

Identifying the weedy amaranths (*Amaranthus*, *Amaranthaceae*) of South America

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Abstract: Background: *Amaranthus* is a genus of *Amaranthaceae* with ca. 75 species. Many of them are of economic importance as cultivated crops (grains or vegetables) or ornamentals, while around 20 range from significant weeds to minor ones.

Objective: List and differentiate the species (and subspecies) of weeds that belong to genus *Amaranthus* and range in South America.

Results: Thirteen species and four subspecies of *Amaranthus* are considered weeds in South America; six of them are of great importance (*A. blitum*, *A. deflexus*, *A. hybridus*, *A. palmeri*, *A. spinosus*, and *A. viridis*), while the rest

Keywords: *Amaranthus albus*; *A. blitoides*; *A. blitum*; *A. crispus*; *A. deflexus*; *A. hybridus*; *A. muricatus*; *A. palmeri*; *A. powellii*; *A. retroflexus*; *A. spinosus*; *A. standleyanus*; *A. viridis*; Pigweed.

cause minor damage. Vernacular names, distribution, diagnoses, notes, and vouchers are given for every taxon.

Conclusions: Within the 13 species of weeds that belong to genus *Amaranthus* in South America, there are two among the worst noxious weeds in the world: *A. hybridus* (with two subspecies), which ranges in many countries of this continent, and *A. palmeri*, present up to now only in Argentina. Other four important weeds are widespread in different countries: *A. blitum* (with two subspecies), *A. deflexus*, *A. spinosus*, and *A. viridis*.

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1. Introduction

The genus *Amaranthus* L. (*Amaranthaceae*) includes ca. 75 species mainly distributed in tropical, warm, and temperate regions of Africa, America, Australia, and Eurasia (Costea et al., 2001a; Mosyakin, Robertson, 2003). Ten of this species are dioecious (Sauer 1955), while 65 are monoecious (Bayón, 2015).

Some species of *Amaranthus* are cultivated for different purposes. To begin with, three species produce edible grains, named “pseudograins”, since they do not belong to *Poaceae* (grass family): *A. caudatus* L., *A. cruentus* L., and *A. hypochondriacus* L. In pre-Columbian times, together with corn (*Zea mays* L.), they were staples in Mexican, Guatemalan, and Peruvian civilizations. Their seeds are rich in proteins and in the essential amino acid lysine (Simpson, Ogorzaly, 2014). In addition, leaves of other species are used as vegetables: *A. blitum* L. [subsp. *blitum* and subsp. *oleraceus* (L.) Costea], *A. dubius* Mart. ex Thell., *A. graecizans* L. subsp. *aschersonianus* (Thell.) Costea, D. M. Brenner & Tardif, *A. spinosus* L., *A. hybridus* L., *A. tricolor* L. (these last two are also ornamentals), and *A. viridis* L. (Fawcett, Rendle, 1914; Costea et al., 2003). Finally, *A. standleyanus* Parodi ex Covas is considered natural forage (Boelcke, 1981).

In the last three decades there have been substantial changes in South American agriculture. The increase of the area cropped with soybean [*Glycine max* (L.) Merr.] observed mainly in Brazil, Argentina, and Paraguay, was due to technological advances (e.g. no-tillage crop production system and soybean transgenic cultivars resistant to glyphosate) resulting in modifications in the composition of weed communities (Fuente et al., 2006). Studies that compare conventional with no-tillage system in central Rolling Pampas of Argentina have shown that the genus *Amaranthus* belong to a group of well adapted weeds that is more frequent in the latter type of management (Fuente et al., 1999).

Within *Amaranthaceae*, apart from *Amaranthus*, there are some other genera with species that can become weeds such as *Alternanthera*, *Froelichia*, *Gomphrena*, and *Pfaffia* (Marzocca et al., 1979). The main differences between *Amaranthus* and these genera are the arrangement of leaves and sexuality of flowers: while *Amaranthus* has alternate distal leaves and unisexual flowers, the other genera have distal opposite leaves and bisexual flowers. Among them, *Alternanthera* and *Gomphrena* are more troublesome weeds. Two features that allow us to recognise them are the following: *Alternanthera* has androecial tube appendages (pseudostaminodes) whereas *Gomphrena* has bifid stigma with short or long branches.

Approximately 20 species of the genus *Amaranthus* are widespread weeds which grow in cultivated dry and irrigated lands around the world (Marzocca et al., 1979;



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Costea et al., 2001b; Francischini et al., 2014). Those that grow in South America are *A. albus* L., *A. blitoides* S. Watson, *A. blitum*, *A. crispus* (Lesp. & Thévenau) Terraciano, *A. deflexus* L., *A. hybridus*, *A. muricatus* (Moq.) Hieron., *A. palmeri* S. Watson, *A. powellii* S. Watson, *A. retroflexus* L., *A. spinosus*, *A. standleyanus*, and *A. viridis* (Marzocca et al., 1979; Eliasson, 1987; Borsch et al., 2014; Bayón, 2015; 2020; Pedersen, 2016). They are species with a great competitive ability: allogamous, C4-species with an enormous capacity of production of longevous seeds that are easily dispersed, which can develop resistance to herbicides. Within them, *A. hybridus* and *A. palmeri* are more problematic.

The objective of this work is to list and differentiate the species (and subspecies) of weeds that belong to genus *Amaranthus* and range in South America.

2. Materials and Methods

The study was performed using specimens and images from these herbaria: BAB, CORD, CTES, F, LP, LPAG, and SI (Thiers, 2021).

3. Results

Amaranthus L.

