



Identification of the weedy pigweeds and waterhemp of Iowa

Sponsored by the Iowa Soybean Promotion Board

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IOWA STATE UNIVERSITY
Extension and Outreach

Pm 1786 April 1999

Cover photo: Common waterhemp in soybean field, Story County, Iowa

Introduction

The pigweeds, including the waterhemp, present many weed management challenges for crop production. Pigweeds are a complex of important field weeds that can vary in their responses to herbicides and weed management practices. Identification is often difficult and producers are left to guess which species are growing in their fields. However, pigweeds can be identified and management practices chosen to control them effectively. The aim of this brochure is to provide the producer with the information necessary to identify pigweeds common to Iowa so that they can be managed more efficiently.

Diversity

Pigweeds and waterhemp belong to a group of plants known as the amaranths (genus *Amaranthus*). There are from 65 to 75 species of amaranths, many of which are important field weeds. They include such well known Iowa pests as redroot pigweed, smooth pigweed, Powell amaranth, and common waterhemp. Other less troublesome weedy pigweeds found in Iowa are spiny amaranth, prostrate pigweed, and tumble pigweed. The term pigweed will be used throughout to refer to any of the above species, including common waterhemp.

Habitat

Pigweeds grow naturally in open areas with full sun and disturbed soils. They are annual plants, growing rapidly in disturbed areas and producing from tens of thousands to hundreds of thousands of seeds per plant. These habitat preferences enable them to grow well in agricultural fields that mimic their natural environments.

Biology

Pigweeds can adapt quickly to new environments and some populations have acquired resistance to many common herbicides, most notably the ALS inhibiting herbicides. Pigweeds are wind pollinated and hybridization between species does occur.

Management

The key to pigweed control is integrated management programs. Pigweeds, like other small-seeded annuals, thrive in no-till systems because they need to germinate close to the soil surface. In addition, pigweeds adapt very quickly to chemical forms of control. The following guidelines should form the basis of a management system.

- 1) Proper identification is needed for an adequate control to be chosen. This is crucial, as different species of pigweed may respond differently to a particular herbicide.
- 2) Rotate herbicides annually. Avoid using a single herbicide or class of herbicide for more than two consecutive seasons.
- 3) Narrow row soybean culture helps manage redroot pigweed due to the weed response to a dense crop canopy but is not as effective on common waterhemp. Late germinating waterhemp can emerge through the crop canopy if the canopy is reduced by other factors such as disease or herbicide injury.
- 4) Tilling reduces pigweed populations. Plowing or heavy soil disturbance may be recommended in cases of major infestation. Rotary hoeing and cultivation are efficient alternative strategies for control of redroot pigweed, but are less effective on common waterhemp.
- 5) Crop rotation is important in diversifying the number of available herbicides, the cropping environment, and other weed controls.

An excellent management guide is "Waterhemp Management in Agronomic Crops," University of Illinois Publication X855. Available from Vocation Agriculture Service, Information Services, College of Agricultural, Consumer and Environmental Sciences, University of Illinois, 1401 S. Maryland Dr., Urbana IL 61801 or FAX (217)333-3871.

Identification

Proper identification of pigweeds is essential for choosing adequate management schemes. Pigweeds are most difficult to identify as seedlings when weed management treatments are applied. Identification in the adult stage is easier and useful in deciding which treatments to use the following year.

To aid the producer in identifying pigweeds, we have provided an illustrated table of their distinguishing characteristics and written descriptions of common waterhemp, redroot pigweed, smooth pigweed, Powell amaranth, and Palmer amaranth, including U.S. distribution, seedling and adult descriptions, technical characters, management schemes, and pertinent notes. Each species is designated by its common name as well as its scientific name and Weed Science Society of America (WSSA) approved abbreviation.

The first step in using this guide is to look at the Identification Table on page 6. The table provides comparative characters for seedlings as well as mature individuals. When using the table remember to consider as many of the characters as possible before making an identification. Once you have reached an identification turn to the species write-up. If the species does not seem to match any of these descriptions, turn to the section on Less Troublesome Pigweeds on page 18. The technical key and characters on page 5 are not necessary for identification, but are provided as an extra tool for interested readers with some botanical experience.

Traditionally, waterhemp has been divided into two species, the common waterhemp (*Amaranthus rudis*) found from Nebraska south to Texas and the tall waterhemp (*Amaranthus tuberculatus*) found from Indiana east to Ohio. Waterhemp from Iowa, Illinois, and Missouri are often intermediate between these species, but seem to respond similarly to weed treatments regardless of which name is placed on them. Currently, waterhemp in Iowa is desig-

nated generally as common waterhemp; ongoing taxonomic studies should resolve this issue.

An excellent field guide is the Kansas State University and USDA/ARS publication "Pigweed Identification: A Pictorial Guide to the Common Pigweeds of the Great Plains." Available from the Kansas State University Cooperative Extension Service Distribution Center, 16 Umberger Hall, Kansas State University, Manhattan, KS 66506-3406.

Characters

One of the problems with pigweed identification is that most of the technical differences are based on flower characters. Pigweed flowers are very small (1-4 millimeters) and most of the characters require magnification to see clearly. The following nontechnical characters are used in the table for identification. They can be divided roughly into two categories, vegetative and floral/seedhead characters.

Color is not a useful character because pigweeds vary greatly in coloration even within a single population (Figures 7 and 8, page 19). All attempts to separate species based on color have failed, although some color trends are noted in the descriptions.

Vegetative characters

Vegetative characters are less reliable than floral and seedhead characters. However, they are important in identifying immature plants and some general trends can be noted.

