

Identification Guide for Fruits of Some Common and Noxious Thistle and Knapweed Species (Asteraceae, tribe Cardueae)



Deborah J. Lionakis Meyer and Robert A. Price

California Department of Food and Agriculture
Plant Pest Diagnostics Center – Seed Science Laboratory
2020

The 2020 edition contains new species and revised information throughout.

Originally published in 2017 under the title:

**Identification Guide for Some Common and Noxious Thistle and Knapweed Fruits
(Asteraceae, tribe Cardueae)**

Deborah J. Lionakis Meyer

California Department of Food and Agriculture
Plant Pest Diagnostics Center

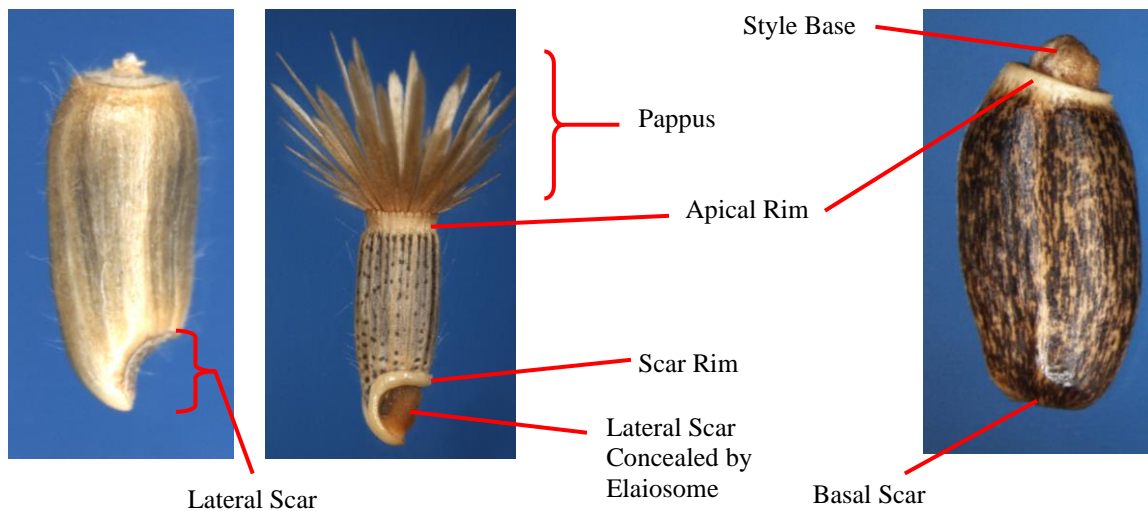
Identification Guide for Fruits of Some Common and Noxious Thistle and Knapweed Species (Asteraceae, tribe Cardueae)

Deborah J. Lionakis Meyer (retired) and Robert A. Price
California Department of Food and Agriculture
Plant Pest Diagnostics Center – Seed Science Laboratory

The typical fruit of the Asteraceae is an achene (cypsela type) derived from an inferior ovary containing one ovule. This type of fruit is one-seeded and indehiscent, with the seed attached to the pericarp in only one location. The pericarp often resembles a seed coat in structure; however, the cell layers of the actual seed coat (derived from the single integument) may become obliterated as the seed develops within the achene (Esau, 1977). For example, in lettuce the inner layers of pericarp and the integument become disorganized as the embryo enlarges during seed development (Borthwick and Robbins, 1928). The remnants of the integument and a thin layer of endosperm are compressed together to form a semi-permeable barrier around the embryo that may inhibit the germination process under certain environmental conditions (Borthwick and Robbins, 1928). At maturity, the spatulate embryo fills the entire fruit (Martin, 1946).

Characters important to identification of fruits in the Asteraceae include: (1) general shape; (2) cross-sectional compression (e.g., circular, oval, angular); (3) surface texture (e.g., epidermal cell patterns, ribs, tubercles, hairs, glands, wrinkles, etc.); (4) color, shape, margin texture, and orientation of the apical rim; (5) shape and location of the point of fruit attachment (referred to as ‘scar’ in the following descriptions); (6) shape of the style base; (7) pappus presence (pappose) or absence (epappose), whether it is persistent or deciduous, and the composition of the pappus (e.g., bristles, awns, scales, etc.); and (8) presence or absence and location of the elaiosome.

The primary focus of this identification guide is species of the thistle tribe (Cardueae) classified as, or under consideration to be classified as noxious or invasive in one or more places in the United States or Canada. Also included are a few species grown commercially as ornamentals, vegetables, or agricultural crops. Genera considered here are *Amberboa*, *Carduus*, *Carthamus*, *Centaurea*, *Cirsium*, *Crupina*, *Cynara*, *Mantiscalca*, *Onopordum*, *Rhaponticum*, *Silybum*, and *Volutaria*. This identification guide is not all inclusive; therefore, for native species of genera, such as *Cirsium* and *Centaurea*, regional or national floras should be consulted (see reference list for suggestions). The common names listed are from four sources: AOSA Rules Volume 3 ⁽¹⁾ (AOSA, 2019); the PLANTS Database ⁽²⁾ (USDA-NRCS, 2020); the GRIN Database ⁽³⁾ (USDA-ARS, 2020); and the all states noxious-weed seed list ⁽⁴⁾ (USDA-AMS, 2020). A glossary of terms to assist the user and a list of reference materials used in the preparation of this guide are provided at the end of the document.





