

Musk (Nodding) Thistle Complex, *Carduus nutans* L. Compositae

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I. Nomenclature: A) *C. nutans* L. Note: The *Carduus nutans* group is a taxonomically difficult assemblage of plants that have been divided into at least eight species by European botanists, and fourteen taxa of the subspecies are included (Flora Europaea 1964-1980). European species in this complex include: 1) *C. macrocephalus* Desf. (*C. m.* subsp. *macrocephalus*, *C. m.* subsp. *sporadum* (Halacsy) Franco, *C. m.* subsp. *siculi's* Franco); 2) *C. granatensis* Willk.; 3) *C. taygeteus* Boiss. & Heldr. (*C. t.* subsp. *taygeteus* = *C. nutans* subsp. *taygeteus* (Boiss. & Heldr.) Hayek, *C. t.* subsp. *insularis* Franco); 4) *C. thoermeri* Weinm. = *C. nutans* auct., non L., *C. leiophyllus* Petrovic; 5) *C. nutans* L. (*C. n.* subsp. *nutans*, *C. n.* subsp. *alpicola* (Gillot) Chassagne, *C. n.* subsp. *platylepis* (Reichenb. & Sauter) Nyman = *C. platylepis* Reichenb. & Sauter); 6) *C. micropterus* (Borbás) Teyber (*C. m.* subsp. *micropterus* = *C. nutans* subsp. *micropterus* (Borbás) Hayek, *C. m.* subsp. *perspinosus* (Fiori) Kazmi); 7) *C. broteroi* Welw. ex Coutinho; 8) *C. sandwithii* Kazmi; B) musk thistle; nodding thistle.

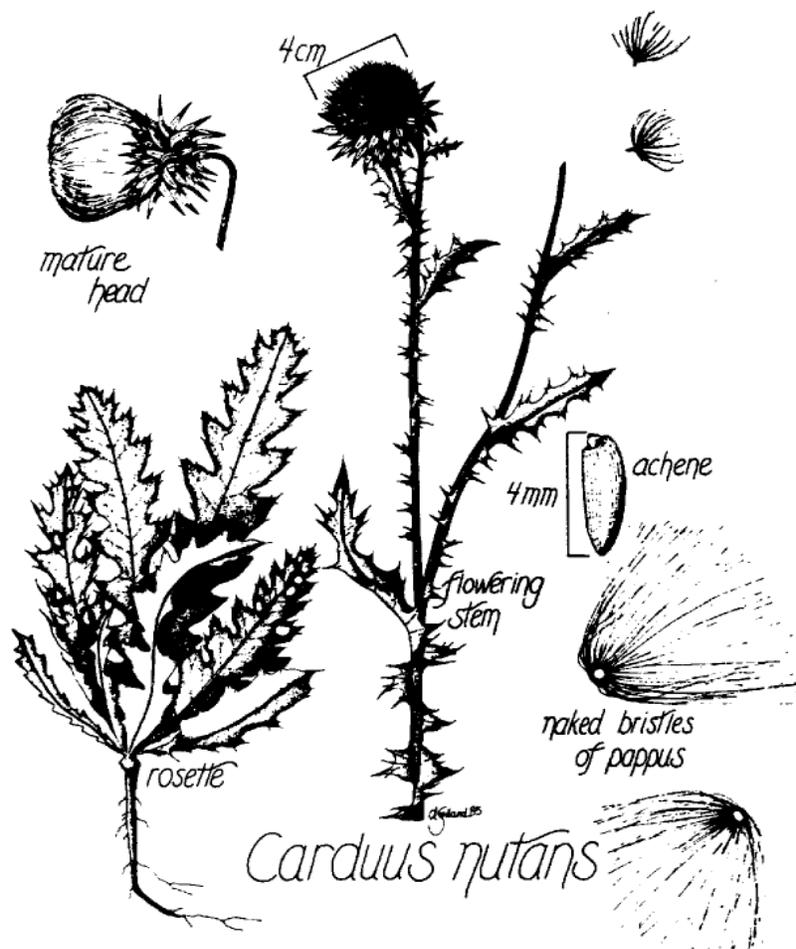


Fig. 1. *Carduus nutans*, also known as musk and nodding thistle. Note the naked pappus.

