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**Autor:** Volponi, Carola Regina

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# Palynological study of Argentine species of *Arenaria* L. and *Stellaria* L. (Caryophyllaceae)

CAROLA REGINA VOLPONI

## RESUMEN

VOLPONI, C. R. (1987). Estudio palinológico de las especies Argentinas de *Arenaria* L. y *Stellaria* L. (Caryophyllaceae). *Candollea* 42: 545-551. En inglés, resúmenes en español e inglés.

Han sido analizados los granos de polen de siete especies argentinas de *Arenaria* L. y ocho de *Stellaria* L. utilizando microscopio óptico y electrónico de barrido. Las especies estudiadas fueron: *Arenaria achalensis* Griseb., *A. bisulca* (Bartl.) Fenzl, *A. catamarcensis* Pax, *A. lanuginosa* (Michx.) Rohrb., *A. rivularis* Phil., *A. serpens* H. B. K., *A. serpyllifolia* L., *Stellaria aphanantha* Griseb., *S. arvalis* Fenzl ex Phil. emend. Pedersen, *S. debilis* Urv., *S. cryptopetala* Griseb., *S. media* (L.) Cyr., *S. pallida* (Dumortier) Piré, *S. parva* Pedersen y *S. pedersenii* Volponi. Todos los granos son esferoidal-poliédricos, pantoporados, con ectexina espinulosa y punteaduras tubulíferas, espinulas irregularmente distribuidas. La variabilidad en el diámetro, número de poros, grosor de la exina, diámetro y densidad de las punteaduras y altura, forma y densidad de las espinulas, no es suficiente para construir una clave de diferenciación. En cinco especies de *Arenaria* y cuatro de *Stellaria* se encontraron diferencias de tamaño en granos de polen provenientes de la misma antera, lo cual podría estar relacionado con viabilidad y/o con flores cleistógamas y/o casmógamas. Finalmente, debe aclararse que fue insuficiente la cantidad de granos de polen hallada en ejemplares de *S. cuspidata* Schlecht. y *S. antoniana* Volponi.

## ABSTRACT

VOLPONI, C. R. (1987). Palynological study of Argentine species of *Arenaria* L. and *Stellaria* L. (Caryophyllaceae). *Candollea* 42: 545-551. In English, Spanish and English abstracts.

Pollen from seven *Arenaria* species and eight *Stellaria* species that occur in Argentina were analyzed using optical and scanning electron microscopy. The species studied were: *Arenaria achalensis* Griseb., *A. bisulca* (Bartl.) Fenzl, *A. catamarcensis* Pax, *A. lanuginosa* (Michx.) Rohrb., *A. rivularis* Phil., *A. serpens* H. B. K., *A. serpyllifolia* L., *Stellaria aphanantha* Griseb., *S. arvalis* Fenzl ex Phil. emend. Pedersen, *S. debilis* Urv., *S. cryptopetala* Griseb., *S. media* (L.) Cyr., *S. pallida* (Dumortier) Piré, *S. parva* Pedersen and *S. pedersenii* Volponi. All grains are spheroidal-polyhedral, pantoporate, with punctate-gillate tectum and irregularly distributed short spinules. The variability in grain diameter, pore number, exine thickness, fovea density and diameter, spinule height, shape and density are not sufficiently different to construct a key. In five *Arenaria* species and four *Stellaria* species, size differences were found in grains from the same anther which could be related to pollen grain viability, cleistogamous or chasmogamous flowers, or both. It must be mentioned that not enough pollen grains were available for *S. cuspidata* Schlecht. and *S. antoniana* Volponi.

The *Caryophyllaceae* pollen grains were studied before by several authors in different contexts. For example NOWICKE (1975) studied 16 families and 190 species of the Order *Centrospermae* coming from all over the world looking for the maintenance of the relationships existing between the betalain and antocianin families. After that, NOWICKE & SKVARLA (1977) examined these pollen grain morphology in connection with the relationships of the *Plumbaginaceae*, *Polygonaceae* and *Primulaceae* to the Order *Centrospermae*.

