IDENTIFICATION OF THISTLES AND THISTLE-LIKE WEEDS

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THE true thistles have had a largely dishonourable, century-long association with New Zealand's agriculture, with in addition the doubtful distinction of being the subject of New Zealand's first weed legislation: the Thistle Act 1854 ("An Act to prevent the propagation of certain plants known as thistles") of the Wellington Provincial Council. Individually or collectively thistles were responsible for 13 Acts and Ordinances in the Provincial Government period and a number have been included in the major weed enactments of the present century.

The vernacular name "thistle" is applied to plants characterised by prickly leaves and/or prickly heads, and in its strict sense should be applied to plants of the tribe *Cynareae* of the family *Compositae* (daisy family). In New Zealand, as elsewhere, the name is used in agricultural practice in a broader sense to include in addition to the true thistles (for example, Californian thistle) other plants of the family (sow-thistles and plants of other families).

The true thistles and other weeds which by virtue of their prickly leaves and/or heads are commonly regarded as coming within the broad interpretation of the term "thistle" have been treated as a group for completeness.

The identification of these weeds in either the unrestricted or the wide sense is no 20-minute topic and the position seems best met by:

1. Preparation of two keys for identification: the first for immature plants and the second for mature plants.
2. Discussion of characters important in field identification.
3. Display of plants of some of the species treated in the paper.

Characters of the plant important in field identification, in the main visible to the naked eyes, and used in the two keys are:

1. **Sap:** Whether watery, for example, all true thistles, or milky (sow-thistles).
2. **Underground parts:** Whether a stout tap root (nodding thistle) or an extensive twitch-like underground root or stem system (Californian thistle, Russian knapweed, corn sow-thistle).
3. **Leaves:** (a) Margins prickly (most true thistles) or non-prickly (star thistles); (b) nature of upper and lower surfaces, whether green or white, hairless, soft hairy, prickly hairy, or woolly; (c) size and degree of dissection or cutting; (d) presence or absence of ears (auricles) at base of stem leaves and their shape (sow-thistles); (e) arrangement, whether alternate (true thistles) or opposite (wild teasel).
4. **Stem:** (a) Brittle (welled thistle) or tough (*Carduus acanthoides*); (b) with wings extending down stem from leaf bases (marsh thistle, yellow star thistle) or without wings (star thistle).
5. **Heads:** (a) Flower colour; (b) size, shape, and number of heads; (c) nature of the bracts surrounding the flowers, shape, size, margins, and apices, appendages; (d) pappus or "seed" hairs, whether feathery or bristly.

Accurate identification of plants requires in general as complete a specimen as possible for examination, and with incomplete material the accuracy and ability to identify down to species level are correspondingly reduced. It must be pointed out therefore that results achieved by use of the key to immature plants will be less accurate than those achieved with the key to mature plants where a greater number of significant diagnostic characters are available for use.

I trust that this paper, despite its limitations, will be of assistance to you

in field identification of this group of weeds. You will encounter difficulties—the botanist has his worries with thistle identification too. You may encounter aberrant forms of thistles already known in New Zealand or you may have an unrecorded newly introduced species. I would be pleased to hear of your problems in identification and to examine any specimens you care to submit.

My thanks are expressed to Mr F. E. Hoskin, Paparua County Council, for live plants of winged thistle and wild teasel, to Mr R. E. Jepson, Horowhenua County Council, for live plants of marsh thistle, to Mr B. L. Nicholls, Botany Division, D.S.I.R., for his careful maintenance of the live plants exhibited, to Mr K. R. West, Botany Division, D.S.I.R., Christchurch, for the illustrations, and Mr A. P. Underhill and Mr C. J. Miles, Crop Research Division, D.S.I.R., Christchurch, for making the slides.

