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Epidermal characteristics of toxic plants for cattle from the Salado river basin (Buenos Aires, Argentina)

SUSANA E. FREIRE[1,2], ANA M. ARAMBARRI[1], NÉSTOR D. BAYÓN[1], GISELA SANCHO[1,2], ESTRELLA URTUBEY[2], CLAUDIA MONTI[1], MARÍA C. NOVOA[1], and MARTA N. COLARES[1]

Summary: One hundred and eighty species belonging to 41 families inhabiting the Salado River Basin of the province of Buenos Aires (Argentina) were previously reported to be toxic for cattle. The purpose of this study was to provide a tool to distinguish the taxa when the plant material is desintegrated. In this way, an approach to the identification of these taxa through leaf epidermal features (anticlinal epidermal cell wall patterns, cuticular ornamentation, stomata, and hair types) is performed. A key to the 180 species as well as illustrations of diagnostic characters are given.

Key words: Buenos Aires, Salado River Basin, toxic plants, anatomy, epidermal characters, stomata, hairs, Dicotyledons, Monocotyledons.

Resumen: Caracteres epidérmicos de las plantas tóxicas para el ganado de la Depresión del Salado (Buenos Aires, Argentina). Las plantas tóxicas para el ganado están representadas en la Depresión del Salado (provincia de Buenos Aires, Argentina) por 180 especies pertenecientes a 41 familias. El objetivo del presente trabajo es determinar estos taxa a partir de material desintegrado, utilizando caracteres epidérmicos foliares (paredes anticlinales de las células epidérmicas, ornamentación de la cutícula, tipos de estomas y pelos). Se brinda una clave para la determinación de las especies e ilustraciones de los caracteres diagnósticos.

Palabras clave: Buenos Aires, Depresión del Salado, anatomía, caracteres epidérmicos, estomas, pelos, Dicotiledóneas, Monocotiledóneas, plantas tóxicas.

Introduction

The political province of Buenos Aires is situated in central eastern Argentina. It is covered in most of its surface by a herbaceous grassy steppe, called "pampas." The species studied are from a plain with a poorly developed drainage system. This area is known as Salado River Basin which represents approximately 80,000 km^2 (Fig. 1). The principal economic activity in this area is the cattle breeding, based on natural pastures. The knowledge of the vegetation of this area is relevant for human development.

Numerous floristic studies have been carried out in this area (Cabrera, 1963-1967; Vervoorst, 1967; Cabrera & Zardini, 1978; Cabrera *et al*., 2000). Within the diverse plant families inhabiting the Salado River Basin, 180 species belonging to 41 families show toxicity for cattle (Casós, 1935; Ratera, 1945; Tokarnia & Dobereiner, 1982; Ragonese & Milano, 1984; Gallo, 1979; Pertusi, 1987). Epidermal traits, i.e. epicuticular wax deposition, cuticular

Fig. 1. Map of Buenos Aires province showing the Salado River Basin (area in gray).

[1] Área de Botánica, Departamento de Ciencias Biológicas, Facultad de Ciencias Agrarias y Forestales, UNLP, calle 60 y 119, C.C. 31, 1900 La Plata, Argentina).
[2] División Plantas Vasculares, Museo de La Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina.

ornamentation, epidermal cells, stomata, and hairs, have proved to be an important tool in taxa delimitation in many plant families (Metcalfe & Chalk, 1950-1979; Uphof *et al*., 1962; Sinclair & Sharma, 1971; Lackey, 1978; Arambarri & Colares, 1993; Ditsch *et al*., 1995; Barthlott *et al*., 1998; Stenglein *et al*., 2003) and also in distinguishing fragmented vegetables from feces and stomach contents being resistant to the digestive process (Yagueddú & Cid, 1992; Pelliza *et al.,* 1997; Cid & Sierra, 2004). Therefore, it would be interesting to seek morphological traits that led to diagnose on causes of animal mortality through feces and stomach contents. In order to achieve this goal, we apply herein histo-morphological characters, such as leaf epidermal features.

Material and Methods

Plant material studied

The study was performed using fresh leaves (collected in Buenos Aires province), and dried leaves taken from herbarium specimens belonging to LP, LPAG, LPS, and SI (acronyms according Holmgren *et al*., 1990). The 180 taxa investigated and vouchers are detailed in Appendix 1.

Methods

Fully expanded leaves were selected for the study. Data were obtained from the central area of the midlamina on both surfaces. For reconstitution of dried leaves we followed D'Ambrogio de Argüeso (1986). Then, the material was fixed in formalin, glacial acetic acid, and 50% ethanol at a 5:5:90 ratio (F.A.A.). Most of the epidermal microcharacters were studied by peeling and/or in samples cleared using the technique of Dizeo de Strittmatter (1973). However, the replica method (according to Freeman, 1984) was used in some taxa where it was not possible to get epidermis by peeling or chloral hydrate clearing. To study the epidermal characters of the species belonging to Poaceae we followed the technique of Metcalfe (1960). The semipermanent slides were stained using saffranin in 80% ethanol and mounted in gelatine-glycerine.

Observations, and original drawings were made with a light microscope, Leitz SM lux with camera lucida. Measurements of stomata (length and width) and hairs were taken using a Nikon light microscope equipped with an ocular micrometer. The average size of hairs and stomata were determined based on measurements performed on 15-20 replicates per sample.

Cuticular ornamentation was cited only when it was conspicuous (Table 1)

The classification of anticlinal epidermal cell wall patterns used in (Table 1) was adapted from Stace (1965): Stace's types 1 and 2 correspond to type 1 here; Stace's types 3 and 4 correspond to type 2 here; Stace's types 5 and 6 correspond to type 3 here; Stace's types 7 and 8 correspond to type 4 here. The anticlinal epidermal cell wall patterns are indicated in Table 1 as: adaxial surface / abaxial surface.

Stomata types were classified according Metcalfe & Chalk (1950, 1979) and Van Cotthem (1970), however, to establish the monocotyledons types, we followed Fryns-Claessens & Van Cotthem's (1973) classification.

Leaf margin (visible in transparent leaves) was only used to distinguish two groups of species with glabrous leaves.

The nomenclature follows Zuloaga *et al*.(1994) and Zuloaga & Morrone (1996, 1999).

Epidermal characters in Poaceae were described according to the terminology of Metcalfe (1960) and Ellis (1979), and hair terminology follows Metcalfe & Chalk (1950, 1979) and Uphof (1962). For glandular hairs (Table 1) the number in brackets indicates the number of head cells, and for non-glandular hairs the number of hair cells above the epidermis. The observed hairs and stomata types are described according to Metcalfe & Chalk (1979), Ramayya (1962), and Uphof (1962).

Results and Discussion

From the 41 studied families inhabiting the Salado River Basin, the most representated were: Asteraceae (41 spp.), Poaceae (16 spp.), Solanaceae (14 spp.), Fabaceae (13 spp.), and Brassicaceae (10 spp.). The results are presented in Table 1.

Even if stomata and indumentum types of the species studied are basically in agreement with those described by Metcalfe (1960), Metcalfe & Chalk (1979, 1989) and Uphof (1962) for all families studied, a more detailed discussion of some families is included, because they have some microcharacters that would be cited for the first time and/or they present some special traits. They are as follows:

Apiaceae (6 spp. surveyed): We found anomocytic, diacytic, and paracytic stomata types; all species showed glabrous epidermal surfaces, although papillae were found at midvein level in two species of *Ammi*. It is the first time in which diacytic stomata type has been cited for Apiaceae, whereas anomocytic and paracytic have been

Table 1. Epidermal characters of the toxic plants of Salado River Basin. Numbers in brackets by the species refer to bibliography cited below the table.

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1) Metcalfe (1960); (2) Prat & Vignal (1968); (3) Caro & Sánchez (1969); (4) Sánchez (1971); (5) Gould & Shaw (1992); (6) Sánchez (1974); (7) Westerkamp & Demmelmeyer (1997); (8) Bayón & Arambarri (1999); (9) Selvi & Bigazzi (2001); (10) Di Fulvio (1976); (11) Amat (1988); (12) Gattuso & Gatusso (1998); (13) Ariza Espinar (1973); (14) Pertusi (1987); (15) Barboza et al. (2001); (16) Simón et al. (2002); (17) Cabrera (1944); (18) Arroyo (1986); (19) Yagueddú & Cid (1992); (20) Arambarri & Colares (1993); (21) Gatusso & Gatusso (1989); (22) Gatusso (1996); (23) Ragonese & Covas (1947); (24) Gatusso (2000); (25) Medán (1986); (26) Metcalfe & Chalk (1950); (27) Colares et al. (1999); (28) Cabrera (1979); (29) Stenglein (2001); (30) Bruno et al. (1999). H = hooks; P = prickles; Pa = papillae

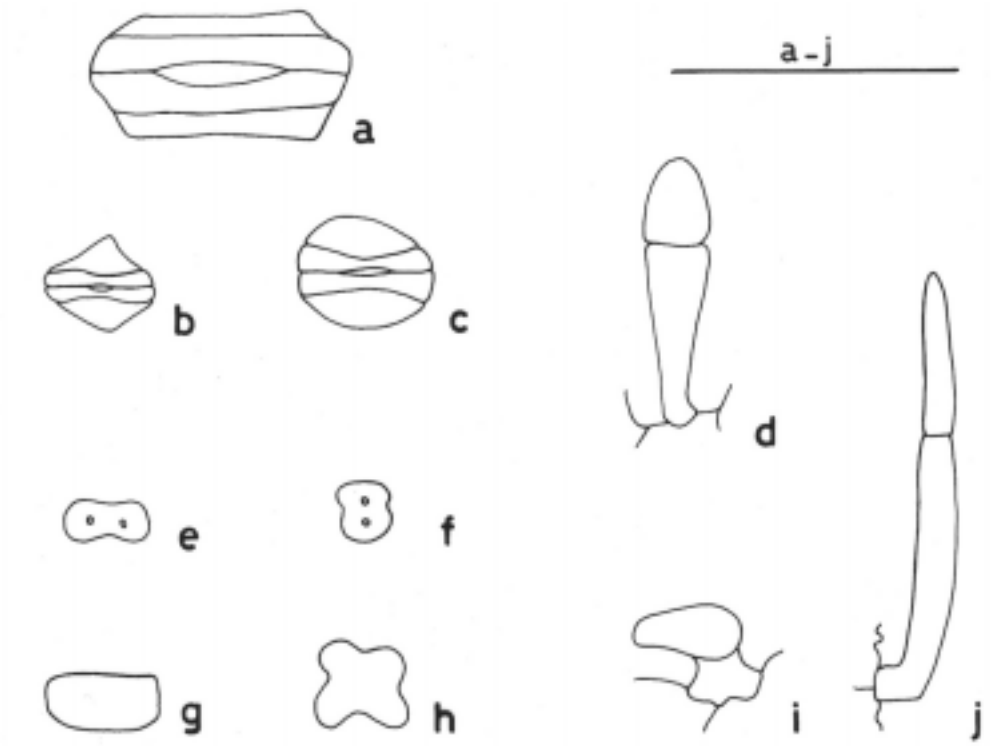

Fig. 2. Epidermal characters of Poaceae. **a**, stoma with parallel-sided subsidiary cells: *Briza minor*; **b**, stoma with triangular subsidiary cells: *Cynodon dactylon*; **c**, stoma with dome subsidiary cells: *Leptochloa chloridiformis*; **d**, micro-hair with almost hemispherical distal cell: *Eragrostis cilianensis*; **e**, dumb-bell silica-body: *Echinochloa crusgalli*; **f**, saddle-shaped silica-body: *Eragrostis cilianensis*; **g**, rectangular silica-body: *Lolium multiflorum*; **h**, cross-like silica-body: *Sorghum halepense*; **i**, micro-hairs with pear-like distal cell: *Eleusine indica*; **j**, micro-hair with rod-like distal cell: *Digitaria sanguinalis*. Scale bar = 50 µm.

previously mentioned by Metcalfe & Chalk (1979). Types of stomata varied notably in such a small group of genera and species. This variability was previously noticed by Forcone & Ayestaran (1996). *Eryngium* epidermal cells showed parallel distribution and also paracytic stomata, which was noted before by Yagueddú & Cid (1992).

Asclepiadaceae (5 spp. analyzed): Results agree with Metcalfe & Chalk (1950, 1979) and also with Bayón & Arambarri (1999) who mentioned that paracytic was the most frequent type of stomata. Bayón & Arambarri (l.c.), also illustrated the epidermal and trichome ornamentation, specially for *Oxypetalum solanoides* which present hairs, exclusively waxes ornamentated on the apical cell.