Pollen of *Caryophyllaceae* has been treated for a few regions. CHANDA (1962) studied the pollen morphology of 36 species from Scandinavia, constructing a key for their identification; VISHNU-MITRE & GUPTA (1964) analyzed pollen of Indian *Caryophyllaceae*; they recognized

Taxon	Collection	Collector and number	Pores No.	Diameter $\mu\text{m}$	Exine thickness $\mu\text{m}$
<i>A. achalensis</i> Griseb	Tucumán, Estancia Las Pavas	Venturi 4617 LP	19(-22-)24	34.4(36.0-)37.6	2.0(-2.5-)3.2
<i>A. bisulca</i> (Bartl.) Fenzl	Salta, Cuesta del Obispo	Cabrera 22019 LP	18(-20-)21	35.2(-42.0-)44.8	2.0(-2.5-)3.2
<i>A. catamarcensis</i> Pax	Jujuy, Abra de Yavi	Cabrera 15323 LP	20(-21-)23	35.2(-37.2-)40.8	2.4(-2.5-)3.2
<i>A. lanuginosa</i> (Michx.) Rohrb.	Jujuy, El Fuerte	Cabrera 21056 LP	18(-21-)23	36.8(-39.0-)41.6	2.0(-2.5-)2.8
<i>A. lanuginosa</i> (Michx.) Rohrb.	Tucumán, Yerba Buena	Venturi 2082 LP	18(-21-)25	31.2(-37.8-)44.0	2.0(-2.4-)2.8
<i>A. rivularis</i> Phil.	Jujuy, Mina Pirquitas	Schwabe 667 LP	14(-17-)21	29.6(-33.5-)39.2	1.6(-1.9-)2.4
<i>A. serpens</i> H. B. K.	Mendoza, Las Leñas	Fabris 8474 LP	13(-16-)22	26.4(-28.0-)30.4	(1.6)
	Chubut, Río Pico	Roth s.n. (LP 29221)	17(-19-)22	28.0(-29.6-)31.2	1.6(-1.8-)2.4
<i>A. serpyllifolia</i> L.	Buenos Aires, Sierra de la Ventana	Cabrera 16470 LP	17(-18-)20	28.0(-32.5-)36.8	2.0(-2.2-)2.4
<i>S. aphanantha</i> Griseb.	Tucumán, La Trampa	Castillón 3257 LIL	13(-14-)16	20.0(-23.3-)24.8	1.6(-1.8-)2.4
<i>S. cryptopetala</i> Griseb.	Jujuy, Abra Pampa, Cerro Huancar	Cabrera 15280 LP	11(-13-)15	30.4(-31.7-)33.6	2.0(-2.3-)2.8
<i>S. arvalis</i> Fenzl ex Phil. emend. Pedersen	Neuquén, Cerro Belvedere	Cabrera y Job 204 LP	15(-18-)19	44.0(-47.2-)51.2	2.0(-2.4-)2.8
<i>S. debilis</i> Urv.	Chubut, Lago Blanco	LPS 19768 en LP	11(-13-)15	31.2(-34.8-)37.6	2.0(-2.3-)2.8
<i>S. media</i> (L.) Cyr.	Neuquén, Lago Lolog	Zardini 34 LP	14(-16-)18	34.8(-39.6-)42.4	2.0(-2.3-)2.4
<i>S. pallida</i> (Dumortier) Piré	Río Negro, boca del río Negro	LPS 20314 en LP	10(-11-)13	24.0(-25.3-)27.2	1.6(-1.8-)2.4
<i>S. parva</i> Pedersen	Corrientes, Carambola	Pedersen 9828 LP	17(-18-)19	35.2(-36.4-)37.6	2.0(-2.4-)2.8
<i>S. pedersenii</i> Volpomi	Jujuy, El Fuerte	Cabrera 26237 LP (Holotypus)	11(-13-)15	28.3(-30.1-)33.2	1.6(-2.2-)2.4

Tab. 1. — Pollen observations on Argentine species of *Arenaria* and *Stellaria*.

13 pollen types from 72 species in 15 genera. IWARSSON (1977) has studied 32 species in 15 genera from East Africa and he defined four pollen morphological groups. He believed pollen morphology could not be used to distinguish genera and species. Finally, HEUSSER (1971) studied 13 species in 13 genera of *Caryophyllaceae* from Chile.