***Amberboa moschata* (L.) DC.**
 [*Centaurea imperialis* hort.; *C. moschata* L.]
Sweet sultan^{1,3}

Fruits narrowly oblong to oblanceolate, slightly compressed, 3.5-5 mm long; smooth, dull, pubescent; dark brown to pale in color with numerous light-colored longitudinal lines; apical rim tan to brown, horizontal, margin crenulate to denticulate; pappus of several whorls of narrow, chaffy scales, each whorl progressively longer, 1/3 to nearly equal to fruit length, tan-colored, persistent; style base exposed; scar surrounded by a light-colored, thick, raised rim, +/- heart-shaped; elaiosome present at scar.



***Carduus acanthoides* L.**
Plumeless thistle^{1,3,4}; **Spiny plumeless thistle**²

Fruits dimorphic oblong to obovate, compressed, slightly gibbous, 2.5-3 mm long; outer fruits (not shown) dull, brown, apical rim yellow, slightly oblique, constricted below, margin smooth; inner fruits glabrous, glossy, light gray to yellowish-brown with numerous brown longitudinal lines, surface appearing pebbled; apical rim light-colored to same color as fruit body, slightly oblique, margin smooth; style base constricted to cone-shaped (elaiosome); pappus white, of many basally fused, minutely barbed bristles, deciduous as a ring; scar basal.



***Carduus crispus* L.**
Curly plumeless thistle²; **Curly thistle**¹; **Wetted thistle**^{3,4}

Fruits oblong to obovate, compressed, slightly gibbous, 2.5-3.8 mm long; glabrous, +/- glossy, light brown to gray-brown with numerous brown longitudinal lines, surface appearing pebbled; apical rim light-colored to same color as fruit body, horizontal to slightly oblique, margin smooth; style base constricted to cone-shaped (elaiosome); pappus white, of many basally fused, minutely barbed bristles, deciduous as a ring; scar basal.



***Carduus nutans* L.**
Musk thistle^{1,3,4}; **Nodding plumeless thistle**²; **Nodding thistle**^{1,3,4}

Fruits oblong, compressed, slightly gibbous, 4-5 mm long; glabrous, glossy, honey-brown with numerous dark brown longitudinal lines, surface appearing pebbled; apical rim honey-brown, horizontal or slightly oblique, margin smooth; style base cylindrical to cone-shaped, lobed at base (elaiosome); pappus white, of many basally fused, minutely barbed bristles, deciduous as a ring, ca. 20 mm long; scar basal.

***Carduus pycnocephalus* L.**

**Italian plumeless thistle²; Italian spiny thistle¹;
Italian thistle^{3,4}; Slender-flowered thistle^{3,4}**



Fruits dimorphic, oblong to elliptic, compressed, 4-6 mm long. Outer fruits: dull, grayish brown; apical rim narrow; style base minute; scar basal. Inner fruits: glabrous, glossy, light gray to beige with numerous brown longitudinal lines, surface appearing faintly pebbled; apical rim brownish, horizontal, margin smooth; style base knob-like on a short stalk (elaiosome); pappus white, of many basally fused, minutely barbed bristles, deciduous as a ring, 15-20mm long; scar basal to slightly oblique.

***Carduus tenuiflorus* Curtis**

Italian clasping thistle¹; Italian thistle⁴; Slender-flower thistle^{1,3,4}; Tender-flower thistle¹; Winged plumeless thistle²; Winged slender thistle³



Fruits dimorphic, oblong to elliptic, compressed, 4-5 mm long. Outer fruits: dull, grayish brown; apical rim narrow; style base minute; scar basal. Inner fruits: glabrous, glossy, tan to light brown with numerous brown longitudinal lines, surface appearing pebbled; apical rim brown, horizontal, margin smooth; style base broad, cylindrical (elaiosome); pappus white, of many basally fused, minutely barbed bristles, deciduous as a ring, 10-15 mm long; scar basal to slightly oblique.

***Carthamus creticus* L.**

[*C. baeticus* (Boiss. & Reut.) Pérez Lara; *C. lanatus* L. subsp. *baeticus* (Boiss. & Reut.) Nyman; *C. lanatus* L. subsp. *creticus* (L.) Holmboe]

Smooth distaff thistle^{1,3,4}; Woolly distaff thistle^{1,2}



Fruits dimorphic, both forms obpyramidal, the four ridges forming sharp points near the apex, margins between ridge points dentate, 4-6 mm long; scar lateral, along ridge. Epappose fruits: dark brown, surface wrinkled. Pappose fruits: smooth and light brown near base, wrinkled and darker colored towards apex; pappus of several whorls of progressively longer straw-colored, narrow, scabrous, chaffy scales (tips of longest scales mostly pointed), up to 10 mm long, persistent.