Asteraceae (41 spp. analyzed): Metcalfe & Chalk (1950, 1979) characterized Asteraceae by having the following seven hairs: uniseriate consisting of uniform cells apart from modification of the terminal and basal cells (similar to bristle hair, according to the illustration); whip hairs (i.e. aseptate flagellate according to Ramayya, 1962); two-armed (i.e. T-shaped); stellate; candelabra hairs; shaggy hairs, and peltate scales. Uniseriate like bristles, peltate scales, and candelabra hairs, were mentioned by these authors for genera not included in the present study, whereas stellate or branched hairs cited by them for the genus *Baccharis* were found in other species not included in this paper (Freire, in prep.). All other hair types, i.e. whip hairs, two-armed or T-shaped, and shaggy hairs, agree with those described in this study. In addition, we found conical hairs in nine species, in two of which (*Ambrosia tenuifolia*, *Aster squamatus*), they were previously reported by Yagueddú & Cid (1992), whereas Barboza *et al*. (2001) illustrated conical hairs in one species of *Xanthium* (*X. spinosum*). In agreement with Metcalfe & Chalk (1950, 1979), glandular hairs are widely distributed (only few species of the total species analyzed have not glandular

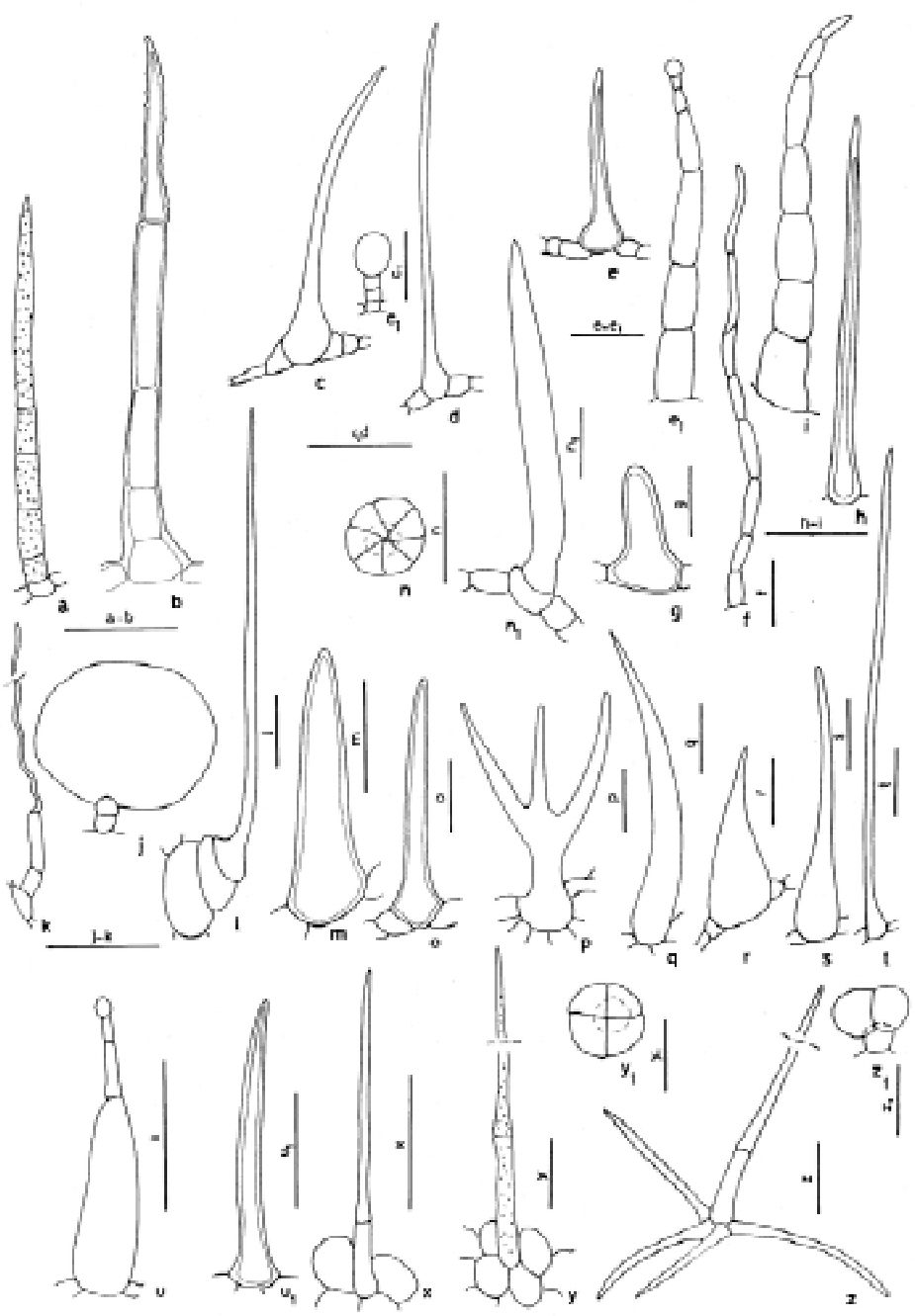

Fig. 3. Hairs of Asclepiadaceae, Boraginaceae, Brassicaceae, Cactaceae, Caprifoliaceae, Caryophyllaceae, Chenopodiaceae, Convolvulaceae, Geraniaceae, and Lamiaceae. **a**, conical: *Morrenia odorata*; **b**, conical: *Oxypetalum solanoides*; **c**, falcate, $\mathbf{c}_1$, glandular capitate: *Anchusa officinalis*; **d**, conical: *Echium plantagineum*; **e**, conical, $\mathbf{e}_1$, glandular capitate: *Heliotropium amplexicaule*; **f**, moniliform: *Parodia ottonis*; **g**, short bristle: *Sambucus australis*; **h**, bristle: *Agrostemma githago*; **i,** moniliform: *Saponaria officinalis*; **j,** vesicular: *Chenopodium album*; **k**, whip: *Ch. murale*; **l,** conical: *Bassia scoparia*; **m,** conical: *Salsola kali*; **n**, glandular capitate, $\mathbf{n}_1$, conical: *Convolvulus arvensis*; **o**, conical: *Brassica nigra*; **p**, 3-armed: *Capsella bursa-pastoris*; **q**, falcate: *Cardaria draba*; **r**, barrel-shaped: *Raphanus sativus*; **s**, falcate: *Rapistrum rugosum*; **t**, long-conical: *Sisymbrium altissimum*; **u**, glandular capitate bottle-shaped: $\mathbf{u}_1$, bristle: *Erodium malacoides*; **x**, conical: *Geranium molle*; **y**, conical, $\mathbf{y}_1$, glandular capitate: *Lamium amplexicaule*; **z**, porrect stellate, $\mathbf{z}_1$, glandular capitate: *Marrubium vulgare*. Scale bars: a, b, c_1, g, j-o, q, z = 50 µm; c, d = 300 µm; e, e_1, h, i, p, r, s, x, y = 100 µm; f, t = 200 µm; y_1, z_1 = 25 µm.

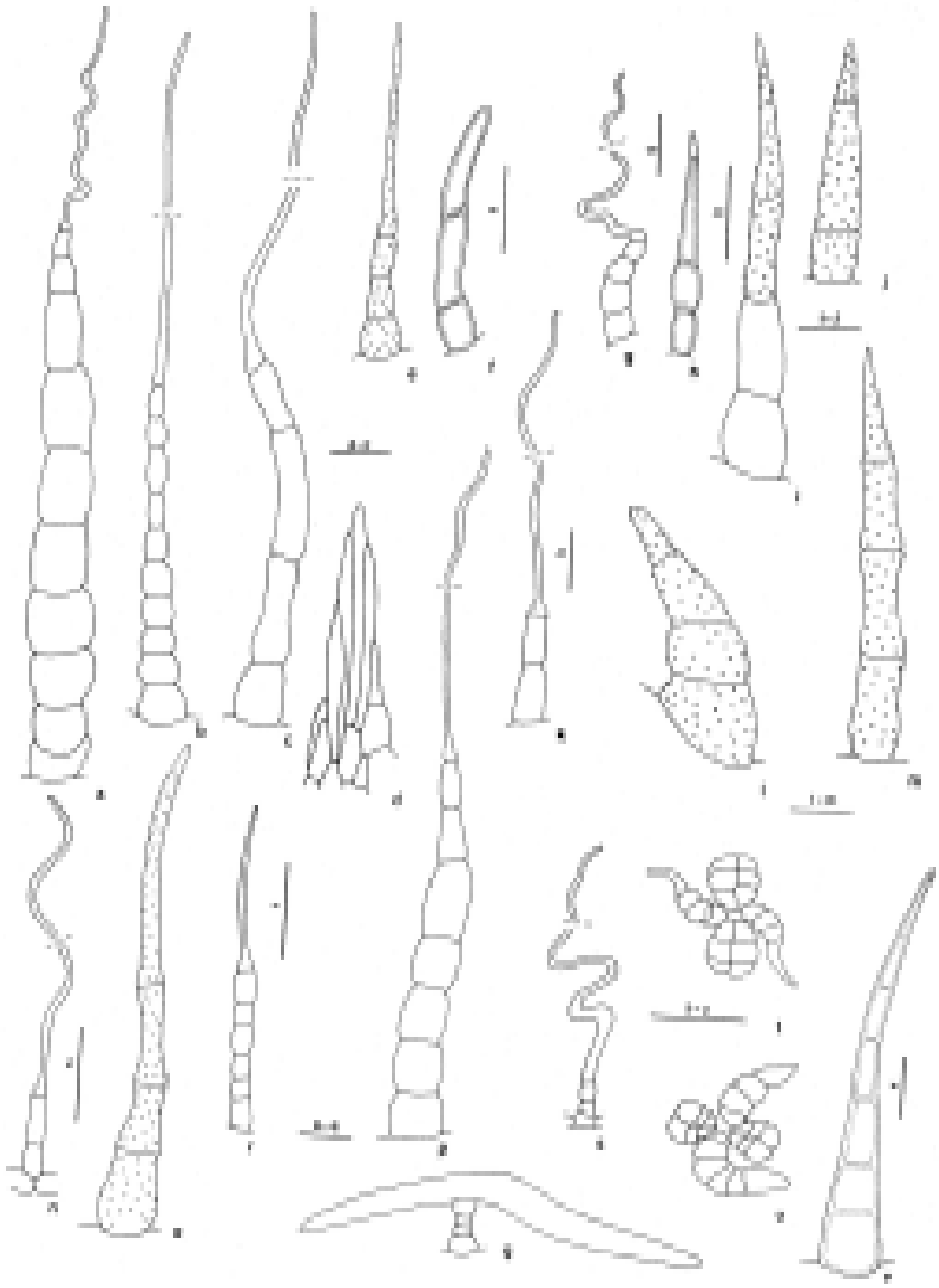

Fig. 4. Hairs of Asteraceae. **a**, whip: *Centaurea calcitrapa*; **b,** whip: *Carduus acanthoides*; **c**, whip and **d**, shaggy: *Cirsium vulgare*; **e**, conical: *Conyza bonariensis*; **f**, conical: *Gaillardia megapotamica*; **g**, whip: *Senecio grisebachii*; **h**, conical: *Solidago chilensis*; **i**, conical: *Verbesina encelioides*; **j**, conical: *Wedelia glauca*; **k**, whip: *Onopordon acanthium*; **l**, conical: *Xanthium cavanillesii*; **m**, conical: *Xanthium spinosum*; **n**, whip: *Achyrocline satureioides*; **o**, conical: *Ambrosia tenuifolia*; **p**, whip: *Arctium minus*; **q**, T-shaped: *Anthemis cotula*; **r**, whip: *Aster squamatus*; **s**, whip: *Baccharis artemisoides*; **t,** pilose nest: *B. rufescens*; **u**, pilose nest: *B. notosergila*; **v**, conical: *Bidens pilosa*. Scale bars: a-e, g-u = 50 μm; v, f = 100 μm.

