

BEST MANAGEMENT PRACTICES

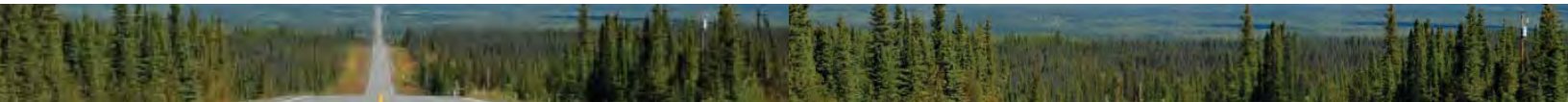
CONTROLLING THE SPREAD OF
INVASIVE PLANTS
DURING ROAD MAINTENANCE



UNIVERSITY OF ALASKA FAIRBANKS

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Intent of the Manual

The intended audience for this best management practices (BMP) booklet is people who perform routine maintenance activities such as vegetation clearing on roads, trails, railways and utility corridors. Many of the practices described in this booklet are applicable well beyond the intended audience.

These best management practices should be used when planning activities and when in the field conducting maintenance projects. Activities such as identification and reporting of high-priority invasive plants are best served if the booklet is in hand when a suspect plant is spotted. Provide these booklets to all employees working on maintenance and place them in all vehicles to ensure they are taken into the field.

Acknowledgements

This publication was produced in cooperation with the UAF Cooperative Extension Service, Alaska Department of Transportation and Public Facilities, and the U.S. Forest Service Alaska Region. Reviewed by the Alaska Division of Agriculture, Washington State University Extension, and the Alaska Department of Transportation and Public Facilities.

Data for map images sourced from the Alaska Exotic Plant Information Clearinghouse (AKEPIC) database (<http://aknhp.uaa.alaska.edu/maps/akepic/>). Alaska Natural Heritage Program, University of Alaska Anchorage. Accessed January 29, 2014.

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The Problem with Invasive Plants

Invasive plants may be accidentally or deliberately introduced to an area where they grow uncontrolled, negatively affecting natural systems, agriculture, the economy or human health. Invasive plants often establish on roadsides and other disturbed sites where there is frequent human traffic. Some invasive plants are problematic for roadside maintenance as they become entangled in and may be spread by mowing equipment. Some grow tall enough to block sighting distances and some may attract wildlife. Finally, many are able to move from the road corridor and invade natural or agricultural areas.

The State of Alaska, Department of Natural Resources, Division of Agriculture regulates noxious weeds (11 AAC 34.020), which are not allowed (or have specific tolerances) as contaminants of seed or other materials for planting. While control of these weeds is not currently a legal requirement, management is a priority for many agencies and the public.

DID YOU KNOW?

Implementing best management practices for roadside maintenance activities and making minor adjustments to mowing schedules can control the establishment and spread of invasive weeds. These practices will also reduce future costly maintenance activities. For more information on best management practices, see page 6.

The growing agricultural industry in Alaska has many advantages because few invasive plants currently infest the state. To a large extent, this allows farmers to reduce tillage and use fewer herbicides than producers in the Lower 48.

Invasive plants negatively impact natural systems. High-density white sweetclover infestations in Alaska prevent certain willow seedlings from establishing on glacial streams, and sweetclover is suspected of altering the pollination of berry-producing plants. Bird cherry growing at water edges provides less food for terrestrial insects eaten by fish than native trees and is toxic to moose.

Regular disturbance from mowing and traffic and a constant influx of seeds that arrive on contaminated equipment, gravel/fill, revegetation seed and vehicles combine to make roadsides a great environment for weeds to grow in. Infestations spread readily on road corridors and can become the source of new infestations on farms and natural areas.

Once established on a roadside, invasive plants are difficult to remove. Invasive plants can grow rapidly and foul machinery and block sighting distance, creating general maintenance and safety issues. Some invasive plants, such as Japanese knotweed, can even grow through asphalt, causing damage to the road surface.