Seedling Shapes

Pigweed seedlings differ in shape. In general, common waterhemp has oar-shaped seed leaves while redroot and smooth pigweeds have long, narrow seed leaves. The table includes drawings illustrating these differences.

Hair

Stem, leaf, and seedling texture and appearance can be altered by the presence of hairs. The texture varies from rough to very smooth. The lack of hairs on smooth plants often gives the leaves and stems a glossy appearance. Vegetative smoothness is distinguished from a smooth seedhead (see table).

Leaf shapes

Pigweed leaves vary greatly in size and shape on a single plant. The table illustrates general trends in species.

Floral and seedhead characters

All pigweeds have separate male (pollen-producing) and female (seed-producing) flowers. The flowers are minute and can be analyzed only with a hand lens or greater magnification. Male flowers are very similar across all species, varying mainly only in size. Female flowers are much more variable and detailed illustrations are provided for each species. Both male and female flowers have bracts (modified leaves), the size and shape of which can alter the appearance of the seedhead (see below).

Male and Female Plants

Common waterhemp and Palmer amaranth have separate male and female plants (dioecious). The other species have both male and female flowers on a single plant (monoecious). This may be difficult to determine, as the ratio of male to female flowers in plants with both sexes can be as low as 1 male flower to 100 female flowers, causing them to resemble female

plants. The best way to determine this character is to look for male plants in the population.

Seedhead Shape

Seedhead shape varies among the species in length, width, and appearance. Lengths are described as short, long, and very long. Widths are described as slender or thick. Appearance is affected by the length of the bracts and is recorded as smooth, slightly prickly, prickly, or very prickly. A comparative illustration of seedheads is provided in Figure 1.

Technical Characters

A short section detailing the technical flower characters used to distinguish amaranth species is included along with the drawings. Distinguishing these characters will require use of a hand lens or greater magnification.

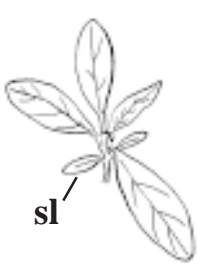











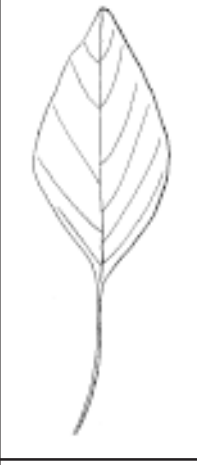
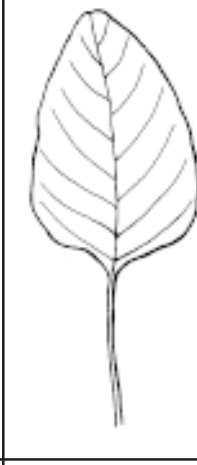
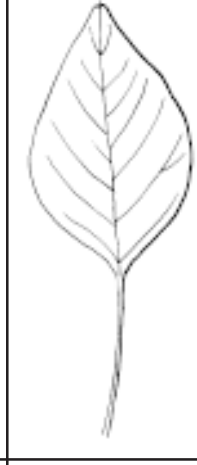
Technical Key

The key is a formal botanical guide to the species and may be useful in addition to the table. The characters refer to the technical characters described and illustrated under the species write-ups. The keys do require some level of botanical expertise to use. However, the table of nontechnical characters is meant to stand alone and the technical key is provided for additional information.

Technical Key to Species

- 1a. Plants dioecious
 - 2a. Plants pistillate (female)
 - 3a. Tepals 0-1; bracts short, 0.5-2.5 mm; stigmas 3.....Common waterhemp
 - 3b. Tepals 5; bracts long, 3-7 mm; stigmas 2.....Palmer amaranth
 - 2b. Plants staminate (male)
 - 4a. Bracts short, 0.9-2.8 mm; all tepal midribs short.....Common waterhemp
 - 4b. Bracts long, 2.3-5 mm; first tepal midrib long.....Palmer amaranth
- 1b. Plants monoecious
 - 5a. Bracts long, 4-7mm; at least one tepal longer than the fruit
 - 6a. Tepals 5, all longer than the fruit, apices obtuse or retuse, sometimes reflexed.....Redroot pigweed
 - 6b. Tepals 3-5, commonly only two longer than fruit, apices acute or acuminate, straight.....Powell amaranth
 - 5b. Bracts short 3-5mm; all tepals shorter than the fruit.....Smooth pigweed

Pigweed and waterhemp identification table

	Common Waterhemp	Redroot Pigweed	Smooth Pigweed	Powell Amaranth	Palmer Amaranth
Seedling shape					
Stem hairs					
Leaf shapes					
Separate male and female plants	Yes	No	No	No	Yes
Seedhead shape	smooth, long, slender	prickly, short, stout	slightly prickly, long, slender	prickly, very long, thick	very prickly, very long, thick