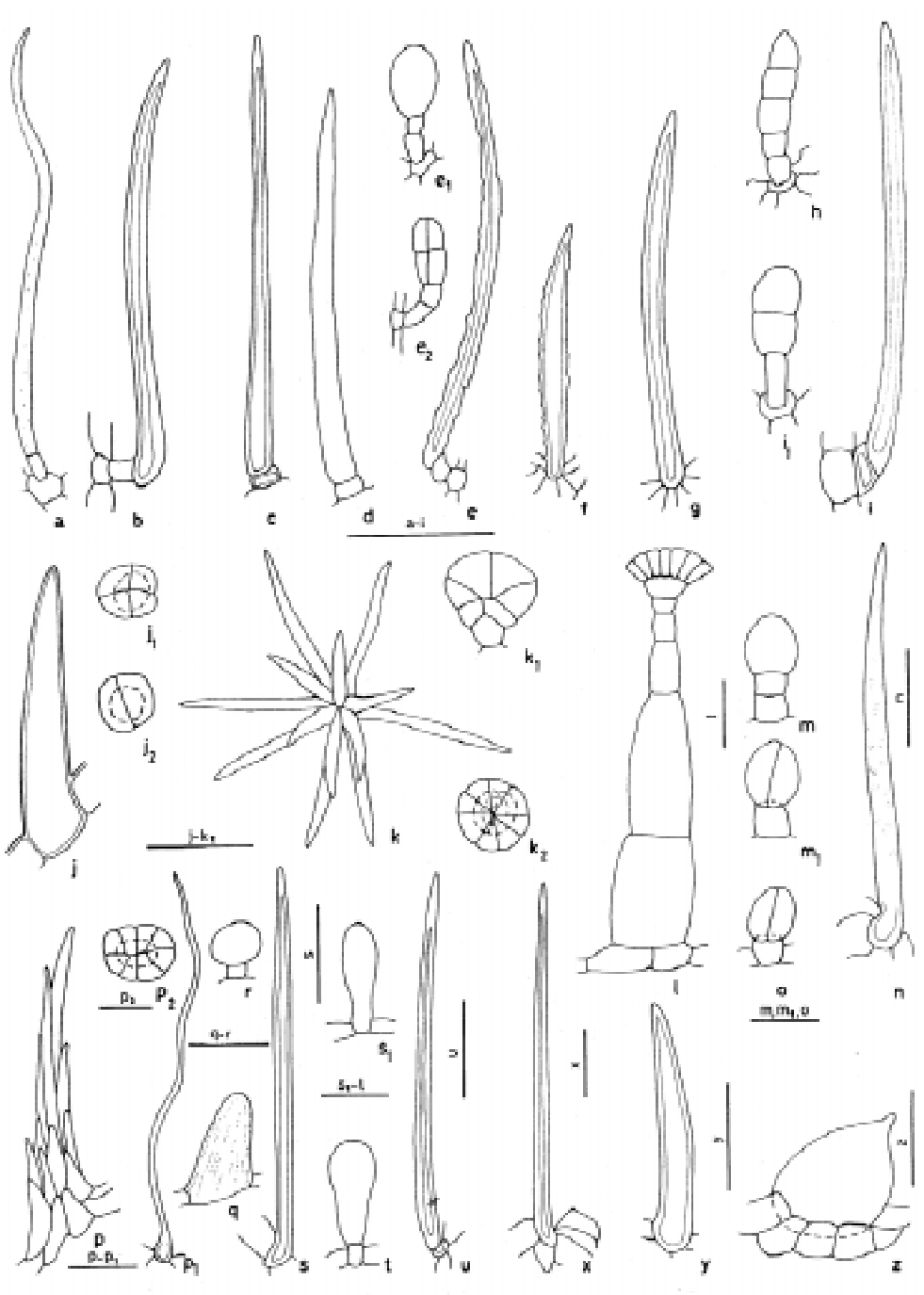

Fig. 5. Hairs of Fabaceae, Malvaceae, Martyniaceae, Nyctaginaceae, Oxalidaceae, Plantaginaceae, Polygonaceae, Primulaceae, Ranunculaceae, Rhamnaceae, and Rubiaceae. **a**, conical: *Adesmia bicolor*; **b**, bristle: *Galega officinalis*; **c**, bristle: *Lotus corniculatus*; **d**, conical: *Lupinus gibertianus*; **e**, bristle, $\mathbf{e}_1$, glandular capitate: *Melilotus indicus*; $\mathbf{e}_2$, glandular capitate: *M. albus*; **f**, bristle: *Parkinsonia aculeata*; **g**, bristle: *Senna corymbosa*; **h**, glandular uniseriate: *Trifolium repens*; **i,** bristle, $\mathbf{i}_1$, glandular capitate: *Vicia graminea*; **j**, conical, $\mathbf{j}_1$-$\mathbf{j}_2$, glandular capitate: *Malva sylvestris*; **k**, stellate multiangulate, $\mathbf{k}_1$-$\mathbf{k}_2$, glandular capitate: *Sida rhombifolia*; **l**, glandular capitate with head cells radiate, *Ibicella lutea*; **m**, glandular capitate: *Boerhavia diffusa* var. *leiocarpa*; $\mathbf{m}_1$, glandular capitate: *Mirabilis jalapa*; **n**, bristle: *Oxalis corniculata;* **o**, glandular capitate: *Plantago australis*; **p**, shaggy, $\mathbf{p}_1$, conical-flagellate, $\mathbf{p}_2$, glandular capitate: *Polygonum lapathifolium*; **q**, short conical: *P. convolvulus*; **r**, glandular capitate: *Anagallis arvensis*; **s**, bristle, $\mathbf{s}_1$, glandular clavate: *Anemone decapetala*; t, glandular clavate: *Clematis bonariensis*; u, bristle: *C. montevidensis*; x, bristle: *Ranunculus repens*; y, bristle: *Discaria americana*; z, barrel shaped: *Borreria verticillata*. Scale bars: a-i, n, p, p_1, q, r, s, u, x, z = 100 µm; j, m_1, o, s_1, t, y = 50 µm; p_2 = 25 µm.

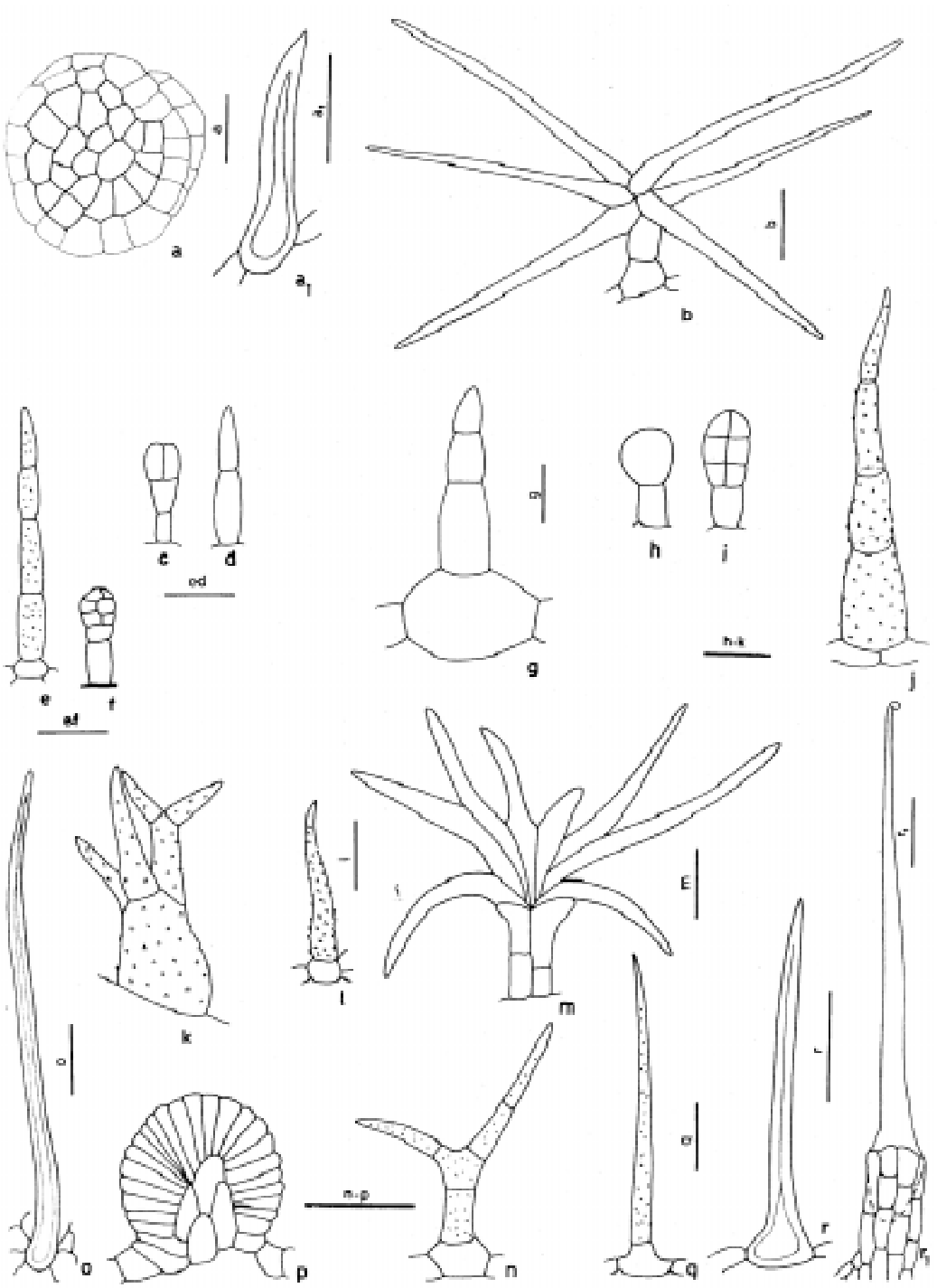

Fig. 6. Hairs of Sapindaceae, Scrophulariaceae, Solanaceae, Turneraceae, and Urticaceae. a, peltate scale, $\mathbf{a}_1$, bristle: *Dodonaea viscosa*; **b**, stellate stalked: *Verbascum thapsus*; **c**, glandular capitate: **d**, conical: *Cestrum parqui*; **e**, conical, **f**, glandular capitate: *Datura ferox*; **g**, conical: *Nicotiana longiflora*; **h, i**, glandular capitate, **j,** conical: *Salpichroa origanifolia*; **k**, dendritic: *Physalis viscosa*; **l**, conical: *Solanum chacoense*; **m**, stellate stalked: *S. elaeagnifolium*; **n**, Y-shaped: *S. diflorum*; **o**, bristle, **p**, glandular shaggy: *Turnera sidoides* subsp. *pinnatifida*; **q**, conical: *Parietaria officinalis*; **r**, bristle, $\mathbf{r}_1$, stinging: *Urtica urens*. Scale bars: a, a_1, b, m, n, p, r = 50 μm; c, d, h-k = 200 μm; e, f, l, o, q, r_1 = 100 μm; g = 300 μm.

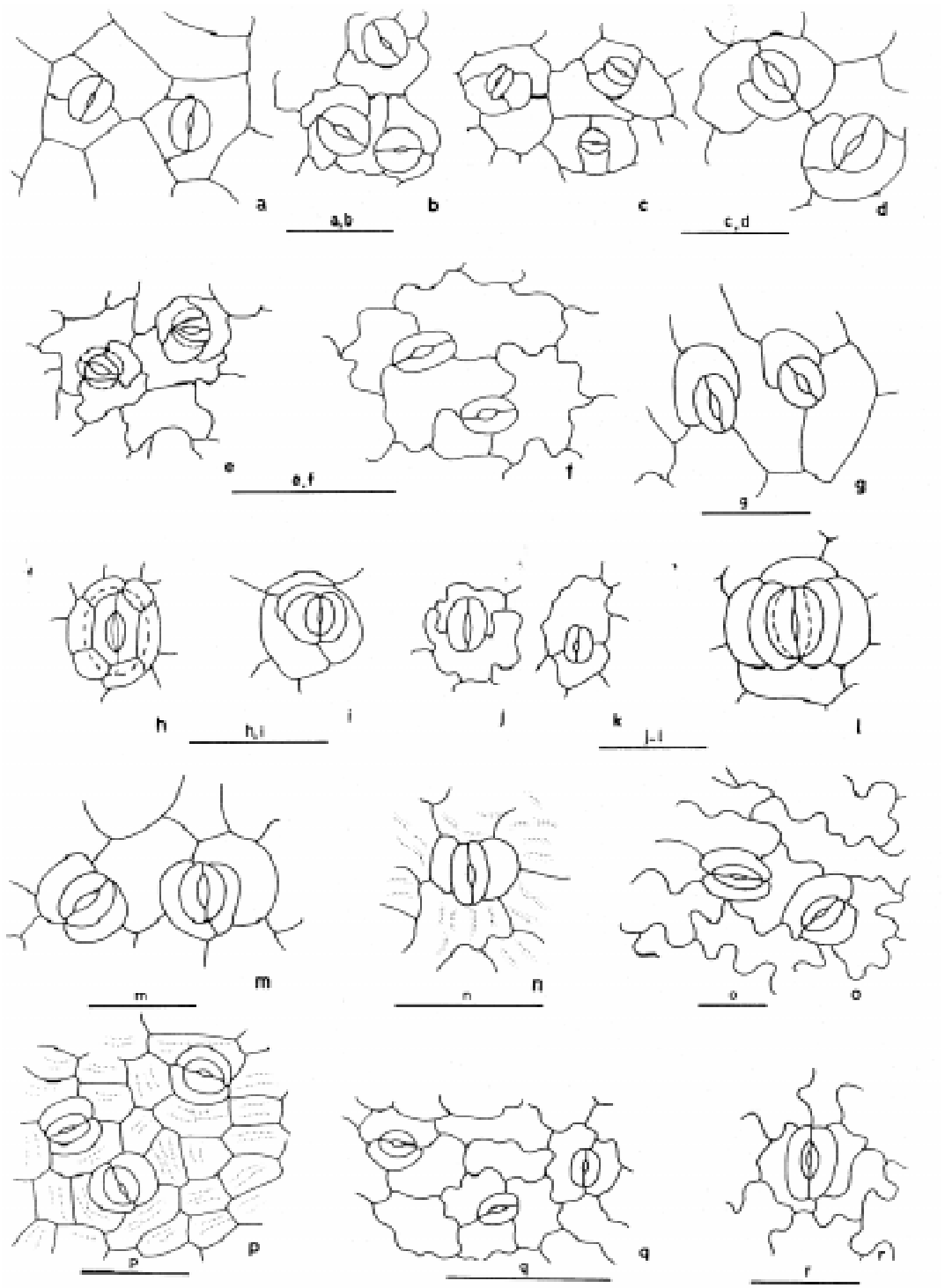

Fig. 7. Stomatal types. **a-f**, anysocytic: **a**, *Polygonum aviculare*; **b**, *Raphanus sativus*; **c**, *Sida rhombifolia*; **d**, *Turnera sidoides* subsp. *pinnatifida*; **e**, *Adesmia bicolor*; **f**, *Nicotiana glauca*; **g**, polycitic: *Plantago australis*; **h**, cyclocytic: *Baccharis notosergila*; **i**, parallelocytic: *Portulaca oleracea*; **j, k**, diacytic: **j**, *Lamium amplexicaule*; **k**, *Ammi majus*; **l**, hexacytic: *Opuntia arechavaletae*; **m-r**, paracytic: **m**, *Convolvulus arvensis*; **n**, *Oxypetalum solanoides*; **o**, *Galium richardianum*; **p**, *Ricinus communis*; **q**, *Senna corymbosa*; r, *Vinca major*. Scale bars: a-d, g, j-p, r = 50 µm; e, f, h, i, q = 100 µm.