***Carthamus lanatus* L.**

Western distaff thistle¹; Woolly distaff thistle^{2,3,4}



Fruits dimorphic, both forms obpyramidal, the four ridges forming points near the apex, margins between ridge points dentate, 4-6 mm long; scar lateral, along ridge. Epappose fruits: brown, wrinkled. Pappose fruits: smooth and light brown near base, ± wrinkled and darker colored towards apex; pappus of several whorls of progressively longer straw-colored, narrow, scabrous, chaffy scales (tips of longest scales mostly pointed), up to 13 mm long, persistent.



***Carthamus leucocaulos* Sm.**
Whitestem distaff thistle^{1,2,3,4}

Fruits dimorphic, both forms obpyramidal, the four ridges forming sharp points near the apex, margins between ridge points dentate, 3-5 mm long; scar lateral, along ridge. Epappose fruits: dark brown, strongly wrinkled. Pappose fruits: smooth and light brown near base, wrinkled towards apex, ± dark-colored near apex; pappus of several whorls of progressively longer, narrow, scabrous, chaffy scales (tips of longest scales mostly blunt or toothed), 5-7 mm long, persistent.



***Carthamus oxyacantha* M. Bieb.**
Jeweled distaff thistle²; **Wild safflower**^{1,3,4}

Fruits oblong to obovate, elliptic to weakly 4-sided in cross-section, 3-5.5 mm long; smooth, glabrous, glossy, creamy white with brownish-black mottling and steaking; fruit apex without raised rim, area surrounding style base round and rough, style base deciduous; epappose; scar oblique, in shallow notch.



***Carthamus tinctorius* L.**
Safflower^{1,2,3}

Fruits white, dull to glossy; with four longitudinal ridges usually forming four bumps near the apex, 7-9 mm long; scar lateral, along ridge, slightly depressed; style deciduous, style base round; pappus of several rows of narrow scales, deciduous.



***Centaurea benedicta* (L.) L.**
 [*Cnicus benedictus* L.]
Blessed thistle^{1,2,3,4}

Fruits barrel-shaped, slightly curved, 8-11 mm long; numerous raised longitudinal ribs, glabrous, light-brown; apical rim strongly ten-dentate; style base deeply depressed in cup-shaped corolla base; scar lateral, ca. 1/3 length of fruit; pappus of two whorls of ten stiff spine-like bristles, outer whorl 9-10 mm long, smooth or scabrous, inner whorl 2-5 mm long with short, stiff, spreading hairs; elaiosome present at scar, ± 3-ridged.



***Centaurea calcitrapa* L.**
Purple starthistle^{1,3,4}; Red starthistle^{2,3}

Fruits oblong to obovate, compressed, 2.5-3.5 mm long; smooth, typically glabrous, dull to lustrous, white to light gray with various amounts of brown mottling to longitudinal streaking; apical rim \pm light-colored, horizontal, margin smooth; style base cylindrical to lobed; scar in lateral, \pm hook-shaped depression; epappose; elaiosome none.



***Centaurea cineraria* L.**
Dusty-miller^{1,2,3}

Fruits oblong, \pm curved, compressed, \pm 3.5 mm long; smooth, glossy, sparsely pubescent, blue-gray with various amounts of light-colored longitudinal lines, area around scar yellowish; apical rim white to yellow, horizontal to slightly oblique, margin crenulate; pappus of 1-2 whorls of divergent, minutely barbed flattened bristles and convergent inner row of short, bristles partially concealing the style base, white, persistent, 0.5-2.5 mm long; scar lateral; elaiosome present at scar.



***Centaurea cyanus* L.**
Bachelor's-button^{1,3}; Cornflower^{1,3,4}; Garden cornflower²; Ragged robin¹

Fruits oblong, compressed, 4-5 mm long; smooth, glossy, sparsely pubescent, blue-gray with various amounts of light-colored longitudinal lines, area around scar yellow; apical rim white to yellow, horizontal, margin mostly smooth; pappus of dense, minutely barbed, narrow scales, brush-like, uneven, erect, tan to reddish-brown, persistent, 2-4 mm long; scar laterally-oblique, opening ca. 1/3 the length of the fruit; elaiosome present at scar.



***Centaurea diffusa* Lam.**
Diffuse knapweed^{1,2,3,4}

Fruits oblong to obovate, compressed, 2-3 mm long; smooth, lustrous, sparsely pubescent, blackish-green with light colored longitudinal lines, area around scar light; apical rim light-colored, horizontal, margin crenulate; pappus none or of a few minutely barbed, flattened bristles, white, less than 1 mm long; scar in lateral hook-shaped depression; elaiosome \pm present at scar.



***Centaurea diluta* Aiton**
North African knapweed²

Fruits oblong to oval, compressed, 3-4 mm long, 1.3-2 mm wide; smooth, glossy, glabrous, tan to grayish-brown (darker colored near apical rim) with light-colored longitudinal lines, area around scar light-colored; apical rim light-colored, horizontal, margin crenulate to denticulate; pappus of several progressively longer whorls of divergent, minutely barbed, flattened bristles and narrow scales and a convergent inner whorl of short bristles concealing the style base, white, persistent, 0.3-5 mm long; scar in lateral hook-shaped depression; elaiosome mostly none.