A. KEY TO IMMATURE THISTLES AND THISTLE-LIKE WEEDS

1. Plant with watery sap.....2
Plant with milky sap.....18
2. Leaf margins spiny (typically thistle-like) (Fig 1c).....3
Leaf margins not spiny (Fig. 1a).....12
3. Plant with extensive creeping underground root system (twitch-like)
Cirsium arvense
Plant with tap root or rootstock.....4
4. Upper leaf surface with white veins or blotches.....5
Upper leaf surface without white veins or blotches.....6
5. Lower leaf surface green, ± hairless.....*Silybum marianum*
Lower leaf surface white with woolly hairs.....*Chamaepeuce afra*
6. Upper leaf surface prickly hairy (Fig. 1e).....*Cirsium vulgare*
(syn. *C. lanceolatum*)
Upper leaf surface hairless, or with soft hairs.....7
7. Upper leaf surface grey or whitish with woolly hairs.....8
Upper leaf surface greenish, without long woolly hairs.....10
8. Basal leaves to 3 ft long, deeply lobed or cut, prickles to $\frac{1}{2}$ in. long (Fig. 1b).....*Cynara cardunculus*
Basal leaves less than 1 ft long, shallowly lobed, prickles to $\frac{1}{4}$ in. long
Onopordum acanthium
9. Leaves with 5 prominent veins from base on lower surface.....
(a) *Carthamus lanatus*
(b) *Carthamus baeticus*
Leaves without 5 prominent veins from base on lower surface.....10
10. Lower leaf surface whitish with woolly hairs.....
(a) *Carduus crispus*
(b) *Carduus tenuiflorus*
(c) *Carduus pycnocephalus*
(d) *Cirsium* sp.
(e) *Cirsium pratense*
Lower leaf surface greenish, hairless, or with white hairs on mid-rib and main veins, or greenish with scattered hairs.....11
11. Upper surface of basal leaves commonly with metallic shine and whitish marginal colouration, especially about base of prickles.....
Carduus nutans
Upper surface of basal leaves dull green (matt).....
(a) *Carduus acanthoides*
(b) *Cirsium palustre*
12. Plant with stout 3-pronged spine at each leaf base.....
Xanthium spinosum
Plant without 3-pronged spine at each leaf base.....13
13. Upper surface of basal leaves with bulbous-based prickles or bristles; puckered; stem leaves smooth on upper surface, with curved prickles on mid-rib on lower surface.....*Dipsacus sylvestris*
Upper leaf surface not prickly or bristly.....14

14. Basal leaves large, long-stalked, somewhat rhubarb-like.....15
 Basal leaves variable, not rhubarb-like.....16
15. Stalks of lower leaves solid.....*Arctium lappa*
 Stalks of lower leaves hollow.....
 (a) *Arctium minus*
 (b) *Arctium tomentosum*
16. Basal leaves large, to 3 ft long, lobed or dissected, greyish-green.....
 Cynara scolymus
 Basal leaves small, to 6 in. long, lobed or entire, green or greyish-green.....17
17. Plant with extensive creeping underground rootstocks (twitch-like).....
 Centaurea repens
 Plant without extensive creeping underground rootstocks (not twitch-like).....
 Centaurea spp.
18. Sap yellow; leaves spiny-toothed; stems spiny.....*Argemone mexicana*
 Sap white.....19
19. Upper leaf surface rough with whitish bulbous-based hooked hairs or
 bristles (feel like a cow's tongue) stems angled (Fig. 1d).....
 Picris echioides
 (syn. *Helminthia echioides*)
 Upper leaf surface smooth.....20
20. Plant with extensive creeping underground stems (twitch-like).....
 Sonchus arvensis
 Plant with tap root.....(a) *Sonchus asper*
 (b) *Sonchus oleraceus*

B. KEY TO MATURE THISTLES AND THISTLE-LIKE WEEDS

1. Plants with watery sap.....2
 Plants with milky sap.....31
2. Leaf margins spiny (typically thistle-like) (Fig. 1c).....3
 Leaf margins not spiny (Fig. 1a).....18
3. Flowers yellow or orange.....4
 Flowers red, white, blue, or purple.....5
4. Outer bracts about as long as head (Fig. 2, 5a); marginal spines short,
 at ± 60 degrees angle to mid-rib.....*Carthamus lanatus*
 Outer bracts about twice as long as head; marginal spines long, at
 ± 90 degrees to mid-rib.....*Carthamus baeticus*
5. Plant with extensive creeping underground root system (twitch-like)
 (Fig. 5b).....*Cirsium arvense*
 Plant with taproot or rootstock.....6
6. Upper leaf surface with white veins or blotches.....7
 Upper leaf surface without white veins or blotches.....8
7. Lower leaf surface green, $\pm$ hairless; stem leaves with rounded clasping
 ears (auricles) (Fig. 3c, 5d).....*Silybum marianum*
 Lower leaf surface white with woolly hairs; stem leaves with narrowed,
 non-clasping bases (Fig. 5c).....*Chamaepeuce afra*
8. Stems winged (that is, stem leaves continued downward on stems as
 spiny wings).....9
 Stems not winged.....16
9. Upper leaf surface prickly hairy (Fig. 1e).....*Cirsium vulgare*
 (syn. *C. lanceolatum*)
 Upper leaf surface hairless, or with soft hairs.....10
10. Pappus hairs feathery (Fig. 4a, 5g).....*Cirsium palustre*
 Pappus hairs rough or barbed only, not feathery (Fig. 4b).....11
11. Leaves white with woolly hairs on both surfaces (Fig. 5h).....
 Onopordum acanthium
 Leaves greenish on upper surface, green or whitish on lower surface.....12
12. Flower heads nodding; if large, solitary: if small, several together;
 bracts usually purplish, abruptly narrowed to an oblong base (Fig. 5i)
 Carduus nutans