II. History: The genus *Carduus* is assigned by botanists to the composite family of plants because the apparent “flower” is actually a head of small individual flowers (florets). This family contributes a substantial number of weeds to the Pennsylvania flora; the number has been estimated to be as high as 15%.

The genus is indigenous to Eurasia and northern Africa. Several species found in the Commonwealth are believed to be of European origin. The time of arrival of *Carduus nutans* is uncertain. It is not mentioned in early floristic works (de Schweinitz 1824, de Schweinitz 1836, Kummer 1839) nor is it mentioned in botanical surveys of ballast ground near Philadelphia (Smith 1867) and Bethlehem, PA (Porter 1892). By 1898 Porter reports species no. 153, *Carduus nutans* L. as an element of the flora of the lower Susquehanna, from Harrisburg, deposited in the herbarium at Lafayette College, collected during the years 1853-1866. Martindale does not record the plant as present around the ports at Philadelphia in 1876; however, he did collect specimens, deposited in the U.S. National Herbarium and the Philadelphia Academy of Science, from ballast at Camden, NJ, in 1880 and 1882 (Britton 1889). A nonexhaustive list of early collection records, taken from a paper by Stuckey and Forsyth (1971), includes, in addition to those mentioned above: New Brunswick, NJ (1871); New York City area (Hoboken, 1879); Providence, RI (1893), and Washington, DC (1897). In its westward migration, *Carduus nutans* reached Ohio by 1925.

A survey conducted in 1974 to determine the distribution of several weedy *Carduus* taxa (Dunn 1976) revealed nodding thistle infestations in Pennsylvania confined to 4 counties: potential economic impact in Franklin Co., occasional plants in Adams, Fulton, and York counties.

III. Technical evaluation: the *plants* are mostly biennial, 0.3-2 m tall; *leaves:* glabrous or long-villous chiefly along the main veins beneath, conspicuously decurrent, alternate, deeply lobed, spiny, 25 x 10 cm; *stems:* generally winged, spiny; *heads:* mostly solitary and nodding at the ends of the partly naked branches, hemispherical, 3-5 cm broad (to 8 cm when pressed); *involucral bracts:* imbricate, middle and outer conspicuously broad, 2-8 mm, lanceolate, armed with long, flat, spreading or reflexed, spine-pointed tips; *inner bracts* narrower and softer; *capitulum:* discoid, the flowers all tubular and perfect; *staminal filaments:* pilose; *anthers:* tailed; *achenes:* glabrous, basifixed, obovate, tan with numerous (± 20) longitudinal, brown nerves, 3.5-4.5 mm with a terminal whitish tubercle; *pappus:* white, capillary, united into a basal ring, deciduous, 2 cm long; *chromosome number:* $2n = 16$; *distribution:* locally abundant in areas where limestone (or dolomite) bedrock is less than six feet below the surface; moderately grazed pasture fields, waste places, roadsides, often on dry or gravelly soils.

IV. Diagnostic characteristics: The uninitiated person generally can recognize nodding (musk) thistle by the large, pink, solitary flower heads on extremely spiny plants. The heads resemble “powder puffs.” The bracts (green leaflike structures under the flower heads) are flat, broad, 1/4 to 1/3 inch wide. The heads are often nodding, as the name implies.

V. Confused taxa: The genus *Carduus* is sometimes confused with the thistle genus *Cirsium*. In fact, at one time botanists considered the species of *Cirsium* to be *Carduus* taxa. The only significant difference between these two genera is the nature of the pappus. The pappus is the crown that is found on top of seeds (achenes) in all members of the daisy family; the Compositae. In the genus *Carduus* the pappus is composed of capillary bristles that are naked, single, and silky; whereas in the genus *Cirsium* the pappus is composed of featherlike bristles. These plumose bristles are especially evident when the pappus has been dried. Fresh material in the field should be air-dried before examination.