***Centaurea iberica* Trevir. ex Spreng. sensu lato**
Iberian knapweed^{2,3}; Iberian starthistle^{1,3,4}

Fruits oblong to obovate, compressed, 3-4 mm long; smooth, glossy, glabrous, tan with dark-colored mottling and streaking, tan around scar area; apical rim light-colored, horizontal, margin \pm smooth; pappus of several progressively longer whorls of divergent, minutely barbed, flattened bristles and narrow scales and a convergent inner whorl of short bristles partially concealing the style base, white, persistent, 1-3 mm long; scar in hook-shaped lateral depression; elaiosome mostly none.



***Centaurea jacea* L. sensu lato (species complex)**

Note: the species complex is taxonomically controversial according to FNA 2007. GRIN database and FNA recognizes *C. jacea* and *C. \times moncktonii* (a hybrid of *C. jacea* and *C. nigra*) as separate taxa. *Centaurea \times gerstlaueri* Erdner recognized for hybrids (Hitchcock & Cronquist, 2018). For practical purposes the fruits are morphologically indistinguishable.

***C. jacea*: Brown knapweed^{3,4}; Brownray knapweed^{2,3}; Brownscale knapweed¹**

***C. \times moncktonii* & *C. \times gerstlaueri*: Meadow knapweed^{1,2,3,4}**

Fruits oblong to obovate, compressed, 2.5-4 mm long; smooth, dull to lustrous, \pm finely hairy, tan to light gray; apical rim horizontal, margin smooth to crenulate; epappose or of few to many short, minutely barbed bristles, white, persistent, 0.5-1 mm long; style base exposed; scar in \pm hook-shaped lateral depression, elaiosome present at scar.



***Centaurea macrocephala* Muss. Puschk. ex Willd.**
Big-head knapweed^{1,2,3,4}

Fruits oblong to obovate, compressed, 5.5-8 mm long; smooth, glabrous, dull to lustrous, brown with a few tan-colored longitudinal lines, area around scar tan; apical rim horizontal, margin crenulate to denticulate; pappus of several progressively longer whorls of flattened, divergent, minutely barbed bristles and a convergent inner row of short bristles partially concealing the long style base, brown, persistent, 5-8 mm long; scar in \pm hook-shaped lateral depression; elaiosome \pm present at scar.



***Centaurea melitensis* L.**

Malta starthistle^{1,4}; Maltese starthistle^{2,3}; Tocalote^{3,4}

Fruits oblong to obovate, compressed, 2-3 mm long; smooth, dull to glossy, ± sparsely pubescent, gray to purplish-brown with light-colored longitudinal lines, yellowish-white around scar area; apical rim light-colored, horizontal, margin ± smooth; pappus of several progressively longer whorls of divergent, minutely barbed, flattened bristles and a convergent inner row of short bristles concealing the style base, white, persistent, 2.5-3 mm long; scar in strongly hook-shaped lateral depression; elaiosome present at scar.



***Centaurea montana* L.**

Mountain-bluet^{1,3}, mountain cornflower³, mountain knapweed³, perennial cornflower²

Fruits oblong to obovate, compressed, 5.2-6.5 mm long 2.4-2.7 mm wide; dull to lustrous, sparsely pubescent, golden-tan with faint longitudinal lines; apical rim same color as main body, horizontal, smooth; pappus of several whorls of short, minutely barbed bristles, +/- erect, +/- concealing style base, persistent, 1-1.5 mm long; scar in large lateral depression, +/- concealed by dense tuft of hairs; elaiosome none.



***Centaurea nigra* L.**

Black knapweed^{1,3,4}; Lesser knapweed^{2,3}

Fruits oblong to obovate, compressed, 2.5-3.2 mm long; smooth, dull to ± lustrous, finely pubescent, tan to gray with longitudinal light-colored lines; apical rim dark-colored, horizontal, margin crenulate to denticulate; pappus none or of few to many unequal, narrow, minutely barbed scales, persistent, 0.5-1 mm long; scar in large ± hook-shaped lateral depression; elaiosome ± present at scar.



***Centaurea nigrescens* Willd.**

Tyrol knapweed^{2,3}; Vochin knapweed^{1,3,4}

Fruits oblong to obovate, compressed, 3-3.5 mm long; smooth, dull to ± lustrous, finely pubescent, tan to gray with longitudinal light-colored lines; apical rim light-colored, horizontal, margin crenulate; pappus none or of many unequal, ± deciduous bristles, 0.5-1 mm long; scar in large ± hook-shaped lateral depression; elaiosome ± present at scar.



***Centaurea x pouzinii* DC.**

[A stable hybrid of *C. aspera* × *C. calcitrapa* (FNA, 2006)]

Pouzin's star-thistle (Keil, 2012)

Fruits oblong to obovate, compressed, 2.5-4 mm long, smooth, glabrous or sparsely fine-hairy, dull to lustrous, white to light gray with various amounts of brown mottling and longitudinal streaking; apical rim ± light-colored, horizontal, margin smooth; style base cylindrical to lobed; scar in lateral, ± hook-shaped depression; pappus of triangular scales and broad-based tapered bristles 0.3-3 mm; elaiosome none.