Some authors studied specifically the pollen grains of *Caryophyllaceae* species. In that form, MELZHEIMER (1975) analyzed 36 species of *Silene* from Greece representing five sections within the genus. This author recognized two groups on the basis of reticulate grains and tectate with ornamentation; he found that the grain diameter, interpore distance and pore diameter overlap and variation surface ornamentation do not follow taxonomic subsections within the genus. McNEILL & BASSETT (1974) studied 25 species from *Minuartia*, *Honkenya* and *Wilhelmsia*; the pollen grains were described as pantoporate and spheroidal, like in most of the subfamily *Alsinoideae* representatives, whereas the subgenus *Rhodalsine* has tricolpate and prolate grains. These authors analyzed the possibility of connections of this subgenus with others of the same subfamily or with the tribe *Sperguleae* of the *Paronychioideae*.

ERDTMAN & al. (1961: 21) said about *Caryophyllaceae* grains: "The pollen grains characters are, as it seems, generally detailed enough for identification of genera as well as species". Such affirmation suggested the present study, which deals with the palynological study of seven argentine species of *Arenaria* L. and eight of *Stellaria* L. for the first time in this part of the world, looking for characters which could allow the construction of a key.

### Material and methods

In all cases herbarium material from the Museo de La Plata (LP); Museo Botánico, Facultad de Ciencias Exactas, Físicas y Naturales, Córdoba (CORD) and Instituto Miguel Lillo of the Fundación Miguel Lillo (LIL) were used. Taxon name, collection and herbarium number are given in Table 1; nomenclature follows that of VOLPONI (1983) and VOLPONI (1985).

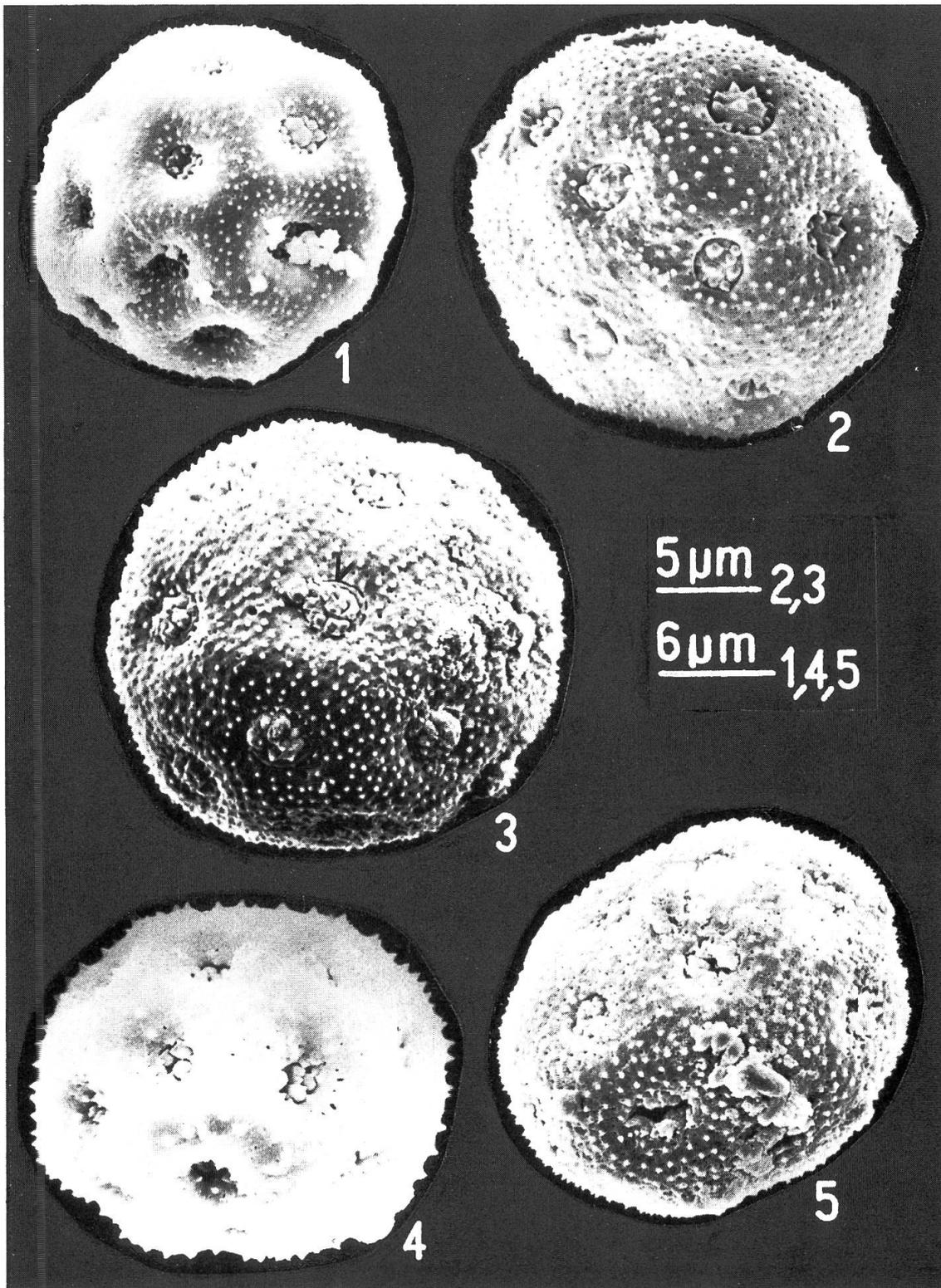
Flowers with mature anthers just opened were used. Flowers were treated 1.5-2 min. with 3% sodium carbonate (MORBELLI, 1980). The anthers were separated from the flower under dissecting microscope, squashed, filtered through a 250 µm mesh screen, centrifugated and acetolyzed (ERDTMAN, 1943). Pollen was then embedded: 1) in glycerine/gelatine for measurements and pore counting; 2) in chloral hydrate/water (5:2) for the examination of surface detail, layers structure and exine L. O. analysis. All slides were sealed with paraffin (ERDTMAN, l.c.). The slides were examined under a Wild M20 light microscope using immersion lens in all cases.