Sp. pl. 2: 989. 1753. Type species: *Amaranthus caudatus* L.

Annual herbs, occasionally perennial, monoecious or dioecious, glabrous or pubescent, green and sometimes reddish; stems erect, ascending, prostrate, simple or branched. *Leaves* alternate, petiolate, exstipulate; blade rhombic, ovate, obovate, lanceolate, oblong, sometimes orbicular, linear or spatulate, cuneate, rounded or attenuate at base, acute, rounded or emarginate at apex, margin entire, sometimes undulate, usually mucronate; Kranz anatomy. *Inflorescence* terminal or/and axillary, formed by compound dichasia, grouped in spiciform or paniculoid inflorescences, thyrses or glomerules. *Flowers* unisexual, protected by a bract and (0–)1–2 bracteoles, (0–2)3–5 glabrous or almost glabrous sepals, free or connate at base, membranous or scarious, greenish or reddish; *pistillate flowers*: 1-pistil, 1-ovulate ovary, style indistinct or very short, 2–3 slender stigmas, stamens absent; *staminate flowers*: (1–2)3–5 stamens, filaments filiform or narrowly strap-shaped, free, dithecal anthers, pistil absent. *Fruits* uniseminate, with thin membranous wall, utricle or pyxis, smooth, deeply wrinkled or tuberculate. *Seed* 1, lenticular or semiglobose, testa smooth, shiny; embryo annular. $x = 16, 17$.

Vernacular names. Amaranth, pigweed.

Ethymology. Greek, ἀμάραντος (*amárantos*), ‘everlasting’, referring to the unfading flowers and inflorescences (Costea, Tardif, 2003a).

Species of *Amaranthus* are difficult to identify because their reproductive organs (flowers and fruits) are very small, green, somehow inconspicuous. It is often necessary to know the habit, size and shape of leaves, and type of

inflorescences. However, the most relevant features to reach a correct determination are present in bracts, bracteoles, and sepals of the pistillate flowers (sometimes also of the staminate flowers), and type of fruit.

Key to the species of genus *Amaranthus* that are weeds in South America

1. Dioecious plants *A. palmeri*
- 1'. Monoecious plants
2. Inflorescence terminal (spiciform, paniculoid or thyrses) and axillary similar; bracts and bracteoles spinescent; fruits pyxis; pistillate flowers with usually 5 sepals (rarely 4); plants erect
3. Stem nodes with paired spines *A. spinosus*
- 3'. Stem nodes without paired spines
4. Sepals of the pistillate flowers obtuse, rounded or emarginate at apex *A. retroflexus*
- 4'. Sepals of the pistillate flowers acute at apex (at least the outermost)
5. Bracts and bracteoles 4.5–6(–8) mm long.; inflorescence terminal, usually rigid, with erect branches and close to the central axis *A. powellii*
- 5'. Bracts and bracteoles 2–4 mm long; terminal inflorescence usually lax, flexible, with separated branches from the central axis
6. Innermost sepals narrowly ovate or oblong-lanceolate, acute, subacute, erect, shorter than fruits *A. hybridus* subsp. *hybridus*
- 6'. Innermost sepals spatulate to obovate, obtuse to truncate, almost erect or reflexed, longer (or equal) than fruits *A. hybridus* subsp. *quitensis*
- 2'. Inflorescence mainly axillary, glomerules or shortly spiciform; bracts and bracteoles membranous or foliaceous, rarely spinescent; fruits pyxis or utricles; sepals 3–5 (rarely 1–2); plants ascending or prostrate, rarely erect
7. Fruits pyxis (dehiscent)
8. Bracts and bracteoles of the pistillate flowers subulate, spinescent, almost doubling in length to sepals *A. albus*
- 8'. Bracts and bracteoles of the pistillate flowers shorter, equaling or slightly longer than sepals *A. blitoides*
- 7'. Fruits utricles (indehiscent)
9. Pistillate flowers with 2–3 sepals
10. Fruits much longer than sepals (although not doubling them), pericarp smooth *A. deflexus*
- 10'. Fruits slightly longer than sepals, pericarp rugose
11. Prostrate plants, leaves (0.75–)1–2(–3.5) cm long; inflorescences in axillary cymes (terminal inflorescences reduced or absent) *A. blitum* subsp. *emarginatus*

11'. Ascending plants, vigorous, leaves 2–4(–6) cm long; inflorescences principally terminal, long, slender, and flexuose
A. blitum subsp. *pseudogracilis*

9'. Pistillate flowers with always 3 sepals, always 5 sepals, or with a variable number between 3 and 5 sepals

12. Pistillate flowers with variable number of sepals between 3 and 5
A. muricatus

12'. Pistillate flowers with a fix number of sepals: 3 or 5

13. Pistillate flowers with 3 sepals
A. viridis

13'. Pistillate flowers with 5 sepals

14. Leaves with undulate margins
A. crispus

14'. Leaves with flattened margins
A. standleyanus

1. *Amaranthus albus* L.

Vernacular names. “Pale amaranth”, “tumbleweed a.”, “tumbling a.”, “white a.”, “tumble pigweed”, “white p.”. (Spanish) “Cardo ruso”, “yuyo bola”.

Diagnosis. Annual herbs; stems erect, ascending proximally, tumbleweeds, glabrous or almost glabrous. Leaves petiolate; blade obovate, oblong or spatulate. Inflorescences axillary. Pistillate flowers: sepals 3, narrowly ovate or linear. Fruit pyxis, urn slightly rugose or smooth, lid rugose.