***Centaurea solstitialis* L. sensu lato**

St. Barnaby's-thistle^{3,4}; Yellow starthistle^{1,2,3,4}

Fruits dimorphic, oblong to obovate, compressed, 2-3 mm long. Epappose fruits: smooth, glabrous, dull, dark brown to black with light mottling; apical rim light-colored, margin smooth; style base inconspicuous; scar lateral, slightly notched, elaiosome none, epappose. Pappose fruits: smooth, glossy, glabrous, white to pale yellow with various amounts of dark mottling; apical rim horizontal, light-colored, margin ± smooth; pappus of 3-4 whorls of progressively longer divergent, minutely barbed, flattened bristles and convergent inner whorl of short bristles concealing the style base, white, persistent, 2-4 mm long; scar lateral, slightly notched; elaiosome none.



***Centaurea stoebe* L. subsp. *australis* (Pančić ex A. Kern.) Greuter**

[*C. stoebe* L. subsp. *micranthos* (Gugler) Hayek; *C. maculosa* auct. Amer.]

Spotted knapweed^{1,2,3,4}

Fruits oblong, compressed, 3-3.5 mm long; smooth, dull to lustrous, sparsely pubescent, brown to blackish-green with light longitudinal lines, area around scar light colored; apical rim light-colored, horizontal, margin smooth to crenulate; pappus of 1-2 whorls of minutely barbed flattened bristles and convergent inner row of short bristles partially concealing the style base, white, persistent; scar in lateral hook-shaped depression; elaiosome present at scar.



***Centaurea sulphurea* Willd.**

Sicilian starthistle^{1,3,4}; Sulphur knapweed^{2,3}

Fruits oblong to oval, compressed, 5-8 mm long; smooth, glabrous, glossy, yellow base color with dark greenish-brown streaking, usually with one or two light longitudinal lines on each side, scar area yellow; apical rim yellow, horizontal, ± crenulate; pappus of several whorls of progressively longer divergent, minutely barbed, narrow scales and flattened bristles, inner whorl of short narrow scales concealing the style base, black, persistent, 6-7 mm long; scar lateral, in hook-shaped depression; elaiosome none.



***Centaurea virgata* Lam. subsp. *squarrosa* (Boiss.) Gugler**
 [*C. squarrosa* Willd., non Roth; *C. virgata* Lam. var. *squarrosa* (Willd.) Boiss.]
Squarrose knapweed^{1,2,3,4}

Fruits oblong, compressed, 2.5-3.5 mm long; smooth, dull to lustrous, glabrous, grayish-tan to light or dark brown with light-colored longitudinal lines, area around scar ± light-colored; apical rim light-colored, horizontal, margin smooth; pappus of several whorls of progressively longer, minutely barbed, narrow scales and flattened bristles and convergent inner whorl of short bristles concealing the style base, white, persistent, 1-2.5 mm long; scar in lateral slightly hook-shaped depression; elaiosome ± present at scar.



***Cirsium arvense* (L.) Scop.**
Canada thistle^{1,2,3,4}

Fruits oblong to obovate, ± gibbous, obscurely 4-angled towards base, ± slightly curved, 2-4 mm long; slightly constricted below apical rim; smooth, dull to lustrous; gray, yellow or golden-brown, darker towards base, some with longitudinal striping; apical rim golden, slightly oblique; style base cylindrical, sometimes with a small knob on top; pappus of many basally fused, plumose bristles, dusty white, deciduous as a ring, 13-32 mm long; scar basal.



***Cirsium japonicum* Fisch. ex DC.**
Japanese thistle^{1,2,3,4}

Fruits oblong to obovate, slightly compressed, obscurely 4-ribbed, ± gibbous, 3-3.5 mm long; smooth, glabrous, dull to lustrous, light gray to light brown; apical rim ± lighter in color than body of fruit, oblique; style base cylindrical to cone-shaped (elaiosome); pappus of many basally fused, plumose bristles, tan, deciduous as a ring, 16-18 mm long; scar basal.



***Cirsium ochrocentrum* A. Gray**
Yellowspine thistle^{1,2,3,4}

Fruits oblong to obovate, compressed, ± gibbous, 6-9 mm long; smooth, glabrous, lustrous, golden-brown to orange-brown; apical rim only slightly lighter in color than body of fruit, oblique; style base cylindrical to lobed (elaiosome); pappus of many basally fused, plumose bristles, tan, deciduous as a ring, 20-30 mm long; scar basal.



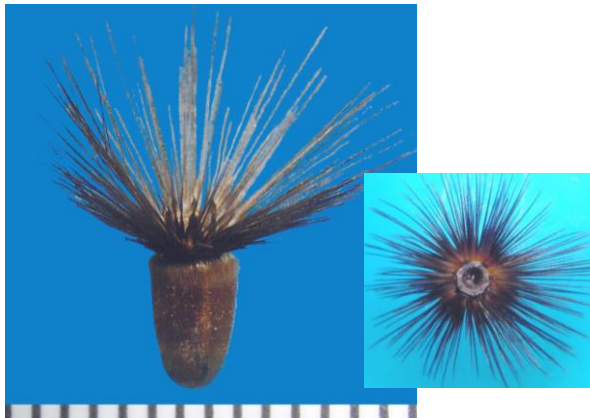
***Cirsium undulatum* (Nutt.) Spreng.**
Wavyleaf thistle^{1,2,3,4}

Fruits oblong to obovate, compressed, ± gibbous, 6-7 mm long; smooth, glabrous, lustrous, light gray to light brown with purple or black longitudinal streaking; apical rim light-colored, oblique; style base cylindrical to lobed (elaiosome); pappus of many basally fused, plumose bristles, creamy white, deciduous as a ring, 20-40 mm long; scar basal.