Fig. 1. Leaf characters: a. Leaf with non-spiny margin. b. Leaf showing dissection or cutting. c. Leaf with spiny margin (typically thistle-like). d. Upper leaf surface with bulbous-based rough hairs or bristles (*Pieris*). e. Upper leaf surface with mixed prickles and hairs (*Cirsium vulgare*).

Fig. 2. Section of a typical thistle flower-head. Left side: bracts with terminal spine only; right side: bracts with marginal and terminal spines.

Fig. 3. Leaf arrangement and leaf bases. a. Leaves alternate, with projecting pointed ears (auricles) at base (*Sonchus oleraceus*). Leaves opposite, and bristles on mid-rib on lower leaf surface (*Dipsacus sylvestris*). c. Leaves alternate, with projecting rounded ears (auricles) at base (*Sonchus asper*).

Fig. 4. Pappus or "seed hairs" (much magnified). a. *Cirsium vulgare*. b. *Carduus nutans*.

Fig. 5 (opposite). Bracts of thistle flower-heads. a. *Carthamus lanatus* (saffron) thistle). b. *Cirsium arvense* (Californian thistle). c. *Chamaepsece alba* (Grecian thistle). d. *Silybum marianum* (variegated thistle). e. *Cynara cardunculus* (cardoon). f. *Cirsium vulgare* (spear thistle). g. *Cirsium palustre* (marsh thistle). h. *Onopordum acanthium* (cotton thistle). i. *Carduus nutans* (nodding thistle). j. *Carduus tenuiflorus* (winged thistle). k. *Carduus crispus* (wreathed thistle). l. *Achillea lappa* (greater burdock). m. *Cynara scolymus* (artichoke). n. *Centaurea calcitrapa* (star thistle). o. *Centaurea solstitialis* (yellow star thistle). p. *Centaurea melitensis* (Malta thistle). q. *Centaurea nigra* (knapweed). r. *Centaurea maculosa*. s. *Centaurea repens* (Russian knapweed).

- Flower heads erect; bracts not abruptly narrowed.....13
13. Flower heads oblong in outline.....14
 Flower heads hemispherical in outline.....15
14. Stems leafy up to flower heads; stem wings broad; flower heads 5–15,
 clustered (Fig. 5j).....*Carduus tenuiflorus*
 Stems naked for some distance below flower heads; stem wings narrow;
 flower heads solitary or 2–4.....*Carduus pycnocephalus*
15. Plant strongly spiny; stem tough; leaves $\pm$ hairless or hairy along mid-
 rib and main veins on lower leaf surface.....*Carduus acanthoides*
 Plant weakly spiny; stem brittle; lower leaf surface whitish hairy (Fig.
 5k)*Carduus crispus*
16. Leaves hairless, bluish-green; flower heads with bracts longer than
 heads and spiny processes projecting between the individual flowers
Eryngium spp.
 Leaves hairy or woolly, green or greyish; spiny processes between indi-
 vidual flowers absent17
17. Basal leaves to 3 ft long, deeply lobed or cut, prickles to $\frac{1}{2}$ in. long;
 heads large, to 4 in. diam.; bracts $\frac{1}{4}$ to $\frac{1}{2}$ in. wide at base (Fig. 5e)
Cynara cardunculus
 Basal leaves to 1 ft long, shallowly lobed; heads smaller, to $1\frac{1}{2}$ in. diam.;
 bracts never more than $\frac{1}{8}$ in. wide at base.....*Cirsium* sp.
18. Stem leaves opposite; curved prickles on mid-rib on lower surface;
 heads large, conical, with long, spiny bracts (Fig. 3b).....*Dipsacus sylvestris*
 Stem leaves alternate (Fig. 3a).....19
19. Fruiting heads burrs or burr-like, with hooked spines (Fig. 5l)20
 Fruiting heads not burrs or burr-like23
20. Plant with stout 3-pronged spine at each leaf base; all leaves small
Xanthium spinosum
 Plant without 3-pronged spine at each leaf base; basal leaves large,
 long-stalked, rhubarb-like21
21. Stalks of lower leaves solid (Fig. 5e)*Arctium lappa*
 Stalks of lower leaves hollow22
22. Inner bracts hooked*Arctium minus*
 Inner bracts not hooked*Arctium tomentosum*
23. Heads typically thistle-like, with spiny bracts (Fig. 2)24
 Heads not spiny, bracts with dark comb-like margin or fringe, or with
 membranous margin (Fig. 5q,s)27
24. Flowers red or purple; stems not winged25
 Flowers yellow; stems winged26
25. Heads large, 3*4 in. diam.; bracts broad, blunt-tipped; leaves to 3 ft or
 more long (Fig. 5m)*Cynara scolymus*
 Heads small; bracts narrow, sharp pointed; leaves small (Fig. 5n)
Centaurea calcitrapa
26. Terminal spine of bract stout, yellow, to $\frac{3}{4}$ in. long, with short lateral
 spines in lower quarter (Fig. 5o)*Centaurea solstitialis*
 Terminal spine of bract weak, usually reddish or purplish tinged, with
 lateral spines in lower half (Fig. 5p)*Centaurea melitensis*
27. Plant with extensive creeping underground rootstocks (twitch-like);
 bracts not fringed (Fig. 5s)*Centaurea repens*
 Plant without extensive creeping underground rootstocks (not twitch-
 like); bracts with comb-like margins or fringe (Fig. 5q)28
28. Bracts shallow toothed on margins; plant annual, with slender tap
 root; leaves greyish*Centaurea cyanus*
 Bracts with comb-like fringe on margins; plant biennial or perennial
 with distinct branching rootstock29
29. Stem leaves entire or with a few teeth near base; marginal fringe of
 bract long (Fig. 5q)*Centaurea nigra*
 Stem leaves deeply dissected or cut; marginal fringe of bract shorter 30