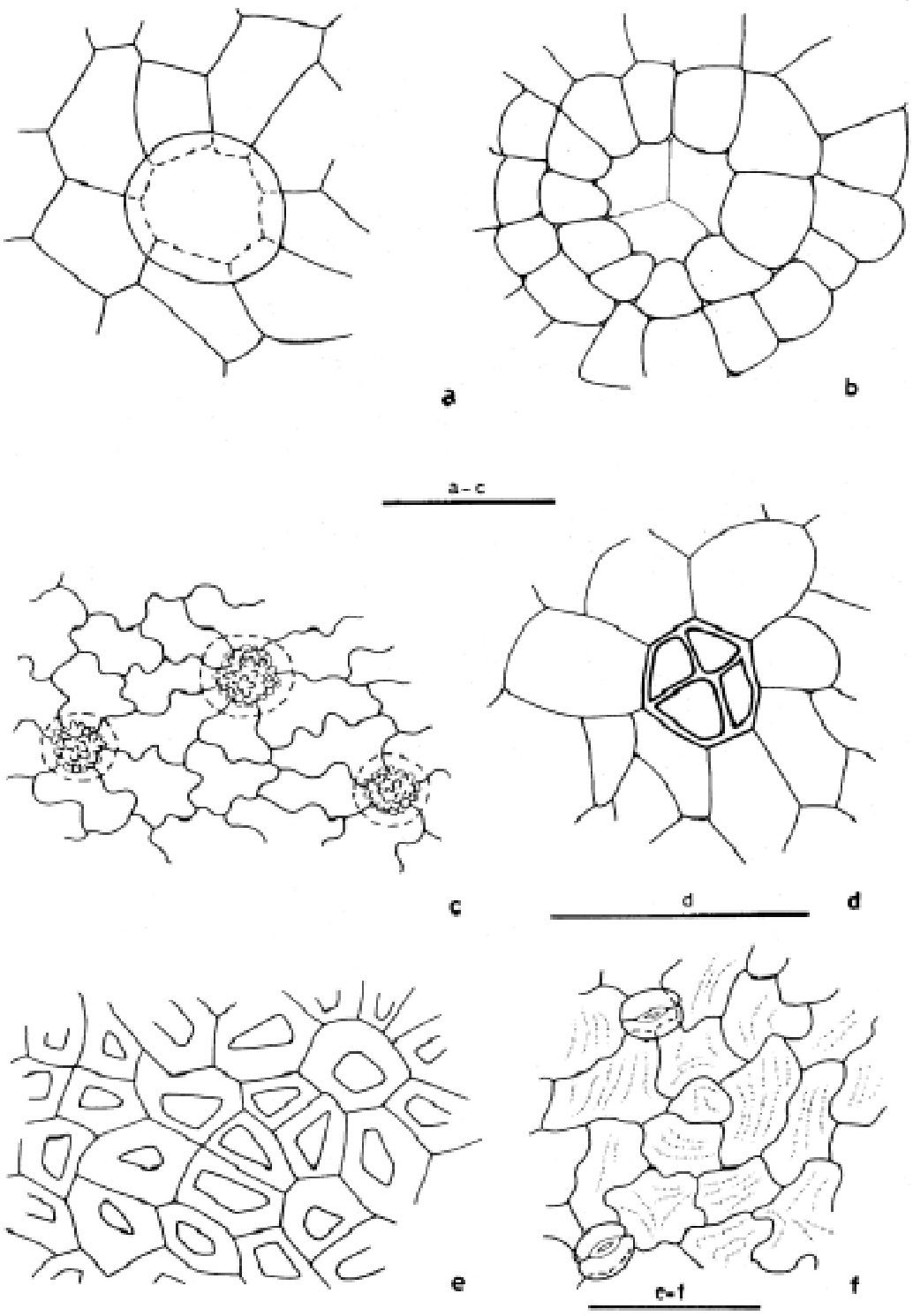

Fig. 8. Epidermal special characters. **a**, vesicular cells: *Polygonum persicaria*; **b**, hydropoten: *Nymphoides indica*; **c**, cystholits: *Urtica urens*; **d**, "Licópoli glands": *Limonium brasiliense*; **e**, thick anticlinal walls: *Wigginsia tephracantha*; **f**, cuticular ornamentation, striate: *Ranunculus cymbalaria*. Scale bars: 100 µm.

hairs), and they are ususally 2-seriate, occasionally depressed below the leaf surface (i.e. *Hymenoxys anthemoides*). In many species of *Baccharis* glandular and non glandular hairs appear forming tufts or pilose nest (Ariza Espinar, 1973; Pertusi, 1987; Helwig, 1992). Four species of the six studied have pilose nest, the remaining two, have isolated non-glandular hairs. Stomata are predominantly anomocytic, however, three species of *Baccharis* show ciclocytic stomata. This stomata type was not mentioned neither by Metcalfe & Chalk (1950, 1979), for Asteraceae nor by Ariza Espinar (1973) for *Baccharis*. However, ciclocytic stomata were reported for other genera of Asteraceae (Freire, 1986; Crisci & Freire, 1986; Anderberg & Freire, 1991; Freire, 1993) and for *Baccharis* (Pertusi, 1987).

Boraginaceae (3 spp. analyzed): All the species showed anomocytic stomata and two types of hairs: (1) simple, unicellular, conical or falcate; (2) capitate with unicellular head. Those features correspond well with Metcalfe & Chalk (1950, 1979) who named the former type (i.e., unicellular conical or falcate), as boraginaceous. Patel & Inmandar (1971) studied 10 species of Boraginaceae and found that eight of them presented three types of stomata: anomocytic (ranunculaceous type of Vesque, 1889), paracytic (rubiaceous type of Vesque, 1889), and anisocytic (cruciferous type of Vesque, 1889), although anomocytic was present in all genera. According to these authors, *Heliotropium* presented also diacytic type (caryophyllaceous type of Vesque, 1889). We found, in accordance with Selvi & Bigazzi (2001), anomocytic stomata type, and from seven hair types mentioned by them we found only hair types 1 and 3 in *Anchusa, Echium,* and *Heliotropium*. These results corroborated the epidermal traits mentioned by Barboza *et al*. (2001) and Monti *et al*. (2003).

Brassicaceae (10 spp. examined): They presented two stomata types: anomocytic and anisocytic. Ancibor (1984) and Barboza *et al*. (2001) cited both types of stomata. Anisocytic type was considered a diagnostic character for this family by Metcalfe & Chalk (1979), and it has been found by Arroyo (1984, 1986) and Diorio (1986) in different species of this family. Different types of hairs were observed: (1) conical, (2) falcate, (3) stellate sessile, (4) 3-armed, and (5) barrel shaped. All these hair types were considered frequent within the family by Metcalfe & Chalk (1950). Although conical hairs are similar to those observed in Solanaceae, the family Brassicaceae presented ornamented 1-celled hairs only as an exception, i.e. *Brassica rapa* and *Sisymbrium irio*.

Cactaceae (3 spp. studied): This family is distinguished by hexacytic and parallelocytic stomata, and moniliform hairs. *Opuntia* presented hexacytic stomata and glabrous surfaces whereas *Parodia* and *Wigginsia* exhibited parallelocytic stomata and moniliform hairs. These results and the presence of thick anticlinal epidermal cell walls in *Wigginsia* are wholy in agreement with characters reported by Di Fulvio (1976) and Metcalfe & Chalk (1979).

Caprifoliaceae: The only studied species, *Sambucus australis,* showed anomocytic stomata and non-glandular hairs. Both features correspond to data reported by Metcalfe & Chalk (1979) and also with those cited for *Sambucus nigra* by Ponessa & Parrado (2001).

Caryophyllaceae (4 spp. studied): We found two stomata types: diacytic and anomocytic. Metcalfe & Chalk (1950, 1979) mentioned anisocytic ones but we did not observe this third type. We saw that three of the four species have non-glandular hairs, the third (*Spergula arvensis)* also has glandular capitate hairs with an unique cell in the apex in according to the results of Metcalfe & Chalk (1979). Furthermore, we observed bristles hairs in *Agrostemma githago* a character that was not mentioned for Caryophyllaceae by Metcalfe & Chalk (1979).

Chenopodiaceae (6 spp. analyzed): Five species showed anomocytic stomata whereas one (*Salsola*) presented paracytic ones. These results are consistent with those exposed by Metcalfe & Chalk (1950, 1979). Barboza *et al*. (2001) found in *Chenopodium* species anomocytic, anisocytic, and tetracytic stomata types, however they also mentioned as the most frequent the anomocytic type. According to our observations there are different types of hairs: 1) conical, 2) whip and, 3) vesicular. A great variability of hairs was also found by Barboza *et al.* (2001). We considered, as Metcalfe & Chalk (1950) did, that *Chenopodium* and *Salsola* have uniseriate thin-walled hairs and we can add *Bassia* to the list. In the toxic species of *Chenopodium* we noticed vesicular hairs with stalks with one or more cells. They were named "salt glands" by Ancibor (1992) and D'Ambrogio *et al.* (2000). There are three ruderal species of the genus *Chenopodium* known as "paicos" which are considered toxic for human consumption (Simon, 1987) but not for cattle, so we

did not include them in our study.

Convolvulaceae: The only species analyzed of this family presented paracytic stomata and conical 1-celled hairs and glandular capitate hairs with a variable number of cells. All characters are completely in coincidence with Metcalfe & Chalk (1950, 1979). The stomata type also agree with epidermal traits reported by Yagueddú & Cid (1992) for other species of this family.

Euphorbiaceae (4 spp. analyzed): We found anomocytic stomata in *Euphorbia lathyrus* and *E. peplus*, and paracytic in *Manihot grahamii* and *Ricinus communis*, both stomata types were mentioned by Metcalfe & Chalk (1950) for this family, but they reported anomocytic type as the usual type. Our results agree with Metcalfe & Chalk (1979), however, we did not find anisocytic type mentioned by them. In spite of the fact that all the species studied may be considered glabrous, *Ricinus communis* presented a few short-conical 1-celled hairs sometimes appearing as papillae. Within the group of species studied we did not find glandular hairs which were mentioned by Metcalfe & Chalk (1950, 1979) for Euphorbiaceae. All our results coincide with those reported by Barboza *et al*. (2001) for *Euphorbia serpens*.

Fabaceae (13 spp. examined): This family was characterized by having bristles hairs, glandular hairs, and anisocytic and anomocytic stomata. The genus *Senna* was an exception, having paracytic stomata. Both epidermal traits are in agreement with Metcalfe & Chalk (1950, 1979) and numerous authors like Ragonese (1969), Lackey (1978), Soladoye (1982), Yagueddú & Cid (1992), Ponesa *et al*. (1998), Barboza *et al.* (2001), Stenglein *et al*. (2003, 2004).

Menyanthaceae: Only *Nymphoides indica* was examined. It was characterized by anomocytic stomata on the adaxial surface and the presence of hydropoten on the abaxial epidermis. Both diagnostic features accord with Metcalfe & Chalk (1979) where the authors described extensively the characteristics of the hydropoten (water drinks) structure. Hydropoten on abaxial epidermis was previously mentioned for this species by Gattuso & Gattuso (1989).

Oxalidaceae: *Oxalis corniculata* var. *corniculata* was the only species studied. It was characterized by having anomocytic stomata and two hairs types: (1) bristles and (2) glandular capitate with 1-celled head. Our results are in agreement with Metcalfe & Chalk (1950). Furthermore, anomocytic stomata type is additioned to the paracytic type reported by Metcalfe & Chalk (1979) for this family.

Passifloraceae: Only *Passiflora caerulea* was studied, which presented anomocytic stomata type as was mentioned by Metcalfe & Chalk (1950). The same authors (1979) included the paracytic type and reported the presence of hairs as characteristic of the family. Barboza *et al.* (2001) studied this species reporting in addition two types of stomata that we have not seen: anisocytic and paracytic. In according to that paper we did not find hairs.