***Cirsium vulgare* (Savi) Ten.**
Bull thistle^{1,2,3,4}

Fruits oblong to obovate, compressed, ± gibbous, 3-5 mm long; smooth, glabrous, lustrous, light gray to light brown with purple or black longitudinal streaking; apical rim light-colored, oblique; style base cylindrical to cone-shaped (elaiosome); pappus of many basally fused, plumose bristles, dusty white, deciduous as a ring, 20-30 mm long; scar basal.



***Crupina vulgaris* Cass.**
Bearded creeper^{1,3,4}, **Common crupina**^{1,2,3,4}

Fruits usually one per head, cylindrical, tapering slightly to a blunt base, 3-6 mm long; puberulent at base, villous towards apex, black to honey brown; pappus of numerous widely divergent bristles and inner whorl of short triangular-lanceolate scales, blackish-brown, persistent, 5-10 mm long; style deeply depressed in cup-shaped corolla base; scar basal, round; elaiosome lacking.



***Cynara cardunculus* L.** (including subsp. *cardunculus* and subsp. *flavescens* Wiklund, as the fruits are indistinguishable)
 [*Cynara scolymus* L.]
Artichoke^{1,3}, **Artichoke thistle**^{1,3,4}, **Cardoon**^{1,2,3}, **Globe artichoke**^{2,3}

Fruits obovate, compressed, gibbous, 4-8 mm long; glabrous, smooth, dull, light tan base color with various shades and amounts of brown and bluish-green mottling, some with light-colored longitudinal lines; style base oblique; pappus of many plumose to barbed bristles, deciduous as a ring; scar basal; elaiosome lacking.

The cultivated forms of cardoon and artichoke are rarely found growing wild. Crosses between artichoke thistle, cardoon and artichoke form fertile F₁ hybrids. It is believed the cultivated forms were derived from artichoke thistle.



***Mantisalca salmantica* (L.) Briq. & Cavillier**

[*Centaurea salmantica* L.]

Dagger flower^{2,3}

Fruit ± barrel-shaped, ± compressed, 3-4 mm long, dimorphic. Pappose fruits: transversely wrinkled between several light-colored longitudinal lines, raised areas between longitudinal lines light-colored, depressions of wrinkles dark brown, glabrous; apical rim light-colored, margin crenulate; scar lateral, surrounded by light-colored raised rim; elaiosome present at scar; pappus of several slightly divergent whorls of distinct, progressively longer stiff bristles, the inner-most whorl consisting of a single broad scale, persistent; style base exposed. Epappose fruits: as described above except pappus lacking or with a few weak bristles, apical rim narrow, scar smaller, elaiosome ± present at scar.



***Onopordum acanthium* L. sensu lato**

Cotton thistle^{1,3,4}; **Scotch cottonthistle**²; **Scotch thistle**^{1,3,4}

Fruits obovate, compressed, slightly four-sided, 4-6 mm long; dull, strongly transversely wrinkled, glabrous, grayish-brown with various amounts of black streaking; apex with slightly depressed ring around style base; pappus of many minutely barbed bristles, pink to reddish, 7-9 mm long, deciduous as a ring; scar basal or nearly so; elaiosome ± present, lance-shaped, attached at or near scar.



***Onopordum acaulon* L.**

Horse thistle³; **Stemless thistle**^{2,3}

Fruits oblong to obovate, compressed, four-sided, 4-5 mm long; glabrous, dull, transversely wrinkled, grayish-brown to brown with various amounts of black streaks or blotches; apex with slightly depressed ring around style base; pappus of many basally fused, plumose bristles, creamy-white, 2-3 cm long, deciduous as a ring; scar basal or nearly so; elaiosome ± present, lance-shaped, attached at or near scar.



***Onopordum illyricum* L.**

Illyrian cottonthistle²; **Illyrian thistle**³

Fruits oblong to obovate, compressed, four-sided, 4-6 mm long; glabrous, dull, slightly transversely wrinkled, grayish-tan to grayish-brown with various amounts of purplish-black streak, spots or mottling; apex with slightly depressed ring around style base; pappus of many basally fused, plumose bristles, creamy-white, 10-12 mm long, deciduous as a ring; scar basal or nearly so; elaiosome ± present, lance-shaped, attached at or near scar.



***Onopordum tauricum* Willd.**
Bull cottonthistle^{2,3}; Scotch thistle^{1,3,4}; Taurian thistle³

Fruits oblong to obovate, compressed, slightly four-sided, 5-6 mm long; dull, transversely wrinkled, grayish brown with various amounts of black streaking; apex with slightly depressed ring around style base; pappus of many scabrous to minutely barbed bristles, whitish to tan, 8-10 mm long, deciduous as a ring; scar basal or nearly so; elaiosome ± present, lance-shaped, attached at or near scar.