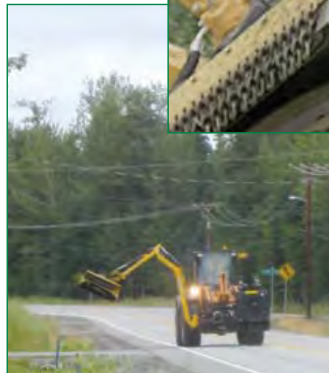
Invasive plants can spread from roadsides to agricultural lands and natural areas where they displace crops and desirable vegetation. It is well known that weeds reduce crop yields and cost farmers money to control. Invasive plants in natural areas can reduce the quality of habitat for salmon and moose as well as other plant and animal species.

This booklet describes best management practices (BMP) that help prevent the spread of invasive plants on roadsides and into agricultural or natural areas. Activities such as mowing, grading, ditching and construction can work to either exacerbate or prevent the spread of invasive plants. The best management practices in this booklet are designed to help road maintenance personnel prevent the spread of invasive plants and provide managers with a variety of control strategies.



Best Management Practices

1. **Clean vehicles and equipment regularly.** When returning to the maintenance station, clean vehicles and equipment using a pressure washer. Wheel wells, areas behind the bumper and other spaces that regularly accumulate dirt, vegetation or seeds deserve extra attention. When possible, clean vehicles and equipment before leaving the infested area.



White sweetclover, shown here, entangles mowing equipment. You can see how spreading seeds and plant parts with equipment is easy to do.

2. **Revegetate** with native, local and/or noninvasive plant species. Vigorous noninvasive perennial grass species may prevent the establishment of invasive plant species. Contact a Department of Transportation and Public Facilities environmental analyst or the Division of Agriculture Plant Materials Center for assistance with seed mixtures for your location.



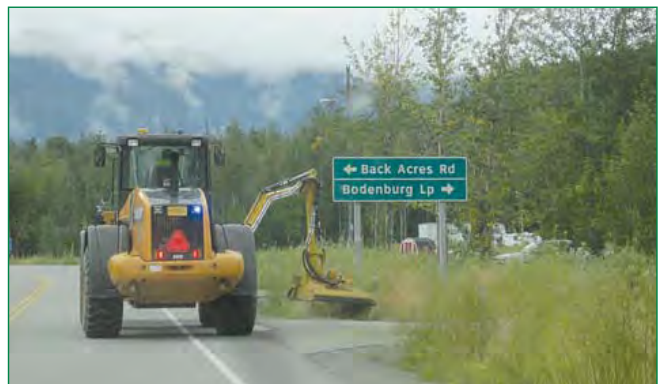
This recently cleaned mower not only looks good but also has a reduced risk of transporting seeds and other plant propagules to a new site. Photo courtesy of Brett Nelson, Alaska Department of Transportation

3. **Avoid infested areas.** Do not travel through infested areas. Do not park or stage equipment in infested areas. If an infested area is used, control weeds to prevent additional seed development and always wash vehicles when leaving the area.



Vigorous low-growing grasses are easy to maintain, and can be effective competitors with weeds. Photo courtesy of Brett Nelson, Alaska Department of Transportation

4. **Work from uninfested to infested areas.** Perform maintenance activities starting in noninfested areas and move toward infested areas. Managing uninvaded areas first ensures that invasive weeds do not contaminate equipment and move to new areas. In most cases, areas away from towns are less likely to be infested.



Mow sites infested with weeds last to prevent the spread of seeds to noninfested areas.



- 5. Coordinate with local groups** that are managing invasive species. Opportunities to complement efforts exist where weed managers are targeting a species or infestations in an area.



The Division of Agriculture and other groups often manage weeds on roadsides and appreciate coordination with roadside maintenance activities. Photo courtesy of Alaska Division of Agriculture

- 6. Time your mowing** to prevent seed production by invasive plants. With some invasive plant species, it may be necessary to mow more than once in the summer.



These creeping thistle plants have ripe seed that if mowed will be transported to new areas.