Distribution. *Amaranthus albus* is native to Mexico and south and southeast of the United States; at present is naturalized in North America, Eurasia, Africa, and Australia. In South America it is present in Argentina and Uruguay (Bayón, 2015; 2020).

Notes. It grows in agricultural fields, in sandy soils, roadsides, waste places, agrestal and ruderal communities (Costea, Tardif, 2003b). It is resistant to simazine (Heap, 2021).

Specimen examined. ARGENTINA. San Luis: Dep. Gral. Pedernera, Villa Mercedes, *D. L. Anderson 1076* (BAB).

2. *Amaranthus blitoides* S. Watson

Vernacular names. “Matweed”, “m. amaranth”, “mat a.”, “prostrate a.”, “spreading a.”, “prostrate pigweed”, “spreading p.”, “tumbleweed”.

Diagnosis. Annual herbs; stems ascending or prostrate, glabrous. Leaves petiolate; blade lanceolate, obovate, elliptic or spatulate. Inflorescences axillary. Pistillate flowers: sepals (3)4–5, narrowly oblong, obovate or ovate. Fruit pyxis, lid verrucose.

Distribution. *Amaranthus blitoides* is probably native to the United States (Mosyakin, Robertson, 2003); at present is widely naturalized in warm regions of northern Africa, south and temperate North America, and western Asia. In South America it is present in Argentina (Bayón, 2015; 2020).

Notes. It grows in agricultural fields where can be a minor weed, disturbed habitats like roadsides, railroads, waste places, agrestal and ruderal communities (Costea,

Tardif, 2003b). It is resistant to atrazine, chlorsulfuron, simazine, and terbacil (Heap, 2021).

Specimen examined. ARGENTINA. La Pampa: Dep. Caleu-Caleu, Río Colorado, *C. A. O´Donell 1626* (CTES).

3. *Amaranthus blitum* L. Figure 1.

Vernacular names. “Amaranth”, “livid a.”, “purple a.”. (Portuguese) “Caruru”, “bredo”, “caruru folha de cuia”, “c. rasteiro”.

Diagnosis. Annual or short-lived perennial herbs; stems prostrate, ascending or erect, glabrous. Leaves petiolate; blade ovate to ovate-elliptic, emarginate to bilobate. Inflorescences axillary and terminal. Pistillate flowers: sepals 2–3, oblong or spatulate. Fruit utricle, pericarp rugose.

Distribution. *Amaranthus blitum* subsp. *blitum* is probably native to the Mediterranean region (Eurasia and North Africa). It is naturalized in Africa, the Americas (mainly South and Central), Asia, and Australia. In South

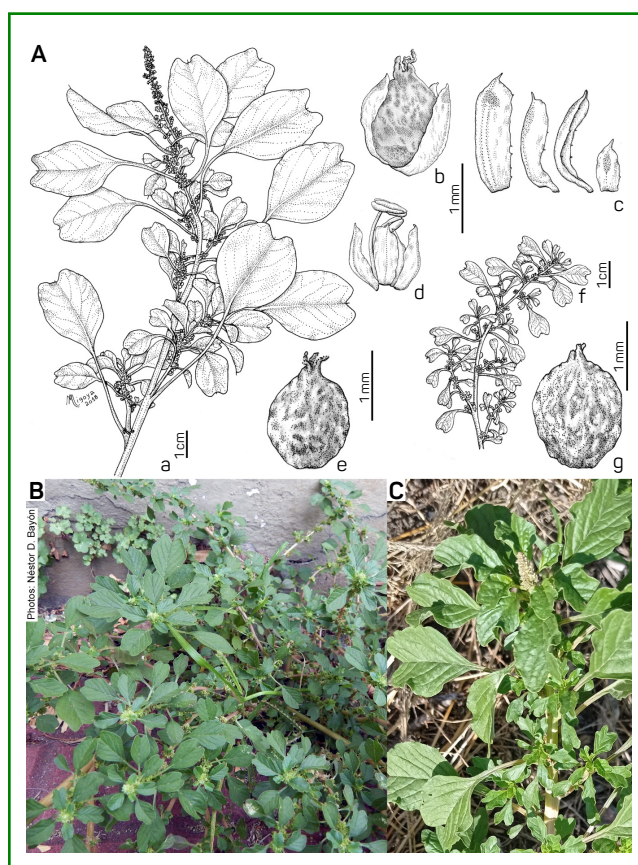


Figure 1 - *Amaranthus blitum* L. (A) Illustration. *Amaranthus blitum* L. subsp. *pseudogracilis* (Thell.) N. Bayón. –a. Floriferous branch. *Amaranthus blitum* L. subsp. *blitum*. –b. Pistillate flower. –c. Sepals and bract of the pistillate flower. –d. Staminate flower. –e. Fruit. *Amaranthus blitum* L. subsp. *emarginatus* (Salz. ex Moq.) Carretero, Muñoz Garmendia & Pedrol. –f. Flowering branch. –g. Fruit. a, Illustrated from Bayón 626 (LPAG); b–e, from Legendre 3895 (LP); f–g, from Lanfranchi 522 (LP). (B) Plant. (C) Floriferous branch

America, the different subspecies are in Argentina (Bayón, 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Smith, Downs, 1972, sub *A. lividus*; Senna, 2006; 2020), French Guiana (Mori et al., 2002), Paraguay (Pedersen, 2016), Uruguay (Bayón, 2015), and Venezuela (Morros et al., 1990, sub *A. lividus*).