***Rhaponticum repens* (L.) Hidalgo**
 [*Acroptilon repens* (L.) DC, *Centaurea repens* L., *C. picris* Pall. ex Willd.]
Hardheads²; Russian knapweed^{1,3,4}

Fruits broadly oval to obovate, compressed, 2-4 mm long; smooth, dull, longitudinally ridged, ivory, occasionally green or yellow tinged; apex with slightly depressed ring around style base; scar basal or oblique; pappus of many flattened bristles, white, deciduous, 6-8 mm long; elaiosome lacking.



***Silybum marianum* (L.) Gaertn.**
 [*Carduus marianus* L.]
Blessed milkthistle^{1,2,3,4}; Milkthistle^{1,3}

Fruits broadly oblong to obovate, compressed, slightly gibbous, 6-8 mm long; smooth, glossy, light-tan base color with various amounts of dark brown mottling; apical rim oblique, light-colored, margin smooth; style base broad, blunt, cylindrical to lobed (elaiosome); pappus of many basally fused, flattened, minutely barbed bristles, creamy-white, 15-20 mm long, deciduous as a ring; scar basal to slightly oblique.



***Volutaria muricata* (L.) Maire**
 [*Centaurea muricata* L.; *Cyanopsis muricata* (L.) Dostál]
Morocco knapweed^{2,3}

Fruits +/- barrel-shaped, weakly compressed, 3-4.1 mm long, with many light-colored longitudinal ribs, inter-rib areas darker-colored, surface randomly pitted, very sparsely pubescent; apical rim horizontal, margin dentate, light-colored; pappus of several divergent whorls of distinct chaffy scales, outer whorls shorter and narrower than longer and broader inner whorls, tan-colored, persistent, scales (1)2-3 mm long; style base exposed, ca. 0.5 mm long, 5-ribbed; scar lateral, surrounded by thick raised, light-colored rim; large elaiosome present at scar.



***Volutaria tubuliflora* (Mirb.) Sennen**

[*Amberboa tubuliflora* Murb.]

Desert knapweed⁴

Fruits +/- slightly obovate, weakly compressed, (3.2)3.5-3.8(4.2) mm long, with several light-colored longitudinal ribs, inter-rib areas darker-colored, surface pitted, pubescent; apical rim horizontal, margin dentate; pappus of 3-4 widely divergent whorls of distinct chaffy scales, (2.8)3-4(4.4) mm long, outer whorls shorter and narrower than longer and broader inner whorls, white, persistent; style base exposed, ca. 0.5 mm long, 5-ribbed; scar lateral, surrounded by light-colored rim thickened near base; large elaiosome present at scar.

Glossary

Basal – positioned or arising from the base.

Bristle – a stiff hair-like structure.

Crenulate – having a margin with small rounded teeth.

Deciduous (pappus) – pappus falling off the mature fruit.

Dentate – having a margin with pointed teeth.

Denticulate – having a margin with very small pointed teeth.

Dimorphic – having two forms.

Divergent – spreading outward.

Elliptic – shape broadest at mid-point and equally narrowed at the two ends.

Elaiosome – specialized aril (an outgrowth of the seed or fruit) containing oil or other nutrients attractive to ants. In the Asteraceae, the elaiosomes may develop near the point of fruit attachment (scar) or the enlarged style base (distal peg) may serve as an elaiosome (Pemberton and Irving, 1990). In this identification guide, use of the term elaiosome is restricted to outgrowths originating at the scar of the fruit.

Epappose – without a pappus (no pappus develops).

Gibbous – humped or swollen on one side.

Glabrous – without hairs, smooth.

Integument – Outer cell layers surrounding the nucellus of the ovule that differentiate into the seed coat.

Lanceolate – lance-shaped, structure several times longer than wide, broadest near the base and tapering to the apex.

Lateral – positioned on the side.

Mottling – colored spots or blotches.

Oblanceolate – inversely lanceolate, attached at the tapered end.

Oblique – slanted.

Oblong – two to four times longer than wide with sides parallel or nearly so.

Obovate – inversely ovate, attached at the narrow end.

Obpyramidal – inversely pyramid-shaped with attachment point at the narrow end.

Pappose – having a pappus.

Pappus – the modified calyx in Asteraceae, forming a crown of varying character at the summit of the achene.

Pericarp – fruit wall developed from the wall of the ovary (carpellary tissue) and in some cases (inferior ovaries) may include non-carpellary tissue (accessory parts).

Persistent (pappus) – pappus remaining attached to mature fruit.

Plumose – having fine hairs or bristles on both sides of the main axis.

Puberulent – covered with very short soft hairs.

Pubescent – covered with hairs.

Scabrous – having minute stiff hairs giving a texture that is rough to the touch.

Spatulate embryo – embryo erect, centrally placed in seed, cotyledons variable in thickness and slightly expanded to broad.

Villous – covered with long, soft, non-matted hairs.