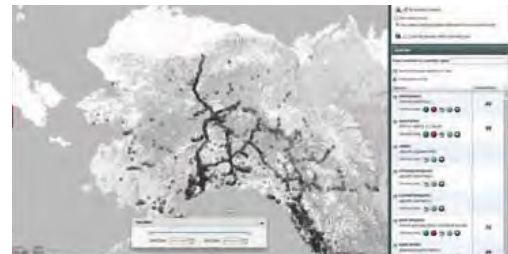
- 7. Use certified weed-free materials**, including gravel, topsoil, hay/straw and erosion control tubes, whenever possible. This is especially important when working near sensitive habitats, such as streams, rivers and wetlands, or areas that are known to be weed-free. Contact your local Soil and Water Conservation District and/or the Division of



Agriculture, Plant Materials Center for local supplies of certified weed-free material.

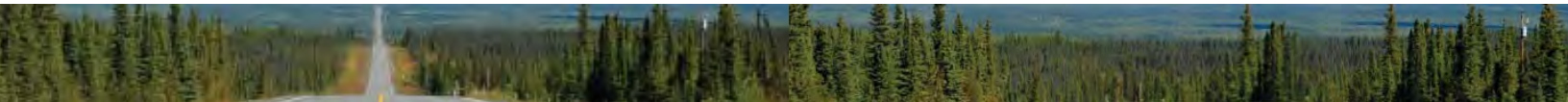
Gravel sometimes harbors weed seeds. Shown here is sweetclover growing on a gravel pile. Photo courtesy of the Alaska Division of Agriculture

- 8. Identify locations of known invasive plant infestations** and plan maintenance activities accordingly. Mowing, ditching and other disturbance activities should occur before plants set seed. Contact the Cooperative Extension Service for timing information if you are unsure.



The AKEPIC data portal is a great resource for determining where weeds are in your work area. Visit <http://aknhp.uaa.alaska.edu/botany/akepic/>.

- 9. Record and report locations of invasive plants** through the Alaska Exotic Plant Information Clearinghouse (AKEPIC, see page 10), or use the citizen monitoring portal submission form if you are unsure of the identification or are unable to use the AKEPIC site (www.uaf.edu/ces/ipm, see page 12).
- 10. Scout for invasive plants prior to performing maintenance activities.** Weed infestations can quietly move into new areas, and the only way to know which species are there is to scout the areas before you work in them.



Planning to Avoid Infestations

Many invasive plant infestations on roadsides are already recorded in an online searchable database known as the **Alaska Exotic Plant Information Clearinghouse**, which is hosted by the University of Alaska Anchorage Alaska Natural Heritage Program. This database does not replace the need to scout work areas regularly. Use this database to help plan in advance what control options are available to avoid spreading invasive plants.

Once you have accessed the AKEPIC website (<http://aknhp.uaa.alaska.edu/botany/akepic/>) click on the AKEPIC data portal link on either the right or left side. Accept the terms of use to access the data. When the data portal is accessed, you see hexagons that represent multiple locations where invasive plants are documented; as you zoom in on the map these hexagons will represent one location. There are two basic ways to query the AKEPIC database: by area or by species.

To explore the types of non-native species found in a given area, navigate to your area of interest and select the polygon tool in the upper section of the right-hand

navigation pane. Using your mouse, draw a polygon around the area of interest; double click to complete the polygon. A data window summarizing the records within your area of interest will appear in the lower left-hand corner of the screen.

To explore the distribution of a given species across the state, type the scientific or common name into the search box in the lower section of the navigation pane. Species can be filtered by invasiveness category or sorted by invasiveness rank within the species list. The known locations of that species will appear as red circles. Summary information can be displayed by hovering over a given location; more detailed information is displayed by clicking on the location. Once finished, you can download the results of your query in a format you prefer by selecting the “Download” tab in the data summary window (for area-specific queries) or the download button to the right of the species name (for species-specific queries); Microsoft Excel is most widely applicable. The ability to print your map is also available. To clear an area-specific search, click on the trash can icon next to the polygon tool; to clear a species-specific search, delete text in the search box.

Can't remember the website address? Just search for AKEPIC (Alaska Exotic Plant Information Clearinghouse) and select the AKEPIC data portal.



Download the results of your query by selecting the “Download” tab in the data summary window.





Reporting Invasive Plants and Identification Help

Contacting the correct people when a new invasive plant shows up in an area can save a lot of money and resources down the road. Whether you think you spotted a new invasive plant or just need to confirm the identity of one, you can use the following online reporting system to submit photos and/or location descriptions and ask questions.

