Bulletin No. 666

Canada Thistle

Biology and Control

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Canada thistle [*Cirsium arvense* (L.) Scop.] is one of the most prevalent and serious noxious weeds in Idaho crop and noncropland areas. It is classified as a noxious weed in 34 states, and Idaho leads all reporting states in estimated infested acreage (2.25 million acres). Canada thistle infests all of Idaho's 44 counties.

Canada thistle was brought to America from Eurasia in seed, feed and animal bedding. Some have intentionally cultivated this plant because of its flower, and honey producers like it for the nectar. Control is difficult because of the plant's perennial root and abundant seed production, and its widespread and diverse habitat.

Identification and Biology

Canada thistle is a perennial that can propagate by seed and roots. Seed can be transported long distances via contaminated grain, on equipment and by water. Local infestations expand from blowing seed and when lateral perennial roots spread and produce new shoots (Fig. 1). Canada thistle usually occurs in patches. Uncontrolled patches expand and merge until a field becomes completely infested. Plants are spiny with deeply lobed leaves and several branching flower stalks. Flowers are about ½ inch in diameter and are normally pink, but can vary in color from white to purple. Flowering plants can reach heights of 4 to 5 feet.

Flowering and Seed Propagation

Not all flowers produce seed. In fact, male and female flowers (Fig. 2a,b) are usually on separate plants, a characteristic termed "dioecious." Both types of flowers will produce white plumes or pappi (Fig. 2c) that blow throughout the countryside in the summer. Only plumes from pollinated female flowers will contain seeds, however, and only those produced under good growing conditions generally are viable. Male and female plants must be located within a few hundred yards of each other for insect pollination and seed set to occur.

Fertile and pollinated heads may produce up to 100 seeds, so a large plant with 50 heads could produce up to 5,000 seeds. Seed viability the first season may be as high as 90 percent. Some seeds remain viable for 20 years. Irrigation water and rivers are common methods of Canada thistle seed dissemination. Seeds that have been in water for several months can still be viable.

Flowering is triggered by long days — over 15 hours of light. Canada thistle flowering and seed production will be limited or prevented in regions with shorter summer days.

Early in the spring, plants remain short (near soil surface) until long days trigger flowering and stem elongation, normally in May and June. Regrowth in the fall does not usually produce flowers. Canada thistle normally does not produce a rosette, i.e., a radial cluster of leaves near

Fig. 1. Canada thistle plant with flowers, roots and secondary shoots coming from roots.

Fig. 2. Close up of flowers. Left: Male flowers with anthers. Right: Female flowers. Bottom center: Seed with pappus attached.

the soil surface. However, the stem will not elongate much in the early spring or late fall. Some literature and some herbicide labels incorrectly refer to these shortened plants as rosettes.

Root Propagation

Roots are a major propagation organ of Canada thistle. Within 3 weeks after germination, a seedling root can begin producing buds that can eventually produce new shoots (Fig. 3). Although older literature often incorrectly refers to rhizomes on Canada thistle, the underground storage organs that overwinter and generate new shoots are roots. New aerial shoots can be produced from Canada thistle roots at any location along the root length (Fig. 4a). Bud development on the roots is controlled by internal hormones and external environment such as temperature, soil fertility, soil moisture and daylength.

Roots can spread 10 feet per year radially from a single plant and may eventually penetrate into the soil as deep as 15 feet. Most roots, however, will develop in the upper 2 feet of the soil.

Any part of the root, even as small as a ½ inch long, can produce buds that will develop new aerial shoots (Fig. 4b). Hence, as roots are chopped by tillage equipment, each root section can produce new plants. In fact, cutting roots will result in more plants since each section will normally produce a new plant. The buds have no seasonal dormancy, but some root buds may be kept dormant for a time if other shoots are already present on the root. Extent or timing of new bud development depends on proper environment and the number of other shoots or buds already present.

Ecotypes

Canada thistle leaf shapes, flower color and response to environmental conditions can vary considerably, even within a geographical region (Fig. 5). Each distinctly different variant is called an ecotype. Ecotypes collected in several states have been grown, studied and partially characterized under a single experimental environment. Such ecotypes will usually retain their distinct characteristics. They may flower at different daylengths, require different temperatures for optimum growth and development and respond differently to herbicides.

