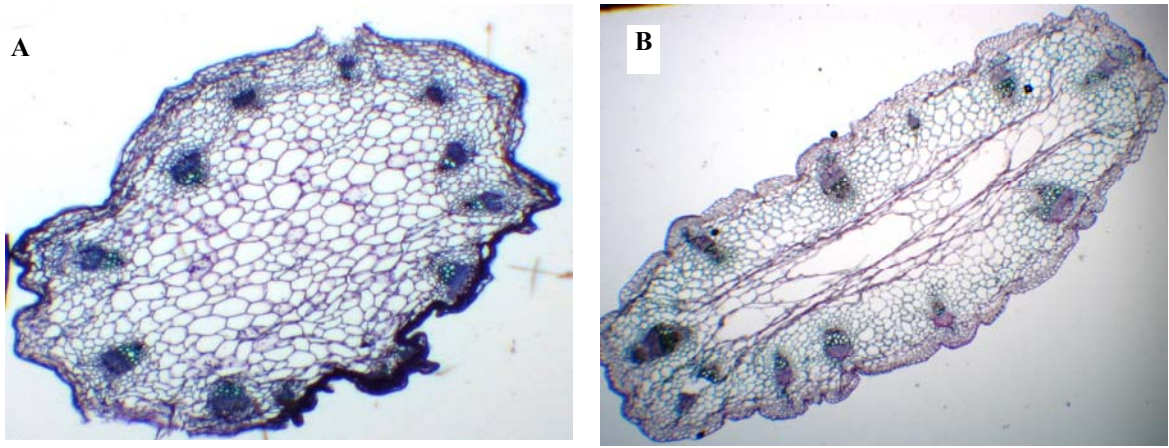
Corydalis

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Corydalis

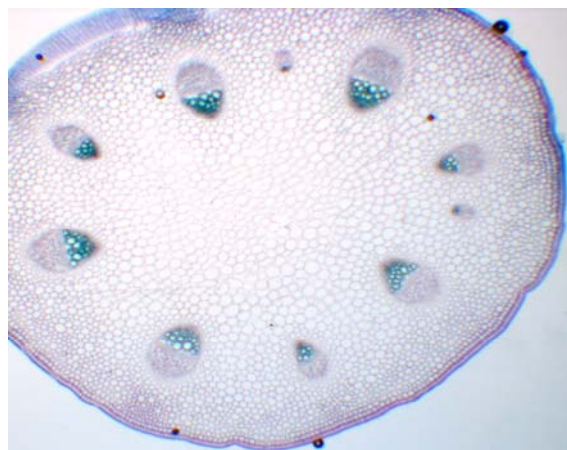
C. rupestris

:
 - *Strictae* *C. rupestris*
C. cava *Radix-cava* .()
 -
C. C. haussknechtii) *Corydalis* .()
Leonticoides .()
 .()
 ()



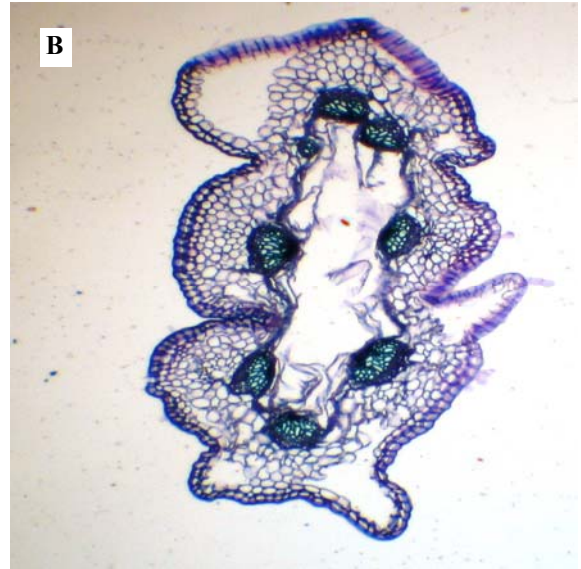
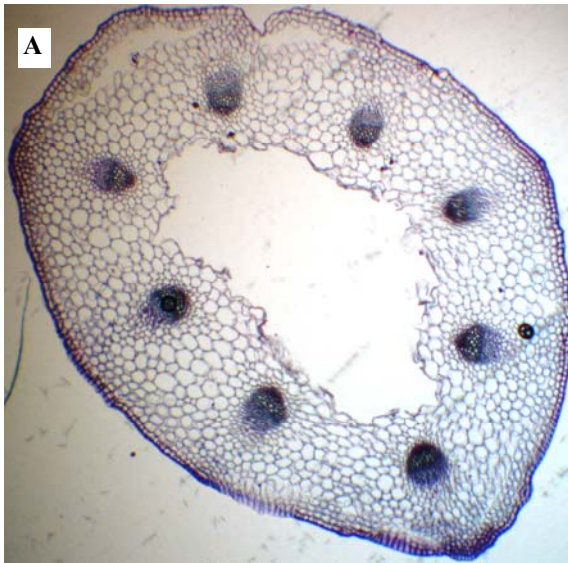
.B .A . X *Strictae* *C. rupestris* -