30. Divisions of stem leaves $\frac{1}{2}$ in. wide or less (Fig 5r) *Centaurea maculosa*
 Divisions of stem leaves $\pm \frac{1}{4}$ in. wide *Centaurea scabiosa* 31
31. Sap yellow; leaf margins, stems, fruit spiny; flower yellow, poppy-like
Argemone mexicana
 Sap white; leaf margins not spiny, or only weakly so; flower yellow,
 not poppy-like 32
32. Upper leaf surface rough with whitish, bulbous-based hooked hairs or
 bristles (feel like a cow's tongue): stems angled: outer bracts large,
 broad based, inner bracts long, narrow (Fig. 1d) *Pieris echioides*
 (syn. *Helminthia echioides*) 33
 Upper leaf surface smooth
33. Plant with extensive creeping underground stem system (twitch-like)
Sonchus arvensis
 Plant with tap root 34
34. Clasping ears (auricles) at base of stem leaves pointed (Fig. 3a)
Sonchus oleraceus
 Clasping ears (auricles) at base of stem leaves rounded (Fig. 3c)
Sonchus asper

FINDING LISTS: NAMES OF THISTLE AND THISTLE-LIKE WEEDS

BOTANICAL NAMES AND COMMON NAME EQUIVALENTS

<i>Arctium lappa</i> L.	(Greater burdock)
minus (Hill) Bernh.	(Lesser burdock)
tomentosum Mill.	(Woolly burdock)
<i>Argemone mexicana</i> L.	(Mexican poppy)
<i>Carduus acanthoides</i> L.	
crispus L.	(Wetted thistle)
nutans L.	(Nodding thistle: Musk thistle)
pycnocephalus L.	(Slender winged thistle)
tenuiflorus Curt.	(Winged thistle)
<i>Carthamus baeticus</i> (Boiss. et Reut.) Nym.	
lanatus L.	(Saffron thistle)
<i>Centaurea calcitrapa</i> L.	(Star thistle)
cyanus L.	(Cornflower)
maculosa Lam.	
melitensis L.	(Malta thistle)
nigra L.	(Lesser knapweed)
repens L.	(Russian knapweed)
scabiosa L.	(Greater knapweed)
solstitialis L.	(Yellow star thistle)
<i>Chamaepeuce afra</i> (Jacq.) DC.	(Grecian thistle)
<i>Cirsium</i> sp.	(Woolly-headed thistle)
<i>Cirsium arvense</i> (L.) Scop.	(Californian thistle)
lanceolatum (L.) scop.	(Invalid name, synonym of <i>C. vulgare</i>)
palustre (L.) Scop.	(Marsh thistle)
vulgare (Savi) Ten.	syn. <i>C. lanceolatum</i> (Spear thistle: "Scotch thistle")
<i>Cynara cardunculus</i> L.	(Cardoon)
scolymus L.	(Artichoke)
<i>Dipsacus sylvestris</i> L.	(Wild teasel)
<i>Eryngium</i> spp.	(Sea holly)
<i>Helminthia echioides</i> (L.) Gaertn.	(Synonym of <i>Pieris echioides</i>)
<i>Onopordum acanthium</i> L.	(Cotton thistle: Scotch thistle)
<i>Silybum marianum</i> (L.) Gaertn.	(Variegated thistle: Milk thistle)

