KNAPWEEDS
Centaurea spp.

HISTORY AND ECOLOGY IN NORTH AMERICA

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INTRODUCTION

Knapweeds belong to the genus *Centaurea* (family Asteraceae), along with starthistles and cornflowers. This genus is native to Europe and Asia, but is particularly species-rich in the Middle East. *Centaurea* species produce flower heads consisting of a few to several florets subtended by overlapping bracts (**Fig. 1**). Many species have grayish-green and hairy leaves sometimes deeply divided into irregular lobes.

Figure 1. Typical *Centaurea* flower head (spotted knapweed) with numerous florets subtended by overlapping bracts (Alexander Baransky, iNaturalist.org CC BY-NC 4.0)

There are 28 *Centaurea* species and three hybrids currently present in North America; 21 of these species and the three hybrids are knapweeds. The most troublesome knapweeds in North America are spotted, diffuse, and squarrose. The lesser-known meadow, brown, black and Tyrol knapweeds are closely related to the others and are included in this publication because they share similar biology and some of the same biological control agents. Meadow, brown, black, and Tyrol knapweed are collectively known as the meadow knapweed complex as meadow is a hybrid of brown and black knapweed (and possibly Tyrol as well). Please note that the problematic rangeland species known as Russian knapweed (*Rhaponticum repens*) is not included here. It is more distantly related to the *Centaurea* knapweeds and has its own biocontrol program covered in its own publication. Likewise, yellow starthistle (*Centaurea solstitialis*) is covered in its own publication.

IMPACT

Knapweeds currently infest millions of acres across North America, primarily occurring in rangelands, open forests, pastures, roadsides, vacant lots, and other disturbed areas. They are responsible for millions of dollars of damage annually in reduced agricultural yields and lowered forage value in grazing systems. Knapweeds also displace native vegetation, negatively impacting wildlife and threatening the delicate ecological balance within many habitats. Allelopathic chemicals have been isolated from North American knapweeds, though their role in plant competition is currently under debate.

CLASSIFICATION

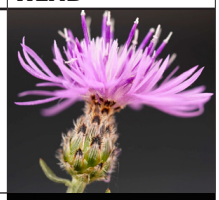
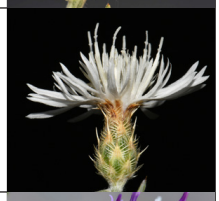
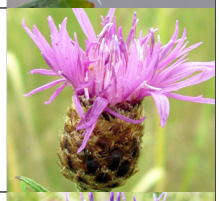
RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Plantae	Plants
Subkingdom	Tracheobionta	Vascular plants
Superdivision	Spermatophyta	Seed plants
Division	Magnoliophyta	Flowering plants
Class	Magnoliopsida	Dicotyledons
Subclass	Asteridae	
Order	Asterales	
Family	Asteraceae	Sunflower family
Tribe	Cynareae	
Subtribe	Centaureinae	
Genus	*Centaurea*	
Species	*Centaurea stoebe* subsp. *micranthos*	Spotted knapweed
	Centaurea diffusa	Diffuse knapweed
	Centaurea virgata subsp. *squarrosa*	Squarrose knapweed
	Centaurea × *moncktonii*	Meadow knapweed
	Centaurea nigra	Black knapweed
	Centaurea jacea	Brown knapweed
	Centaurea nigrescens	Tyrol knapweed

DIFFERENTIATING KNAPWEEDS

Leaf shape, bract shape, flower head size, and floret color are important traits for distinguishing knapweed species. In general, spotted, diffuse, and squarrose knapweed have more gray-green and divided leaves and grow in drier habitats compared to the species in the meadow knapweed complex. Spotted knapweed bracts are green with dark brown, fringed tips that give the flower head a "spotted" appearance. The bracts of both diffuse and squarrose knapweed are fringed with spines; the terminal spine curves distinctly backward

on squarrose knapweed but not on diffuse knapweed. The florets of diffuse knapweed are also usually white. Within the meadow knapweed complex, brown knapweed can be identified by having light brown bracts with papery, translucent margins. Black and Tyrol knapweed are most easily differentiated by their bracts. The fringe of black knapweed is longer, has more teeth, extends further down the bracts, and overlaps adjacent bracts, giving the receptacle an overall black appearance. The fringe of Tyrol knapweed is restricted to the small appendage at the tip of the bract and is shorter, not overlapping adjacent bracts. Consequently, the green bases of Tyrol knapweed bracts are visible, giving the receptacle an overall "spotted" appearance. Meadow knapweed can be very difficult to identify as it may exhibit traits very similar to any of its parent species. **Table 1** contains additional key traits useful for differentiating the invasive knapweed species described in this publication.

Table 1. Key traits for differentiating seven knapweed species that are exotic and invasive in North America.

SPECIES	LIFE HISTORY	PREFERRED HABITAT	AVERAGE HEIGHT	BASAL LEAVES	HEAD DIAMETER	BRACTS	FLOWER HEAD
Spotted *Centaurea stoebe*	Biennial to short-lived perennial (usually perennial)	Disturbed initially; dry to mesic sites	2½ ft (¾ m)	4–8 in long (10–20 cm); deeply divided into elliptic lobes; gray-green; densely hairy	¼–½ in (0.6–1¼ cm)	Triangular green; dark brown triangular tip; tip with short, stiff, comb-like fringe	
Diffuse *Centaurea diffusa*	Annual to short-lived perennial (usually biennial)	Disturbed initially; dry sites	1½ ft (½ m)	4–8 in long (10–20 cm); deeply divided into linear lobes; gray–green; densely hairy	≤0.3 in (0.8 cm)	Narrow; fringed by sharp spines; terminal spine longer than laterals and not curved backward	
Squarrose *Centaurea virgata* subsp. *squarrosa*	Long-lived perennial	Disturbed initially; dry sites	1½ ft (½ m)	4–8 in long (10–20 cm); deeply divided into fine lobes; gray-green; densely hairy	≤¼ in (0.6 cm)	Narrow; fringed by sharp spines; terminal spine longer than laterals and strongly curved backward	
Meadow *Centaurea ×moncktonii*	Perennial	Mesic to moist sites	2 ft (0.6 m)	≤6 in long (15 cm); entire or slightly lobed margins (sometimes with a few small teeth); tapered both ends; less hair	≤1 in (2½ cm)	May vary from dark brown with stiff, comb-like fringe to light brown with translucent papery margins	
Black *Centaurea nigra*	Perennial	Mesic to moist sites	1½ ft (½ m)	≤6 in long (15 cm); entire or slightly lobed margins (sometimes with a few small teeth); tapered both ends; green; fine hair	0.6–1 in (2½ cm)	Mostly dark brown or black; margins with comb-like black, stiff fringe; ≤15 teeth on each side of fringe	
Brown *Centaurea jacea*	Perennial	Disturbed initially; moist sites	2 ft (0.6 m)	≤6 in long (15 cm); entire or slightly lobed margins (sometimes with a few small teeth); tapered both ends; green; less hair	≤¾ in (2 cm)	Light brown with papery, translucent margins	
Tyrol *Centaurea nigrescens*	Perennial	Mesic to moist sites	2 ft (0.6 m)	≤9 in long (23 cm); entire or slightly lobed margins (sometimes with a few small teeth); tapered both ends; green; fine hair	½–1 in (1¼–2½ cm)	Triangular green, streaked with white or dark pink; tipped by triangular, dark brown appendage with short comb-like fringe	

Photos: spotted: Travis McMahon, MIA Consulting; diffuse: Brian Finzel, iNaturalist.org CC BY-NC 4.0; squarrose: Bogdan V. Kryzhatyuk, iNaturalist.org CC BY-NC 4.0; meadow: Angelica Velasquez, Cowlitz County Noxious Weed Control Board; black: Ben, iNaturalist.org CC BY-NC 4.0; brown: Lorenzo Dotti, iNaturalist.org CC BY-NC 4.0; Tyrol: Peakaytea, iNaturalist.org CC0

Spotted knapweed

Centaurea stoebe L. **subsp.** ***micranthos*** (Gulger) Hayek

SYNONYMS

Bushy knapweed, *Centaurea maculosa* Lam., *Centaurea stoebe* L. *Centaurea biebersteinii* DC, *Acosta maculosa* (Lam.) Holub

HISTORY AND DISTRIBUTION

Spotted knapweed is native to Europe and western Asia. It was introduced to North America by 1890 as a contaminant in hay and has been reported in all 50 U.S. states, eight Canadian provinces, and one Canadian territory (**Fig. 2**).