Fig. 14. Stem of *C. rupestris* section *Strictae*: in T.S. (4X), A. siphonial type, B. non-siphonial type.



. X *Radix-cava* *C. cava* -

Fig. 15. Stem of *C. cava* in T.S. (4X), section *Radix-cava*.



: X *Corydalis*

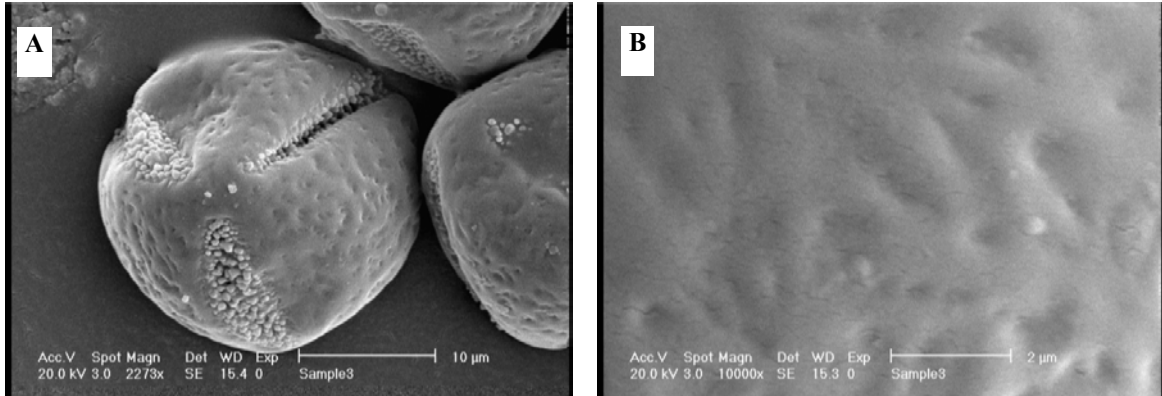
.*C. angustifolia* .B *C. haussknechtii* .A

Fig. 16. Stems in section *Corydalis* in T.S. (4X): A. *C. haussknechtii*, B. *C. angustifolia*.