If you see an unusual plant or need help determining how to control the spread of invasive weeds, you can get information in the following ways:

Submit data online at www.alaskainvasives.org.

Call 1-877-520-5211 for local assistance from the Cooperative Extension Service.



Make sure to provide the following information:

- Pictures of the plant or a contained sample of the specimen
- Location description, milepost, GPS latitude and longitude, etc.
- Size of the infestation
- Your contact information

Plant submission

Name: First and Last*

E-mail*

Phone

District

Other location

Location/Physical Address

Latitude

Longitude

When did you first notice the pest?

Area affected

- Garden
- Landscape
- Forest/natural area
- Turf/Lawn
- Agricultural field
- Structure of building

Is the plant impacting vegetation

What do you think the plant might be?

Additional comments. What is your main concern?

Upload picture

 0 file selected



Integrated Vegetation Management Overview

Integrated vegetation management uses five general classifications of weed control methods: prevention, physical, biological, cultural and chemical. In many cases, it is beneficial to use a combination of methods to ensure adequate control.

Prevention is the first step in any integrated vegetation management program. Cleaning equipment regularly to ensure that weed seeds are not transported is an ideal measure. Other measures include using certified weed-free gravel, topsoil and erosion control tubes.

Physical (mechanical) methods such as mowing, grading and hand pulling are often used in conjunction with other control methods. Mowing considerations of timing and frequency are covered in the best management practices for each target weed in this publication.

Biological weed control — the use of insects, grazers and pathogens to control a weed population — is not included in this booklet. Currently there are no weed species in Alaska that have an approved biocontrol agent. While grazing animals can be valuable for biocontrol, use of these on rights-of-way can be problematic.

Cultural methods include keeping areas mowed before weed seeds develop and promoting desirable vegetation. Growth stages appropriate for mowing are included under each target weed management profile. Promoting desirable vegetation can help prevent weed establishment by eliminating bare ground where weeds are likely to invade. For information on practices to promote desirable vegetation, refer to *A Revegetation Manual for Alaska* (<http://dnr.alaska.gov/ag/RevegManual.pdf>).

Chemical methods of control are covered in the profile of each of the target species, including rates and species-specific chemical control information. In Alaska, all right-of-way applications must be made by a certified pesticide applicator. This publication is not exhaustive

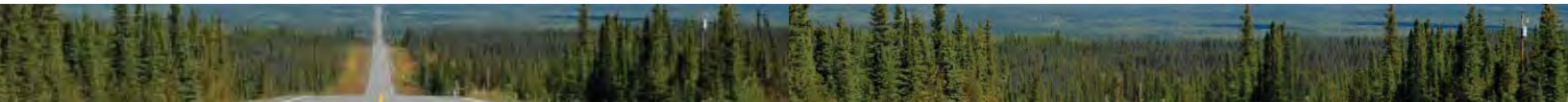
in providing herbicide options, and control success may be obtained with additional registered products. The recommendations provided are identified as the most efficacious for non-grazed rights-of-way and may not be compatible with other sites. Below are some considerations for herbicide application that apply to all plants.

Timing of chemical methods is critical to success and should correspond to the most sensitive growth stage of target species for each herbicide (see “Did You Know?” for information about timing control methods). Additionally, herbicides are most effective when applied to unstressed and actively growing plants.

The herbicide recommendations in this publication are for active ingredients; any brand names are provided as examples. Brand name products may come premixed with adjuvants, which are additives used to improve herbicidal activity and application characteristics. In most control efforts, adding a compatible surfactant will increase product effectiveness; consult product label for recommended adjuvants.

Product labels often list a range of application rates. This booklet provides recommendations based on the highest label rate for ground broadcast treatments. If lower use rates are preferred, start with the highest rate and reduce rates only if the desired control is achieved. Labels may include aerial treatment, spot treatment, stem injection or other application methods. If using a method of application other than ground broadcast treatment, consult the label for the appropriate concentration and rate. Aerial applications are not covered under integrated vegetation management (IVM) plans approved by the Department of Environmental Conservation (DEC). Aerial applications require a pesticide use permit from the DEC.