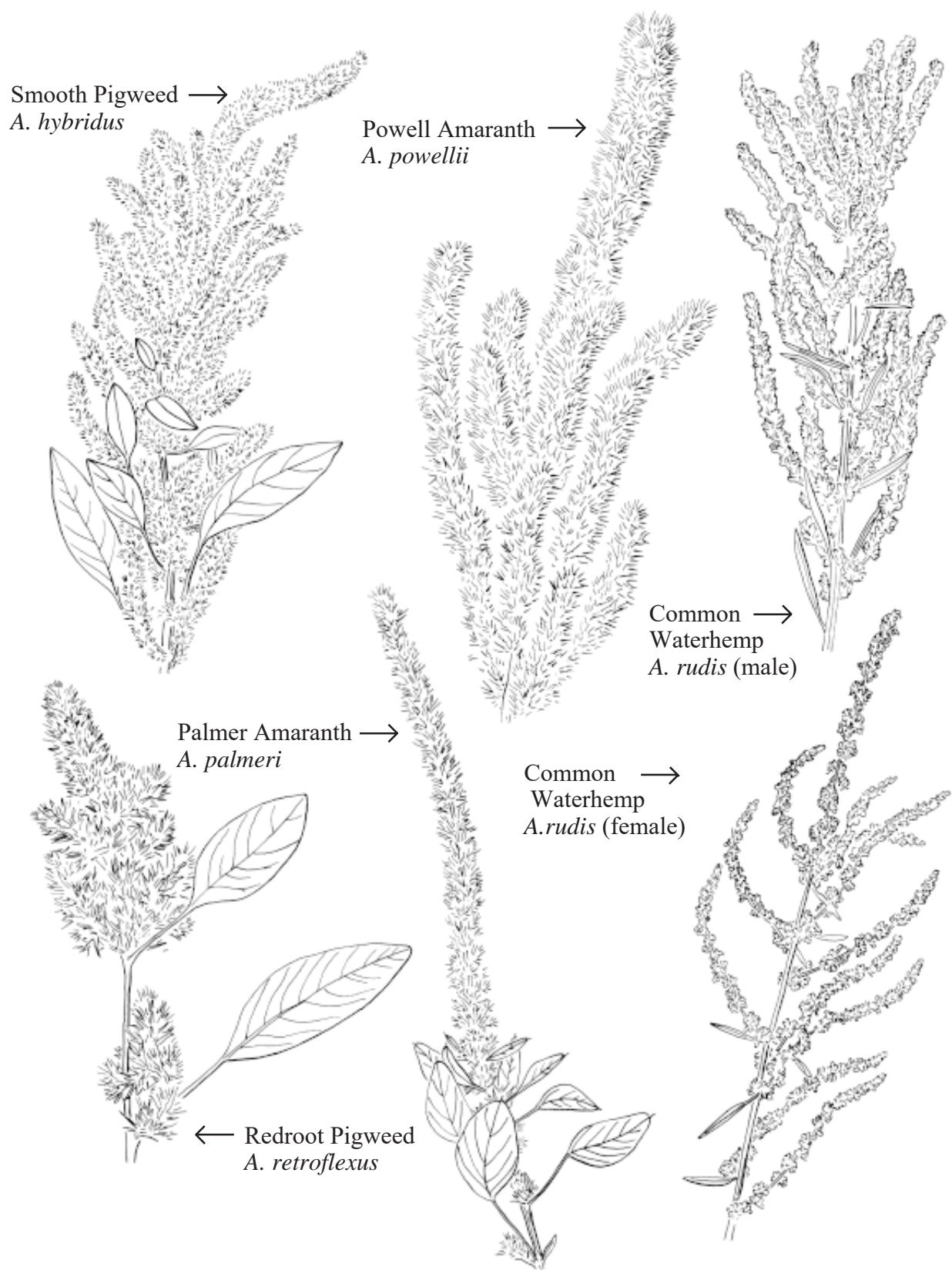


Figure 1. Seedhead shapes with male common waterhemp for comparison.