(:) *Corydalis* -

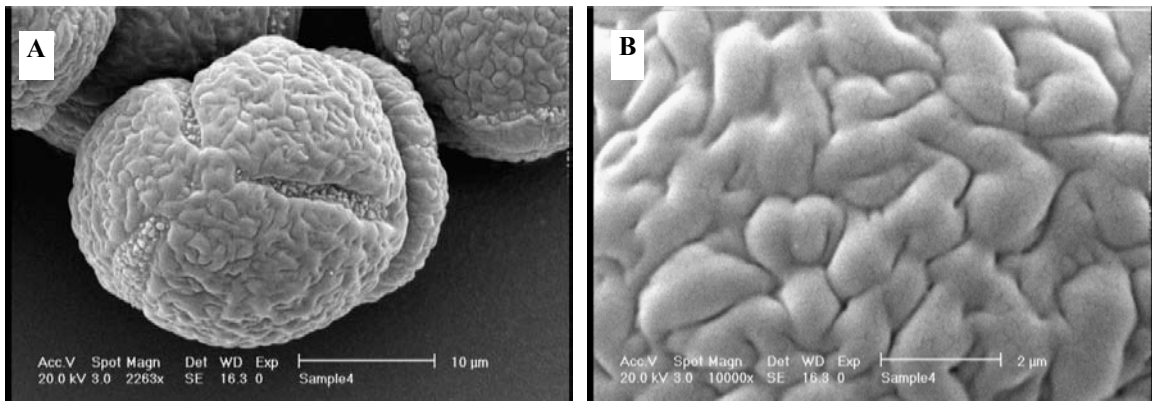
Table 4. Selected pollen morphology data of the genus *Corydalis* (unit: μm)

(Taxon)		(Polar diameter)			(Equatorial diameter)			P/E	(Colpi length)	(Ornamentation)	(Perforation)
(Section)	(Specimen)	Min.	Mean	Max.	Min.	Mean	Max.				
<i>Strictae</i>	<i>C. rupestris</i>	22.90	24.00	25.10	21.30	23.33	24.50	1.03	16.20	(Rugulate)	(Imperforate)
<i>Radix-cava</i>	<i>C. cava</i>	22.00	23.07	25.20	20.90	22.17	23.60	1.04	11.10	(Densely rugulate)	(Indistinctly fossulate)
<i>Corydalis</i>	<i>C. angustifolia</i>	25.10	25.75	26.80	22.80	24.80	26.40	1.04	16.20		/
	<i>C. haussknechtii</i>	20.90	24.03	26.60	22.50	23.87	25.00	1.01	11.50	(Rugulate)	(Perforate fossulate)
	<i>C. chionophila</i>	18.20	24.89	27.80	18.70	24.33	28.40	1.02	18.45		
<i>Leonticoides</i>	<i>C. aitchisonii</i>	25.50	27.60	29.80	27.00	27.17	27.50	1.02	16.90		/
	<i>C. oppositifolia</i>	23.70	25.37	27.00	23.60	25.20	26.00	1.01	17.10	(Rugulate)	(Densely fossulate)
	<i>C. hyrcana</i>	26.00	27.28	27.90	24.10	26.45	28.90	1.03	13.98		
	<i>C. verticillaris</i>	21.30	26.90	33.90	23.40	26.38	28.10	1.02	14.63		