After treatment with any chemical, the plants must absorb and translocate (move through vascular tissue) the chemical to all of its parts before it will die. Translocation may take several weeks. Do not mow, pull



or treat plants with other chemicals until the original chemical application has had time to take effect. Lengths of time for chemicals to take effect are included on product labels.

After treatment, it is imperative to monitor the application site for control success. Plants that are not affected by an application may be resistant to the chemical mode of action chosen and will need to be controlled by an alternative method. If resistant plants are allowed to reproduce (by seed or otherwise), their offspring may also be resistant. Integrating multiple control methods, choosing a different chemical mode of action, tank mixing different mode-of-action chemicals for retreatment or removing plants by physical methods are good ways to avoid selecting for resistant plants.

When weed seeds are suspected of contaminating soil beyond the area where they are growing, treating the area beyond the boundary of the identified infestation with a chemical that has a soil residual period (e.g., aminopyralid) that kills any later-germinating seeds can be effective. The optimal area to treat will vary based on the target species and infestation size. Consult your local Cooperative Extension Service office for a recommended spray boundary.

Soil-persistent chemicals can be used for multiple years of control at a site; however, additional care should be taken when using these chemicals. Treated soil or vegetation from the site should not be moved since it may still contain the active ingredient, which can affect nontarget species. Additionally, plans for future revegetation should be considered to avoid the effects of soil-persistent chemicals on sensitive species.

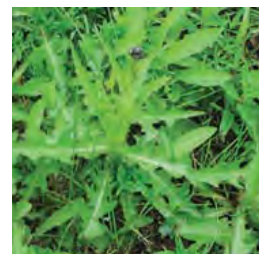
The herbicide application rates and site information contained in this publication are accurate at the time of writing; however, labels change, ALWAYS REFER TO THE LABEL for the most current information.

DID YOU KNOW?

Timing is critical. Plants develop through several growth stages: seed, seedling, vegetative, flowering and mature. If herbicides are not used during the optimum stage, the results are usually unsatisfactory. As a general rule, weeds are more susceptible at the seedling stage, when rapid growth takes place. Spraying large weeds may burn off leaves, but the plant may regrow. Mowing weeds at maturity may expand the problem by further spreading seeds. Regular scouting of weed-infested areas will help you decide which best management practice to use for controlling weeds.



Seedling (Photo courtesy of Bruce Ackley, The Ohio State University, Bugwood.org, perennial sowthistle, *Sonchus arvensis*)



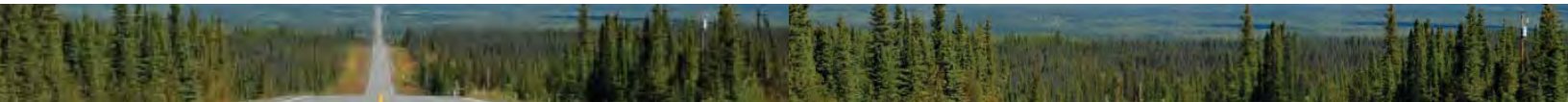
Vegetative (Photo courtesy of Caleb Stemmmons, University of Wisconsin, Stevens Point, Bugwood.org, perennial sowthistle, *Sonchus arvensis*)



Flowering (Photo courtesy of OSU Extension Slide Set Archives, The Ohio State University, Bugwood.org, perennial sowthistle, *Sonchus arvensis*)



Mature (Photo courtesy of David Cappaert, Michigan State University, Bugwood.org, perennial sowthistle, *Sonchus arvensis*)



Herbicides for woody vegetation and selected invasive weeds on Alaska rights-of-way

	Triclopyr with 2,4-D	Clopyralid	Triclopyr	2,4-D	2,4-D with Dicamba
Bird vetch	E	E	E	G	G
Creeping thistle	G	E	G	G	G
Knotweeds	F	F	F-G	F	F
Giant hogweed	G	P		P	P
Orange hawkweed	G	E	G	G	G
Perennial sowthistle	G	F	G	G	G
Reed canarygrass	P	P	P	P	P
Spotted knapweed	G	E	F	G	G
White sweetclover	G	G	G	G	G
Woody vegetation	G	P-E	G	F	F

E = Excellent (90+ percent control)
 G = Good (75-90 percent control)
 F = Fair (some suppression)
 P = Poor (no control)



Orange hawkweed is shown here.