Phytolaccaceae (3 spp. studied): They were characterized by the presence of anomocytic stomata type and infrequent simple, uniseriate conical hairs. These epidermal features coincide with Metcalfe & Chalk (1950, 1979) and Gattuso (1996). According to Gattuso (1996) anisocytic and paracytic stomata are rare in Phytolaccaceae.

Plantaginaceae: Only *Plantago australis* var. *australis* was examined. It was characterized by having predominantly polocytic stomata, i.e. stomata attached to the distal side of the single subsidiary cell, only a few ones are anomocytic. Polocytic stomata was previously reported by Van Cotthem (1970) in ferns. Metcalfe & Chalk (1979), Yagueddú & Cid (1992), and Barboza *et al*. (2001), reported anomocytic stomata in other species of *Plantago*. However, the illustrations of *P. lanceolata* by Barboza *et al.* (2001) and by Yageddú & Cid (1992) reveal that although the stomata are predominantly anomocytic, a few ones can be considered as polocytic. Although Metcalfe & Chalk (1979) and Barboza *et al*. (2001) found different types of hairs within *Plantago,* we are able only to report the presence of glandular capitate hairs with 2-celled head.

Poaceae (16 spp. examined): Three characters were mainly employed to distinguish these species: shape of silica-bodies, shape of stomata subsidiary cells, and micro-hairs. They are discussed below arranged by types of epidermis defined by Prat (1936), Parodi (1958), and Tateoka *et al.* (1959).

Festucoid type: eigth of the 16 species showed this type. No-one had micro-hairs. Four species (*Briza minor, Elymus breviaristatus*, *Holcus*

lanatus, and *Hordeum murinum*) presented stomata with parallel-sided subsidiary cells, one (*Cortaderia selloana*) stomata with low domed-shaped subsidiary cells and three species of *Lolium* showed both types of subsidiary cells. In this group, the shape of silica-bodies varied within this range of shapes: quadrangular, rectangular, rounded, or elongated. All these features are tightly in agreement with Metcalfe´s results (1960).

Chloridoid type: five species presented this type: *Cynodon dactylon*, *C. hirsutus*, *Eleusine indica*, *Eragrostis cilianensis,* and *Leptochloa chloridiformis*. They showed saddle-shaped silica-bodies and micro-hairs with hemispherical apical cell. *Eleusine indica* is an exception because of its characteristic pear-like microhairs, which were studied by several authors like Metcalfe (1960), Prat & Vignal (1968), and Sánchez (1974). Metcalfe considered that this micro-hairs can also be regarded as sunken papillae or very small macro-hairs. *Eleusine indica* presented stomata with triangular subsidiary cells whereas the rest of species showed both triangular or low domed-shaped ones. Other characters, such as macrohairs, prickles and papillae, found here in genus *Cynodon,* were also reported by other authors (Prat & Vignal, 1968; Caro & Sánchez , 1969; Sánchez, 1971).

Panicoid type: three species showed this kind of epidermis: *Digitaria sanguinalis*, *Echinochloa crusgalli,* and *Sorghum halepense*. They were characterized by rodlike micro-hairs. *Digitaria* presented dumb-bell silica-bodies while *Echinochloa* nodular ones, and *Sorghum* dumb-bell, nodular and cross shaped silica-bodies. Except for the macro-hairs that we observed in *Echinochloa crusgalli,* as Gould & Shaw (1992) did, the rest of features studied are completely in agreement with Metcalfe´s results (1960).

Polygonaceae (7 toxic spp. analyzed): We found anomocytic stomata as the commonest type, but there are also paracytic and anisocytic stomata. Metcalfe & Chalk (1950, 1979) considered that paracytic stomata are not as frequent as anomocytic but they do not mentioned anisocytic. We observed papillae and different types of hairs: (1) simple, (2) conical-flagellate, (3) shaggy, (4) capitate, (5) hydropoten, and (6) vesicular cells. Metcalfe & Chalk (1950) mentioned papillae, simple and uniseriate hairs and shaggy hairs (the last ones in 1979). According to them, glandular hairs are sessile. However, we found glandular hairs with two neck cells. Metcalfe & Chalk (1950) included within the group of glandular hairs a special type described as superficial mucilage glands, usually present in young leaves. Then, these authors (1979) gave a detailed explanation of this special "hairs" named hydropoten and mentioned Polygonaceae as one of the dicotyledoneous families in which they found them. Mitchell (1971) described the derived structure of these hairs as "valvate chambers". Some species also presented vesicular cells, and these were mentioned by Gattuso (2000).

Rhamnaceae: Only *Discaria americana* was studied, which presented anomocytic stomata and bristles. These characters are in agreement with Metcalfe & Chalk (1950, 1979) and Medan (1986).

Rutaceae: *Fagara hyemalis*, the only species analyzed, showed anomocytic stomata and stellate hairs. Metcalfe & Chalk (1950) considered that this family shows different stomata types whilst in 1979 they cited paracytic but not anomocytic stomata. Barboza *et al*. (2001) also found anomocytic stomata type in this family. Metcalfe & Chalk (1950, 1979) also reported the presence of the stellate hairs.

Solanaceae (14 spp. surveyed): They had mainly two types of stomata: anisocytic and anomocytic. We also occasionally found paracytic stomata. This feature was also mentioned by Bruno *et al.* (1999), Cosa *et al*. (2000), Barboza *et al*. (2001), and Stenglein (2001). *Solanum glaucophyllum* presented glabrous epidermis (Mansilla *et al*., 1999; Stenglein, 2001), while the rest of species showed different types of hairs, ie. (1) simple, conical 1-2-many celled in almost all the genera, (2) Y-shaped (in *Physalis* and rarely in *Salpichroa* and *Solanum*), (3) dendritic (in *Physalis* and rarely in *Solanum*), and (4) glandular capitate (head 2-many celled) in almost all genera. Our results agree with hair types found in *Datura* by Carpano *et al*. (1990) and Licovsky *et al*. (2002). Our results accord to Metcalfe & Chalk (1950, 1979) and Colares *et al*. (1999) who found the same hair types for *Nicotiana, Physalis* and *Salpichroa*. Our results also agree with Cabrera (1979) who found the same features in *Physalis,* and Cabrera (1979) and Stenglein (2001) in different species of *Solanum*.

On the basis of the stomatal types and size, anticlinal epidermal cell wall patterns, hair types and wax ornamentation, the 180 species belonging to 41 families here surveyed can be differenciated by using the following key:

Key to the toxic species of plants of Salado River Basin

1. Epidermal cells generally elongated.
   1. **MONOCOTYLEDONS**

1'. Epidermal cells generally isodiametric.
   2. **DICOTYLEDONS**

2. Leaves glabrous or papillose.
   Group A

2'. Leaves pilose.

3. Stomata paracytic.
   Group B

3'. Stomata not paracytic.

4. Leaves with glandular hairs exclusively.
   Group C

4'. Leaves with glandular and non-glandular hairs.

5. Glandular and non-glandular hairs in tufts (pilose nest) or hairs isolated, conical or whip.
   Group D

5'. Hairs isolated. Conical or whip hairs absent.

6. Bristles hairs present.
   Group E

6'. Bristles hairs absent.
   Group F

1. MONOCOTYLEDONS

1. Stomata anomocytic or tetracytic.

2. Stomata tetracytic.
   1. **Triglochin palustris**

2'. Stomata anomocytic.
   2. **Habranthus tubispatus**
   3. **Rhodophiala bifida**

1'. Stomata paracytic.

3. Both macro- and micro-hairs present or at least one of them.

4. Macro- and micro-hairs present.

5. Micro-hairs with hemispherical distal cell.

6. Micro-hairs 14-20 µm long. Short cells solitary on intercostal zones.
   4. **Cynodon dactylon**
   5. **C. hirsutus**

6'. Micro-hairs 25-50 µm long. Short cells solitary or paired on intercostal zones.
   6. **Eragrostis cilianensis**

5'. Micro-hairs with distal cell rod-like shaped.

7. Subsidiary cells domed. Papillae absent.

7. **Digitaria sanguinalis**

7'. Subsidiary cells triangular to dome. Papillae present.

8. **Echinochloa crusgalli**

4'. Micro-hairs or macro-hairs exclusively.

8. Micro-hairs exclusively.

9. Micro-hairs rod-like shaped.

9. **Sorghum halepense**

9'. Micro-hairs pear-like shaped or with hemispherical distal cell.

10. Short cells paired or in rows on costal zones. Papillae present. Subsidiary cells triangular to domed. Micro-hairs with hemispherical distal cell.

10. **Leptochloa chloridiformis**

10'. Short cells mostly solitary on costal zones. Papillae absent. Subsidiary cells triangular. Micro-hairs with distal cell pear-like shaped

11. **Eleusine indica**

8'. Macro-hairs exclusively.

11. Subsidiary cells parallel-sided.

12. Prickles absent.

12. **Holcus lanatus**

12'. Prickles present.

13. **Hordeum murinum** subsp. **murinum**

11'. Subsidiary cells domed.

14. **Cortaderia selloana**

3'. Macro-hairs and micro-hairs absent.

13. Prickles and hooks present.

14. With short cells on intercostal zones.

15. **Elymus breviaristatus**

14'. Without short cells on intercostal zones.

16. **Lolium temulentum**

13'. Prickles and hooks absent or prickles exclusively.

15. Prickles present.

16. Subsidiary cells parallel-sided.

17. **Briza minor**

16'. Subsidiary cells parallel-sided to dome.

18. **Lolium multiflorum**

15'. Prickles absent.

17. Subsidiary cells domed.

19. **Cyperus rotundus**

17'. Subsidiary cells parallel-sided to domed.

20. **Lolium perenne**

2. DICOTYLEDONS
Group A: Leaves glabrous or papillose.

1. Stomata hexacytic.

1. **Opuntia arechavaletae**

1'. Stomata not hexacytic.

2. Stomata anomocytic.

3. Papillae on the veins present.

2. **Ammi visnaga**

3'. Papillae on the veins absent.

4. Licópoli glands present.

3. **Limonium brasiliense**

4'. Licópoli glands absent.

5. Hidropoten present.

4. **Nymphoides indica**

5'. Hidropoten absent.

6. Margin dentate.

7. Adaxial surface with cell type 3.

5. **Polycarpon tetraphyllum**

7'. Adaxial surface with cell type 1.

8. Both surfaces with cell type 1. Stomata more than 35 µm long.

6. **Senecio bonariensis**

8'. Abaxial surface with cell type 3. Stomata shorter than 35 µm long.

7. **Senecio madagascariensis**

6'. Margins not dentate.

9. Adaxial and abaxial surfaces with identical cell type.

10. Cell type 3/3.

11. Cuticular ornamentation present.

8. **Conium maculatum**

11'. Cuticular ornamentation absent.

12. Stomata shorter than 30 µm long.

9. **Euphorbia peplus**

12'. Stomata equal or longer than 30 µm long.

10. **Cichorium intybus**

10'. Cell type 1/1 or 2/2.

13. Cell type 2/2

11. **Taraxacum officinale**

13'. Cell type 1/1

14. Stomata shorter than 30 µm long.

12. **Sonchus oleraceus**

14'. Stomata longer than 30 µm long.

13. **Phytolacca dioica**

14. **P. tetramera**

9'. Adaxial and abaxial surfaces with different cell types.

15. Abaxial surface with only one cell type, 2 or 3.

16. Abaxial cell type 2.

17. Cuticular ornamentation present. Stomata 27-36 x 27-30 µm

15. **Ranunculus cymbalaria**

17'. Cuticular ornamentation absent. Stomata 20-30 x 20-25 µm

16. **Passiflora caerulea**

16'. Abaxial cell type 3.

18. Stomata 25-30 µm long.

17. **Fumaria capreolata**

18'. Stomata 30-45 µm long.

18. **Ranunculus apiifolius**

15'. Abaxial surface with cell type 1-2.

19. Adaxial cell type 1. Stomata 22-30 x 14-24 µm.

19. **Euphorbia lathyrus**

19'. Adaxial cell type 1-2. Stomata 25-35 x 20-30 µm.

20 **Fumaria officinalis**

21. **Fumaria parviflora**

22. **Holmbergia tweedii**

2'. Stomata not anomocytic.

22. Stomata paracytic, parallelocytic or diacytic (sometimes combined with stomata anomocytic).

23. Stomata paracytic or parallelocytic.

24. Stomata parallel to veins.

23. **Eryngium paniculatum**

24'. Stomata non-parallel to veins.

25. Stomata parallelocytic. Epidermal cells papillose.

24. **Portulaca oleracea**

25'. Stomata paracytic. Epidermal cells not papillose.

26. Stomata 35-45 x 20-30 µm. Bristles.

25. **Galium richardianum**

26'. Stomata 24-30 x 12-16 µm.

26. **Manihot grahamii**

23'. Stomata diacytic (sometimes combined with stomata anomocytic).

27. Papillae on veins present.

27. **Ammi majus**

27'. Papillae on veins absent.

28. Stomata diacytic exclusively.

28. **Cyclospermum lept ophyllum**

28'. Stomata diacytic and anomocytic.

29. **Foeniculum vulgare**

22'. Stomata anisocytic (sometimes combined with stomata anomocytic).