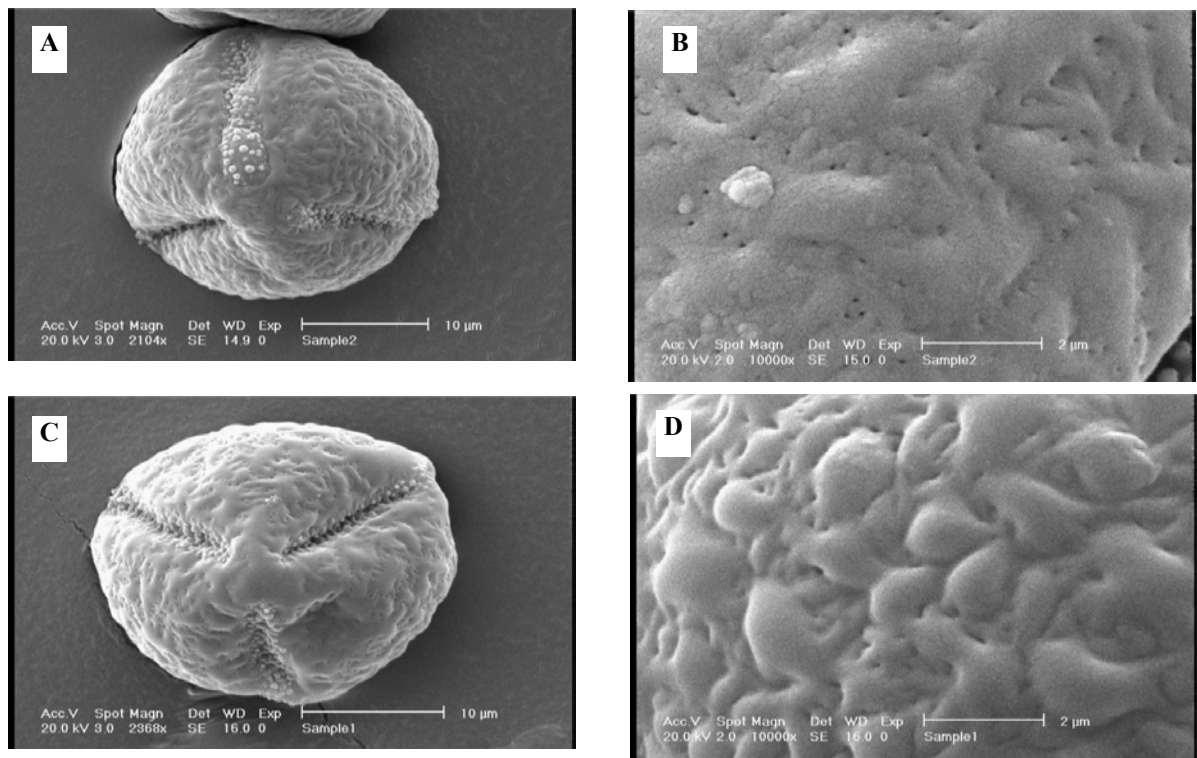
.B .A : *C. rupestris* -

Fig. 18. Pollen in *C. rupestris*: A. polar view, B. exine ornamentation.



.B .A : *C. cava* -

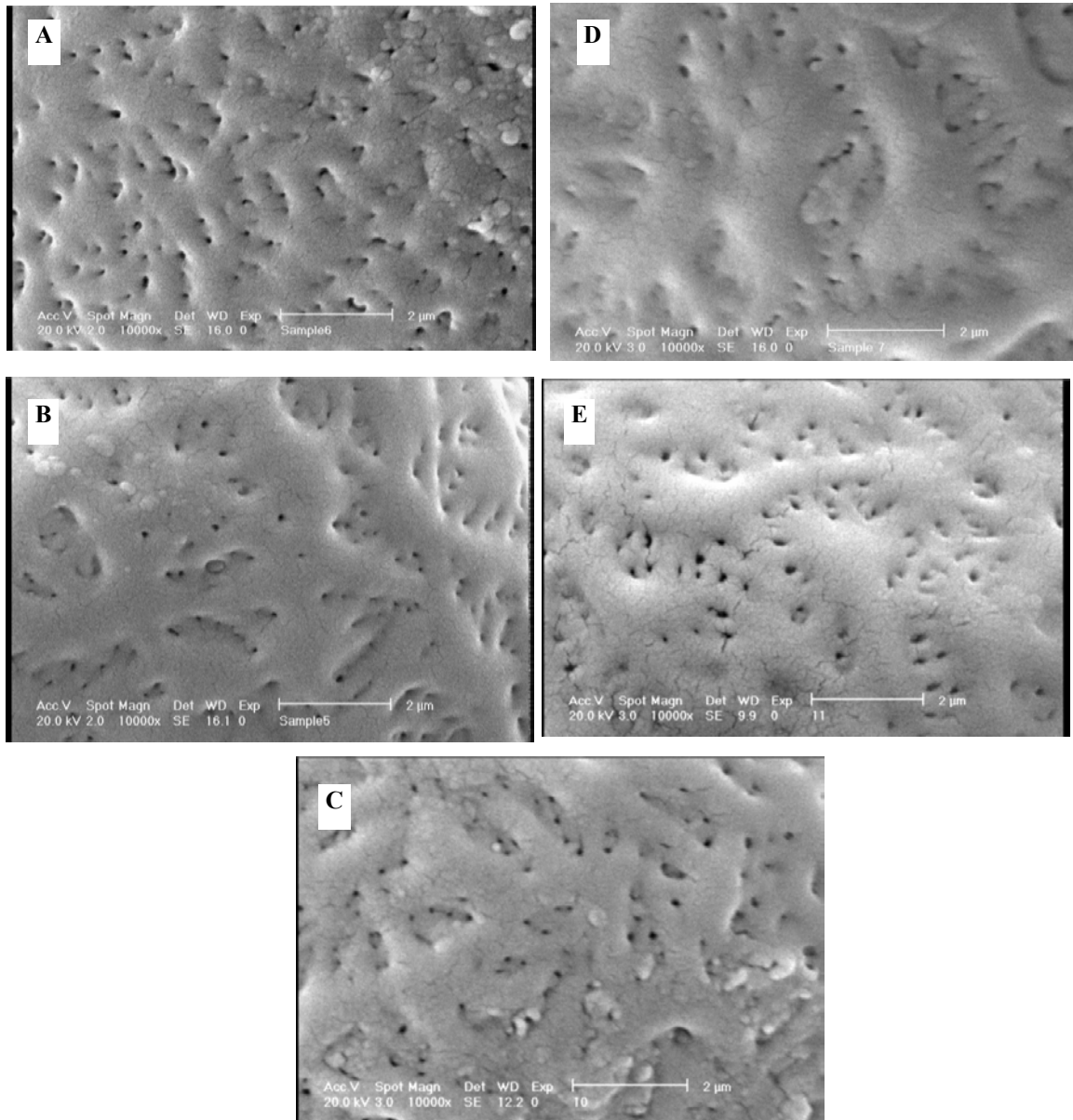
Fig. 19. Pollen in *C. cava*: A. polar view, B. exine ornamentation.