Notes. *Amaranthus blitum* has been cultivated as a leaf-vegetable in the Old World. In Eastern Europe it is tolerated as a semicultivated crop (Costea, Tardif, 2003b). Two subspecies of *A. blitum* can become weeds: subsp. *emarginatus* (Uline & W. L. Bray) Carretero, Muñoz Garmendia & Pedrol, and subsp. *pseudogracilis* (Thell.) N. Bayón. Both are present in tropical and temperate regions of America and Europe. In addition, there are two other subspecies: *A. blitum* subsp. *blitum*, which sometimes becomes a weed in irrigated lands of the Old World. Finally, there is a cultigen also used in Europe as a vegetable, *A. blitum* subsp. *oleraceus* (L.) Costea. *A. blitum* is resistant to atrazine, paraquat, simazine, and imazethapyr (Heap, 2021).

Specimens examined. ARGENTINA. Buenos Aires: Pdo. Tigre, A. E. Lanfranchi 522 (LP) [*A. blitum* subsp. *emarginatus*]; Buenos Aires: Pdo. La Plata, N. D. Bayón 626 (LPAG) [*A. blitum* subsp. *pseudogracilis*].

4. *Amaranthus crispus* (Lesp. & Thévenau) Terraciano

Vernacular names. “Crisp-leaved amaranth”.

Diagnosis. Annual herbs; stems decumbent or ascending, pubescent. Leaves petiolate; blade ovate, rhombic or lanceolate, margins undulate. Inflorescences axillary. Pistillate flowers: sepals 5, spatulate or obovate. Fruit utricle, pericarp rugose.

Distribution. *Amaranthus crispus*, a native to Argentina and Uruguay (Bayón, 2015, 2020), is naturalized in Eurasia and North America.

Note. It prefers sandy and rocky soils where invades disturbed habitats and crops, where can be a minor weed.

Specimen examined. ARGENTINA. La Pampa: Dep. Caleu-Caleu, H. H. Bartlett 19933 (SI).

5. *Amaranthus deflexus* L. Figure 2.

Vernacular names. “Argentinian amaranth”, “deflexed a.”, “low a.”, “large-fruit a.”, “perennial pigweed”. (Spanish) “Bledo”, “tomatillo”, “yuyo rastrero”.

Diagnosis. Annuals or short-lived perennials; stems prostrate to ascending, glabrous or almost glabrous. Leaves petiolate; blade rhombic, ovoid, elliptic or lanceolate. Inflorescences terminal and axillary. Pistillate flowers: sepals 2(3), linear, linear-lanceolate, oblong-lanceolate or lanceolate. Fruit utricle, pericarp smooth.

Distribution. *Amaranthus deflexus* is native to South America. Is naturalized and widely distributed in south tropical and temperate regions of the world. In South America it is present in Argentina, Chile (Bayón, 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Siqueira, 2002; Senna, 2020), Peru (Macbride, 1937), and Venezuela (Morros et al., 1990).

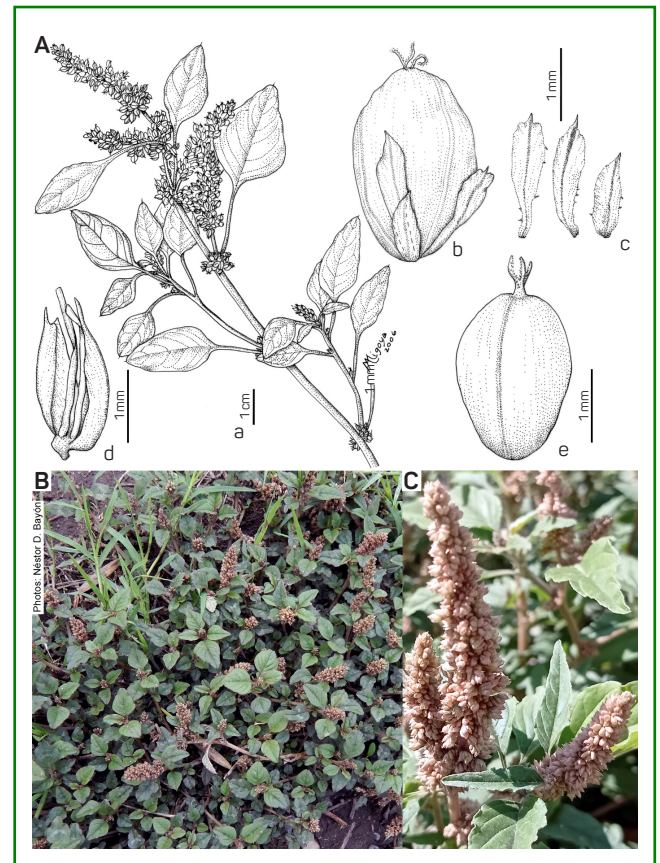


Figure 2 - *Amaranthus deflexus* L. (A) Illustration. -a. Floriferous branch. -b. Pistillate flower. -c. Sepals and bract of the pistillate flower. -d. Staminate flower. -e. Fruit. a-e, Illustrate from Fabris 6055 (LP). (B) Plant. (C) Inflorescence

Note. A ruderal species, which grows on roadsides and uncultivated lands and sometimes becomes an invasive weed.

Specimen examined. ARGENTINA. Buenos Aires: Pdo. La Plata, La Plata, H. A. Fabris 6055 (LP).

6. *Amaranthus hybridus* L. Figure 3.

Vernacular names. “Green amaranth”, “hybrid a.”, “smooth a.”, “green pigweed”, “smooth p.”. (Portuguese) “Bredo”, “caruru”. (Spanish) “Ajara”, “aroma”, “ataco”, “bledo”, “caruro colorado”, “hataco”, “hat’ago”, “hierba colorada”, “jataco”, “moco de pavo”, “penacho”, “tataco”, “yuyo colorado”.