For the observations with the scanning electron microscope (SEM), flowers were put in water and gently heated. Pollen grains were then separated, filtered through a 250 µm mesh screen, washed repeatedly with absolute alcohol and mounted on aluminium disks of 10 mm diameter. No sticking agent was necessary. Pollen grains were subsequently coated with gold-palladium. The material was observed and photographs were taken in a Jeol JSM U3 Scanning Electron Microscope.

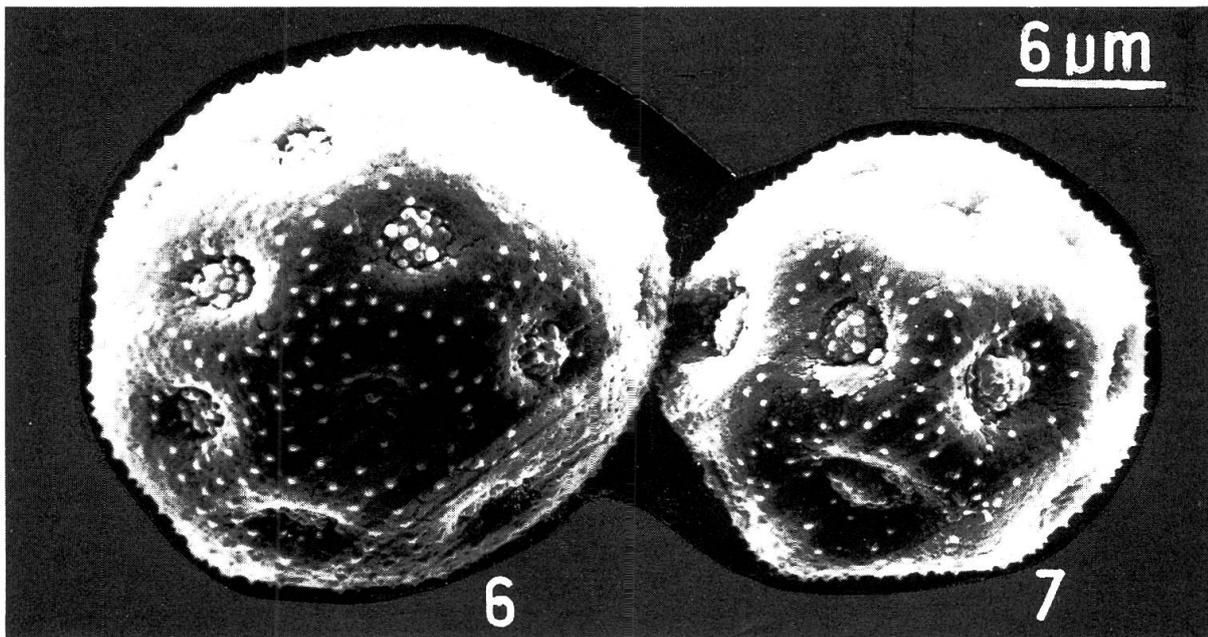
Species	Voucher specimen	Pores	Grain Diam. µm	Exine thickness µm
<i>A. achalensis</i> .....	Venturi 4617 LP	18(-19-)20	(32)	2.4(-2.6-)2.8
<i>A. bisulca</i> .....	Cabrera 22019 LP	16(-19-)20	28.0(-32.3-)36.8	2.4(-3.2-)4.0
<i>A. catamarcensis</i> .....	Cabrera 15323 LP	14(-17-)19	24.0(-26.0-)29.6	3.2(-3.7-)4.0
<i>A. lanuginosa</i> .....	Cabrera 21056 LP	17(-19-)21	28.0(-30.4-)34.4	2.4(-2.8-)3.6
<i>A. rivularis</i> .....	Schwabe 667 LP	14(-16-)20	20.8(-24.0-)27.2	2.4(-2.6-)2.8
<i>S. cryptopetala</i> .....	Cabrera 15280 LP	10(-13-)15	24.8(-26.4-)28.0	2.8(-3.2-)3.6
<i>S. arvalis</i> .....	Cabrera y Job 204 LP	13(-14-)17	33.6(-36.9-)40.0	2.4(-3.6-)5.6
<i>S. media</i> .....	Zardini 34 LP	13(-15-)16	30.4(-33.3-)36.0	3.2(-3.6-)4.0
<i>S. pallida</i> .....	LPS 20314 en LP	(9)	16.8(-18.7-)20.0	(2.4)