.B .A:*C. angustifolia* :*Corydalis* -

.D .C:*C. haussknechtii*

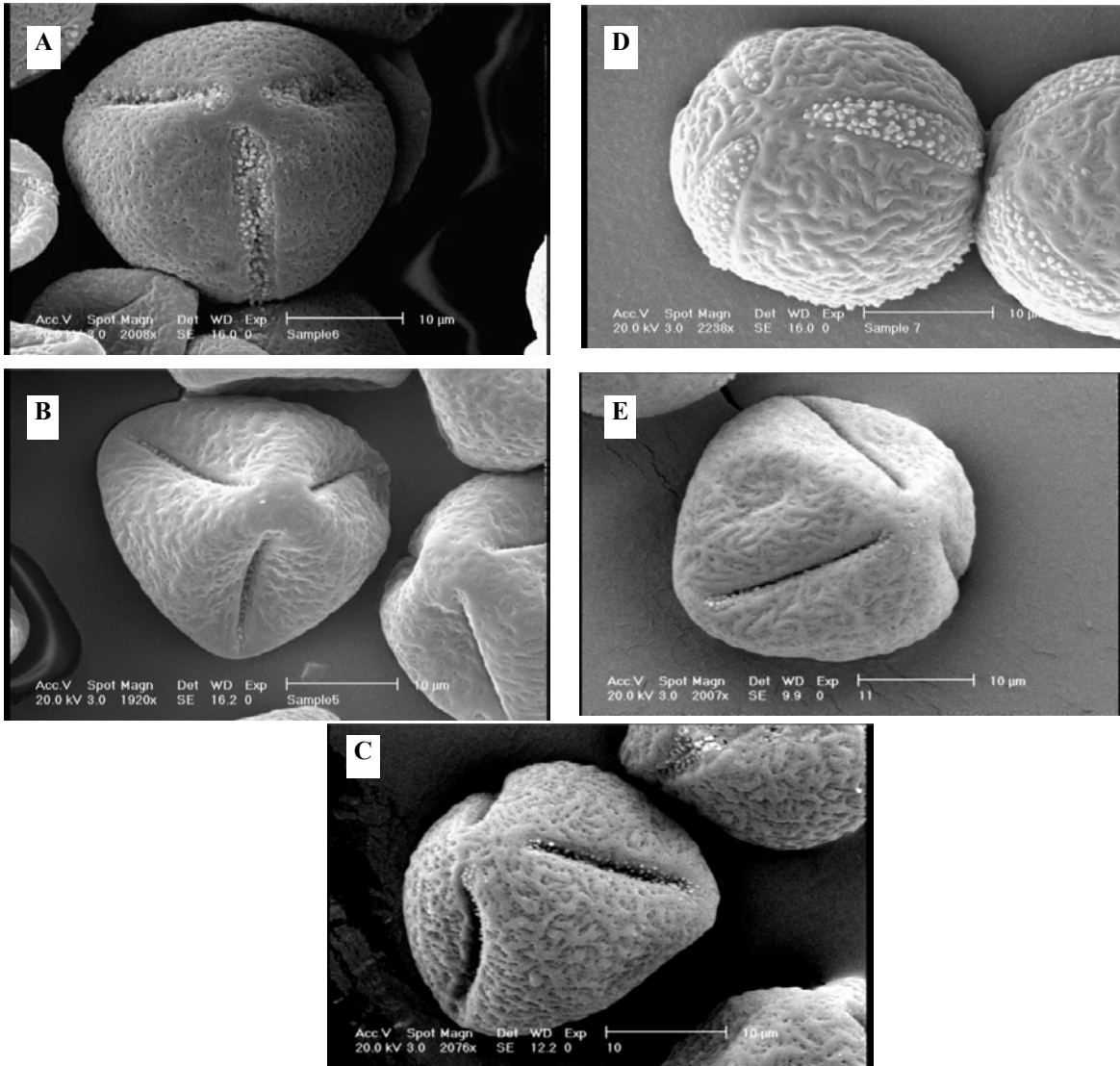
Fig. 20. Pollen in section *Corydalis*: *C. angustifolia*: A. polar view, B. exine ornamentation. *C. haussknechtii*: C. polar view, D. exine ornamentation.