Diagnosis. Annual herbs; stems erect, sometimes ascending, glabrous or slightly pubescent. Leaves petiolate; blade lanceolate, rhombic or ovate. Inflorescences terminal and axillary, erect or reflexed. Bracts of pistillate flowers 2–4 mm long. Pistillate flowers: sepals 5, lanceolate or oblong, acute or subacute (subsp. *hybridus*), or innermost obtuse or truncate (subsp. *quitensis*). Fruit pyxis, pericarp smooth or lid longitudinally furrowed.

Distribution. *Amaranthus hybridus* is native to the east of North America, Central America, and tropical and warm temperate regions of South America (Eliasson, 1987; Costea et al., 2001a; Mosyakin, Robertson, 2003).

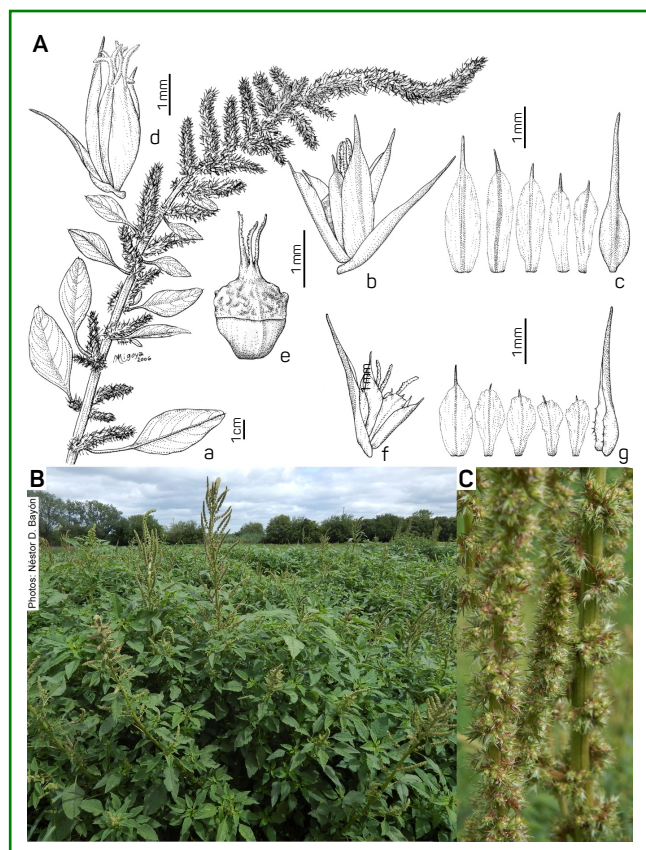


Figure 3 - *Amaranthus hybridus* L. (A) Illustration. *Amaranthus hybridus* L. subsp. *hybridus*. -a. Floriferous branch. -b. Pistillate flower. -c. Sepals and bract of the pistillate flower. -d. Staminate flower. -e. Fruit. *Amaranthus hybridus* L. subsp. *quitensis* (Kunth) Costea & Carretero. -f. Pistillate flower. -g. Sepals and bract of the pistillate flower. a-e, illustrated from Bayón 1097 (LPAG); f-g, from Bayón 642 (LPAG). (B) Stand of plants. (C) Detail of the inflorescence

A. hybridus subsp. *quitensis* (“mucronate amaranth”) is naturalized in Australia and Europe. In South America this species is present in Argentina, Uruguay (Bayón, 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Smith, Downs, 1972; Siqueira, 2002; Senna, 2020), Colombia (Agudelo-H, 2008), Ecuador (Eliasson, 1987), Paraguay (Pedersen, 2016), Peru (Macbride, 1937), and Venezuela (Morros et al., 1990).

Notes. The two subspecies of *Amaranthus hybridus* (*A. hybridus* subsp. *hybridus* and *A. hybridus* subsp. *quitensis* (Kunth) Costea & Carretero) (Costea et al., 2001a; Bayón, 2015) are abundant in disturbed places and agricultural fields where they are regarded as important weeds. The name of *A. hybridus* has been misapplied to other species, such as *A. powellii* and *A. retroflexus*. *A. hybridus* has shown multiple resistance to different active ingredients in several countries of North America and Europe. In South America, specifically in Argentina, has shown resistance to 2-4-D, chlorimuron-ethyl, dicamba, glyphosate, and imazethapyr; in Bolivia to chlorimuron-ethyl, imazamox, imazethapyr, fomesafen, lactofen, oxasulfuron, and sulfentrazone; in

Brazil has presented resistance to chlorimuron-ethyl and glyphosate (Heap, 2021).

Specimens examined. ARGENTINA. Catamarca: Dep. Belén, Hualfin, 2000 m, 10 May 1946, *P. V. de Droghetti s.n.* (CTES) [*A. hybridus* subsp. *hybridus*]; ECUADOR. Azuay: Valle del Río Paute, entre Paute y Cuenca, *W. H. Camp E-2551* (CTES) [*A. hybridus* subsp. *quitensis*].

7. *Amaranthus muricatus* (Moq.) Hieron.

Vernacular names. “African amaranth”, “muricate a.”. (Spanish) “Ataco”, “meona”, “hierba m.”, “yerba m.”.

Diagnosis. Annuals or short-lived perennials; stems prostrate or ascending, glabrous. Leaves petiolate; blade linear or linear-lanceolate. Inflorescences terminal or axillary. Pistillate flowers: sepals (3)4–5, linear-spathulate, linear-obovate or lanceolate. Fruit utricle, completely verrucose.