Figure 2. Spotted knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 24 August 2022])

IDENTIFICATION

At a Glance

Spotted knapweed (**Fig. 3a**) is a winter-hardy herbaceous weed that typically grows as a perennial or (less commonly) as a biennial. Plants grow 1–3½ ft (0.3–1 m) tall, often have numerous spreading branches, and are supported by a deep taproot. Stems are ridged and covered in small hairs. Leaves are up to 8 in (20 cm) long, gray-green, woolly, and deeply divided near the plant base. Flower heads are produced at the tips of stems and branches. They are ≤½ in (1¼ cm) in diameter, have rows of fringed bracts with dark tips, and have several lavender or pink florets. Each floret produces a single brown seed topped by a tuft of bristly hairs. This plant reproduces only by seed.

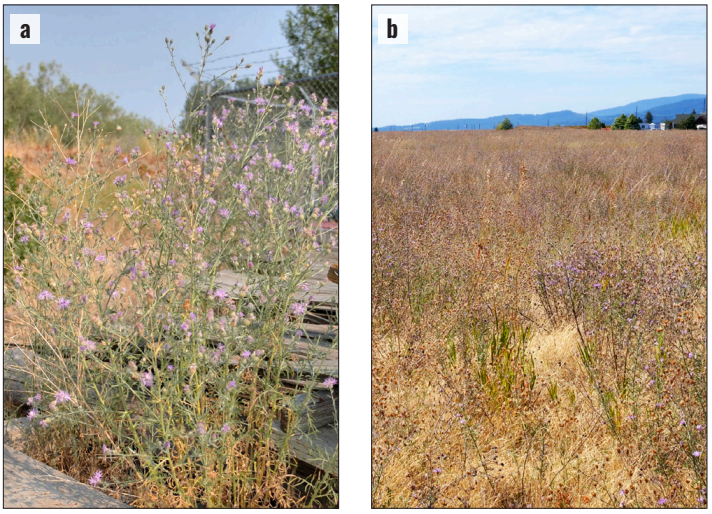


Figure 3. Spotted knapweed (a) plant; (b) patch growing in a pasture (a,b: Travis McMahon, MIA Consulting)

Roots

Spotted knapweed has a deep and stout taproot and does not reproduce vegetatively.

Stems and Leaves

Stems are 1–3½ ft (0.3–1 m) tall and often have numerous spreading branches. Stems have ridges, are somewhat roundish in cross-section, and are covered in hairs. Upper stems are wiry and slender with many alternate branches that end in flower heads. Small plants usually have an unbranched stem and one flower head, whereas older plants can have hundreds of flower-tipped branches. Rosette leaves are gray-green, covered in small hairs, 4–8 in (10–20 cm) long, and deeply divided into elliptic lobes that may resemble leaflets. Stem leaves are alternate and stalkless (**Fig. 4a**), getting smaller and less divided higher up the stem.

Flowers

Spotted knapweed flower heads are typically ¼–½ in (⅔–1¼ cm) wide and 0.4–0.8 in (1–2 cm) long and contain 20–50 pink

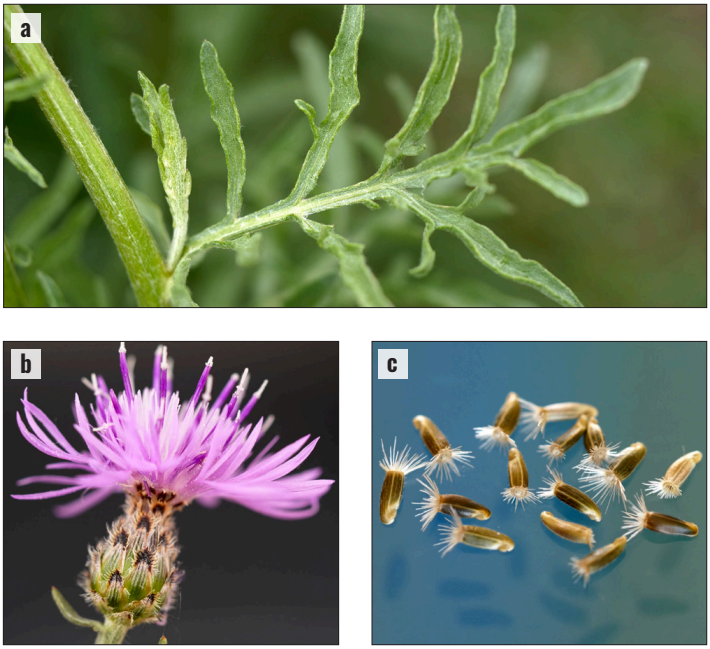


Figure 4. Spotted knapweed (a) leaf and stem; (b) flower head; (c) seeds (a–c: Travis McMahon, MIA Consulting)

or lavender florets. The bracts at the base of the flower head are triangular and green, but the tips are dark brown with fringed, comb-like margins. The dark bract tips give the flower head a "spotted" appearance, hence the common name (**Fig. 4b**).

Fruits and Seeds

Each floret produces one small brown seed streaked in white. Seeds are topped by a tuft of bristly hairs (pappus; **Fig. 4c**) about half the length of the seed. A single large flowering plant may produce well over 1,000 seeds annually.

ECOLOGY

Spotted knapweed spreads only by seed. Seeds germinate throughout the growing season. Plants may remain as rosettes the first year and bolt the second year, or they may remain as rosettes for a few years. Bolting occurs in late spring, and plants flower in mid to late summer (late June to September). Seeds typically fall around the parent plant or are transported by animal fur and human activity. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Plants often die back in fall after producing seed, but most re-sprout the following year(s) from their root crown.

HABITAT

Spotted knapweed rapidly colonizes disturbed and often dry sites including rocky roadsides, coastal dunes, sandy river margins, vacant lots, pastures, and fields (**Fig. 3b**). It can also invade adjacent undisturbed grasslands and open forests.

Diffuse knapweed

Centaurea diffusa Lam.

SYNONYMS

White knapweed, tumble knapweed, *Acosta diffusa* (Lam.) Soják

HISTORY AND DISTRIBUTION

Diffuse knapweed is native to the eastern Mediterranean and western Asia and was introduced into North America by 1907 as a contaminant in hay. It has been reported in 27 U.S. States, six Canadian provinces, and one Canadian territory (**Fig. 5**).

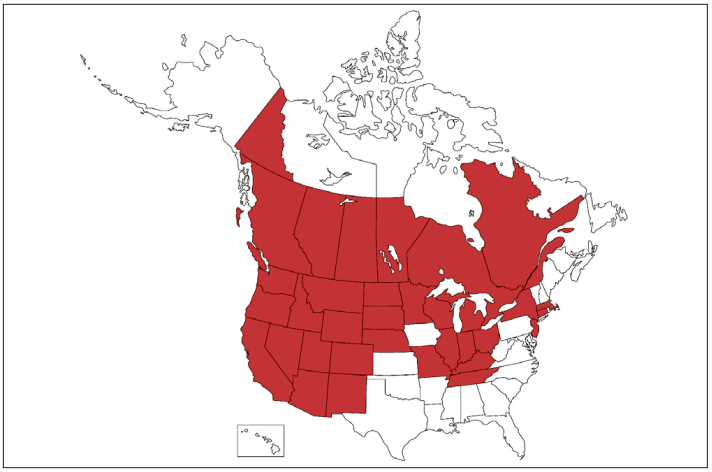


Figure 5. Diffuse knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 24 November 2021])

IDENTIFICATION

At a Glance

Diffuse knapweed (**Fig. 6a**) is a winter-hardy forb that usually grows as a biennial but may at times grow as an annual or short-lived perennial. Plants grow 1–3½ ft (0.3–1 m) tall, often have numerous spreading branches, and are supported by a long taproot. Stems are ridged and covered in small hairs. Leaves are up to 8 in (20 cm) long, gray-green, woolly, and frequently deeply divided. Flower heads are produced at the tips of stems and branches. They are ≤⅓ in (0.8 cm) in diameter, and have bracts fringed with spines, of which the terminal spine is distinctly longer. The florets are typically white but may occasionally be pink or lavender. Each floret produces a single brown seed topped by a tuft of very short, bristly hairs. This plant reproduces only by seed.

Roots

Diffuse knapweed produces a long taproot and does not reproduce vegetatively.