Environmental Influences on Physiology

Canada thistle is adapted to a wide range of soil types and environmental conditions. Sandy and heavy clay soils will support the plant, but it is best adapted to heavier soils. Extended periods with temperatures over 90°F will reduce plant vigor and generally limit growth. High temperatures and daylengths less than 15 hours prevent Canada thistle from thriving in the southern part of the United States. Optimum growth conditions are day/night temperatures near 77° and 59°F, good soil fertility with nitrogen levels

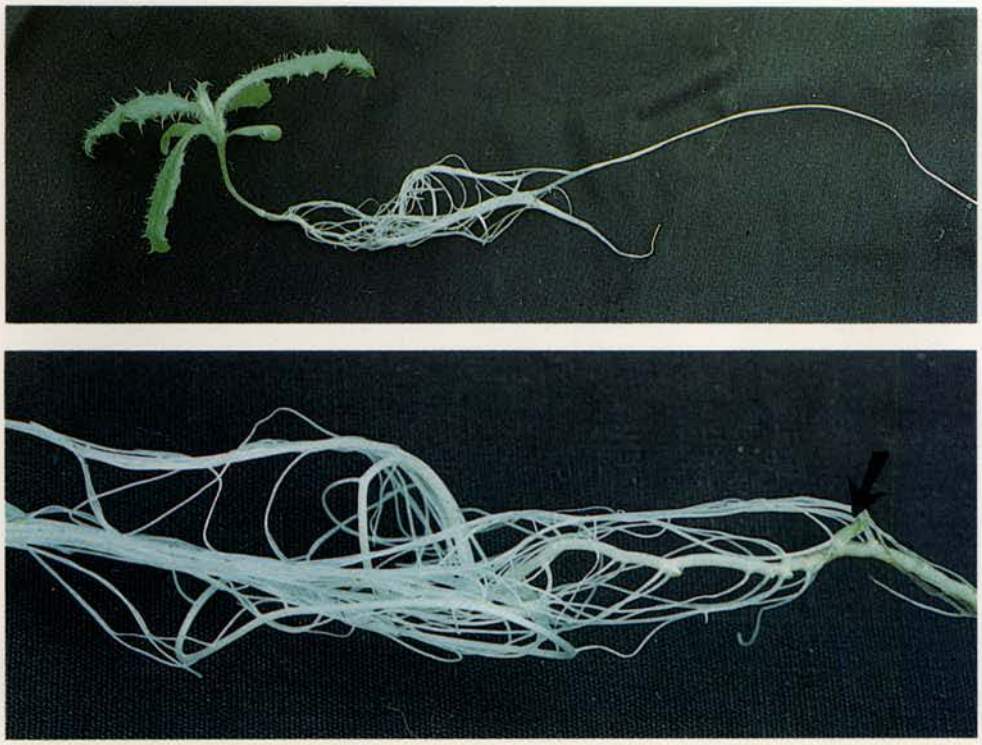

Fig. 3. Canada thistle seedling 3 weeks after seed germination. Note the four leaves and long primary root which has a bud developing. Top: Closeup of root and new bud on root. Bottom: Arrow shows start of new bud.