Distribution. *Amaranthus muricatus* is native to the Southern Cone of South America (Argentina, Paraguay, and Uruguay). It was introduced in south Europe, Australia, and is naturalized in Africa. In South America it is present in Argentina, Uruguay (Bayón, 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Senna, 2020), and Paraguay (Pedersen, 2016).

Note. A ruderal species, which grows in roadsides and waste places. This species can be sometimes a weed of minor importance.

Specimen examined. PARAGUAY. Boquerón: Paratodo, Puerto Casado, *T. M. Pedersen 4010* (CTES).

8. *Amaranthus palmeri* S. Watson. Figure 4.

Vernacular names. “Dioecious amaranth”, “Palmer’s a.”. (Spanish) “Ataco”, “bledo”, “yuyo colorado”.

Diagnosis. Annual herbs; stems erect, glabrous. Leaves long petiolate, petiole equaling blade; blade obovate, rhombic-lanceolate, rhombic-obovate to elliptic. Inflorescence terminal, flexible or moderately stiff. Bracts of pistillate flower 4–6 mm long, subulate, rigid. Pistillate flowers: sepals 5, dissimilar, the outermost acute, the innermost spathulate and obtuse to emarginate. Fruit pyxis, pericarp smooth or somewhat rugose.

Distribution. *Amaranthus palmeri* is native to the southwest of North America, from the south of California to the north of Mexico (Sauer, 1957). It is a widespread invasive weed present in the east of North America, Asia, Australia, Europe (Mosyakin, Robertson, 2003), and South America, specifically in Argentina (Morichetti et al., 2013; Bayón, 2020).

Notes. *Amaranthus palmeri* is established in the center of Argentina (south-west of the province of Córdoba, San Luis, and La Pampa; Montoya et al., 2015) where appears invading summer crops, along with railroads and roadsides. It is resistant to glyphosate (Argentina), chlorimuron-ethyl, cloransulam-methyl, glyphosate, and imazethapyr (Brazil). In the United States this species has shown resistance to multiple herbicide modes of action (Tuesca et al., 2012; Singh et al., 2018; Heap, 2021).

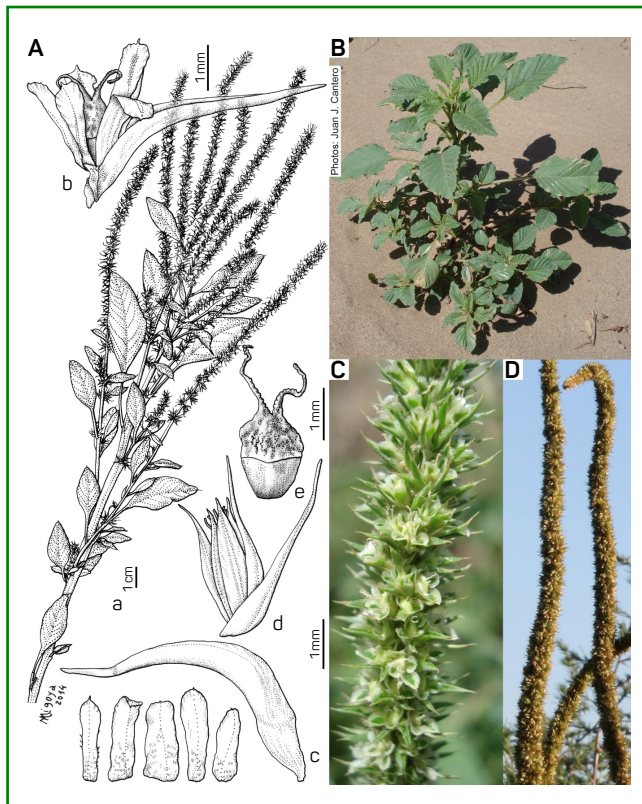


Figure 4 - *Amaranthus palmeri* S. Watson. (A) Illustration. –a. Floriferous branch. –b. Pistillate flower. –c. Sepals and bract of the pistillate flower. –d. Staminate flower. –e. Fruit. a-c, e, illustrated from *Cantero 6441* (LPAG); d, from *Cantero 6440* (LPAG). (B) Plant. (C) Detail of the inflorescence with pistillate flowers. (D) Inflorescences with staminate flowers

Specimens examined. ARGENTINA. La Pampa: Dep. Capital, Estación Experimental Anguil, *J. H. Hunziker 8320* (♀)(CORD), (♂♀)(SI).

9. *Amaranthus powellii* S. Watson

Vernacular names. “Green amaranth”, “Powell’s a.”, “Powell’s smooth a.”.

Diagnosis. Annual herbs; stems erect, glabrous, pubescent toward inflorescence. Leaves petiolate, petiole equaling or longer than blade; blade ovate, elliptic, rarely lanceolate. Inflorescence terminal, erect, rigid, rarely axillary. Bracts of the pistillate flowers 4.5–6(–8) mm long, lanceolate or linear, spinescent, rigid. Pistillate flowers: sepals 3–5, linear-lanceolate to elliptic, acute. Fruit pyxis, lid slightly rugose.

Distribution. *Amaranthus powellii* is native to southwest of the United States and northeast of Mexico. At present is naturalized in temperate regions of North America, Eurasia, and Australia, being also present in the western tropics of South America.

Notes. It prefers cultivated lands, disturbed areas, roadsides, and railroads. It is present in Bolivia (Borsch et al., 2014) and Ecuador (Eliasson, 1987). However, the distribution of *Amaranthus powellii* is confusing due to

specimens determined as *A. powellii* belong to *A. hybridus* subsp. *hybridus*. In Canada and the United States *A. powellii* is resistant to many active ingredients showing multiple resistance (Heap, 2021).