References

- AOSA. 2019. AOSA Rules for Testing Seeds: Volume 3. Uniform Classification of Weed and Crop Seeds. Association of Official Seed Analysts. Washington, DC
- Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. J. Wilken (Eds.). 2012. The Jepson Manual, Vascular Plants of California. 2nd Ed. University of California Press.
- Bellue, M. K. 1949. Weed Seed Handbook, Descriptions and Illustrations of the Primary and Secondary Noxious-Weeds as Included in California Seed Law. Department of Agriculture Bulletin, Vols. XXXIV, XXXV and XXXVI.
- Borthwick H. A. and W. W. Robbins. 1928. Lettuce seed and its germination. *Hilgardia* 3:275-305.
- Cronquist, A. 1994. Intermountain Flora, Vascular Plants of the Intermountain West, U.S.A. Vol. 5, Asterales. The New York Botanical Garden, Bronx, New York.
- Digital Flora of Taiwan. http://efloras.org/florataxon.aspx?flora_id=100&taxon_id=242313096
- DiTomaso, J. M. and E. A. Healy. 2007. Weeds of California and Other Western States. Vol. 1 Aizoaceae – Fabaceae. University of California Agriculture and Natural Resources Publication 3488.
- Edgecombe, W. S. 1970. Weeds of Lebanon. American University of Beirut, Heidelberg Press, Beirut, Lebanon.
- Esau, K. 1977. Anatomy of Seed Plants (2nd Ed.). John Wiley & Sons.
- Flora Iberica, http://www.floraiberica.es/floraiberica/texto/pdfs/16_159_023_Volutaria.pdf
- FNA Editorial Committee (FNA). 2006. Flora of North America. Vol. 19, Magnoliophyta: Asteridae, part 6: Asteraceae, part 1. Oxford University Press.
- Harris, J. G. and M. W. Harris. 1994. Plant Identification Terminology: An Illustrated Glossary. Spring Lake Publishing, Spring Lake, UT. 197 pp.
- Hitchcock, C. L. and A. Cronquist. 2018. Flora of the Pacific Northwest. 2nd Ed. (edited by D. E. Giblin, B. S. Legler, P. F. Zika, and R. G. Olmstead). Univ. of Washington Press. 882 pp.
- Keil, D. J. 2012. *Centaurea pouzinii*, in Jepson Flora Project (eds.) Jepson eFlora, https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=91736, accessed on December 03, 2020.
- Lee, J., J. H. Kim, S. M. Lee, S. H. Park, M. A. Ali, J. Kim, C. Lee, G. Kim. 2009. Seeds of Wild Plants of Korea. The Wild Plant Seed Bank of Korea. 399 pp.
- Martin, A. C. 1946. The comparative internal morphology of seeds. *The American Midland Naturalist* 36(3):513-660.
- Meyer, D. J. L. and J. Effenberger. 2010. California Noxious Weed Disseminules Identification Manual. CA Dept. of Food & Agriculture. https://www.cdafa.ca.gov/plant/ppd/PDF/2010_CA_Noxious_Weed_Disseminules_Identification_Manual.pdf
- Meyer, D. J. L., M. Schori, and J. H. Wiersema (eds.). 2019. AOSA Rules for Testing Seeds: Vol. 3 Uniform Classification of Weed and Crop Seeds. Association of Official Seed Analysts.
- Musil, A. F. 1963. Identification of Crop and Weed Seeds, Agriculture Handbook No. 219. U. S. Department of Agriculture, Washington, D. C.
- Pemberton, R. W. and D. W. Irving. 1990. Elaiosomes on weed seeds and the potential for myrmecochory in naturalized plants. *Weed Science* 38:615-619.
- Ryder, E. J., N. E. De Vos and M. A. Bari. 1983. The globe artichoke (*Cynara scolymus* L.). *HortScience*, Vol. 18:646-653.
- Scher, J. L., D. S. Walters, and A. J. Redford. 2015. Federal Noxious Weed Disseminules of the U. S., Edition 2.2.

- California Department of Food and Agriculture, and USDA APHIS Identification Technology Program. Fort Collins, CO. [17 November 2020.] <http://idtools.org/id/fnw>
- Tutin, T. G., et al. (ed.). 1976. *Flora Europaea*, Vol. 4, Plantaginaceae to Compositae. Cambridge University Press.
- USDA, Agricultural Marketing Service, Seed Regulatory and Testing Division (USDA-AMS). 2020 State noxious-weed seed requirements recognized in the administration of the Federal Seed Act. July 2020 version. <https://www.ams.usda.gov/sites/default/files/media/StateNoxiousWeedsSeedList.pdf>
- USDA, Agricultural Research Service, National Plant Germplasm System (USDA-ARS). 2020. Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysimple>. Accessed 17 November 2020.
- USDA, Natural Resource Conservation Service (USDA-NRCS). 2020. The PLANTS Database (<http://plants.usda.gov>, 17 November 2020). National Plant Data Team, Greensboro, NC 27401-4901 USA.
- Walters, D. S. 2011. Identification Tool to Weed Disseminules of California Central Valley Table Grape Production Areas. USDA APHIS PPQ CPHST Identification Technology Program, Fort Collins, CO. <http://itp.lucidcentral.org/id/table-grape/weed-tool/> [17 November 2020].