The common pasture or roadside thistles that might be confused with *C. nutans* are *Cirsium arvense* (L.) Scop. (Canada thistle, which has been detailed in weed circular no.2 in this series, see Hill 1983), *Cirsium vulgare* (Savi) Tenore (bull thistle), *Cirsium pumilum* (Nutt.) Spreng. (pasture thistle), and *Carduus acanthoides* L. (plumeless thistle).

The pappus must be examined to determine the genus of an unidentified thistle. The difference in pappus types between *Carduus* and *Cirsium* are described above and can be seen in the accompanying illustrations. In regard to the genus *Cirsium*, Canada thistle can be differentiated from nodding thistle by its shorter, less-branched stems, with numerous, erect, lavender-purple flower heads that terminate leafy peduncles. Additionally, Canada thistle is a perennial plant, with rhizomes, that form dense stands of very closely spaced stems. On the other hand, bull thistle (see weed circular no.11, this series) is characterized by single plants with several large, erect purple heads terminating leafy peduncles. The showy purple bull thistle flowers appear in late July through August. Nodding thistle flowers, equally showy; are pink and appear in late June through July. The leaflike bracts that subtend the flowers (involucres) of bull thistle are more narrow and spiny than those of nodding thistle. The pasture thistle closely resembles nodding thistle. It flowers from June through September. It differs from bull thistle in having the upper half of the stem devoid of longitudinal spiny wings. The bracts are long (4-6 mm) spine tipped. In nodding thistle the peduncles are also naked (or partly naked); however, the involucral bracts are reflexed (in part), and short spine-tipped. Plumeless thistle bears clusters of small purple flowers. A simple key to the commonly encountered species of thistles is provided.

1. Pappus bristles naked (not plumose) 2
2. Heads nodding, solitary; involucral bracts 2 mm wide or more *Carduus nutans* (nodding thistle)
2. Heads erect or ascending, usually clustered; involucral bracts less than 2 mm wide *Carduus acanthoides* (plumeless thistle)

1. Pappus plumose at least to the middle3
3. Upper half of the stem conspicuously spiny winged with decurrent leaf bases
Cirsium vulgare (bull thistle)
3. Upper half of the stems not *long-winged*.....*Cirsium pumilum* (pasture thistle)

It should be noted that 16 species of *Cirsium* and 2 species of *Carduus* commonly occur in our range. For the exact identity of a thistle, it is recommended that a botanist be consulted.

VI. Natural History: The life cycle of nodding thistle, *Carduus nutans*, has been studied extensively (McCarty and Scifres 1969, McCarty 1964, Feldman et al. 1968 and others). Research shows that nodding thistle behaves as a biennial or winter annual, rarely as an annual plant. This behavior is possible because seeds germinate from early spring to late fall. The length of time between germination and flowering can vary from 4 to 22 months. Adverse conditions such as drought stress and competition affect the conversion from a vegetative phase to a reproductive one; the onset of flowers is encouraged by these factors. Flowering commences in June beginning with the terminal head and progresses down the stem from branch to branch. Large plants can average 10,000 achenes (seeds) per plant (McCarty 1964). Germination percentages reveal that each plant has the potential of producing more than 3,000 seedlings. Seed viability is high for achenes stored in low temperature/low moisture regimes. Moist environments cause viability to drop off rapidly. Achenes are not highly discriminatory and will germinate without dormancy. The 4 mm long seed can emerge from a soil depth of 50 mm, and tolerances are high for salt concentrations, pH range (3.0 to 9.0), and high moisture tension. The seedlings survive the winter as dense rosettes of leaves; winter-kill is not appreciable. Hot, dry growing conditions can cause some natural mortality in a population.

Generally stem elongation begins in early May and flowering commences in early June. Plants emerging from seed in early summer may begin stem elongation in October or November. These individuals are not to be expected to complete flowering because of frost and severe cold.

Some white-flowered forms of *Carduus nutans* are known. A portion of the progeny from white flowered seeds will also produce white flowers.