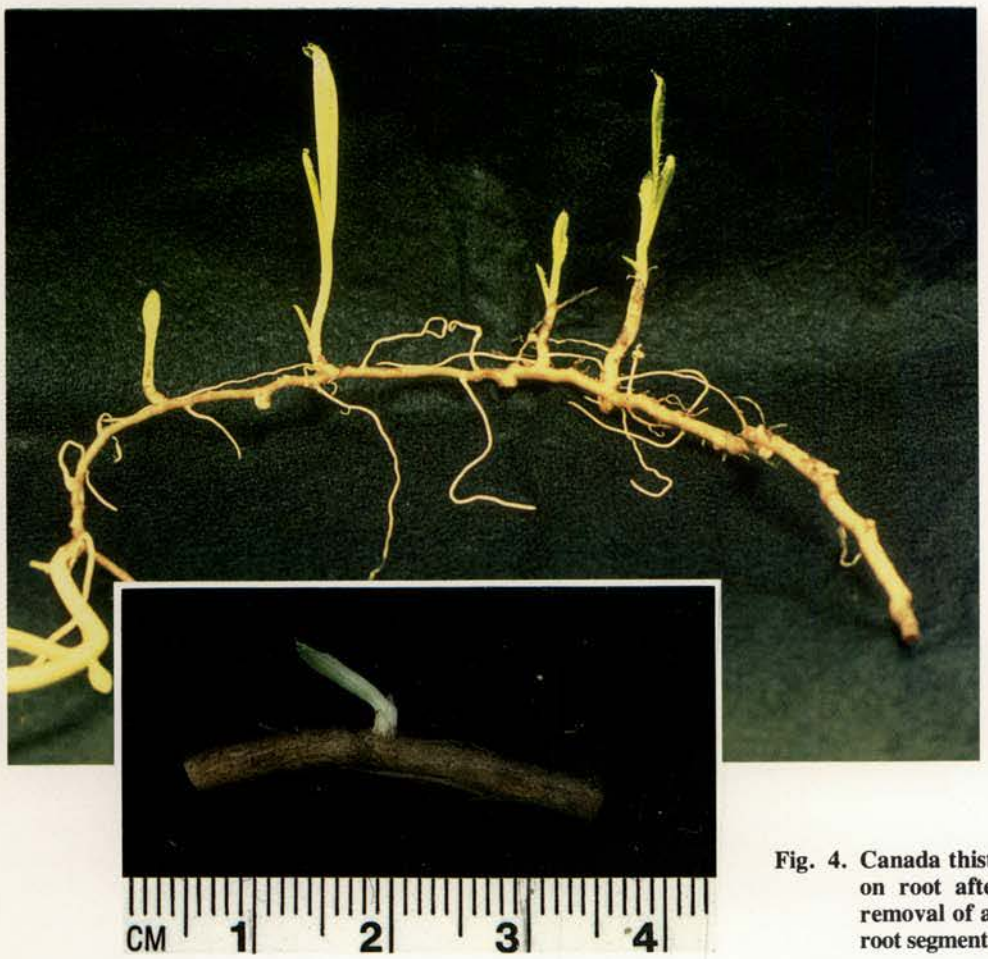

Fig. 4. Canada thistle root section and new shoots and buds on root after 2 weeks development after previous removal of all shoots. Bottom: An inch-long (2½ cm) root segment with new developing root bud after 5 days.

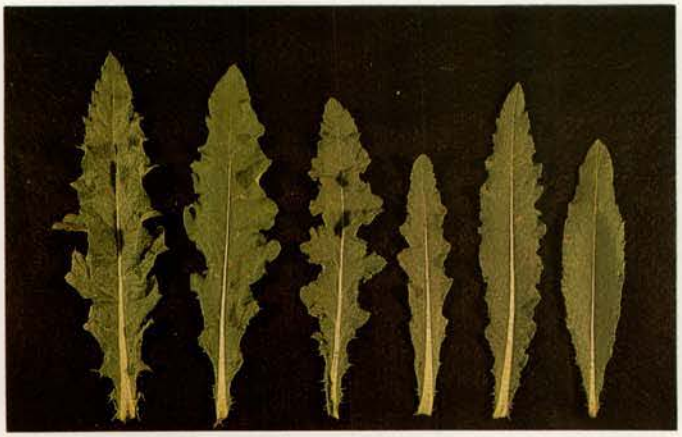

Fig. 5. Leaf shape variability from six proposed ecotypes.

between 15 and 30 ppm and medium soil moisture (up to field capacity).

Warm air temperatures, high soil nitrogen levels and long days favor foliage growth and flowering. Root growth is favored by moderate soil temperatures of 60° to 75°F, air temperatures below 70°F, daylengths less than 15 hours and low nitrogen levels. The fall season in Idaho and northern Utah corresponds closely to the latter environment. Root growth in Idaho continues late into the fall, even after several frosts, until the leaves die.

Overwintering success of roots depends on sufficient energy reserves and on cold temperature conditioning. Cold temperature conditioning prepares plants biochemically to live through freezing temperatures.

Carbohydrate reserves are depleted in the spring and at other times when new emerging shoots use energy from roots (Fig. 6). Energy depletion will continue until enough leaves are present to produce food for the growing foliage. Most sugars produced by photosynthesis during spring are used for plant growth, heading and flowering. Little replacement of root reserves occurs until plants are about 1 foot tall. Repeated mowing or tillage will further deplete root energy reserves because regrowth will use additional root energy.

Fall environmental conditions usually promote accelerated root, shoot or bud production in the soil with little or no apparent foliage growth. Leaves have to be present in the fall for this root growth to occur, but sugars produced by photosynthesis go to the roots rather than into large numbers of new leaves.

Interference with Crops

Canada thistle reduces crop yield through competition and allelopathic factors. Where Canada thistle stands are dense, crop yields may be near zero. Pasture grass, corn and wheat production have been reduced 60, 57 and 50 percent, respectively, in research studies where Canada thistle density was moderate.

Canada thistle releases toxic chemicals into the soil that inhibit growth of other plants. This is called allelopathy.