Common Waterhemp

A. rudis

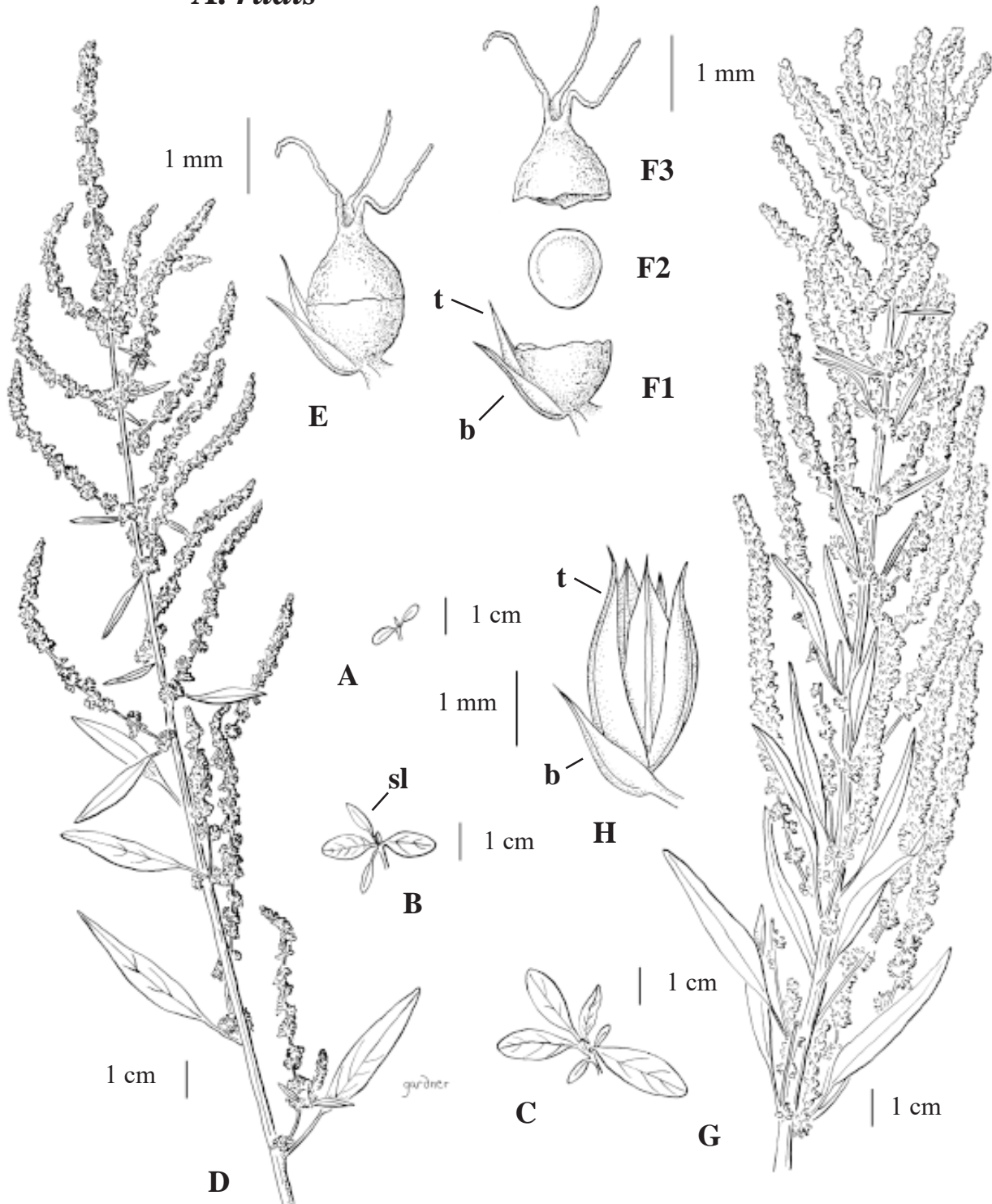


Figure 2. A-C. Seedlings: A. Seed leaf stage. B. Two-leaf stage (sl—seed leaf). C. Four-leaf stage. D. Seedhead (female plant). E. Female flower. F. Female flower, exploded view: F1. Flower and bract; F2. Seed; F3. Seed cap. G. Flowering male plant. H. Male flower. (b—bract; t—tepals)



Common waterhemp in cornfield, Wapello County, Iowa



Seedlings.



Female seedhead.



Male flowers.

Common Waterhemp (*Amaranthus rudis*, AMATA)

U.S. Distribution: Texas to Ohio.

Descriptions

Seedlings: Seed leaves are oar-shaped. First true leaves are lance-shaped with a slight notch at the tip. Seedlings are very smooth and the plants remain smooth.

Adults: Common waterhemp are slender and willowy plants with many branches. Plants vary greatly in size, from knee high to eight feet tall. Stems and leaves are often brightly colored, varying from deep red or pink to emerald green; stems, leaves, and seedhead all may be differently colored on a single individual. Stems and leaves are very smooth and hairless with a bright, glossy appearance. Leaves are long and narrow. Seedheads are long, slender and smooth. Male and female plants are found in approximately equal numbers.

Technical Characters

Pistillate flowers: Bracts short, 0.5-2.5 mm. Tepals usually 1, but often absent. Stigmas 3. Fruit opening when mature, the seed falling free (dehiscent) or not (indehiscent).

Staminate flowers: Bracts short, 0.9-2.8 mm. Tepals 5, all midribs short, extending 0-0.6 mm beyond the tepal blade apex.

Management

Common waterhemp can be difficult to manage. Many biotypes are ALS herbicide resistant; there are also reports of triazine resistant biotypes. In addition, this species germinates later in the growing season and continues to germinate late in the growing season. Late germinating plants may only grow to a few inches but will flower and set viable seed. Narrow row soybean culture and rotary hoeing are not completely effective common waterhemp controls, but late cultivation, when row spacing is appropriate, or narrow row culture can minimize the impact of late emerging common waterhemp.