29. Stomata anisocytic exclusively.

30. **Polygonum aviculare**

29'. Stomata anisocytic and anomocytic.

30. Papillae present.

31. Papillae on the veins.

31. **Rumex pulcher**

31'. Papillae on all the surface.

32. **R. obtusifolius**

30'. Papillae absent.

32. Stomata longer than 40 µm.

33. **R. crispus**

32'. Stomata shorter than 40 µm.

33. Stomata shorter than 30 µm. Abaxial cell type 2-3.

34. **Nicotiana glauca**

33'. Stomata 30-35 µm long. Abaxial cell type 1.

35. **Solanum glaucophyllum**

Group B: Leaves pilose with stomata paracytic

1. Conical hairs.

2. Hairs ornamented.

3. Apical cell ornamented.

36. **Oxypetalum solanoides**

3'. All cells ornamented.

4. Abaxial surface with cell type 2.

37. **Asclepias curassavica**

4'. Both surfaces with cell type 1.

5. Cuticular ornamentation present.

38. **A. mellodora**

5'. Cuticular ornamentation absent

39. **Morrenia brachystephana**

40. **M. odorata**

2'. Hairs not ornamented.

6. Short conical hairs present.

41. **Ricinus communis**

6'. Short conical hairs absent.

7. Capitate glandular hairs present.

42. **Convolvulus arvensis**

7'. Capitate glandular hairs absent.

8. Stomata 20-25 µm long.

43 **Salsola kali**

8'. Stomata ca. 35 µm long.

44. **Vinca major**

1'. Other type of hairs.

9. Barrel shaped hairs.

45. **Borreria verticillata**

9'. Bristle hairs.

46. **Senna corymbosa**

Group C: Leaves with glandular hairs exclusively.

1. Glandular hairs not capitate.

2. Glandular hairs 1-seriate.

47. **Trifolium repens** f. **repens**

2'. Glandular hairs 2-seriate.

3. Glandular hairs sunken.

48. **Hymenoxys anthemoides**

3'. Glandular hairs not sunken.

49. **H. cabrerae**

1'. Glandular hairs capitate.

4. Head 1-celled.

5. Vesicular trichome (head prominent).

50. **Chenopodium album**
51. **C. hircinum**

5'. Head slightly developed.

52. **Boerhavia diffusa** var. **leicarpa**

4'. Head 1-2-many celled.

6. Glandular trichome with head many-radiate-celled.

53. **Ibicella lutea**

6'. Glandular trichome with head 1-2-celled.

7. Stomata anomocytic exclusively.

54. **Anagallis arvensis**

7'. Stomata anomocytic and anisocytic or polocytic

8. Stomata predominantly polocytic.

55. **Plantago australis**

8'. Stomata anomocytic and anisocytic.

56. **Mirabilis jalapa**

Group D: Leaves with pilose nest or with isolated hairs conical or whip.

1. Non glandular hairs associated with glandular hairs, forming pilose nest.

2. Ciclocytic stomata

3. Non glandular hairs with apical cell triangular.

57. **Baccharis articulata**

58. **B. notosergila**

3'. Non glandular hairs with apical cell tail-like.

59. **B. rufescens**

2'. Stomata anomocytic.

60. **B. trimera**

1'. Pilose nest absent.

4. Whip hairs.

5. Glandular hairs absent.

6. Whip hairs and other types of trichones.

7. Whip hairs on leaf surface and shaggy hairs on margin.

61. **Carduus acanthoides**

7'. Whip hairs and conical on leaf surfaces.

62. **Aster squamatus**

6'. Whip hairs exclusively.

8. Whip hairs ca. 9-celled.

63. **Senecio tweediei**

64. **S. vulgaris**

8'. Whip hairs 3-5-celled.

65. **S. brasiliensis** var. **tripartitus**

66. **S. grisebachii**

67. **Baccharis artemisioides**

5'. Glandular hairs present.

10. Glandular hairs capitate.

11. Head 1-celled (vesicular trichome).

68. **Chenopodium murale**

11'. Head many-celled.

69. **Polygonum lapathifolium**

10'. Glandular hairs not capitate.

12. Shaggy hairs present.

70. **Cirsium vulgare**

12'. Shaggy hairs absent.

13. Whip hairs with apical cell straight at the base.

71. **Cynara cardunculus**

13'. Whip hairs with apical cell bulbose at the base.

14. Whip hairs 2-4-celled.

72. **Achyrocline satureioides**

73. **Centaurea solstitialis**

74. **Onopordon acanthium**

14'. Whip hairs 3-11-celled.

75. **Arctium minus**

76. **Centaurea calcitrapa**

77. **C. melitensis**

4'. Conical hairs.

15. Vesicular cells present.

78. **Polygonum convolvulus**

15'. Vesicular cells absent.

16. Glandular hairs present.

17. Glandular hairs capitate.

18. Head 1-celled.

19. Glandular hairs with long stalk (ca. 6-celled).

79. **Heliotropium amplexicaule**

19'. Glandular hairs with short stalk (less than 6-celled).

20. Short conical hairs 1-celled.

80. **Spergula arvensis**

20'. Conical hairs 2-many celled.

21. Conical hairs 2-celled.

81. **Geranium molle**

21'. Conical hairs 2-many celled.

82. **Solanum pygmaeum**

18'. Head 2-many-celled (occasionally 1-celled mixed with many-celled).

22. Conical hairs 1-2-celled.

23. Stomata diacytic.

83. **Lamium amplexicaule**

23'. Stomata anomocytic and anisocytic.

84. **Malva sylvestris**

22'. Conical hairs 2-many-celled.

24. Y-shaped hairs present.

25. Asymmetrical Y-shaped.

85. **Solanum sublobatum**

25'. Symmetrical Y-shaped.

86. **Salpichroa origanifolia**

24'. Y-shaped hairs absent.

26. Conical hairs not ornamented.

87. **Cestrum parqui**

26'. Conical hairs ornamented.

27. Adaxial surface with cell type 1.

88. **Datura ferox**

27'. Adaxial surface with cell types 2 or 2 and 3.

89. **Solanum chacoense**

90. **S. commersonii**

17'. Glandular hairs not capitate.

28. Conical hairs ornamented.

29. Both surfaces with cell type 3.

91. **Xanthium spinosum**

29'. Both surfaces with cell types 1 and 2 or 2.

92. **X. cavanillesii**

93. **Wedelia glauca**

28'. Conical hairs not ornamented.

30. Cell types 1 and 2.
94. **Ambrosia tenuifolia**

30'. Cell type 3.
95. **Bidens pilosa**

16'. Glandular hairs absent.

31. Stomata anisocytic (sometimes combined with stomata anomocytic).

32. Conical hairs exclusively.

33. Conical hairs ornamented.

34. Hairs 1-celled.

35. Hairs longer than 400 µm long.
96. **Sisymbrium irio**

35'. Hairs shorter than 400 µm long.
97. **Brassica rapa**

34'. Hairs 2-3-celled.

36. Stomata anisocytic exclusively. Stomata 25-30 x 20-30 µm.
98. **Adesmia bicolor**

36'. Stomata anisocytic and anomocytic. Stomata 20-25 x 15-20 µm.
99. **Melilotus officinalis**

33'. Conical hairs not ornamented.

37. Hairs 1-celled.

38. Hairs on the surfaces.

39. Hairs shorter than 640 µm long.
100. **Brassica nigra**

39'. Hairs longer than 640 µm long (frequently 740-1300µm).
101. **Sisymbrium altissimum**

38'. Hairs on the margin exclusively.
102. **Rorippa nasturtium-aquaticum**

37'. Hairs 2-3-celled.

40. Conical hairs 3-celled.
103. **Nicotiana longiflora**

40'. Conical hairs 2-celled.
104. **Lupinus gibertianus**

32'. Conical and other types of hairs (non-glandular).

41. Hairs armed.

42. Stellate and 3-armed hairs.
105. **Capsella bursa-pastoris**

42'. Y-shaped and dendritic hairs.

106. **Solanum diflorum**

41'. Hairs not armed.

43. Barrel shaped.

107. **Raphanus raphanistrum**

108. **R. sativus**

43'. Falcate.

109. **Cardaria draba**

31'. Stomata anomocytic exclusively.

44. Conical hairs ornamented.

45. Hairs 1-celled.

110. **Parietaria officinalis**

45'. Hairs 3-6-celled.

46. All trichome cells ornamented.

111. **Conyza bonariensis**

46'. Apical cell ornamented exclusively.

112. **Verbesina encelioides**

44'. Conical hairs not ornamented.

47. Cuticula ornamented around the stomata present.

113. **Gaillardia megapotamica**

47'. Cuticula ornamented around the stomata absent.

48. Hairs 1-3-celled.

49. Apical cell bulbose at the base.

50. 1-celled hairs.

114. **Echium plantagineum**

50'. 3-celled hairs.

115. **Bassia scoparia**

49'. Apical cell not bulbose at the base.

116. **Phytolacca americana**

48'. Hairs 3-many-celled.

51. Papillae on the midvein present.

117. **Amaranthus viridis**

51'. Papillae on the midvein absent.

52. Both surfaces with cell type 1.

53. Apical cell with thick walls.

118. **Solidago chilensis**

53'. Apical cell with thin walls.

119. **B. coridifolia**

52'. Both surfaces with cell types 3 or with cell type 1 on adaxial surface, and type 3 on abaxial surface.

54. Adaxial surface with cell types 1, abaxial surface with cell types 3.

120. **Amaranthus hybridus**

54'. Both surfaces with cell types 3.

121. **Tagetes minuta**

Group E: Leaves with bristles hairs

1. Stomata diacytic.

122. **Agrostemma githago**

1'. Stomata not diacytic.

2. Peltate scales present.

123. **Dodonaea viscosa**

2'. Peltate scales absent.

3. Stinging hairs and cystholits present.

124. **Urtica urens**

3'. Stinging hairs and cystholits absent.

4. Glandular hairs present.

5. Glandular shaggy hairs present.

125. **Turnera sidoides** subsp. **pinnatifida**

5'. Glandular shaggy hairs absent.

6. Glandular clavate hairs 1-celled.

7. Cell type 1.

126. **Clematis montevidensis**

7'. Cell types 2 or/and 3.

127. **C. bonariensis**

128. **Anemone decapetala**

6'. Glandular capitate hairs.

8. Head 4-celled.

129. **Melilotus albus**

8'. Head 1-celled.

9. Bristles hairs ornamented.

10. Hairs 1-celled.

130. **Oxalis corniculata**

10'. Hairs 2-celled.

131. **Melilotus indicus**

9'. Bristles hairs not ornamented.

11. Hairs 1-celled.

12. Glandular capitate 1-celled with bottle shaped present.

132. **Erodium malacoides**

12'. Glandular capitate 1-celled with bottle shaped absent.

133. **E. cicutarium**

11'. Hairs 2-celled.

134. **Vicia sativa** subsp. **nigra**

135. **Vicia graminea**

4'. Glandular hairs absent.

13. Bristles hairs ornamented.

136. **Parkinsonia aculeata**

13'. Bristles hairs not ornamented (or only occasionally).

14. Bristles 1-celled.

15. Cuticular ornamentation present.

137. **Sambucus australis**

15'. Cuticular ornamentation absent.

16. Abaxial cell type 1.

138. **Discaria americana**

16'. Abaxial cell type 3.

139. **Ranunculus repens** var. **repens**

140. **R. muricatus**

14'. Bristles 2-celled.

141. **Galega officinalis**

142. **Lotus corniculatus**

143. **L. glaber**

Group F: Leaves with stellate, T-shaped, branched, shaggy, moniliform, or falcate hairs.

1. Glandular hairs present.

2. Glandular hairs not capitate. T-shaped hairs present.

3. Glandular hairs commonly present. Symmetrical T-shaped hairs.

144. **Anthemis cotula**

3'. Glandular hairs rarely present. Asymmetrical T-shaped hairs.

145. **Vernonia rubricaulis**

2'. Glandular hairs capitate. T-shaped hairs absent.

4. Glandular hairs with head 1-celled.

5. Falcate hairs, 1-celled.

146. **Anchusa officinalis**

5'. Stellate hairs, many-celled.

147. **Solanum elaeagnifolium**

4'. Glandular hairs with head 1-many-celled.

6. Stellate hairs present.

7. Porrect stellate hairs present.

148. **Marrubium vulgare**

7'. Porrect stellate hairs absent.

8. Stellate stalked hairs present.

149. **Verbascum thapsus**

8'. Stellate stalked hairs absent.

9. Stellate multiangulate hairs. Glandular hairs with head 2-celled.

150. **Sida rhombifolia**

9'. Stellate not multiangulate hairs. Glandular hairs with head 1-many-celled.

151. **Solanum bonariense**

6'. Stellate hairs absent.

10. Shaggy hairs. Vesicular cells and hydropoten present.

152. **Polygonum persicaria**

10'. Dendritic and Y-shaped hairs. Vesicular cells and hydropoten absent.

153. **Physalis viscosa**

1'. Glandular hairs absent.