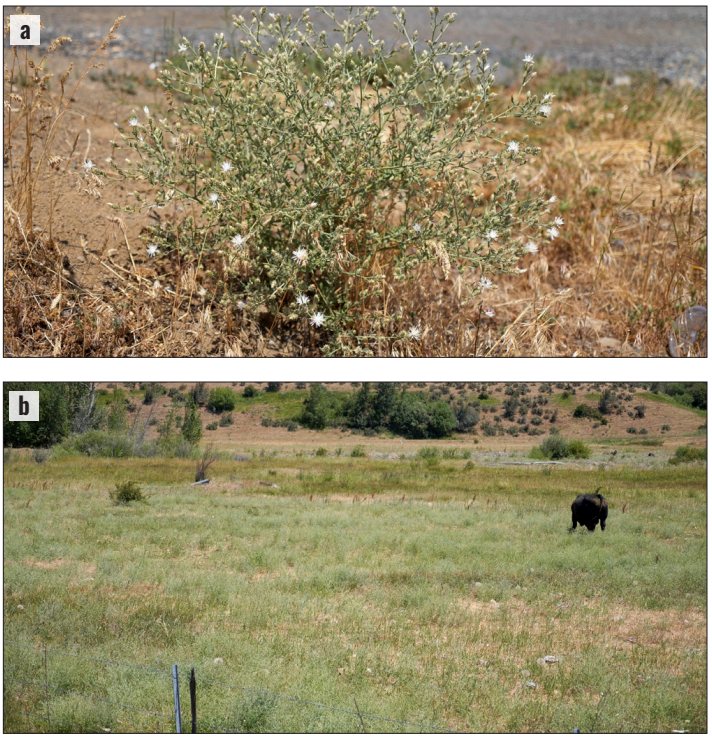


Figure 6. Diffuse knapweed (a) plant; (b) infestation in a pasture (a,b: Travis McMahon, MIA Consulting)

Stems and Leaves

Stems are 1–3½ ft (0.3–1 m) tall and often have numerous spreading branches. Stems have ridges, are somewhat roundish in cross-section, and are covered in hairs. Upper stems are wiry and slender with many alternate branches that end in flower heads. Small plants usually have an unbranched stem and one flower head, whereas older plants can have over 100 flower-tipped branches. Rosette leaves are gray-green, covered in small hairs, 4–8 in (10–20 cm) long, and deeply divided into elliptic lobes that may resemble leaflets. Stem leaves are alternate and stalkless (**Fig. 7a**), getting smaller and less divided higher up the stem.

Flowers

Diffuse knapweed flower heads are typically ≤⅓ in (0.8 cm) wide and ≤⅔ in (1½ cm) long and contain 10–15 florets that are typically white but may be pink or lavender. The bracts at the base of the flower head are fringed with spines, of which the terminal spine is distinctly longer (**Fig. 7b**).

Fruits and Seeds

Each floret produces one small brown seed topped by a tuft of very short, bristly hairs (pappus; **Fig. 7c**). A single large flowering plant may produce over 1,000 seeds annually.

ECOLOGY

Diffuse knapweed spreads only by seed. Seeds germinate throughout the growing season. Plants typically remain as rosettes the first year and bolt the second year. Bolting occurs in late spring, and plants flower in mid to late summer (typically late June to September). Unlike other knapweeds, the flower heads of diffuse do not open to shed seeds. Instead, seeds are shed primarily after the stiff central stalk breaks and the mature plants tumble in the wind (**Fig. 7d**). Secondarily, seeds can be spread by vehicles, animals, and people. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Plants usually die back in fall after producing seed, though less frequently some may re-sprout from the root crown the following spring.

HABITAT

Diffuse knapweed rapidly colonizes dry and disturbed lands. It is frequently found in pastures (**Fig. 6b**), rangeland, and open roadsides.

NOTES

Diffuse and spotted knapweed hybrids have been identified at many diffuse knapweed sites in North America. These are hybrids between diffuse knapweed and a form of spotted knapweed present only in Eurasia, and these hybrids were likely introduced to North America along with pure diffuse knapweed. The form of spotted knapweed present throughout North America is incompatible with and does not form hybrids with diffuse knapweed in North America. Consequently, hybrids are often found at diffuse knapweed sites in North America but not at spotted knapweed sites. Where present, hybrids tend to grow larger than pure diffuse knapweed (**Fig. 8a**), they may have all white or lavender florets, and their bracts are often a combination of the two with a darker tip as well as a fringe of spines with the terminal spine distinctly longer (**Fig. 8b**).

Diffuse knapweed is perhaps most similar in appearance to squarrose knapweed with its wiry form and small flower heads. Squarrose knapweed differs by having florets that are always pink or lavender (**Fig. 11b**). While squarrose knapweed bracts are also fringed with spines, its terminal spine curves distinctly backward (**Fig. 11b**), unlike diffuse knapweed (**Fig. 7b**).

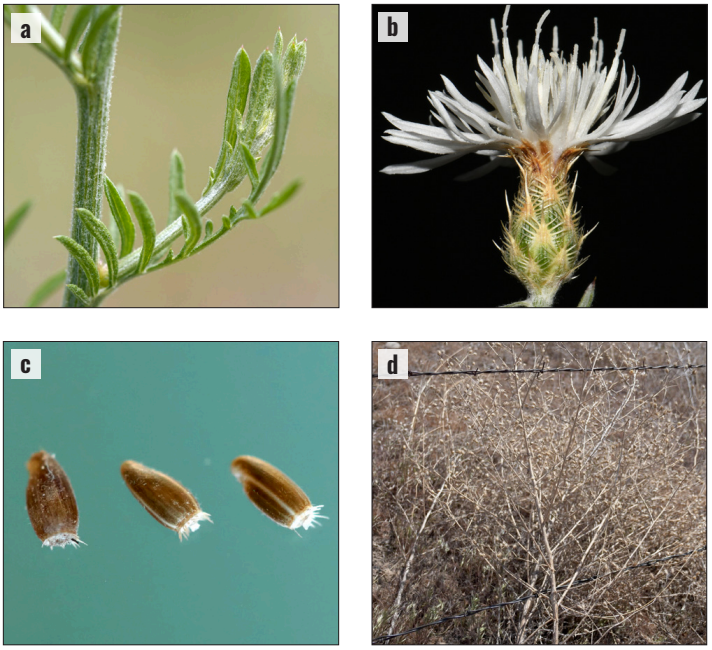


Figure 7. Diffuse knapweed (a) leaf and stem; (b) flower head; (c) seeds; (d) tumbleweed (a,c,d: Travis McMahon, MIA Consulting; b: Brian Finzel, iNaturalist.org CC BY-NC 4.0)

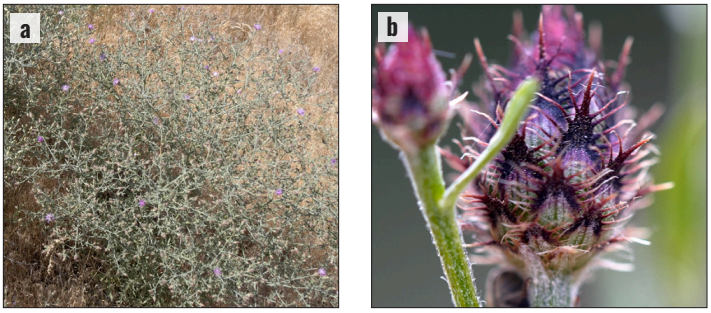


Figure 8. Hybrids of diffuse and spotted knapweed (a) tend to grow larger than pure diffuse knapweed and have bracts (b) with a dark tip and a fringe of spines (a,b: Travis McMahon, MIA Consulting)

Squarrose knapweed

Centaurea virgata Lam. **subsp. *squarrosa*** (Boiss.) Gugler

SYNONYMS

Centaurea virgata auct. Amer., *Centaurea squarrosa* Willd.

HISTORY AND DISTRIBUTION

Squarrose knapweed is native to eastern Europe and western Asia. It was introduced to North America by the early 1950s as a contaminant in wool and has been recorded in ten states (**Fig. 9**) but has not been reported as established in Canada.