Natural hybridization occurs between nodding thistle (*Carduus nutans*) and plumeless thistle (*Carduus acanthoides*) (Moore and Mulligan 1956). The morphological appearance of the offspring more closely resembles plumeless thistle. Kartesz and Kartesz (1980) indicate that the valid name for plants resulting from this cross is *Cardutis x orthocephalus* Wallr.

The distribution of nodding thistle is very interesting. Studies by Stuckey and Forsyth (1971) show that *C. nutans* is most abundant in situations where the limestone or dolomite bedrock is less than six feet below the soil surface. Plants were rare where the bedrock was deeper, in flat terrain, or in cultivated fields. Expansion of the plants' range by natural means is generally slow for several reasons: many achenes do not fully develop, achenes remain attached to the heads, and the heads tend to drop to the ground in the immediate vicinity of the parent plant. This is in contrast to the statement by Roof and Anderson (1982) that the seeds are air borne and consequently carried by wind for many miles from the site where they originate.

VII. Economic Importance: A) Beneficial. Nodding thistle appears to have few desirable attributes with the possible exception of achene production for wild bird consumption. B) Detrimental. Musk thistle is not a serious weed problem in crops that require a spring seedbed preparation. Tillage easily eradicates any leaf rosettes established during the previous season. However, nodding thistle can be a problem in fall-planted grains, alfalfa, or clover when established seedlings survive the winter. The plant is a common weed of roadsides, railroads, fence rows, rights-of-way; wasteland, and pasture and rangeland. In the latter two situations nodding thistle is of greatest economic impact because it competes with desirable forage crops. Once established, livestock tend to avoid eating the armed stems and branches.

VIII. Control: Herbaceous broadleaf weeds, application by farm-spray; high volume: Weedone¹ LV6 Emulsifiable (2,4-D ester), rate: 2-3 lb. ai (2.67-4.0 pt) in enough water to thoroughly cover, apply when weeds are actively growing; Herbaceous broadleaf weeds, low volume: Weedmaster (dicamba + 2,4-D), rate: 0.25 lb dicamba + 0.75 lb 2,4-D acid equiv. (1 qt Weedmaster); spot treatment: 1.5 teaspoon Weedmaster with 1 gal. water to treat 1 sq. rod.; fallow land: Acme Ultra-Sulv (2,4-D), rate: 1-3 lb ai (1-3 qt) / A; Banvel Herbicide (dicamba), rate: 0.5-1.0 lb ai (1.0-2.0 pt); field corn: Banvel Herbicide (dicamba), rate: 0.5-1.0 lb ai (1.0-2.0 pt); small fruit: Roundup (glyphosate), rate: wiper applicators, 33% solution for grapes; 20% solution for cranberries; soybeans: Roundup (glyphosate), rate: wiper application, roller, 10 % solution; rope wick and other wipers, 33% solution; noncropland: Tordon 101 Mixture (picloram + 2,4-D), rate: 1.25-10.0 lb ai (0.5-4.0 gal 101); Tordon K (picloram), rate: 0.125-2.0 lb ai (0.25-4.0 qt K) / A; Weedmaster (dicamba + 2,4-D), rate: 0.125-0.5 lb dicamba ai and 0.375-1.5 lb 2,4-D ai (0.5-2 qt); spot treatment: 0.75-3.0 tsp. with 1 gal water /1 sq. rod.

Note: Both picloram and 2,4-D are considered effective chemical controls if applied at the proper time (Roof and Anderson 1982). The herbicides are applied to rosettes before they bolt. This should be done in the fall or spring. The effective eradication

of nodding thistle from an infested pasture requires dedication and perseverance since seeds remain viable in the soil for 5-7 years.

Recent experiments (Roof and Anderson 1982, Puttler et al. 1978, Surles and Kok 1978, Batra 1978) indicate that the musk thistle weevil, *Rhinocyllus conicus* Froelich, may be an effective biological control agent. Adults feed on thistle stems, leaves, and bracts of flowerheads, while larvae feed within the receptacles, inhibiting seed production.

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