Specimen examined. ECUADOR. Pichincha: vicinity of Quito, 2800 m, *M. Acosta Solís1056* (F).

10. *Amaranthus retroflexus* L.

Vernacular names. “Common amaranth”, “redroot a.”, “wild beet a.”, “redroot pigweed”, “rough p.”. (Spanish) “Bledo”, “moco de pavo”, “penacho”.

Diagnosis. Annual herbs; stems erect, densely pubescent toward inflorescence. Leaves petiolate; blade ovate, oblong-ovate or rhombic. Inflorescences terminal or axillary, erect or reflexed. Pistillate flowers: sepals 5, oblong-spathulate to spatulate, rounded, truncate or emarginate. Fruit pyxis, lid rugose.

Distribution. *Amaranthus retroflexus* ranges in the center and east of North America. It is widespread as a weed in all the continents. In South America it is present in Argentina (Bayón, 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Siqueira, 2002; Senna, 2020), and Venezuela (Morros et al., 1990).

Notes. *Amaranthus retroflexus* is a pioneer which grows in disturbed areas, waste fields, verge of roads and railroads. It also grows in irrigated and dry cultivated lands and gardens. Although it is among the worst weeds which infests a wide range of crops in North America and Europe, it is not relevant in South America.

Specimen examined. ARGENTINA. Córdoba: Dep. Punilla, Sierra Grande, Ea. San Bernardo, *A. T. Hunziker 11628* (CORD).

11. *Amaranthus spinosus* L. Figure 5.

Vernacular names. “Needle burr”, “spiny amaranth”, “thorny a.”, “spiny pigweed”. (Portuguese) “Bredo-de-espino”, “caruru-de-espinos”. (Spanish) “Ataco”, “a. casa”, “a. casha”.

Diagnosis. Annual herbs; stems erect, with paired nodal spines, glabrous, pubescent toward inflorescence. Leaves petiolate, petiole equaling or longer than blade; blade ovate, lanceolate, oblong or rhombic. Inflorescences terminal or axillary. Pistillate flowers: sepals 5, spatulate-oblong, obtuse. Fruit pyxis, smooth or rugose.

Distribution. *Amaranthus spinosus* is probably native to the lowlands of the tropics of America, from the United States to Argentina. Now is a cosmopolitan weed, mainly distributed in the tropics, but also in temperate regions (elsewhere in America, south of Europe, tropical Asia, and Africa) (Eliasson, 1987; Carrizo, Isasmendi, 1998). In South America it is present in Argentina (Bayón 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Smith, Downs, 1972; Siqueira, 2002; Senna, 2006; 2020), Colombia (Agudelo-H, 2008), Ecuador (Eliasson, 1987), Paraguay (Pedersen, 2016), Peru (Macbride, 1937), and Venezuela (Romero, 1975; Morros et al., 1990).

Notes. It is a weed of intermediate importance, usually problematic in pastures. According to Nandula et al. (2014), the resistance to glyphosate of populations of *Amaranthus spinosus* in the United States is likely due to a hybridization event between this species with glyphosate-resistant *A. palmeri*. In addition, *A. spinosus* is resistant to many active ingredients in the United States (Heap, 2021).

Specimen examined. PERU. Junín: San Ramón, A. L. Cabrera 10935 (LP).

12. *Amaranthus standleyanus* Parodi ex Covas

Vernacular names. “Indehiscent pigweed”. (Spanish) “Ataco”, “a. blanco”, “yuyo colorado”.

Diagnosis. Annual herbs; stems erect or decumbent, glabrous, pubescent toward inflorescence. Leaves petiolate; blade lanceolate, ovate or rounded-rhombic. Inflorescences mainly axillary, but also terminal. Pistillate flowers: sepals 5, spatulate. Fruit utricle, rugose.

Distribution. *Amaranthus standleyanus* is native to South America: Argentina (Bayón, 2015; 2020), Bolivia (Borsch et al., 2014), and Paraguay (Pedersen, 2016).

Notes. *Amaranthus standleyanus* is a minor weed in Argentina, where prefers sandy soils, roadsides, and railways.