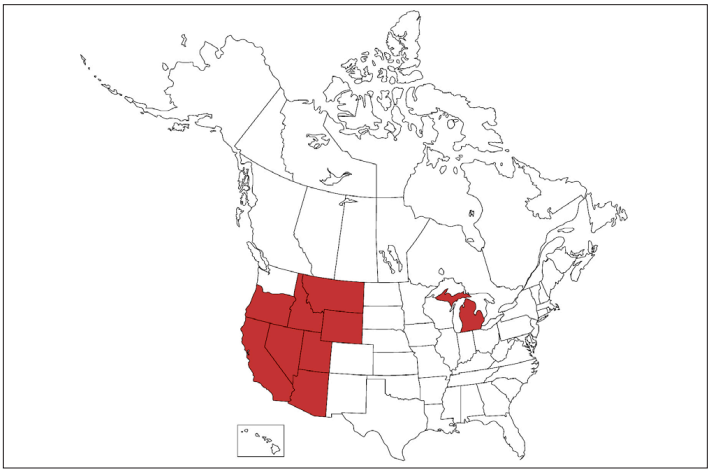


Figure 9. Squarrose knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 24 November 2021])

IDENTIFICATION

At a Glance

Squarrose knapweed (**Fig. 10a**) is a long-lived perennial forb. Plants grow 1–3½ ft (0.3–1 m) tall, often have numerous spreading branches, and are supported by a long taproot. Stems are ridged and covered in small hairs. Leaves are up to 8 in (20 cm) long, gray-green, woolly, and frequently deeply divided. Flower heads are produced at the tips of stems and branches. They are ≤¼ in (≤⅔ cm) in diameter, and have bracts fringed with spines, of which the terminal spine curves distinctly backward. The florets are pink or lavender. Each floret produces a single brown seed topped by a tuft of bristly hairs. This plant reproduces only by seed.

Roots

Squarrose knapweed produces a long taproot and does not reproduce vegetatively.

Stems and Leaves

Stems are 1–3½ ft (0.3–1 m) tall and often have numerous spreading branches. Stems have ridges, are somewhat roundish in cross-section, and are covered in hairs. Upper stems are wiry and slender with many alternate branches that end in flower heads. Small plants usually have an unbranched stem and one flower head, whereas older plants can have over 100 flower-tipped branches. Rosette leaves are gray-green, covered in small hairs, 4–8 in (10–20 cm) long, and deeply divided into elliptic lobes that may resemble leaflets. Stem leaves are alternate and stalkless (**Fig. 11a**), getting smaller and less divided higher up the stem.

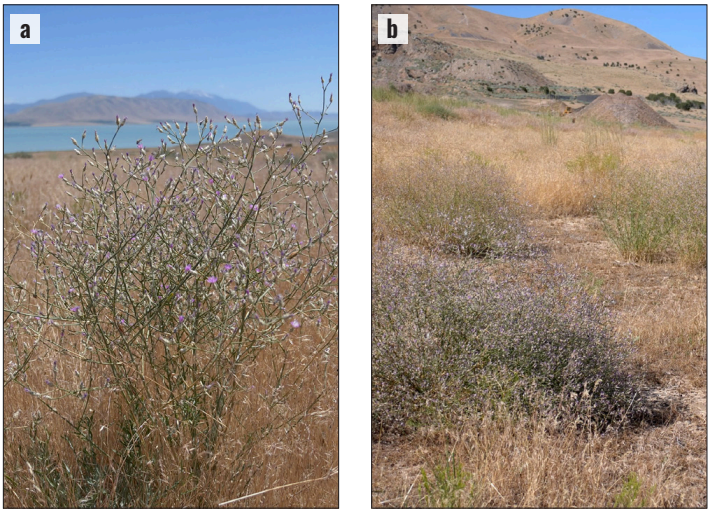


Figure 10. Squarrose knapweed (a) plant; (b) typically dry habitat (a–b: Travis McMahon, MIA Consulting)

Flowers

Squarrose knapweed flower heads are typically ≤¼ in (≤⅔ cm) wide and ≤⅔ in (1½ cm) long and contain 4–8 pink or lavender florets. The bracts at the base of the flower head

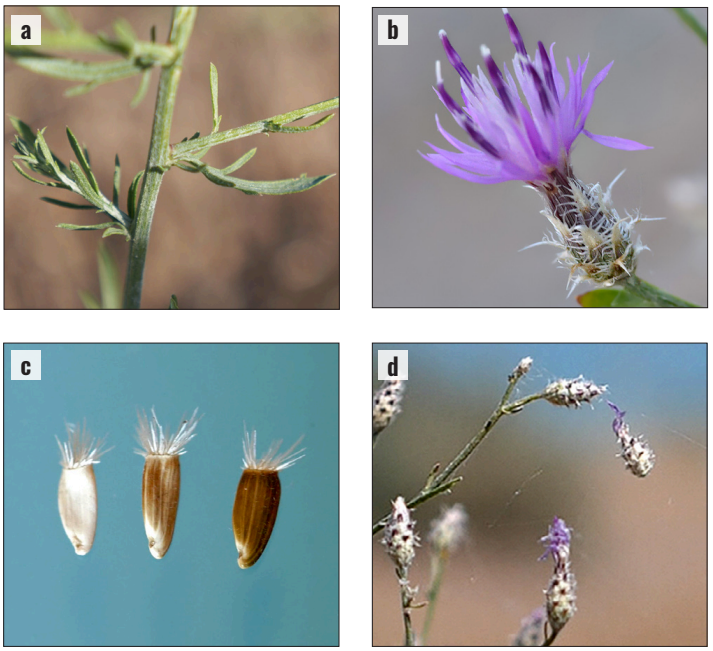


Figure 11. Squarrose knapweed (a) leaves and stem; (b) flower head; (c) seeds; (d) seed head detaching at maturity (a,c,d: Travis McMahon, MIA Consulting; b: Bogdan V. Kryzhatyuk CC-BY-NC 4.0)

are fringed with spines, of which the terminal spine curves distinctly backward (**Fig. 11b**).

Fruits and Seeds

A single floret produces one small brown seed that is white at first but matures to brown streaked in white. Seeds are topped by a tuft of bristly hairs (pappus; **Fig. 11c**) about half the length of the seed. Each flower head produces 3–4 seeds on average, so a large flowering plant may produce hundreds of seeds annually.

ECOLOGY

Squarrose knapweed spreads only by seed. Seeds germinate throughout the growing season. Under favorable conditions, this species may remain as a rosette for multiple years before developing flowering stems. Bolting occurs in spring, and plants flower in early to late summer. Seeds disperse when whole heads break off from the stem (**Fig. 11d**) and get lodged in the hair and fur of animals due to the spiny bract fringes. They can also be spread by vehicles, animals, and people. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Some plants die back in fall after producing seed, but most re-sprout the following year from their root crown.

HABITAT

Squarrose knapweed grows in a wide range of habitats in North America, but is specially adapted to withstand harsh, dry climates better than any other knapweed species. It rapidly colonizes roadsides and disturbed lands, and is frequently found in deserts and shrub-steppe (**Fig. 10b**).

NOTES

Squarrose knapweed is perhaps most similar in appearance to diffuse knapweed with its wiry form and small flower heads. Diffuse knapweed flower heads typically have white florets (**Fig. 7b**), though some may be pink (**Fig. 8a**). While diffuse knapweed bracts are also fringed with spines, the terminal spine does not curve distinctly backward (**Fig. 7b**), unlike squarrose knapweed (**Fig. 11b**).

Meadow Knapweed Complex

The meadow knapweed complex is a confusing and often controversial group of plants. Some botanists believe it is all one highly variable species (*Centaurea jacea*). Others have concluded it consists of several closely related species and subspecies that frequently hybridize and backcross, creating highly variable intermediates. In this publication, we follow the Flora of North America and present the complex as a group of three species including: black knapweed (*C. nigra*), brown knapweed (*C. jacea*), and Tyrol knapweed (*C. nigrescens*), as well as meadow knapweed (*C.* × *moncktonii*), which is a hybrid of brown and black knapweed (and possibly Tyrol as well).

Meadow knapweed

Centaurea* × *moncktonii C.E.Britton

SYNONYMS

Centaurea debeauxii subsp. *grandiflora, Centaurea jacea* nothosubsp. *pratensis*

HISTORY AND DISTRIBUTION

Meadow knapweed is a fertile hybrid of black (*Centaurea jacea*) and brown knapweed (*C. nigra*) and possibly Tyrol knapweed (*C. nigrescens*) in some instances (see next sections), all of which are native to Europe. They were introduced to North America by the late 1800s where they were reportedly grown as a hay or forage crop and also as a pollen source for honeybees. Please note, the ecological harm they cause far outweighs their value for grazing or honey production. Their hybrid, meadow knapweed, is scattered throughout North America and has been reported in 14 U.S. states and four Canadian provinces (**Fig. 12**); however, its true distribution is likely greater as it probably occurs anywhere its parent species are present (see **Fig. 16, 19, 22**).