Redroot Pigweed

A. retroflexus

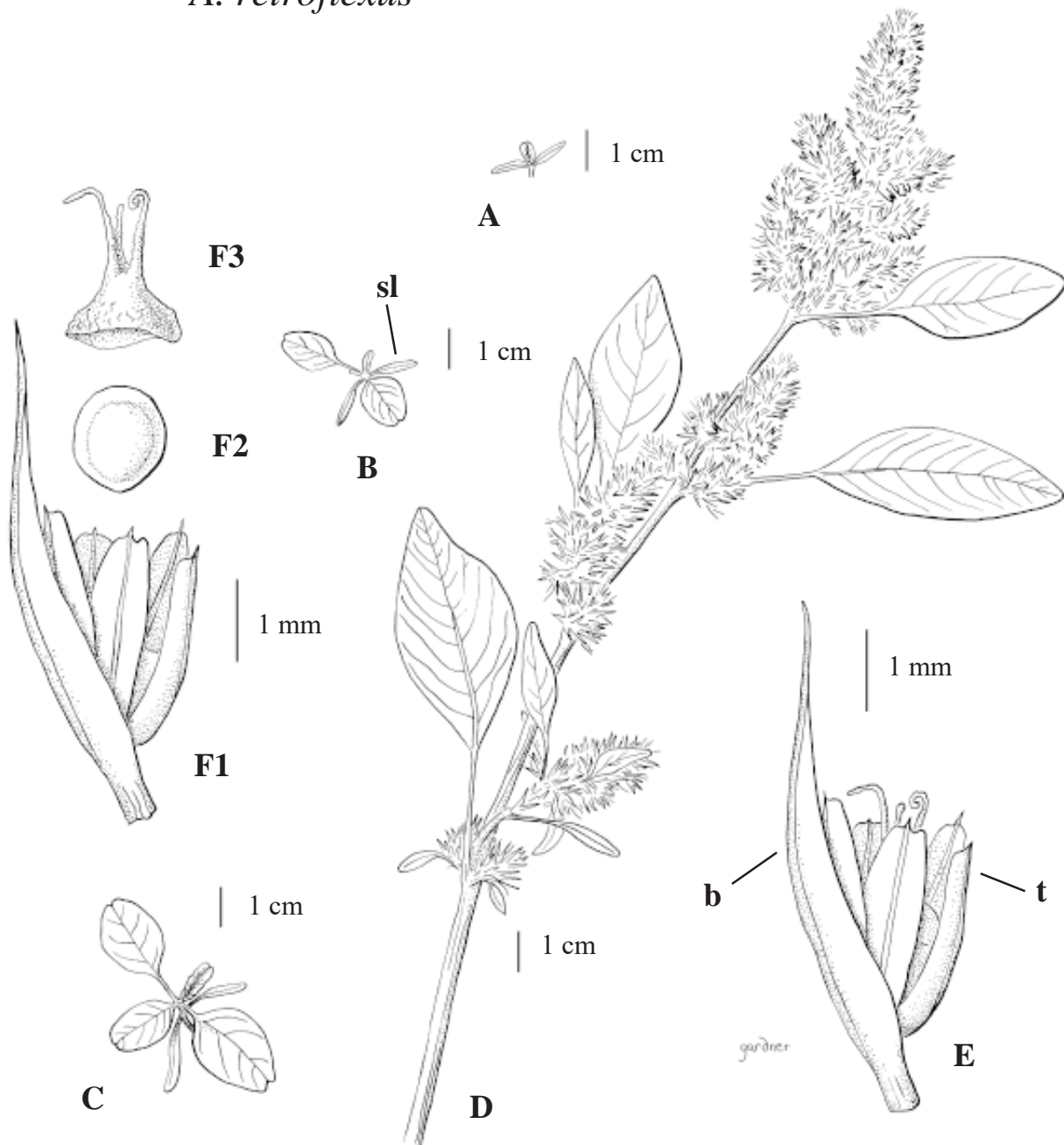


Figure 3. A-C. Seedlings: **A**. Seed leaf stage. **B**. Two-leaf stage (sl—seed leaf). **C**. Four-leaf stage. **D**. Seedhead. **E**. Female flower. **F**. Female flower, exploded view: **F1**. Flower and bract; **F2**. Seed; **F3**. Seed cap. (**b**--bract; **t**--tepal)



Flowering plant, Lee County, Iowa



Redroot pigweed in cornfield, Jefferson County, Iowa



Seedlings.

Redroot Pigweed

(*Amaranthus retroflexus*,
AMARE)

U.S. Distribution: Continental U.S.

Descriptions

Seedlings: Seed leaves are long and narrow. First true leaves are strongly egg-shaped with a deep notch at the tip. As seedlings mature the stem becomes very roughly hairy.

Adults: Redroot pigweeds are tall plants with few branches. Stems tend to be green or reddish in color with green leaves. Stems and leaves are very hairy. Leaves are egg-shaped. Seedhead branches are few and tend to be short and stout with a prickly appearance.

Technical Characters

Bracts long, 4-7 mm. Tepals 5, longer than the fruit; apices obtuse or retuse, sometimes reflexed. Stigmas 3.

Management

Redroot pigweed is less difficult in general to manage than common waterhemp. However, caution is needed. Some populations have triazine resistant biotypes. Although not currently resistant to ALS inhibiting herbicides, redroot pigweeds are known to hybridize with common waterhemp in Iowa. Although most hybrid individuals are sterile, they can produce some viable seed. These second generation hybrids have the potential to backcross resistance genes into redroot pigweed populations. An integrated program combining cultivation and appropriate herbicides should facilitate effective redroot pigweed control.



Seedhead.