C. chionophila .B *C. aitchisonii* .A :*Leonticoides* -

.*C. verticillaris* .E *C. oppositifolia*. D *C. hyrcana* .C

Fig. 21. Exine ornamentation in section *Leonticoides*: A. *C. aitchisonii*, B. *C. chionophila*, C. *C. hyrcana*, D. *C. oppositifolia*, E. *C. verticillaris*.



.C *C. chionophila* .B *C. aitchisonii* .A :*Leonticoides* -

.C. *verticillaris* .E *C. oppositifolia* .D *C. hyrcana*

Fig. 22. Polar view in section *Leonticoides*: A. *C. aitchisonii*, B. *C. chionophila*, C. *C. hyrcana*, D. *C. oppositifolia*, E. *C. verticillaris*.

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A BIOSYSTEMATIC STUDY OF THE FAMILY FUMARIACEAE IN IRAN

S. Sajedi

The stem anatomy and pollen morphology of all Iranian members of the genus *Corydalis* (except *C. seisumsiana* in pollen morphology) were studied using light and SEM microscopy. The results verified the argument that tuberous sections of *Corydalis*, including *Radix-cava*, *Corydalis* and *Leonticoides* could be classified in a single subgenus as a natural group. The study also revealed that the species brought under each of the above sections in systematics had strong communalities with each other in anatomical (number and type of vascular bundles and stem cells) and pollen (pollen size, exine ornamentation and perforations) features. This supported the existing section-wise classification of the Iranian members of the genus *Corydalis* as being a natural grouping. Accordingly, two sets of keys were presented for section-level identification of the *Corydalis* taxa using anatomical and pollen characteristics.

Key words: Fumariaceae, anatomy, pollen morphology, Iran

Ministry of Jihad-e Agriculture
Agricultural Research, Education and Extension Organization
Iranian Research Institute of Plant Protection

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- **Advisor:** M. Asadi
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AGRICULTURAL RESEARCH, EDUCATION AND EXTENSION ORGANIZATION

IRANIAN RESEARCH INSTITUTE OF PLANT PROTECTION

FINAL REPORT OF PROJECT/RESEARCH

BIOSYSTEMATIC STUDY OF THE FAMILY FUMARIACEAE IN IRAN

S. Sajedi

REGISTER NO.