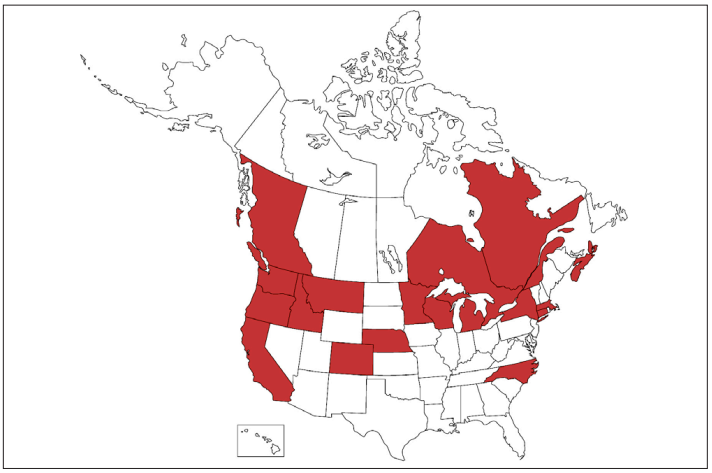


Figure 12. Meadow knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 24 November 2021])

IDENTIFICATION

At a Glance

Because it is a hybrid of black and brown knapweed (and possibly sometimes Tyrol knapweed), meadow knapweed

may closely resemble either parent species, or it may combine the characteristics randomly. Consequently there can be a lot of variation in its appearance. Meadow knapweed typically grows as a perennial with multiple stems 1–3½ ft (0.3–1 m) tall (**Fig. 13a**). Mature plants have a cluster of roots beneath their woody root crown. Leaves are up to 6 in (15 cm) long, undivided, tapering at both ends, and often less gray-green than other knapweeds. Flower heads are produced singly at the tips of stems and branches. They are ≤1 in (2½ cm) in diameter and have 20–40 pink or lavender florets. The bracts vary from dark brown with a stiff, comb-like fringe to light brown with papery margins. Each floret produces a single grayish-brown seed with either no pappus or only a short row of fine hairs. This plant reproduces only by seed.

Figure 13. Meadow knapweed: (a) plant; (b) patch infesting a moist forest clearing (a: Travis McMahon, MIA Consulting; b: Jennifer Andreas, Washington State University Extension)

Roots

Meadow knapweed seedlings have taproots. As plants grow and mature, they produce additional roots in a cluster beneath the woody root crown.

Stems and Leaves

Stems are nearly round in cross-section, hairy, 1–3½ ft (0.3–1 m) tall, and often branch near their middle. Rosette leaves are typically a brighter green than most other knapweed species, with only subtle gray tones and fine hair. They are up to 6 in (15 cm) long, taper at both ends, and are either undivided or only slightly lobed (**Fig. 14a**). Stem leaves are alternate and stalkless, becoming smaller, less lobed, and more lance-shaped higher up the stem (**Fig. 14b**).

Flowers

Meadow knapweed flower heads are ≤1 in (2½ cm) wide and ¾–1 in (2–2½ cm) long with 20–40 pink or lavender florets. The outer florets are often larger and spread outward compared to the central florets (**Fig. 14c**). The receptacles

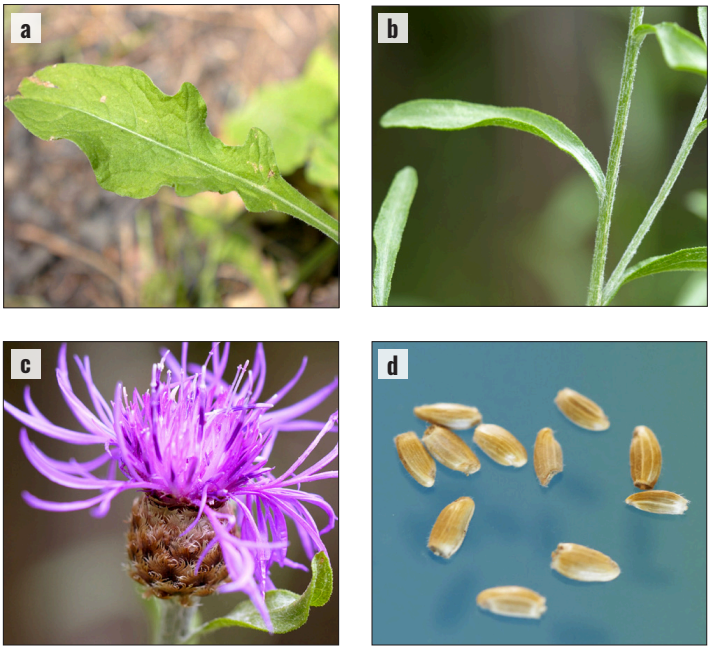


Figure 14. Meadow knapweed (a) basal leaf; (b) stem leaves and stem; (c) flower head; (d) seeds (a–d: Travis McMahon, MIA Consulting)

are broadly oval and covered with overlapping rows of bracts that can vary quite a bit in their color and shape. The bracts of the parent species black knapweed (and Tyrol knapweed where applicable) are often mostly dark brownish-black and have a comb-like fringe around the margins. The bracts of the parent species brown knapweed are light brown and have papery, sometimes translucent margins. The bracts of the hybrid meadow knapweed can exhibit any of these traits (**Fig. 15**), but are often a mixture with light brown comb-like margins.

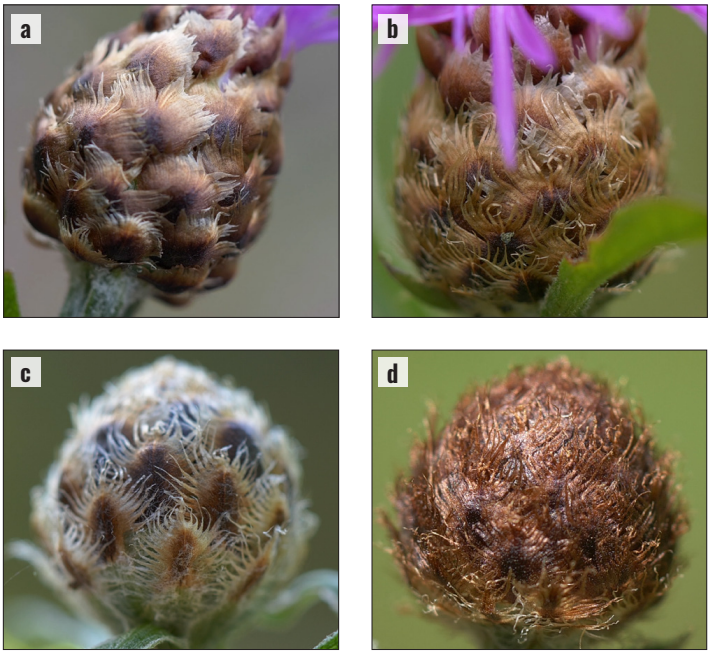


Figure 15. Variation in meadow knapweed flower head bracts (a–d: Travis McMahon, MIA Consulting)

Fruits and Seeds

Each floret produces one small grayish-brown seed streaked in white and with either no pappus (**Fig. 14d**) or only a short row of fine hairs. A single large flowering plant may produce over 500 seeds annually.

ECOLOGY

Meadow knapweed spreads only by seed. Seeds germinate throughout the growing season. Plants may remain as rosettes the first year and bolt the second year, or they may remain as rosettes for a few years. Bolting occurs in late spring, and plants flower in mid to late summer (late June to September). Seeds typically fall around the parent plant or are transported by animal fur, hay, human activity, and water. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Some plants die in fall after producing seed, but many re-sprout the following year from their root crown.

HABITAT

Meadow knapweed grows at mesic to moist sites, including irrigated pastures, meadows, riverbanks, irrigation ditches, and forest openings (**Fig. 13b**).

Black knapweed

Centaurea nigra L.

SYNONYMS

Lesser knapweed, common knapweed, *Centaurea jacea* L. subsp. *nigra* (L.) Bonnier & Layens

HISTORY AND DISTRIBUTION

Black knapweed is native to Europe and was introduced to North America via the United Kingdom. It was first recorded in the USA in 1895 near Pullman, Washington, and has since been reported in 27 states and six Canadian provinces (**Fig. 16**).