Smooth Pigweed

A. hybridus

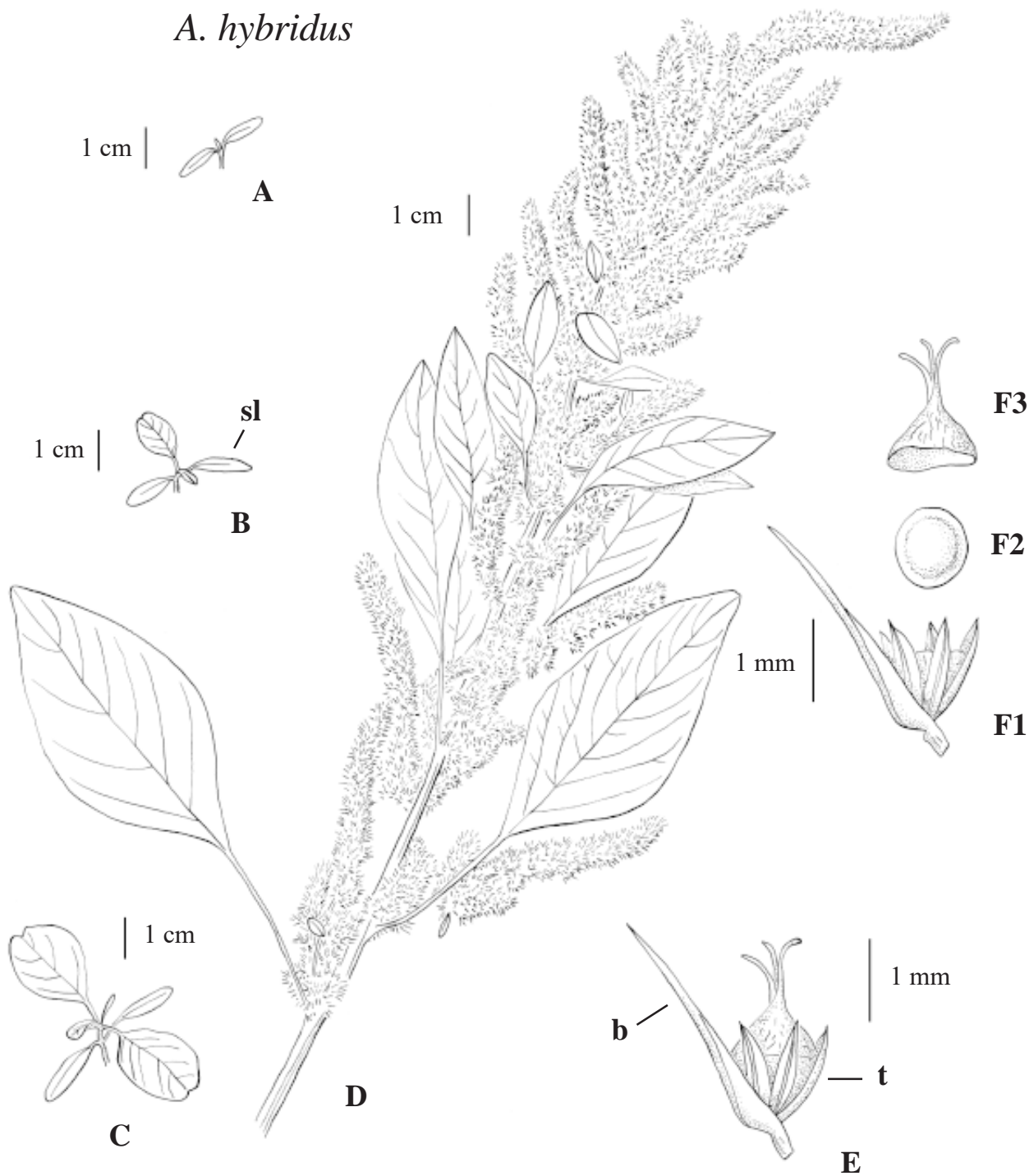


Figure 4. A-C. Seedlings: **A**. Seed leaf stage. **B**. Single-leaf stage(**sl**—seed leaf). **C**. Two-leaf stage. **D**. Seedhead. **E**. Female flower. **F**. Female flower, exploded view: **F1**. Flower and bract; **F2**. Seed; **F3**. Seed cap. (**b**—bract; **t**—tepal)



Flowering plant, Lee County, Iowa



Seedlings.



Seedhead.

Smooth Pigweed

(*Amaranthus hybridus*, AMACH)

U.S. Distribution: Eastern U.S.

Descriptions

Seedlings: Seed leaves are long and narrow. First true leaves are strongly egg-shaped with a deep notch at the tip. Seedlings become hairy as they mature.

Adults: Smooth pigweeds are tall plants with few branches. Stems and leaves tend to be red or green. Leaves are egg-shaped. Stem and leaves tend to be slightly hairy, but not roughly hairy like redroot pigweed. Seedhead branches are numerous, long, thick, and slightly prickly.

Technical Characters

Bracts short, 3-5 mm long. Tepals 5, shorter than the fruit; apices acute to acuminate; straight. Stigmas 3.

Management

Smooth pigweed is less common than redroot pigweed in Iowa, and appears to be restricted to the southeastern corner of the state. Because it is extremely weedy in Illinois and Missouri, the potential for spread into Iowa from these states is great. Management of smooth pigweed is similar to that of redroot pigweed. Smooth pigweed biotypes outside of Iowa have been found with multiple resistances to ALS and triazine herbicides.