<i>Picris echioides</i> L. syn. <i>Helminthia echioides</i>	(Oxtongue)	
<i>Sonchus arvensis</i> L.	(Corn sow-thistle; perennial	sow-thistle)
<i>asper</i> (L.) Hill	(Prickly sow-thistle)	
<i>oleraceus</i> L.	(Sow-thistle)	
<i>Xanthium spinosum</i> L.	(Bathurst burr)	

COMMON NAMES AND BOTANICAL NAME EQUIVALENTS

Artichoke	(<i>Cynara scolymus</i>)
Bathurst burr	(<i>Xanthium spinosum</i>)
Burdock	
Greater	(<i>Arctium lappa</i>)
Lesser	(<i>Arctium minus</i>)
Woolly	(<i>Arctium tomentosum</i>)
Cardoon	(<i>Cynara cardunculus</i>)
Cornflower	(<i>Centaurea cyanus</i>)
Knapweed	
Greater	(<i>Centaurea scabiosa</i>)
Lesser	(<i>Centaurea nigra</i>)
Russian	(<i>Centaurea repens</i>)
Mexican poppy	(<i>Argemone mexicana</i>)
Oxtongue	(<i>Picris echioides</i>)
Rauriki	(<i>Sonchus oleraceus</i>)
Sea holly	(<i>Eryngium</i> spp.)
Sow-thistle	(<i>Sonchus oleraceus</i>)
Corn	(<i>Sonchus arvensis</i>)
Perennial	(<i>Sonchus arvensis</i>)
Prickly	(<i>Sonchus asper</i>)
Teasel, wild	(<i>Dipsacus sylvestris</i>)
Thistle	
Californian	(<i>Cirsium arvense</i>)
Cotton	(<i>Onopordum acanthium</i>)
Grecian	(<i>Chamaepeuce afra</i>)
Malta	(<i>Centaurea melitensis</i>)
Marsh	(<i>Cirsium palustre</i>)
Milk	(<i>Silybum marianum</i>)
Musk	(<i>Carduus nutans</i>)
Nodding	(<i>Carduus nutans</i>)
Saffron	(<i>Carthamus lanatus</i>)
Scotch (heraldic)	(<i>Onopordum acanthium</i>)
"Scotch" (of N.Z.)	(<i>Cirsium vulgare</i>)
Spear	(<i>Cirsium vulgare</i>)
Star	(<i>Centaurea calcitrapa</i>)
Star, yellow	(<i>Centaurea solstitialis</i>)
Variegated	(<i>Silybum marianum</i>)
Wetted	(<i>Carduus crispus</i>)
Winged	(<i>Carduus tenuiflorus</i>)
Winged, slender	(<i>Carduus pycnocephalus</i>)
"Woolly-headed" (of N.Z.)	(<i>Cirsium</i> sp.)
Star thistle	(<i>Centaurea calcitrapa</i>)
Yellow star thistle	(<i>Centaurea solstitialis</i>)

DISCUSSION

Q.—Do hybrid forms occur?

A.—Hybrids occur between Californian thistle and spear thistle; sow thistle and prickly sow thistle; and marsh thistle and spear thistle.

Q.—Do thistles that are regarded as annuals to biennials live longer?
A.—Yes, you get annuals which last longer than a year and biennials which seed in first year.

Q.—Why are seeds of Californian thistle not usually viable?

A.—There are male and female Californian thistle plants. Where both occur you get seed. In some districts only one or the other is present and get down formed but no seed.

Q.—Why is Californian thistle not very common in North Auckland?

A.—No explanation.

Q.—Are there variations in the rosette stage of growth of nodding thistle?

A.—Yes, there is variation, but in most cases this thistle has a sheen on the upper surface; also white bases to all prickles.

Q.—Would the speaker give an idea of the length of time thistle seed remains viable in soil.

A.—Thistle seeds are oily and capable of remaining viable in the ground for a long period.

Q.—Would the speaker comment on introduction and spread of nodding thistle?

A.—It was first recorded about the turn of the century. Fifteen years ago it appeared in the North Island. This thistle is possibly spreading, but has been present for many years. Seed falls usually within a few feet of the plant.

Q.—At what stage of flower development is viable seed produced?

A.—The flower has to push open the bracts and then pollen is free.