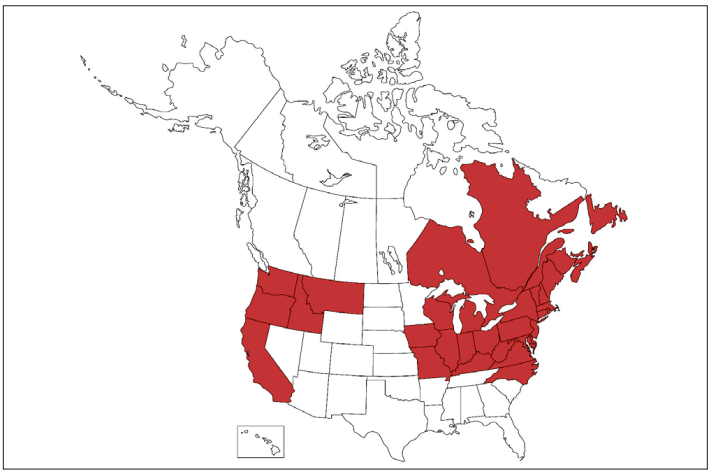


Figure 16. Black knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 24 November 2021]). Note: many infestations originally identified as pure black knapweed have since been confirmed to be the hybrid meadow knapweed. Likewise, many infestations attributed to black knapweed are likely Tyrol knapweed, and vice versa.

IDENTIFICATION

At a Glance

Black knapweed is a perennial forb typically growing 1–3 ft (0.3–0.9 m) tall (**Fig. 17a**) from a cluster of roots beneath its woody crown. Leaves are up to 6 in (15 cm) long, undivided, tapering at both ends, and often less gray-green than other knapweeds. Flower heads are produced singly at the tips of stems and branches. They are ≤1 in (2½ cm) in diameter and have 20–60 pink or lavender florets. The bracts are dark brown or black with a stiff, comb-like fringe. Each floret produces a single brown seed with either no pappus or only a short row of fine black hairs.

Roots

Black knapweed seedlings have taproots. As plants grow and mature, they produce additional roots in a cluster beneath the woody root crown. Rooting sometimes occurs from the leaf nodes of prostrate stems.

Stems and Leaves

Stems are 1–3 ft (0.3–0.9 m) tall, and often branch near their tops. Stems are nearly round in cross-section and have grooves or ridges. Most are covered with fine, cobwebby hairs though some older stems can be hairless. Upper stems are wiry and end in solitary flower heads. Rosette leaves are often a brighter green than most other knapweed species, with only subtle gray tones and fine hair. They are up to 6 in (15 cm) long, taper at both ends, and are usually undivided but may be slightly lobed or have a few small teeth (**Fig. 18a**). Stem leaves are alternate

Figure 17. Black knapweed (a) plant; (b) patch growing along a roadside (a: Thomas Vaer, iNaturalist.org CC BY-NC 4.0; b: Laurat12, iNaturalist.org CC BY-NC 4.0)

Figure 18. Black knapweed (a) basal leaves; (b) stem leaves; (c) flower head (a: Jean-Philippe Basuyaux; b: Drepanostoma; c: Ben; a–c: iNaturalist.org CC BY 4.0)

and stalkless, becoming smaller, less lobed, and more lance-shaped higher up the stem (**Fig. 18b**).

Flowers

Black knapweed flower heads are ⅔–1 in (1½–2½ cm) wide and ⅔–1¼ in (1½–3 cm) long with 20–60 pink or lavender florets (**Fig. 18c**). The receptacles are broadly oval and covered with overlapping rows of bracts that are dark brown or black and have a long, stiff, comb-like fringe around the margins made up of ≤15 stiff, comb-like "teeth". The long, dark fringes frequently overlap the bract bases, giving the receptacle an overall black appearance (**Fig. 18c**).

Fruits and Seeds

Each floret produces one small brown seed streaked in white and with either no pappus, or only a short row of fine black hairs. A single large plant with multiple flower heads may produce well over 100 seeds annually.

ECOLOGY

Black knapweed mostly spreads by seed, but reportedly occasionally spreads by rooting from leaf nodes of prostrate stems. This form of spread (termed layering) has not been reported for brown, Tyrol, or meadow knapweed, the other species in the meadow knapweed complex. Seeds germinate throughout the growing season. Plants may remain as rosettes the first year and bolt the second year, or they may remain as rosettes for a few years. Bolting occurs in late spring, and plants flower in mid to late summer (July to September). Seeds typically fall around the parent plant or are transported by animal fur, hay, or human activity. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Some plants die in fall after producing seed, but many re-sprout the following year from their root crown.

HABITAT

Black knapweed often tolerates drier habitats than meadow knapweed, but grows in damper conditions than spotted, diffuse, and squarrose knapweed. Its preferred habitat includes disturbed sites such as waste places, fields, logged clearings, and roadsides (**Fig. 17b**).

Brown knapweed

Centaurea jacea L.

SYNONYMS

Brownray knapweed, *Centaurea jacea* L. subsp. *jacea*

HISTORY AND DISTRIBUTION

Brown knapweed is native to Europe. It was reportedly grown as a hay or forage crop (known in Quebec in the 1850s as bull clover) and also as a pollen source for honeybees into the late 1800s. It has since been reported in 30 U.S. states and four Canadian provinces (**Fig. 19**). The ecological harm it causes far outweighs its value for grazing or honey production.

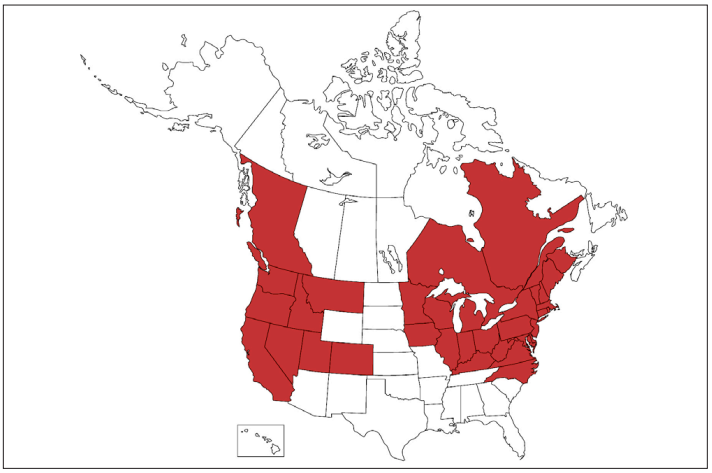


Figure 19. Brown knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 24 November 2021]). Note: many infestations originally identified as pure brown knapweed have since been confirmed to be the hybrid meadow knapweed.

IDENTIFICATION

At a Glance

Brown knapweed is a perennial forb typically growing 1–3½ ft (0.3–1 m) tall (**Fig. 20a**) from a cluster of roots beneath its woody crown. Leaves are up to 6 in (15 cm) long, undivided, tapering at both ends, and often less gray-green than other

Figure 20. Brown knapweed (a) plant; (b) infestation along a moist roadside (a: Martin A. Prinz, iNaturalist.org CC BY-NC 4.0; b: Michael Cripps, iNaturalist.org CC BY-NC 4.0)

knapweeds. Flower heads are produced singly at the tips of stems and branches. They are ≤¾ in (2 cm) in diameter and have 20–40 pink or lavender florets. The bracts are light brown and have papery, sometimes translucent margins. Each floret produces a single brown seed with no pappus. This plant reproduces only by seed.

Roots

Brown knapweed seedlings have taproots. As plants grow and mature, they produce additional roots in a cluster beneath the woody root crown.

Stems and Leaves

Stems are 1–3 ft (0.3–0.9 m) tall, and often branch near their tops. Stems are nearly round in cross-section and have grooves or ridges that are sometimes purple. Most are covered with fine hairs though they are far less hairy than spotted, diffuse, and squarrose knapweed. Upper stems end in solitary flower heads. Rosette leaves are often a brighter green than most other knapweed species, with only subtle gray tones and fine hair. They are up to 6 in (15 cm) long, taper at both ends, and either have smooth margins or are shallowly lobed (**Fig. 21a**). Stem leaves are alternate and stalkless, becoming smaller, less lobed, and more lance-shaped higher up the stem (**Fig. 21b**).