Powell Amaranth

A. powellii

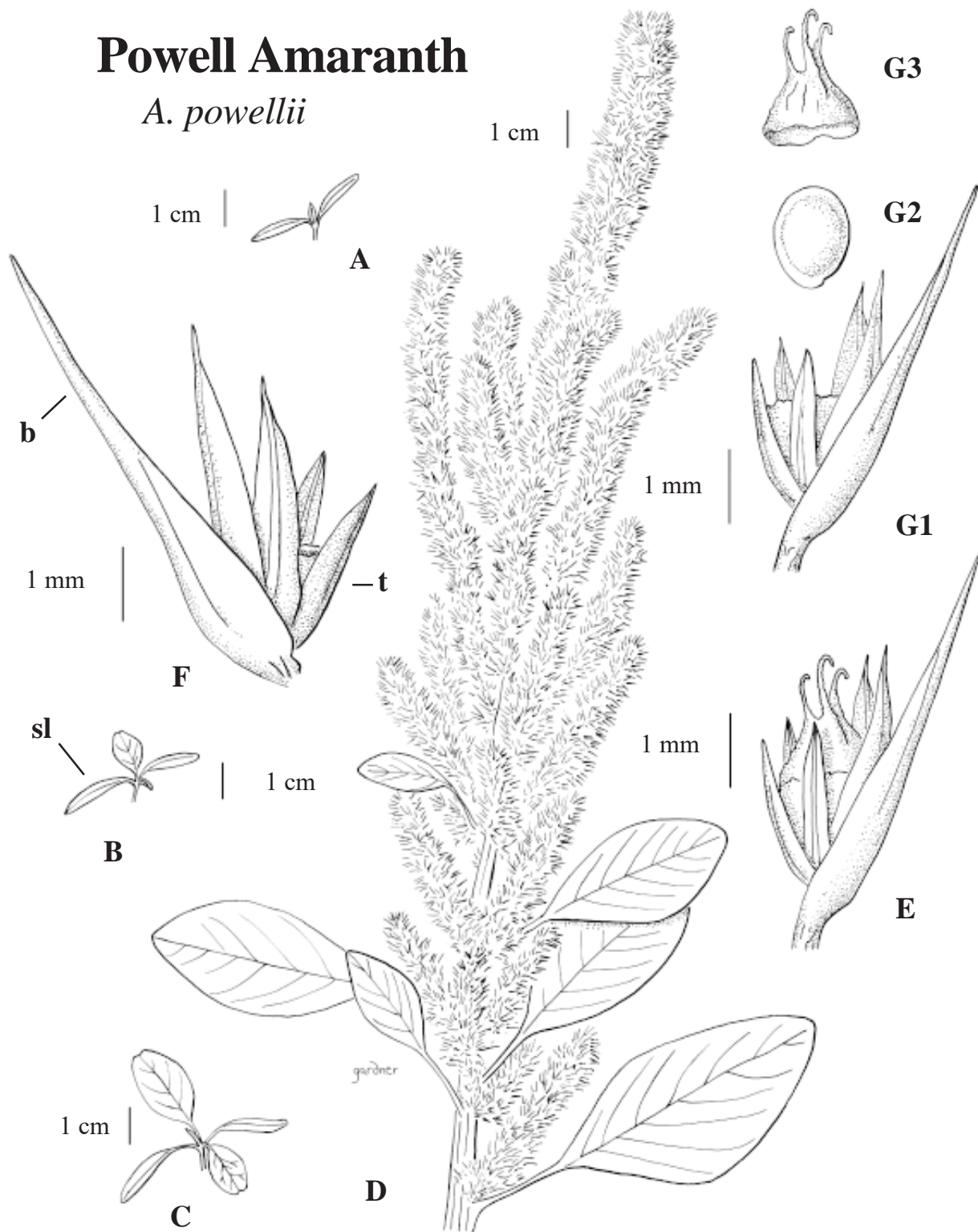


Figure 5. A-C. Seedlings: **A.** Seed leaf stage. **B.** Single-leaf stage (sl—seed leaf;). **C.** Two-leaf stage. **D.** Seedhead. **E.** Female flower with five tepals. **F.** Female flower (without seed cap), with four tepals. **G.** Female flower with five tepals, exploded view: **G1.** Flower and bract; **G2.** Seed; **G3.** Seed cap (b—bract; t—tepal).



Flowering plant in greenhouse.



Seedlings.

Powell Amaranth

(*Amaranthus powellii*, AMAPO)

U.S. Distribution: Northern and western U.S.

Descriptions

Seedlings: Seed leaves are very long and narrow. First true leaves are egg-shaped. Seedlings may be deep red or green in color. As seedlings mature they become lightly hairy.

Adults: Powell amaranths are tall plants with few branches. Stems and leaves tend to be red or green and lightly hairy. Leaves are egg-shaped. Seedhead branches are few and are usually very long, thick, and prickly.

Technical Characters

Bracts long, 5-7mm. Tepals 3-5, this number often varying between flowers on a single individual, the first one or two tepals (those located immediately behind the bract) are longer than the fruit; the remaining tepals often shorter than the fruit; apices acute to acuminate, straight. Stigmas 3.

Management

Powell amaranth appears to be restricted to the northern two tiers of Iowa counties, especially in the northeast. It is a major weed in Minnesota, Wisconsin, and northern Illinois. Powell amaranth should respond to the same control strategies that are effective against redroot pigweed. Triazine resistant biotypes have been reported.



Seedhead.