Herbicides for woody vegetation and selected invasive weeds on Alaska rights-of-way

	Aminopyridin	Glyphosate	Imazapyr	Imazapic	Chlor-sulfuron
Bird vetch	E	G			G
Creeping thistle	E	G	G	P	F
Knotweeds	G	G-E	E	F	F
Giant hogweed	G	G	G-E	G	E
Orange hawkweed	E	G	P	P	P
Perennial sowthistle	G	G	G	P	P
Reed canarygrass	P	G-E	E	E	G
Spotted knapweed	E	G	P	P	P
White sweetclover	E	G		G	E
Woody vegetation	F	G	G	F	F

DID YOU KNOW?

Active ingredient (ai) and acid equivalent (ae) are not interchangeable. The acid equivalent represents the base molecule primarily responsible for the phytotoxic effect. The active ingredient includes additives to the base molecule that increase performance (e.g., absorption) but are removed by enzymes in the plant before phytotoxic effects occur. If you are working with a recommendation to apply a specific amount of ai for a specific product and you choose to use a different product, applying the same amount of ai might not result in the right amount of ae. If you use a different formulation than recommended or provided as examples in this booklet, make sure that you apply a similar amount of ae to get the job done. Labels include the ae for that product.



Bird vetch, *Vicia cracca*



Photo courtesy of Katie Spellman, University of Alaska Fairbanks

Bird vetch is a prevalent perennial in communities around Fairbanks, Palmer and Anchorage; less so in areas such as Salcha-Delta and the Kenai Peninsula. It spreads by seed and underground rhizomes, smothering woody vegetation and fences.

Be Aware: Some native plants look like bird vetch. Marsh pea and beach pea both look similar; however, they typically do not grow as aggressively and they have winged stems.

Mowing: Mow before flowering. Mowing mature plants will spread seeds and contaminate equipment. Mowing does not kill bird vetch, but it will delay flowering and

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Clopyralid	0.5 pound acid equivalent/acre	Transline	1.3 pints/acre
Triclopyr	0.75 pound acid equivalent/acre	Garlon 3A	2 pints/acre
2,4-D	1.85 pounds acid equivalent/acre	Whiteout	4 pints/acre

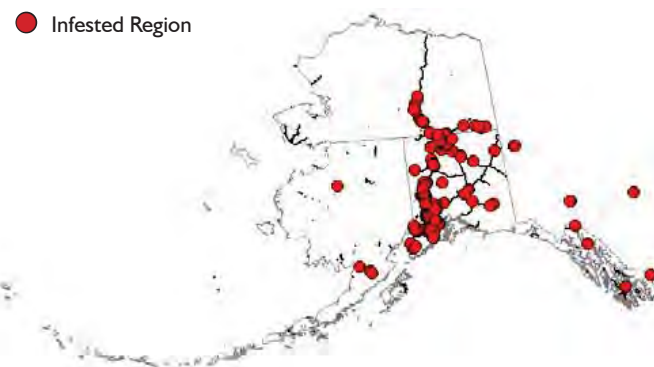


Photo courtesy of Michael Rasy, University of Alaska Fairbanks, Bugwood.org

seed set. Mowing multiple times throughout the season will favor grasses and reduce bird vetch.

Grading: Grading will spread root fragments, replanting them where the grader pushes the roots.

Herbicides: Chemical control of bird vetch is most effective early in the growing season when leaves of the plant are obvious and before plants form flowers. Apply the maximum label rate of an herbicide containing clopyralid, triclopyr or 2,4-D as the primary active ingredient. Only 2,4-D may be used in areas managed as lawns or with ornamental plantings. Do not pull or mow the bird vetch for at least two weeks after herbicide application. Herbicides are most effective when allowed to translocate to the plants roots. Management with the mentioned herbicides will damage other broadleaf plants but will not damage grasses.