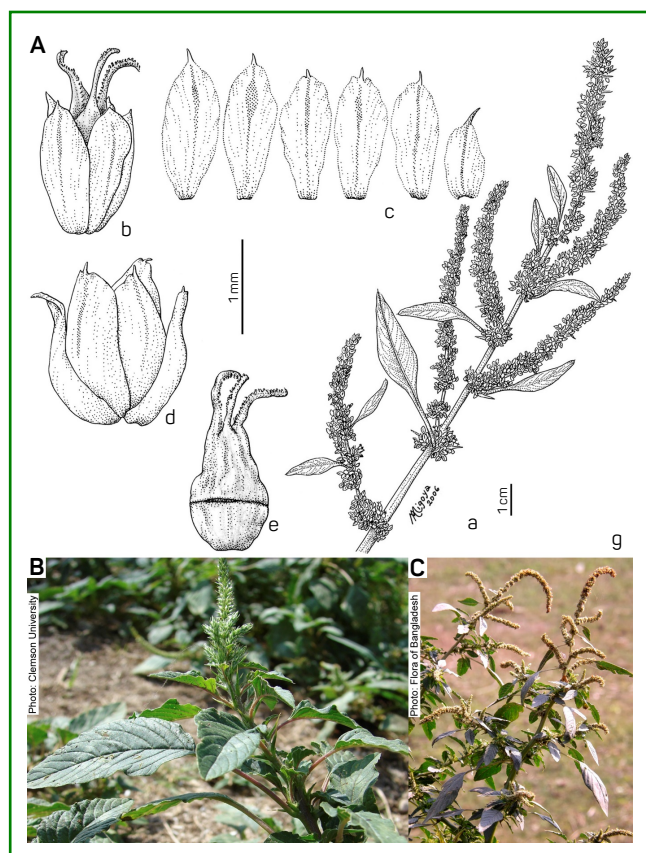


Figure 5 - *Amaranthus spinosus* L. (A) Illustration. –a. Floriferous branch. –b. Pistillate flower. –c. Sepals and bract of the pistillate flower. –d. Staminate flower. –e. Fruit. a, Illustrated from Cabrera 10872 (LP); b–e, from Cabrera 10931 (LP). (B) Floriferous branch. (C) Floriferous branches

Specimen examined. BOLIVIA. Tarija. Dep. Gran Chaco, 30 km al N de Yacuiba campo de Tapia, 2 km E de la ruta a Villa Montes, A. Krapovickas & A. Schinini 32484 (CTES).

13. *Amaranthus viridis* L. Figure 6.

Vernacular names. “Common garden calalu”, “green c.”, “green amaranth”, “slender a.”, “tropical green a.”. (Portuguese) “Caruru de soldado”, “c. bravo”. (Spanish) “Bledillo”, “bledo”, “caá-rurú”, “c. macho”, “chacilón”, “chaquillón”, “karurú”, “quinoa rosada”, “hierba del sapo”.

Diagnosis. Annuals or short-lived perennials; stems erect, glabrous or puberulent. Leaves petiolate; blade ovate, ovate-elliptic or rhombic. Inflorescences terminal and axillary, the first ones long and slender. Pistillate flowers: sepals 3, oblong or narrowly-spathulate. Fruit utricle, rugose.

Distribution. *Amaranthus viridis* is native to South America, widely naturalized all around the globe, mainly in tropical, sub-tropical, and temperate regions of America, Asia, Europe, and Australia. In South America it is present in Argentina (Bayón 2015; 2020), Bolivia (Borsch et al., 2014), Brazil (Smith, Downs, 1972; Siqueira, 2002; Senna, 2006; 2020), Colombia (Agudelo-H, 2008), Ecuador (Eliasson, 1987), Paraguay (Pedersen, 2016), Peru (Macbride, 1937), and Venezuela (Romero, 1975; Morros et al., 1990).

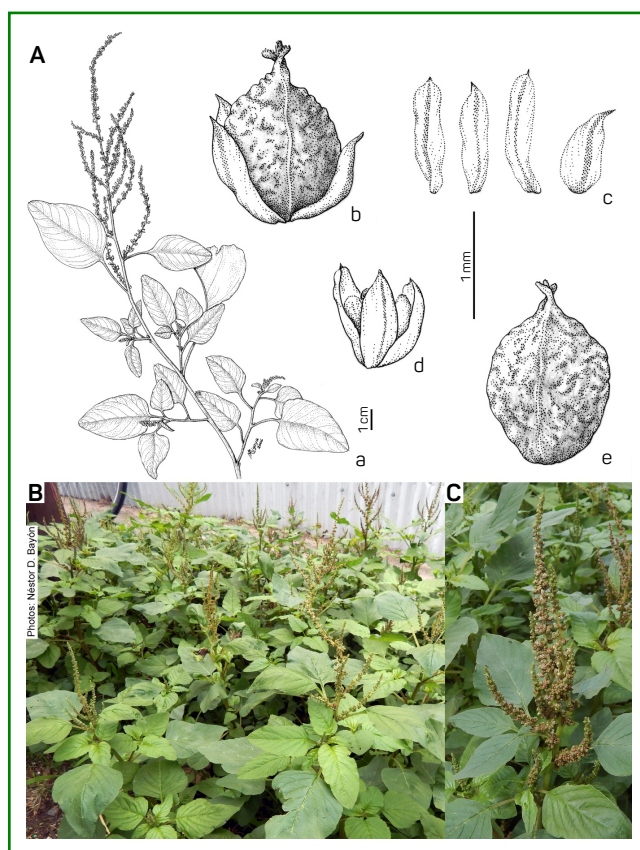


Figure 6 - *Amaranthus viridis* L. (A) Illustration. –a. Floriferous branch. –b. Pistillate flower. –c. Sepals and bract of the pistillate flower. –d. Staminate flower. –e. Fruit. a–e, Illustrated from Bayón 613 (LPAG). (B) Plant. (C) Inflorescence

Notes. *Amaranthus viridis* is a ruderal species, usually present in modified soils. Common weed in fertile soils in southern Brazil (Smith, Downs, 1972). Resistant to atrazine, prometryn, and trifloxysulfuron-sodium (Brazil) (Heap, 2021).

Specimen examined. BRASIL. Santa Catarina. Mun. Aguas de Chapecó, *L. B. Smith & R. M. Klein 14089* (LP).

4. Conclusions

Within the 13 species of weeds that belong to genus *Amaranthus* in South America, there are two among the worst noxious weeds: *A. hybridus* (with two subspecies), that ranges in many countries of this continent, and *A. palmeri*, in a restricted area of Argentina. Other four important weeds are widespread in different countries of

South America: *A. blitum* (with two subspecies), *A. deflexus*, *A. spinosus*, and *A. viridis*. Finally, although *A. powellii* and *A. retroflexus* are relevant weeds in North America and Europe, they are, together with the other species, of minor importance in South America.

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