11. Moniliform hairs present.

12. Stomata anomocytic.

154. **Saponaria officinalis**

12. Stomata parallelocytic.

13. Anticlinal cell wall very thick.

155. **Wigginsia tephracantha**

13'. Anticlinal cell wall thin.

156. **Parodia ottonis**

11'. Moniliform hairs absent.

13. Stomata anisocytic. Falcate hairs present.

157. **Rapistrum rugosum**

13'. Stomata anomocytic. Falcate hairs absent.

14. Shaggy hairs present.

15. Shaggy hairs on margin. Cell type 1.

158. **Silybum marianum**

15'. Shaggy hairs on margin and on midvein. Cell type 2.

159. **Lactuca serriola**

14'. Shaggy hairs absent (occasionally stellate hairs).

160. **Fagara hyemalis**

Conclusions

The following epidermal characters revealed high diagnostic value for the identification of the toxic plants from the Salado River basin: 1) hydropoten (*Nymphoides indica*); 2) licópoli glands (*Limonium brasiliense*); 3) cystholits (*Urtica urens*); 4) parallelocytic stomata (*Portulaca oleracea*, *Wigginsia tephracantha*, *Parodia otonis*); 5) polocytic stomata (*Plantago australis*); 6) ciclocytic stomata (*Baccharis* spp.); 7) papillae (*Amaranthus viridis, Rumex* spp.); 8) vesicular cells (*Polygonum* spp.); 9) barrel shaped hairs (*Borreria verticillata*, *Raphanus* spp.); 10) vesicular hairs (*Chenopodium* spp.); 11) glandular hairs with head many-radiate-celled (*Ibicella lutea*); 12) hairs forming tufts (*Baccharis* spp.); shaggy hairs (*Cirsium vulgare, Silybum marianum, Lactuca serriola*, *Polygonum lapathifolium*); 13) Y-shaped hairs (*Solanum* spp., *Salpichroa origanifolia*; 14) stellate hairs (*Capsella bursa-pastoris*, *Verbascum thapsus*, *Sida rhombifolia*, *Solanum* spp); 15) peltate scales (*Dodonaea viscosa*); 16) stinging hairs (*Urtica urens*); T-shaped hairs (*Anthemis cotula*, *Vernonia rubricaulis*).

There are few characters which were not found in the literature examined, and they could contribute to improve the circumscription, from a anatomical point of view, the respective taxonomic group, i.e. diacytic stomata in Apiaceae (*Ammi, Cyclospermum, Foeniculum*); polocytic stomata in Plantaginaceae (*Plantago*); anisocytic stomata in Polygonaceae (*Polygonum, Rumex*); and bristles in Caryophyllaceae (*Agrostemma*).

In addition, some epidermal characters analyzed in this study, can be correlated with previously delimitated taxonomic groups above of family level within Dicotyledons: 1) Our epidermal characters are consistent with the order Centrospermae (Caryophyllales order of Cronquist, 1981). In fact, stomata are basically anomocytic in the relatively primitive families, (e.g. Amaranthaceae, Chenopodiaceae, Nyctaginaceae, Phytolaccaceae). Paracytic stomata, present in some species of Chenopodiaceae, can be related to the parallelocytic stomata (i.e. paracytic stomata with an additional pair of subsidiary cells also parallel to the long axes of the pore), of the more derivate families Cactaceae and Portulacaceae. Stomata tetracytic present in *Chenopodium* spp. (Barboza *et al.*, 2001) can be related to hexacytic stomata (i.e. tetracytic type with an additional pair of lateral subsidiary cells) observed in the present study in Cactaceae. Hairs of the families of this group are basically conical (Amaranthaceae, Caryophyllaceae, Chenopodiaceae, Phytolaccaceae) while the special type moniliform is present in Cactaceae and Caryophyllaceae; 2) The close taxonomic relationship between Convolvulaceae and Solanaceae (order Solanales of Cronquist, 1981) is also supported by some of our data, e.g. conical hairs and capitate hairs, and stomata predominantly anisocytic and anomocytic; 3) Lamiaceae and Scrophulariaceae (belonging to close related orders of Cronquist, 1981, Lamiales and Scrophulariales, respectively), have in common porrect hairs; 4) Geraniaceae and Oxalidaceae (order Geraniales of Cronquist, 1981) have bristles hairs; 5) Apocinaceae and Asclepiadaceae (order Gentianales of Cronquist, 1981) share conical hairs and paracytic stomata.

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Appendix 1. Taxa and vouchers of toxic species used.

Amaranthaceae

Amaranthus hybridus L. La Plata, *Bayón 615* (LPAG).

Amaranthus viridis L. La Plata, *Bayón 603* (LPAG).

Amaryllidaceae

Habranthus tubispatus (L'Her.) Traub. Abra del Pantanoso Viejo, *Pertusi 152* (LP).

Rhodophiala bifida (Herb.) Traub. La Plata, *Fabris 7039* (LP)

Apiaceae

Ammi majus L. Punta Lara, *Cabrera 5*710 (LP).

Ammi visnaga (L.) Lam. Azul, *Cabrera 9996* (LP).

Conium maculatum L. Garín, *Lanfranchi 211* (LP).

Cyclospermum leptophyllum (Pers.) Sprague. Haedo, *Spegazzini s. n*. (LPS 20534 in LP).

Eryngium paniculatum Cav. & Dombey ex F. D. Laroche. Sa. de la Ventana, *Dawson et Núñez 148* (LP).

Foeniculum vulgare Mill. La Plata, *Cabrera 368* (LP).

Apocinaceae

Vinca major L. La Plata, *Amorín in 1966* (LPAG).- Isla Martín García, *Hurrell et al. 2374* (LP) - Laguna Brava, *Cabrera et Fabris 17169* (LP).

Asclepiadaceae

Asclepias curassavica L. La Plata, *Bayón 387* (LPAG).

Asclepias mellodora A. St.-Hil. Gral. Villegas, *Cabrera et Fabris 14789* (LP).

Morrenia brachystephana Griseb. San Pedro, *Fabris 3251* (LP).

Morrenia odorata (Hook. & Arn.) Lindl. Pereyra, *Cabrera 2058* (LP).

Oxypetalum solanoides Hook. & Arn. Parque Pereyra Iraola, *De la Torre in 1973* (LPAG).

Asteraceae

Achyrocline satureioides (Lam.) DC. San Clemente, *Cabrera 4263, 4915* (LP).

Ambrosia tenuifolia Spreng. Córdoba: San Javier, *Bridarolli 1276* (LP) - Río Ceballos, *Escalante 61* (LP).

Anthemis cotula L. Pellegrini, *Cabrera 6928* (LP) - Juancho, *Cabrera 2744* (LP).

Arctium minus (Hill.) Bernh. San Fernando, *Lanfranchi 486* (LP) - La Plata, *Cabrera 149* (LP).

Aster squamatus (Spreng.) Hieron. var. *squamatus*. Buenos Aires. La Plata, Palo Blanco. *Cabrera 138* (LP); Pellegrini, *Cabrera 6984* (LP).

Baccharis artemisioides Hook. & Arn.. Olavarría, *Abbiatti 4095* (LP) - Pedro Luro, *Cabrera 4514* (LP).

Baccharis articulata (Lam.) Pers. Balcarce, *Cabrera et Fabris 17.159* (LP) - Elizalde, *Cabrera 1799* (LP).

Baccharis coridifolia DC. Olavarría, *Abbiatti 4015* (LP) - San Nicolás, *Cabrera 7161* (LP).

Baccharis. notosergila Griseb. Bavio, *Zardini 593* (LP).

Baccharis rufescens Spreng. Tandil, *Hunziker 3912* (LP) - Salliqueló, *Cabrera 7547* (LP).

Baccharis trimera (Less.) DC. Magdalena, *Zardini 592* (LP) - La Plata, *Cabrera 464* (LP).

Bidens pilosa L. var. *pilosa*. Delta del Paraná, Aº. Tuyuparé, *Scala 427* (LP) – San Isidro, *Cabrera 10647* (LP).

Carduus acanthoides L. Monte Veloz, *Cabrera 638* (LP) - Saladillo, *Cabrera 6427* (LP).

Centaurea calcitrapa L. Garín, *Lanfranchi 576* (LP) - Sa. de la Ventana, *Cabrera 5764* (LP).

Centaurea melitensis L. Elizalde, *Cabrera 534* (LP) – Magdalena, *Cabrera 627* (LP).

Centaurea solstitialis L. Gral. Conesa, *Cabrera 4249* (LP).

Cichorium intybus L. Gonnet, *Delucchi 1757* (LP) – La Plata, *Delucchi 1493* (LP).

Cirsium vulgare (Savi) Ten. Pinamar, *Cabrera 10078* (LP) - La Plata, *Cabrera 140* (LP).

Conyza bonariensis (L.) Cronsquist var. *bonariensis*. Otamendi, *Hunziker 374* (LP).

Cynara cardunculus L. La Plata, *Cabrera 139* (LP).

Gaillardia megapotamica (Spreng.) Baker var. *megapotamica*. Río Negro: Cipolletti, *Cabrera 703* (LP) – Neuquén: Portada Covunco, *Cabrera 11090* (LP).

Hymenoxys anthemoides (Juss.) Cass. Santa Fe: Laguna Paiva, *Tur 647* (LP) – Leyes, *Tur 455* (LP).

Hymenoxys cabrerae K. L. Parker. Buenos Aires. Villarino, salitral de la Vidriera, *Cabrera 6663* (LP).

Lactuca serriola L. Prov. Corrientes. Santo Tomé, *Krapovickas et al. 17033* (LP). Prov. Chaco. Cnia. Benítez, *Schulz 178* (LP).

Onopordon acanthium L. Magdalena, *Cabrera 9159* (LP) – Entre Monte Veloz y Pipinas, *Cabrera 622* (LP).

Senecio bonariensis Hook. & Arn. Quilmes, *Cabrera 319* (LP).

Senecio brasiliensis (Spreng.) Less. var. *tripartitus* (DC.) Baker. Punta Lara, *Dawson 867* (LP).

Senecio grisebachii Baker var. *grisebachii*. Delta, *Cabrera 4877* (LP).

Senecio madagascariensis Poir. Mar del Plata, *Solbrig 1073* (LP).

Senecio tweediei Hook. & Arn. Punta Indio, *Cabrera 24273* (LP) – Gral. Madariaga, *Cabrera 10720* (LP).

Senecio vulgaris L. Isla Maciel, *Cabrera 938* (LP) - Miramar, *Cabrera 5568* (LP).

Silybum marianum (L.) Gaertn. Lincoln, *Spegazzini 10341* (LP) - La Plata *Cabrera 100* (LP).

Solidago chilensis Meyen var. *chilensis*. Isla Martín García, *Hurrell et al. 2875* (LP).

Sonchus oleraceus L. San Clemente, *Cabrera 4918* (LP).

Tagetes minuta L. Tucumán: Tafí, *Venturi 6111* (LP).

Taraxacum officinale Weber ex F. H. Wigg. La Plata, *Cabrera 176* (LP) – Isla Martín García, *Hurrell 1934* (LP).

Verbesina encelioides (Cav.) Benth. & Hook. f. La Plata, *Cabrera 217* (LP) – Pinamar, *Cabrera 10737* (LP).

Vernonia rubricaulis Humb. & Bonpl. var. *rubricaulis*. Santa Fe: El Tostado, *Job 1092* (LP).

Wedelia glauca (Ortega) O. Hoffm. ex Hicken. Entre Ríos: S. Cerrito, *Krapovickas et al. 22698* (LP).

Xanthium cavanillesii Schouw. La Plata, *Cabrera 1692, 175* (LP).

Xanthium spinosum L. var. s*pinosum*. Jujuy: La Quiaca, *Cabrera et al. 15291* (LP) – El Carmen, *Cabrera 7858* (LP).

Boraginaceae

Anchusa officinalis L. La Pampa: Santa Rosa, *Fabris 1899* (LP) - S*pegazzini s. n*. (LPS 23884 in LP).

Echium plantagineum L. Ensenada, *Pérez Moreau in 1963* (LP) - La Plata, *Monti 11* (LPAG).

Heliotropium amplexicaule Vahl. Buenos Aires, *Cabrera in 1943* (LP) - Gral. Alvarado, *Fabris in 1960* (LP).

Brassicaceae

Brassica nigra (L.) W. D. J. Koch. Castelli, *Alberto 6* (LPAG).

Brassica rapa L. La Plata, *Monti 15* (LPAG).

Capsella bursa-pastoris (L.) Medik. Los Hornos, *Bayón 588* (LPAG).

Cardaria draba (L.) Desv. San Isidro, *Cabrera 11565* (LP).

Raphanus raphanistrum L. Otamendi, *Hunziker 1488* (LP).

Raphanus sativus L. Los Hornos, *Bayón 589* (LPAG).

Rapistrum rugosum (L.) All. La Plata, *Monti 16* (LPAG).

Roripa nasturtium-aquaticum (L.) Hayed. Tandil, *Cabrera 6895* (LP).

Sisymbrium altissimum L. Lomas sobre la margen izquierda del Río Limay, *Chicchi 168* (LP).

Sisymbrium irio L. Chubut: Isla de los Pájaros, *Daciuk 63* (LP).