Creeping thistle, *Cirsium arvense*



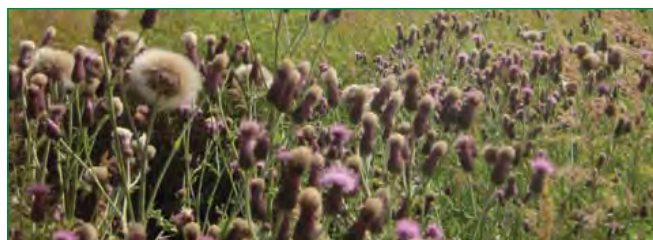
Photo courtesy of Alaska Division of Agriculture



UAF Cooperative Extension Archive, University of Alaska Fairbanks, Bugwood.org

Creeping thistle is a perennial with extensive underground rhizomes; also known as Canada thistle. It is widespread in Anchorage and Haines but rare elsewhere in Alaska. If found, report infestations (see page 10) so information can be forwarded to the Alaska Division of Agriculture, which is leading an effort to manage thistle in Anchorage and eradicate it elsewhere.

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
2,4-D with Dicamba	2 pounds active ingredient/acre	Escalade	2-5 pints/acre
Aminopyralid	0.1 pound active ingredient/acre	Milestone	7 ounces/acre
Clopyralid	0.5 pound acid equivalent/acre	Transline	1.3 pints/acre
Glyphosate	3.1 pounds active ingredient/acre	Aqua-master	2.3 quarts/acre



Manual: Not effective.

Mowing: Mow when the plants begin to bolt (shoots elongate and begin to form a flower) but before flowering; this will keep seeds from spreading and reduce seed production.

Grading: Creeping thistle spreads readily from root fragments; grading will spread thistle.

Herbicides: Chemical control of creeping thistle is effective at multiple times of the year, depending on the active ingredient used. Products containing 2,4-D with dicamba, aminopyralid or clopyralid as the primary active ingredients are effective in the early summer or fall. Applications of these products in the fall are enhanced by mowing midsummer to force plants into the rosette stage. Midsummer mowing also may reduce seed production. Products containing glyphosate are most effective when used at the prebud or bud stage (shoots elongating and beginning to form flowers) or in the fall after midsummer mowing.





Giant hogweed, *Heracleum mantegazzianum*



Photo courtesy of Alaska Division of Agriculture

Giant hogweed has only been found once, in Kake, Alaska. If giant hogweed is found, report the location immediately (see page 10). Giant hogweed looks similar to the native *Heracleum* sp., commonly called cow parsnip or pushke, and is distinguished by size and leaf form. Giant hogweed can reach 10–15 feet in height, with flowers that are up to 2½ feet across and deeply divided leaves 3 to 5 feet wide. In contrast, cow parsnip or pushke is 4 to 6 feet tall with flowers up to 1 foot across and lobed leaves up to 2 feet wide.

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Glyphosate	1.50 pounds acid equivalent/acre	Aqua-master	48 ounces/acre
Imazapic	0.19 pound active ingredient/acre	Plateau	12 ounces/acre



Photos courtesy of Alaska Division of Agriculture

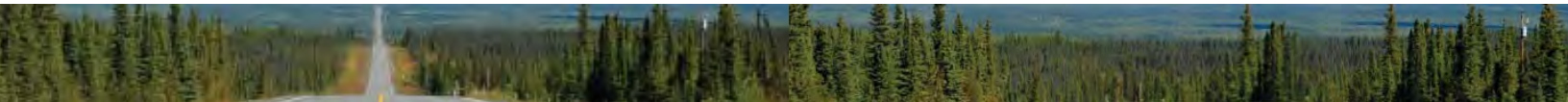
Caution: Giant hogweed has toxic sap that can cause photosensitivity and chemical burns on skin. Do not allow any part of the plant or sap from cut plants to come into contact with skin. Always wear appropriate personal protective equipment: long sleeves, long pants, closed-toe shoes, gloves and safety glasses.

Manual: Digging plants up is effective if done before flowers produce seed and if all of the roots are removed. Dispose of flowers in plastic bags to prevent the spread of seeds. Note the cautionary statement regarding skin contact above.

Mowing: When mowed, giant hogweed will resprout from the main root stalk. Long-term repetitive mowing is necessary to prevent flowering and starve the root stock of nutrients. Note the cautionary statement regarding skin contact above.