Tab. 2. — The "small" pollen grains observations on Argentine species of *Arenaria* and *Stellaria*.

Ten measurements were made on each slide. When pollen grains of two sizes were present (see below), ten measurements were made for each. The "big" size pollen grains in all species are reported in Table 1, whereas in Table 2, the "small" pollen grains in the species where they were found



Figs. 1-5. — Scanning electron micrographs of pollen grains of some Argentine *Caryophyllaceae* species. 1, *Arenaria rivularis* (Jujuy, Mina Pirquitas, Schwabe 667 LP). 2, *Arenaria serpens* (Neuquén, Meli-Quina, Bridarolli 2219 LP). 3, *Arenaria achalensis* (Tucumán, Estancia Las Pavas, Venturi 4617 LP; the arrow indicates the well differentiated ring). 4, *Stellaria cryptopetala* (Jujuy, Cerro al este de Huacalera, Lierner 394b LP). 5, *Stellaria parva* (Corrientes, Estancia San Justo del Palma, Pedersen 13454 LP).



Figs. 6-7. — Scanning electron micrographs showing diameter differences of pollen grains in Argentine material of *Stellaria antoniana* (Jujuy, Abra de Cañas, Krapovickas 26593 LP).  
6, "big" pollen grain. 7, "small" pollen grain.

are reported. These measurements are pore number, grain diameter and exine thickness, in all cases minimum, mean (between parenthesis) and the maximum are given.

For the sake of completeness it must be mentioned that not enough pollen grains were available for other two Argentine species, namely, *Stellaria cuspidata* Schlecht. and *S. antoniana* Volponi. Solely one good anther was found in *S. antoniana* holotypus, used for the SEM (Fig. 6-7).

## Results

### *Description of the pollen grains*

The pollen grains of all species studied were found to be spheroidal-polyhedral, pantoporate, with a spinulose and tubuliferous/punctate exine; spinules are irregularly distributed and relatively wide at the base. In some species two sized pollen grains were found in the same specimen. Dimorphic grains were found in *Arenaria achalensis*, *A. bisulca*, *A. catamarcensis*, *A. lanuginosa*, *A. rivularis*, *Stellaria arvalis*, *S. cryptopetala*, *S. media* and *S. pallida*.