Cactaceae

Opuntia arechavaletae Speg. San Isidro (cultivado), *Burkart 17911* (SI).

Parodia ottonis (Lehm.) N. P. Taylor. Misiones, Teyucuaré, *Burkart 15288* (SI).

Wigginsia tephracantha (Link & Otto) D. M. Porter. URUGUAY: Dpto. Colonia, Estancia "Cerros de San Juan", *Kiesling 11593* (SI).

Caprifoliaceae

Sambucus australis Cham. & Schltdl. Buenos Aires, La Plata, *Capelletti 85* (LPAG) - Bahía

Samborombón, *Ringuelet 206* (LPAG).

Caryophyllaceae

Agrostemma githago L. Agustina, *Cabrera 6548* (LP).

Polycarpon tetraphyllum (L.) L. Isla Martín García, *Volponi 993* (LP).

Saponaria officinalis L. Lincoln, *Spegazzini in 1903.* (LP).

Spergula arvensis L. Entre Ríos: Colonia Adela, *Bottino 463* (LP).

Chenopodiaceae

Bassia scoparia (L.) A. J. Scott. La Plata, *Cabrera* 7468 (LP).

Chenopodium album L. Mar Chiquita, *Dimitri in 1973* (LPAG).

Chenopodium hircinum Schrad. var. *hircinum*. Punta Lara, *Cabrera 4898* (LP).

Chenopodium murale L. La Plata, *Bulta in 1972* (LPAG).

Holmbergia tweedii (Moq.) Speg. Santa Fe: Santo Tomé, *Job 1044* (LP).

Salsola kali L. var. *kali*. San Clemente, *Cabrera 4268* (LP).

Convolvulaceae

Convolvulus arvensis L. La Plata, *Otero-Ríos in 1998* (LP).

Cyperaceae

Cyperus rotundus L. La Plata, *Bayón 616* (LPAG).

Euphorbiaceae

Euphorbia lathyrus L. Boca del Riachuelo, *Spegazzini s. n.* (LPS 13929, 22794 in LP).

Euphorbia peplus L. Isla Martín García, *Hurrell 4117* (LP).

Manihot grahamii Hook. Salta: Capital, *Novara 2669* (LP).

Ricinus communis L. Jujuy: Ledesma, *Cabrera et Fabris 15985* (LP), *Cabrera et Zardini 23840* (LP).

Fabaceae

Adesmia bicolor (Poir.) DC. Dolores, *Arambarri 44* (LPAG).

Galega officinalis L. Chascomús, *Arambarri 197* (LPAG).

Lotus corniculatus L. Buenos Aires. La Plata, *Arambarri 61* (LPAG) - Entre Ríos: Concordia, *Masut* in *1972* (LPAG) .

Lotus glaber Mill. Buenos Aires. La Plata, *Arambarri 141* (LPAG) - Vieytes, *Arambarri 220*, *Colares et al. s.n*. (LPAG).

Lupinus gibertianus C. P. Sm. Misiones: Cainguás, *Leouncusat 948* (LP).

Melilotus albus Desr. Castelli, *Aguiar 2* (LPAG).

Melilotus indicus (L.) All. Pilar, *Dimitri in 1973* (LPAG).

Melilotus officinalis (L.) Lam. Pilar, *Arambarri in 1973* (LPAG) - Neuquén: Valle de Chasalnilla, *Chicchi 100* (LP).

Parkinsonia aculeata L. La Plata, *Delucchi 1499* (LPAG).

Senna corymbosa (Lam.) H. S. Irwin & Barneby. La Plata, *Arambarri 242* (LPAG).

Trifolium repens L. f. *repens*. La Plata, *Delucchi 884* (LPAG).

Vicia graminea Sm. var. *graminea*. La Plata, *Pisano 96* (LP).

Vicia sativa L. subsp. *nigra* (L.) Ehrh. La Plata, *Arambarri et Perrotta 240* (LPAG).

Fumariaceae

Fumaria capreolata L. f. *capreolata.* La Plata, *Monti 14* (LPAG).

Fumaria officinalis L. Córdoba: Bajo Chico, *Maldonado 101* (LP).

Fumaria parviflora Lam. Carmen de Patagones, *leg?* (LP 21066).

Geraniaceae

Erodium cicutarium (L.) L' Hér. ex Aiton. Chubut, Trevelín, *Casaubón in 1979* (LPAG).

Erodium malacoides (L.) L' Hér. ex Aiton. Lavallol, *Rinieri in 1966* (LPAG) - La Plata, *Butta in 1972* (LPAG).

Geranium molle L. La Plata, *Arambarri 243* (LPAG).

Juncaginaceae

Triglochin palustris L. Isla Santiago, *Spegazzini s. n.* (LPS 16099 in LP).

Lamiaceae

Lamium amplexicaule L. Vedia, *Martínez 1* (LPAG) - La Plata, *Amorín in 1966* (LPAG).

Malvaceae

Malva sylvestris L. Los Talas, *Cabrera 1827* (LP).

Marrubium vulgare L. Etcheverry, *Martínez 2* (LPAG) – *Dimitri in 1973* (LPAG).

Sida rhombifolia L. Punta Lara, *Cabrera 6342* (LP).

Martyniaceae

Ibicella lutea (Lindl.) Van Eselt. La Plata, *Dimitri in 1972* (LPAG 7238).

Menyanthaceae

Nymphoides indica (L.) Kuntze. Tucumán, Santa Rosa, *Venturi 616* (SI).

Nictaginaceae

Boerhavia diffusa L. var. *leiocarpa* (Heimerl) Adams. La Plata, *leg? in 1988* (LPAG2349).

Mirabilis jalapa L. Villa Elisa, *Monti 12* (LPAG).

Oxalidaceae

Oxalis corniculata L. var. *corniculata.* La Plata, *Arambarri 234* (LPAG) - La Plata, *Cabrera 5353* (LP).

Passifloraceae

Passiflora caerulea L. La Plata, *Vizcaíno in 1996* (LPAG) - *Montes de Oca in 2001* (LPAG 5372).

Phytolaccaceae

Phytolacca americana L. Pereyra, *Cabrera 2054* (LP) - Punta Lara, *Landrum et Zardini 3052* (LP).

Phytolacca dioica L. San Fernando, Isla Martín García, *Hurrell et al. 2112* (LP) - La Plata, *Pereyra in 1981* (LP).

Phytolacca tetramera Hauman. Magdalena, *Cabrera 1641* (LP).

Plantaginaceae

Plantago australis Lam. subsp. *australis.* Pta. Atalaya, *Tur 1680* (LP).

Plumbaginaceae

Limonium brasiliense (Bois.) Kuntze var. *brasiliense.* Villarino, *Cabrera 10171* (LP).

Poaceae

Briza minor L. La Plata, *Bayón 568* (LPAG).

Cortaderia selloana (Schult. & Schult. f.) Asch. & Graebn. La Plata, *Bayón 605* (LPAG).

Cynodon dactylon (L.) Pers. La Plata, *Bayón 577* (LPAG).

Cynodon hirsutus Stent. Luján, *Nicora 629* (SI).

Digitaria sanguinalis (L.) Scop. La Plata, *Bayón 573, 574* (LPAG).

Echinochloa crusgalli (L.) P. Beauv. La Plata, *Bayón 581* (LPAG).

Eleusine indica (L.) Gaertn. La Plata, *Bayón 572* (LPAG).

Elymus breviaristatus (Hitchc.) Á. Löve. Punta Indio, *Rodrigo 3447* (LP).

Eragrostis cilianensis (All.) Vignolo-Lutati ex Janch. La Plata, *Bayón 576* (LPAG).

Holcus lanatus L. Río Negro: Río Foyel, *Bayón 590* (LPAG).

Hordeum murinum L. subsp. *murinum*. El Talar, *Lanfranchi 1* (SI).

Leptochloa chloridiformis (Hack.) Parodi. Santa Fe: Logroño, *Pire 1101* (SI).

Lolium multiflorum Lam. La Plata, *Bayón 592* (LPAG).

Lolium perenne L. La Plata, *Bayón 545* (LPAG).

Lolium temulentum L. Entre Ríos: Concepción del Uruguay*, Nicora 2023* (SI).

Sorghum halepense (L.) Pers. La Plata, *Bayón 575* (LPAG).

Polygonaceae

Polygonum aviculare L. Sa. de Olavarría, *Abbiatti 4033* (LP) - Hurlingham, *Schwabe 180* (LP).

Polygonum convolvulus L. Garín*, Lanfranchi 579* (LP) - Saliqueló, *Cabrera 7510* (LP).

Polygonum lapathifolium L. El Trigo, *Cabrera 14725* (LP) - Sa. de la Ventana, *Cabrera et Fabris 1* (LP).

Polygonum persicaria L. BRASIL: Río Grande do Sul, *Rambo 46510* (LPAG).

Rumex crispus L. Isla Santiago, *Cabrera 2222* (LP).

Rumex obtusifolius L. Isla Martín García, *Tur et. al 1810* (LP) - Sa. de Tandil, *Delucchi 2198* (LP).

Rumex pulcher L. Isla Martín García*, Hurrell et al. 3877* (LP) - La Plata, *Cabrera 5576* (LP).

Portulacaceae

Portulaca oleracea L. La Plata, *Cabrera 527* (LP) - Isla Martín García, *Hurrell et al. 3877* (LP).

Primulaceae

Anagallis arvensis L. San Nicolás, *Cárdenas 7185* (LP) - Isla Martín García, *Hurrell et al. 3874* (LP).

Ranunculaceae

Anemone decapetala Ard. var. *decapetala*. Tornquist, *Proyecto Ventania 290* (LP) - Sa. de la Ventana, *Spegazzini in 1895* (LP).

Clematis bonariensis Juss. ex DC. Punta Lara, *Cabrera 2434* (LP).

Clematis montevidensis Spreng. Sa. de las Tunas, *Pertusi 60* (LP) - Corrientes: Bella Vista, *Skorupka 10* (LP).

Ranunculus apiifolius Pers. San Nicolás, *Cabrera 7199* (LP)- Las Chilcas, *Cabrera 8521* (LP).

Ranunculus cymbalaria Pursh. Mar del Plata, *Cabrera 9954* (LP).

Ranunculus muricatus L. Isla Santiago, *Cabrera 2263* (LP).

Ranunculus repens L. var. *repens*. Atalaya, *Tur 1531* (LP) - La Plata, *Rodrigo 2814* (LP).

Rhamnaceae

Discaria americana Gillies & Hook. Tandil, *Fabris et Schwabe 4738* (LP) - San Clemente, *Cabrera 4928* (LP).

Rubiaceae

Borreria verticillata (L.) G. Mey. Lobería, *Scala in 1918* (LP).

Galium richardianum (Gillies ex Hook & Arn.) Endl. ex Walp. subsp. *richardianum*. Pellegrini, *Cabrera 6934* (LP).

Rutaceae

Fagara hyemalis (Gillies) Engl. La Plata, *Reitano 2002* (LPAG).

Sapindaceae

Dodonaea viscosa Jacq. Balcarce, *Cabrera et Fabris 17.133* (LP).

Scrophulariaceae

Verbascum thapsus L. Tigre, *Lanfranchi 430* (LP).

Solanaceae

Cestrum parqui L' Hér. La Plata, *Bayón 123* (LPAG).

Datura ferox L. Benavídez, *Lanfranchi 519* (LP).

Nicotiana glauca Graham. La Plata, *Bayón 371(b)* (LPAG), *Colares 6* (LPAG).

Nicotiana longiflora Cav. La Plata, *Bayón 381 (a)* (LPAG).

Physalis viscosa L. La Plata, *Bayón 113* (LPAG).

Solanum bonariense L. City Bell, *Bayón 389 (a)* (LPAG).

Solanum chacoense Bitter subsp. *chacoense*. La Plata, *Bayón 114* (LPAG).

Solanum commersonii Dunal ex Poir. subsp. *commersonii*. Isla Martín García, *Hurrell 3915* (LP).

Solanum diflorum Vell. Vieytes, *Bayón et Vizcaíno 466* (LPAG).

Solanum elaeagnifolium Cav. La Plata, *Butta in 1972* (LPAG) - Monte Hermoso, *Ringuelet in 1942* (LPAG).

Solanum glaucophyllum Desf. M. B. Gonnet, *Ronco 1991* (LPAG) - Entre Los Porteños y City Bell, *Bayón 175 (a)* (LPAG).

Solanum pygmaeum Cav. var. *pygmaeum*. Entre Ríos, *Burkart 22721* (SI).

Solanum sublobatum Willd. Vieytes, *Bayón 468 (a)* (LPAG).

Salpichroa origanifolia (Lam.) Baill. City Bell, *Bayón 139* (LPAG).

Turneraceae

Turnera sidoides L. subsp. *pinnatifida* (Juss. ex Poir) Arbo. Cnel. Suárez, *Pertusi 76* (LP) - Sa. de la Ventana, *Proyecto Ventana 899* (LP).

Urticaceae

Parietaria officinalis L. La Plata, *Fabris in 1964* (LP).

Urtica urens L. Lobería, *Scala 1918.* (LP).