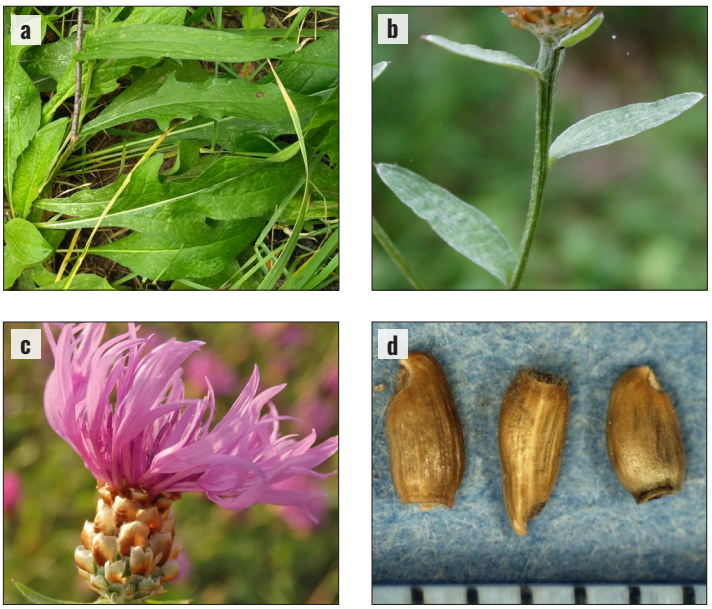


Figure 21. Brown knapweed (a) basal leaves; (b) stem leaves; (c) flower head; (d) seeds (a: Natalya; b: Елена Алексеевна Р.; c: Lorenzo Dotti; d: Bruce Ackley, The Ohio State University, Bugwood.org, CC BY 3.0 US; a–c: iNaturalist.org CC BY 4.0)

Flowers

Brown knapweed flower heads are ≤¾ in (2 cm) wide and ¾–1 in (2–2½ cm) long with 20–40 pink or lavender florets. The outer florets are often larger and spread outward compared to the central florets (**Fig. 21c**). The receptacles are broadly oval and covered with overlapping rows of bracts that are light brown with papery, translucent margins.

Fruits and Seeds

Each floret produces one small brown seed that has no pappus (**Fig. 21d**). A single large plant with multiple flower heads may produce well over 100 seeds annually.

ECOLOGY

Brown knapweed spreads only by seed. Seeds germinate throughout the growing season. Plants may remain as rosettes the first year and bolt the second year, or they may remain as rosettes for a few years. Bolting occurs in late spring, and plants flower in mid to late summer (July to September). Seeds typically fall around the parent plant or are transported by animal fur, hay, human activity, and water. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Some plants die in fall after producing seed, but many re-sprout the following year from their root crown.

HABITAT

Similar to meadow and Tyrol knapweed, brown knapweed prefers more mesic to moist habitats compared to spotted, diffuse, and squarrose knapweed. It can be found growing in grasslands, open woods, meadows, pastures, and woodland clearings (**Fig. 20b**) and can tolerate partial shade.

Tyrol knapweed

Centaurea nigrescens (Willd.)

SYNONYMS

Short-fringed knapweed, Vochin knapweed, alpine knapweed, *Centaurea jacea* L. subsp. *nigrescens* (Willd.) Čelak

HISTORY AND DISTRIBUTION

Black knapweed is native to Europe and was introduced to eastern North America in the 1800s, possibly as a contaminant in alfalfa or intentionally as a forage crop. It has since been reported in 28 states and three Canadian provinces (**Fig. 22**). The ecological harm it causes far outweighs its value for grazing.

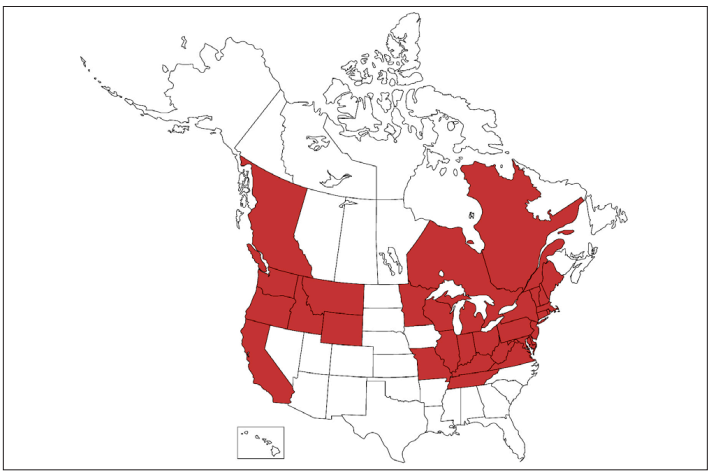


Figure 22. Tyrol knapweed reported distribution in North America (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 26 July 2022]). Note: many infestations originally identified as Tyrol knapweed have since been confirmed to be the hybrid meadow knapweed. Likewise, many infestations attributed to Tyrol knapweed are likely black knapweed, and vice versa.

IDENTIFICATION

At a Glance

Tyrol knapweed is a perennial forb typically growing 1–3 ft (0.3–0.9 m) tall (**Fig. 23a**) from a cluster of roots beneath its woody crown. Leaves are up to 9 in (23 cm) long, tapering at both ends, and often less gray-green than other knapweeds. Flower heads are produced singly at the tips of stems and branches. They are ½–1 in (1¼–2½ cm) in diameter and have 20–60 pink or lavender florets. The bracts are narrow with appendages at tips. Appendages are triangular, dark brown or black, and have a fringe of stiff, comb-like teeth on their margins. Each floret produces a single brown seed with either no pappus or only a short row of fine hairs. This plant reproduces only by seed.

Roots

Tyrol knapweed seedlings have taproots. As plants grow and mature, they produce additional roots in a cluster beneath the woody root crown.

Stems and Leaves

Stems are typically 1–3 ft (0.3–0.9 m) tall, though sometimes grow taller, and they often branch near their tops. Stems are nearly round in cross-section and have grooves or ridges. Most are covered with fine, cobwebby hairs though some older stems can be hairless. Upper stems and branches end

Figure 23. Tyrol knapweed (a) plant; (b) infestation (a: Alessandro Longhi, iNaturalist.org CC BY-NC 4.0; b: Needsbettercamera, iNaturalist.org CC BY-NC 4.0)

in solitary flower heads. Rosette leaves are often a brighter green than most other knapweed species, with only subtle gray tones and fine hair. They are up to 9 in (23 cm) long, somewhat tapered at both ends, and are usually undivided but may be lobed or have a few small teeth (**Fig. 24a**). Stem leaves are alternate and stalkless, becoming smaller, less lobed, and more lance-shaped higher up the stem (**Fig. 24b**).

Flowers

Tyrol knapweed flower heads are ½–1 in (1¼–2½ cm) in diameter and ovoid (generally longer than they are wide). They have 20–60 pink or lavender florets; the outer florets are often larger and spread outward compared to the central florets (**Fig. 24c**). The receptacles are covered with overlapping rows of somewhat narrow, triangular bracts that are green and often streaked with white (**Fig. 24c**) or dark pink. Each bract

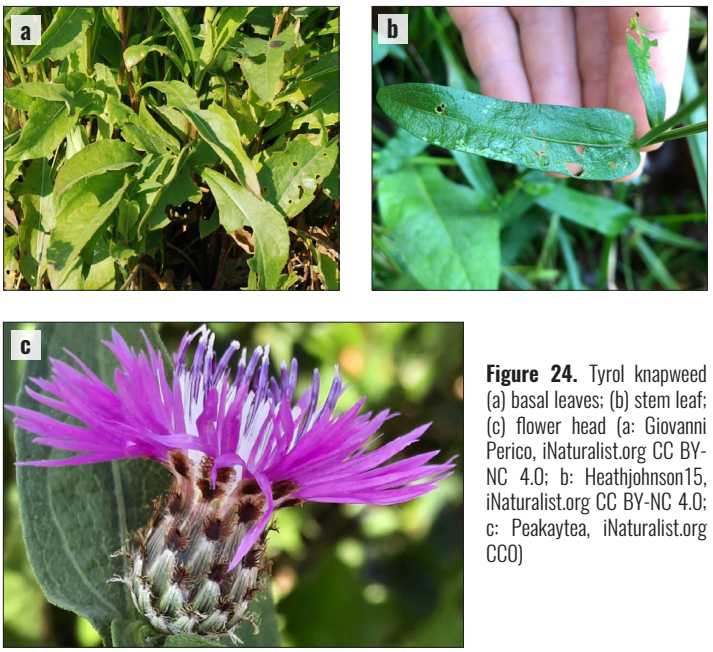


Figure 24. Tyrol knapweed (a) basal leaves; (b) stem leaf; (c) flower head (a: Giovanni Perico, iNaturalist.org CC BY-NC 4.0; b: Heathjohnson15, iNaturalist.org CC BY-NC 4.0; c: Peakaytea, iNaturalist.org CC0)

is narrowed at the top and then tipped by a small, triangular, dark brown or black appendage. Appendages have a fringe of ≤8 stiff, comb-like teeth on each side margin (**Fig. 24c**). The fringe does not extend down the length of the green bracts, nor do the teeth overlap adjacent bracts. From a distance, green bract bases are visible, and the dark brown appendages give the receptacle a "spotted" appearance.