Palmer Amaranth

A. palmeri

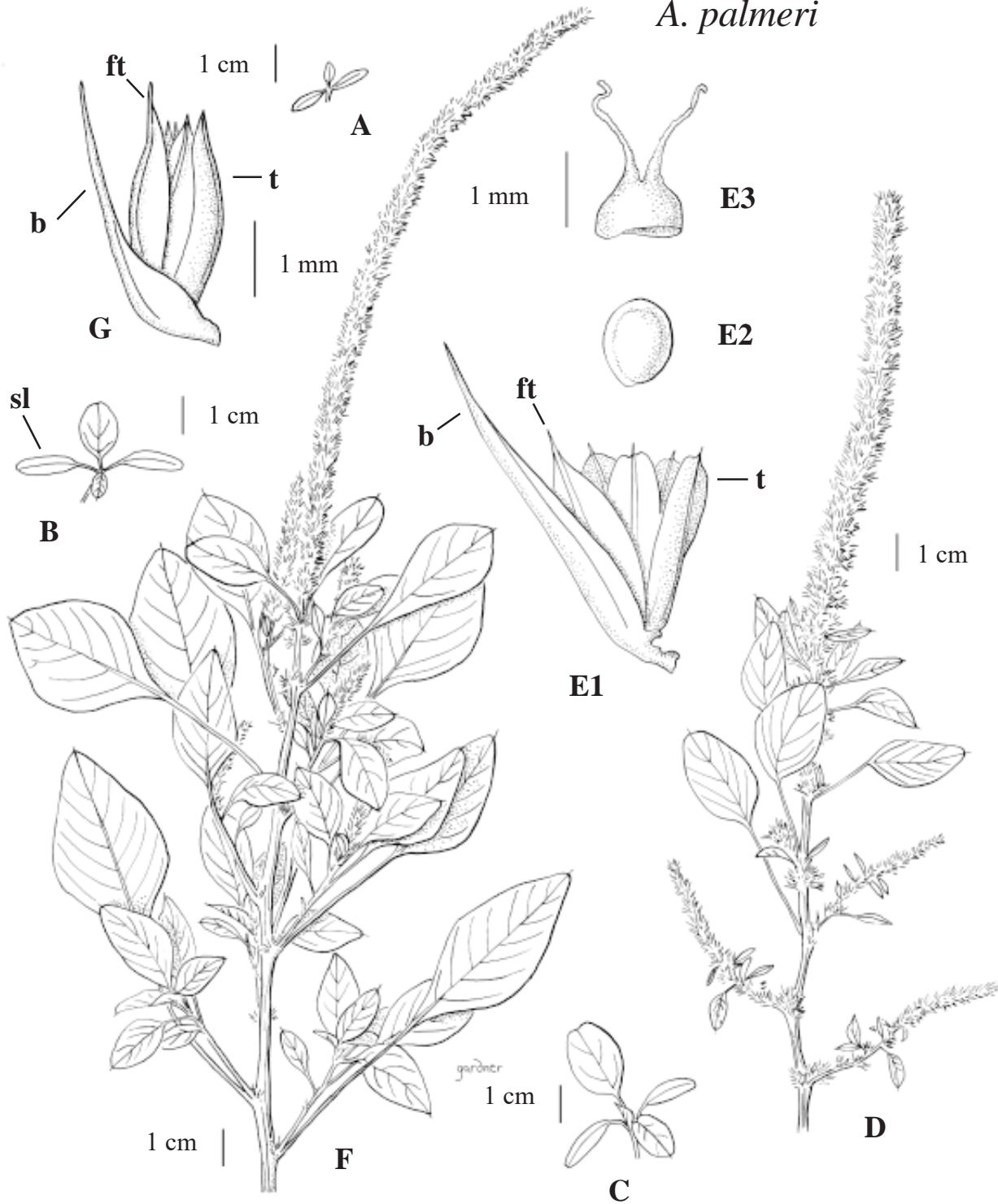


Figure 6. A-C. Seedlings: **A.** Seed leaf stage. **B.** Single-leaf stage (sl—seed leaf). **C.** Two-leaf stage. **D.** Seedhead (female plant). **E.** Female flower, exploded view: **E1.** Flower and bract; **E2.** Seed; **E3.** Seed cap. **F.** Flowering male plant. **G.** Male flower. (b—bract; ft—first tepal; t—tepal)



Flowering plant, Riley County, Kansas



Seedlings.



Female seedhead.



Male flowers.

Palmer Amaranth

(*Amaranthus palmeri*, AMAPA)

U.S. Distribution: Southern U.S., north to Nebraska.

Descriptions

Seedlings: Seed leaves are long and wide. First true leaves are egg-shaped, later leaves becoming diamond-shaped. Seedlings are very smooth and hairless. Leaves may have a white or red V-shaped mark during early stages of development.

Adults: Palmer amaranth is an extremely vigorous, tall plant. Stems and leaves vary from green to pink. The leaves are diamond-shaped and have long leaf stalks. Leaf tips have a fine, short hair extending from the midrib beyond the leaf blade. Stems and leaves are hairless and smooth. The seedhead is very long, thick, and extremely prickly due to the very long bracts.

Technical Characters

Pistillate flowers: Bracts long, 3-7 mm. Tepals 5; first tepal acute, the remaining four retuse or obtuse, sometimes reflexed. Stigmas 2.

Staminate flowers: Bracts long, 2.3-5 mm. Tepals 5, first tepal with long midrib extending 0.25-1.4 mm beyond the tepal blade apex.

Management

This species is not currently established in Iowa. However, it has been rapidly extending its range northward into southern Missouri, Nebraska, and Illinois, and a few samples are known from southwestern Iowa. Palmer amaranth can be ALS herbicide resistant. It grows vigorously and post-emergence herbicides like the diphenylethers may not be effective. This species has an extended germination time and should be managed similarly to common waterhemp. Contact the ISU Extension Agronomy Office, 2104 Agronomy Hall, Ames IA 50011, telephone (515) 294-1923, Fax (515) 294-9985 if you believe you have found this species in your fields.

Less troublesome pigweeds

The following pigweed species are currently less troublesome in Iowa. Spiny amaranth is a problem weed elsewhere in the United States, but appears to be rare and of limited distribution in Iowa. Tumble pigweed and prostrate pigweed are common in Iowa, but are not important as field weeds.

Spiny Pigweed (*Amaranthus spinosus*, AMASP)

Distribution: Rare in Iowa, confined mainly to the southern two tiers of counties.

Description: Spiny pigweed is unique in having sharp, vegetative spines throughout the plant at the point where leaves attach to the stem. It also has a unique arrangement of male and female flowering branches, with male flowers found on branches at the top and female flowers on branches near the bottom and middle of the plant.

Notes: Spiny amaranth is distinct due to its spines. Iowa appears to be the northern extension of its range. It is most common in pastures.

Tumble Pigweed (*Amaranthus albus*, AMAAL)

Distribution: Tumble pigweed is found in all counties of Iowa.

Description: Tumble pigweed is a small plant, about three feet high at maturity. Its flowers are found in small, inconspicuous clusters throughout the plant attached between the leaves and stems.

Notes: Tumble pigweed is common across the entire United States. In Iowa it seems to be confined mainly to construction areas and is not currently an important field weed.

Prostrate Pigweed (*Amaranthus blitoides*, AMABL)

Distribution: Prostrate pigweed is found in all counties of Iowa.

Description: Prostrate pigweed is a low-lying, spreading, mat-like plant, rarely growing more than a few inches off the ground. Like tumble pigweed, its flowers are found in small, inconspicuous clusters throughout the plant attached between the leaves and stems.

Notes: Although prostrate pigweed is common in the state, it seems to be confined to sidewalk cracks and waste ground. It is not a major agricultural weed.

Color variation



Figure 7. Smooth pigweed, a red plant and a green plant.



Figure 8. Common waterhemp, a red plant behind the green one.

Reviewed by: Douglas Buhler, USDA/ARS National Soil Tilth Laboratory, Ames, Iowa; Robert Hartzler, Iowa State University Extension; Michael Horak, Kansas State University, Manhattan, Kansas; and Loyd Wax, University of Illinois, Champaign-Urbana, Illinois.

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