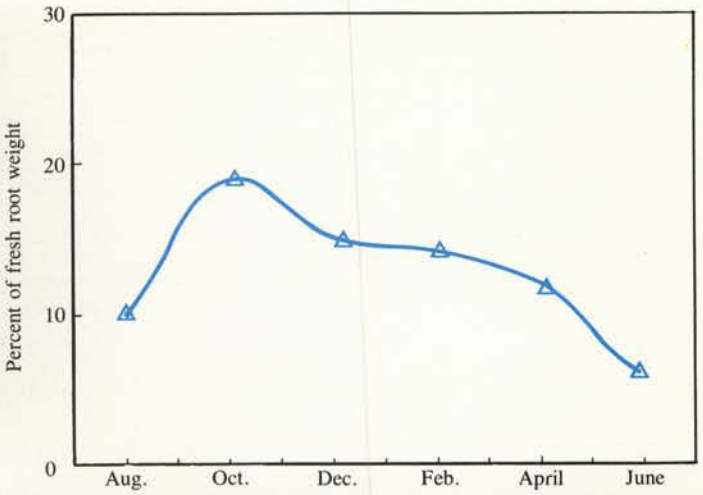

Fig. 6. Seasonal trends in carbohydrate root reserves for Canada thistle. Data are averages of two locations over 2 years (adapted from McAllister and Haderlie, Weed Sci. 33:48, 1985).

Roots and shoots of Canada thistle allowed to decay in the soil have reduced growth or vigor of sugarbeets, wheat, alfalfa and seedlings of Canada thistle. Allelopathy can be in reverse, as well, where a desirable plant may inhibit Canada thistle.

Canada thistle interference is also significant in rangelands because forage production may be reduced and animals may avoid infested forage. Recreation areas that are infested with Canada thistle are much less desirable than those without this weed.

Control

Control is feasible with personal and community vigilance and determination. An integrated approach with good management of the crop, cultivation and herbicides will be most effective. A cooperative effort by all landowners is necessary to reduce Canada thistle infestations.

To obtain long-term control of Canada thistle, seed production, seedling growth and established perennial plants must all be eliminated. Since seeds can remain viable in the soil for several years, seed production must be prevented. New seedlings must be sprayed or cultivated with 2½ weeks of emergence so they will not become perennial. Any treatment to control the perennial plants will usually take more than 1 year.

Cultivation alone has been shown to control the perennial plants when tillage is started at flower bud time (when root energy reserves are low) and continued every 10 days through the season. To be successful, this practice must be repeated the next year. Late fall moldboard plowing will bring some roots to the soil surface where they are exposed to freezing and desiccation. Late fall plowing can also delay Canada thistle emergence in the spring by 3 to 5 weeks since late fall-produced shoots are destroyed.

Crop interference can also control Canada thistle. A heavy, vigorous alfalfa crop mowed at least three times

Table 1. Herbicides for Canada thistle control.

Herbicide*	Crops	Time of application	Remarks
Bentazon (Basagran)	Field beans Peas	When Canada thistle is 8 inches tall	Suppression will result
Chlorsulfuron (Glean)	Grain, fallow	See label for grain	Suppresses Canada thistle. May remain in soil 3 to 5 years. See label to restrictions for pH and recropping.
Dicamba (Banvel) or dicamba + 2,4-D	Grain or noncropland, pasture, rangeland	In grain according to the label for suppression. To fall regrowth under good growing conditions.	Observe the recropping waiting period (see label). Do not apply to drought-stressed plants or old leaves.
Glyphosate (Roundup)	Noncropland	Best on fall regrowth, second at flower/bud stage, third in spring to 10-inch-tall plants	Do not apply to drought-stressed plants or old leaves. Some crops can be planted 1 week after application (see label)
MCPA	Grain	In grain for suppression	Observe the recropping restriction (see label). Control will vary from suppression to good control.
Metsulfuron-methyl (Ally)	Grain, fallow	When thistles are small up to 6 inches.	Add a surfactant. Only suppression will result.
Picloram (Tordon 22K)	Pasture, rangeland, noncropland	Flower bud stage or to fall regrowth	Is most effective herbicide available. **Do not use near or before potatoes.** Tordon may remain active in soil 3 or more years. Gives preemergence seedling control.
2,4-D	Grain, pasture, rangeland	In grain according to the label for suppression. To fall regrowth under good growing conditions.	Observe the recropping restriction (see label). Control will vary from suppression to good control.

***Read label for rate, directions and restrictions!**

per year will weaken the thistle roots by depleting carbohydrate reserves and will eventually suppress Canada thistle growth.

Some biologial control agents (diseases and insects) have been found to suppress Canada thistle to a limited extent. Insects have stopped flowering certain years, and leaf rusts have reduced vigor. Research is continuing on biological control agents, but potential for control from these agents is limited at present.