Fruits and Seeds

Each floret produces one small brown seed with either no pappus or only a short row of fine hairs. A single large plant with multiple flower heads may produce well over 100 seeds annually.

ECOLOGY

Tyrol knapweed spreads only by seed. Seeds germinate throughout the growing season. Plants may remain as rosettes the first year and bolt the second year, or they may remain as rosettes for a few years. Bolting occurs in late spring, and plants flower in mid to late summer (July to September). Seeds typically fall around the parent plant or are transported by animal fur, hay, or human activity. Seed viability of knapweed species is variable. In general, some seeds may remain viable for 10–15 years, though the majority germinate within 1–3 years. Some plants die in fall after producing seed, but many re-sprout the following year from their root crown.

HABITAT

Similar to meadow and brown knapweed, Tyrol knapweed prefers more mesic to moist habitats compared to spotted, diffuse, and squarrose knapweed. It can be found in or along irrigated pastures (**Fig. 23b**), meadows, riverbanks, irrigation ditches, and forest openings, and it prefers full sun.

Similar Species

In addition to the six *Centaurea* species and the meadow knapweed hybrid described in this fact sheet, there are an additional 22 exotic *Centaurea* species and two hybrids currently present in North America. Although some have similarities to the knapweeds described in this publication, many can be easily differentiated by having yellow florets (e.g., *Centaurea macrocephala*) or having long sharp spines extending from receptacle bracts (e.g., *Centaurea calcitrapa*) (**Fig. 25**). **Table 2** includes other and more distantly related species that resemble invasive knapweeds as well as key traits that can be used for differentiation.

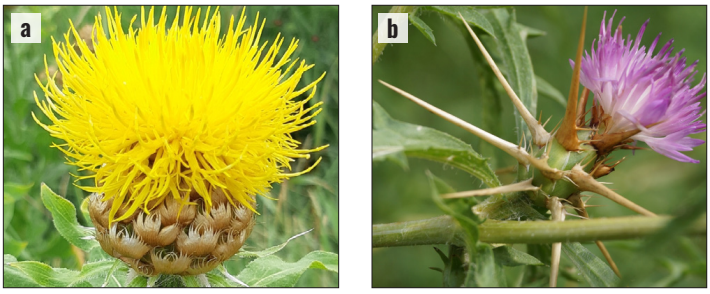


Figure 25. Many other exotic *Centaurea* present in North America can be easily differentiated from knapweeds by having (a) yellow florets (*Centaurea macrocephala*) or (b) long spines extending from bracts (*Centaurea calcitrapa*) (a: Rinrat86, iNaturalist.org CC BY 4.0; b: Елена Алексеевна P., iNaturalist.org CC BY-NC 4.0)

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Table 2. Key traits for differentiating *Centaurea* knapweeds from similar species. Knapweed abbreviations: *Centaurea* knapweeds (kw), spotted (sp), diffuse (di), squarrose (sq), meadow (me), black (bl), brown (br)

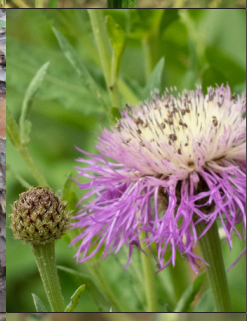
SPECIES	CHARACTERISTICS	PLANT	LEAVES	FLOWER HEAD
Cornflower/ bachelor's button *Centaurea cyanus* Asteraceae Exotic annual	This plant is often included in wildflower mixes, but is also a weed established throughout North America. It grows to a similar height and in similar habitat to all 6 kw species. It has gray-green foliage similar to sp, di, and sq, although its leaves are much longer and linear and are unlobed. Its flower head bracts are fringed in dark spines and may resemble sp, md, and bl. The florets of some cultivars may be white or pink, but most often the outer (obvious) ray florets are bluish-purple, while the inner disc florets are purple or magenta. The seeds are grayish-yellow with bristly yellow pappus.			
Russian knapweed *Rhaponticum repens* Asteraceae Exotic perennial	Russian knapweed is a weed with creeping roots that is established in central and western North America. It grows to a similar height as all 6 kw species, but prefers drier habitat similar to sp, di, sq, and md. It has gray-green foliage similar to sp, di, and sq; although its lower leaves are also lobed, Russian knapweed lobes are far less deep. Its pink or lavender florets resemble all 6 kw species. Russian knapweed bract margins differ from 5 kw species by not having a comb-like fringe or spines. They are translucent, similar to md, however they are more white and triangular. Russian knapweed seeds are gray, and its pappus is long and bristly but falls off quickly.			
American basketflower *Plectocephalus americanus* Asteraceae Native annual	Previously *Centaurea americana*, this species is native to the midwestern and southwestern USA, overlapping all 6 kw species and occurring in similar habitat. It grows to a similar height as all 6 (sometimes taller), but is infrequently branched (unlike all 6). Its foliage is most similar to md, bl, and br in that it is bright green, less hairy, and not deeply (or at all) lobed or divided. Its flower heads are much wider (1½–3 in or 3¾–7½ cm with florets). American basketflower florets tend to be light pink or white, and its bracts are fringed in a comb-like margin much longer than the kw species. Its seeds are dark brown and teardrop-shaped.			
Rothrock's knapweed *Plectocephalus rothrockii* Asteraceae Native annual	Previously *Centaurea rothrockii*, this species is native to moist canyon sites of Mexico, Arizona and New Mexico, overlapping only sp, di, and sq. It grows taller than all 6 and is infrequently branched. Its foliage is most similar to md, bl, and br in that it is bright green, less hairy, and not deeply (or at all) lobed or divided, though leaves often have small teeth. Its flower heads are much wider (≤4 in or 10 cm with florets). Rothrock's knapweed florets tend to be pink around the periphery and white in the center. Its bracts are most similar to sp. Its seeds are dark brown and teardrop-shaped.			
Hoary aster *Diateria canescens* Asteraceae Native annual to short-lived perennial	This plant is native to central and western North America, but often grows as a weed. It typically grows shorter than all 6 kw species. Hoary aster has gray-green foliage similar to sp, di, and sq and grows in similar dry habitat. Its wiry stems, small and unlobed higher stem leaves, and small flower heads most closely resemble di and sq, and it is frequently confused for these species prior to flowering. Hoary aster differs by having toothed basal leaves, and its flower heads produce daisy-like purple ray florets around the periphery and yellow disc florets in the center.			

Photo credits: cornflower: plant (Eric Keith), leaves (Woodsyogi), flower head (Stephanie A. Rivest, iNaturalist.org, CC BY-NC 4.0); Russian knapweed plant (Eric Coombs, Oregon Department of Agriculture, Bugwood.org CC BY 3.0 US), leaves (Travis McMahon, MIA Consulting), flower head (Jennifer Andreas, Washington State University Extension); American basketflower plant (C. D. Winke), leaves and flower head (Michaelkalisek, iNaturalist.org CC BY-NC 4.0); Rothrock's knapweed plant (Christina M. Selb), leaves (Pete Siminski), flower head (Bettina Arrigoni); hoary aster plant (pre-flowering), basal leaves, flower head (Travis McMahon, MIA Consulting)

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NAISMA is a network of professionals challenged by invasive species: land managers, water resource managers, state, regional, and federal agency directors and staff, researchers, and nonprofit organizations. NAISMA's members are a diverse group of individuals and organizations who are involved in implementing invasive species management programs at all scales. Our mission is to support, promote, and empower invasive species prevention and management in North America. Our vision is to have North America's lands and waters protected from invasive species. NAISMA's programs aim to provide the support, training, and standards needed by the professional invasive species management community.

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