### **Arenaria L.**

The diameter of the grains vary from 26.4  $\mu\text{m}$  in *A. serpens* (Fig. 2) to 44.8  $\mu\text{m}$  in *A. bisulca*, the mean being 35.1  $\mu\text{m}$ . The number of pores oscillate between 13 in *A. serpens* and 25 in *A. lanuginosa*, with a mean value of 19. The pores are covered with a sculptured membrane and the ornamentations are conical and mammillate. In *A. achalensis* (Fig. 3) the pores have a well differentiated ring, 0.35  $\mu\text{m}$  thick. The exine presents thickness variations, the thinner being 1.6  $\mu\text{m}$  in *A. rivularis* (Fig. 1) and *A. serpens* and the thicker 3.2  $\mu\text{m}$  in *A. achalensis*, *A. bisulca* and *A. catamarcensis*, the mean value being 2.25  $\mu\text{m}$ . The sexine is formed by straight collumelae, single and/or coalescent at both ends; the tectum is perforate and spinulose.

### **Stellaria L.**

The diameter of the grains vary from 20  $\mu\text{m}$  in *S. apnanantha* to 51.2  $\mu\text{m}$  in *S. arvalis* and the mean value is 34.06  $\mu\text{m}$ . The number of pores fluctuate between 10 in *S. pallida* and 23 in *S. arvalis* with a mean value of 15, which is also the mean value in *S. cryptopetala* (Fig. 4). The pores

are covered with a sculptured membrane and the ornamentation is mammillate. The exine show little variation on its thickness, from 1.6  $\mu\text{m}$  measured for *S. aphanantha* and *S. pallida* to 2.8  $\mu\text{m}$  in *S. debilis*, *S. arvalis* and *S. parva* (Fig. 5), the mean value being 2.2  $\mu\text{m}$ . The sexine is formed by straight collumelae, single and/or coalescent at both ends; the tectum is perforate and spinulose; the perforations, generally, are circularly outlined but in *S. cryptopetala* there are circular and irregular perforations, these last being somewhat bigger (0.2  $\times$  0.5  $\mu\text{m}$ ).

It was possible to observe in herbaria material of *S. cryptopetala* some specimens with all the stamens reduced to staminoids.

### Discussion

Although NOWICKE (l.c.) offered no data on diameter and pore number, her observations on *Caryophyllaceae* grains are in agreement with those made in the present paper.

Because there are few studies about *Caryophyllaceae* pollen grains in South America is very difficult to know about the reality of differences. HEUSSER (l.c.) studied Chilean material of *A. serpens* and *S. arvalis*; for *A. serpens*, the measurements differed from those made on Argentine material, particularly in the pore number (22-32 in Chilean material); for *S. arvalis* (HEUSSER, l.c. names it as *S. cuspidata*) the dissimilarities found in diameter, pore number and exine thickness are accentuated. Besides, the presence of two sized grains is not mentioned for the Chilean material.

*Stellaria media* has been studied by many authors as already mentioned (CHANDA, l.c.; VISHNU-MITRE & GUPTA, l.c. and IWARSSON, l.c.). All them had treated the pollen in the same way it was done in the present work; however, their measurements differed from those in Argentine specimens: pore number and mean diameter are smaller and the exine thicker.

It was possible to repeat the observation of two pollen grain sizes in *S. media*, whose vegetative morphology is variable (cfr. MATZKE, 1932; VOLPONI, 1983). As to the anthers contents, it was noted that anthers with normal development coming from flowers with petals had two pollen sizes, whereas those coming from flowers without petals had only one-sized pollen grains. The anthers with smaller development had less pollen grains or none at all. It was possible also to test the viability of pollen grains using acetocarmin dye; the bigger ones, which were also those on the stigmatic papillae emitting the pollen tube, were stained. Particularly in the case of *S. media*, the presence of pollen with different sizes in the same anther could be due to the existence of cleistogamous and chasmogamous flowers.

Pollen dimorphism within *Caryophyllaceae* was previously mentioned by VAN CAMPO (1966). On the other hand, McNEILL & CROMPTON (1978) observed differences in size of pollen grains and variation on the ectexine sculpturation between different herbaria specimens named under the same species.

### Conclusion

The differences found in pollen grain characteristics between Argentine taxa and material of other geographic regions are significant.

Dimorphic grains were observed in nine out of the fifteen species considered in this palynological study of *Arenaria* and *Stellaria*. In Argentine material of these genus, grains with different sizes were found in the same flower.

The study of pollen from Argentine species of *Arenaria* and *Stellaria* reveals variations on diameter, pore number, exine thickness, fovea density and diameter, spinule height, shape and density. However, these features do not present enough variation to permit satisfactory differentiation among the species. This conclusion agree with the results of some authors mentioned above.

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