Several herbicides effectively control Canada thistle (Table 1), but results can vary for several reasons. Some thistle ecotypes may be more susceptible to certain herbicides than other ecotypes. Growth stage of the thistle or season of year also influence plant susceptibility. Improper application method, incorrect herbicide rate or poor calibration also account for much of the variability. Using the same herbicide for several successive years increases the possibility of selecting a tolerant variety from the original Canada thistle stand. **Always follow directions on the herbicide label.**

Optimize Control

Under irrigated conditions, the best control of established Canada thistle will include a fall herbicide treatment following irrigation. Dryland Canada thistle control may be best at flower-bud stage in early summer.

Principles for improving fall Canada thistle control:

1. **Weaken roots.** Weaken the root and deplete root carbohydrate reserves. To weaken the root, suppress Canada thistle growth during the summer either through herbicide treatment, vigorous crop growth or by mowing or tilling several times.
2. **Promote shoots.** Obtain as many foliar shoots per root quantity as possible if foliar herbicide is to be used. This allows more herbicide to be taken up by the plant and move into the root area. A late summer tillage to chop roots will increase the number of foliar shoots and the leaf area per root in the regrowth.
3. **Maximize growth.** The weed must be growing rapidly for maximum herbicide action. Disc or till all old foliage in late summer, but no later than September 5. Irrigate immediately after the last tillage, and allow new growth to occur for 3 to 5 weeks. Keep the soil moist until herbicide treatment. Promote new growth by maintaining adequate soil moisture and soil fertility.
4. **Apply suitable herbicides.** Translocated herbicides such as glyphosate (Roundup) and dicamba (Banvel), alone or in combination with 2,4-D, should be applied to new growth when leaves are green (in September or October). Herbicides can be applied after several frosts unless the leaves die. *Do not apply to old leaves or drought-stressed plants.*

Under these optimum control conditions, herbicides will be readily absorbed into the plant because new leaves have not yet developed a thickened cuticle to resist herbicide penetration. As an additional benefit of fall timing, her-

bicides together with the sugars produced by photosynthesis will move rapidly into the roots because the plants are storing energy reserves at this time of year. The key is to make sure the plants are growing well, even if foliage or leaf number is not increasing greatly. As long as the leaves are green, photosynthesis and root growth are continuing. Good soil moisture is especially important for glyphosate. Picloram (Tordon) is the least affected by soil moisture or general growing conditions.

The next best application time for most herbicides is at flower-bud stage. Generally, root energy reserves are lowest at that time, and good spring moisture will promote rapid growth.

Control During a Fallow Period

Spray Canada thistle at flower bud stage, if growing conditions are good, and cultivate every 2 to 3 weeks after spraying until the end of August. Spray any regrowth again in September or October if soil has been watered sufficiently by rain or irrigation. Winter grain can be planted one week after Roundup is used.

Control During a Cropping Period

Harvest the crop by the first week of September. Immediately disc or cultivate and irrigate. Spray Canada thistle regrowth in late September or early October, or later if leaves are still green.

Control in Noncropland/Range

Canada thistle control will normally be best during flower-bud stage because of better soil moisture conditions at that time compared to fall. Another application in the fall is possible if plants are under good growing conditions. Repeated applications will likely be required.

Control in Conservation Reserve (CRP) Lands

Most herbicides used for Canada thistle control will kill broadleaf species often planted for CRP. Farmers must control noxious weeds according to CRP contracts. The ASCA should be contacted to obtain permission to spray Canada thistle-infested areas because such spraying will likely kill planted legumes or forbs. *Do not let Canada thistle go to seed or spread!*

Summary

Seedlings will continue to be a problem for several years. Fall and spring tillage or herbicide application within 2½ weeks of thistle germination will control seedlings and prevent plants from becoming perennial. Retreatment of infested areas with herbicides (on an annual or biennial basis) should be expected and planned.

Drought stress reduces the effectiveness of most herbicides on Canada thistle. DO NOT treat drought-stressed plants or old stressed leaves with dicamba, 2,4-D or glyphosate. Wait for irrigation or rains and new growth.

Herbicides can be applied in the spring before a crop is planted but less control can be expected than at flower-bud stage or in the fall. Allow perennial Canada thistle to be about 10 inches tall before treatment in the spring.

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Trade Names

Trade names are used in this publication to simplify the information presented. Such use does not imply endorsement of any product nor criticism of similar products that are not mentioned.

Chemical Recommendations

The chemical recommendations are based on the best information available at the time of printing. Before using any pesticide, read the instructions on the label. Follow all precautions and restrictions for safe product use.

The grower is responsible for residues on his crops. He also is responsible for drift from his property to adjacent properties or crops.

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2,000; March 1987

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