Herbicides: Control with herbicides is effective for management. Herbicide control in Alaska is not documented. However, the *Pacific Northwest Weed Management Handbook* (<http://pnwhandbooks.org/weed/>) recommends products containing the active ingredients glyphosate or imazapic.





Knotweeds — Japanese, Giant, Himalayan and Bohemian, *Fallopia* and *Persicaria spp.*



Photo courtesy of Tom Heutte, USDA Forest Service, Bugwood.org



Photo courtesy of Alaska Division of Agriculture

Introduced as garden ornamentals, Japanese, giant, Himalayan and Bohemian knotweeds are often found on roadsides and disturbed areas in Southeast Alaska. Knotweeds also grow on stream banks, lake shores and beach fringes. Plants will grow to 10 feet tall and smother vegetation around them. Knotweed spreads by stems and roots. Southcentral Alaska has some ornamental plantings. If found outside of cultivation, report these knotweeds (see page 10).

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Triclopyr	0.05 – 0.19 pound acid equivalent/gallon	Garlon 3A*	2–8 ounces/gallon
Glyphosate	0.19 – 0.59 pound acid equivalent/gallon	Aquamaster*	6–19 ounces/gallon
Imazapyr	0.5 – 1 pound active ingredient/acre	Habitat	3–4 pints/acre

*Garlon 3A is for spot treatment. Label states not to exceed 9 pounds acid equivalent/acre/year. **Aquamaster is for broadcast treatments not to exceed 3 pounds acid equivalent/acre/year. Spot treatments are for 2 percent Aquamaster or 5 ounces Aquamaster per gallon.

Infested areas should be avoided and any dirt or fill material from infested areas should be disposed of in a contained area where it will not be allowed to grow. For disposal recommendations, contact your local Cooperative Extension Service office (<http://uaf.edu/ces/info/directory/districts/>).



Photo courtesy of Michael Shephard, USDA Forest Service, Bugwood.org

Manual: Not effective

Mowing: Do not mow knotweeds or allow brush-cutting activities in infested areas. Mowing or cutting knotweeds will encourage stem growth and may spread plant fragments to new areas.

Grading: Knotweeds spread by root and stem fragments. Grading will spread knotweeds to new areas.

Herbicide: Currently, the control of knotweeds is best achieved through chemical methods. Effective active ingredients for knotweed control are triclopyr, glyphosate and imazapyr. These active ingredients are sold under many trade names, some labeled for use around water. Knotweeds are best treated when actively growing from the bud stage or beyond. Imazapyr can be used just before a killing frost. Stem injection of knotweeds with Aquamaster is possible, but sometimes adjacent vegetation can be injured from root uptake of injected glyphosate.



● Infested Region



Orange hawkweed, *Hieracium aurantiacum*



Orange hawkweed spreads aggressively with rhizomes and stolons. Shown here, orange hawkweed is the dominant species in a meadow near Karluk Lake on Kodiak Island. Photo courtesy of Leslie Kerr, USFWS

Orange hawkweed is a perennial with unmistakable bold orange flowers that make identification easy. No other wild aster plants in Alaska have red-orange flowers. Typically, where there is one plant and flower there are many. Avoid areas with orange hawkweed present and not actively controlled.

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Aminopyralid	0.1 pound active ingredient/acre	Milestone	7 ounces/acre
Clopyralid	0.5 pound acid equivalent/acre	Transline	1.3 pints/acre
2,4-D with Dicamba	2 pounds acid equivalent/acre 2,4-D and 0.25 pounds acid equivalent/acre Dicamba	Escalade	2–5 pints/acre



Orange hawkweed is a small, perennial, dandelionlike herb topped with bright orange flowers. Photo courtesy of UAF Cooperative Extension Archive, Bugwood.org

Manual: Not effective.

Mowing: Orange hawkweed is not controlled by mowing. If mowing or brush cutting is needed for an area where hawkweed is present and not actively controlled, mow early in the season before plants flower. To prevent spreading seeds and contaminating equipment, do not mow mature plants.

Grading: Orange hawkweed spreads by below-ground rhizomes and above-ground stolons. Grading will move viable plant parts and spread the infestation.

Herbicides: Application of herbicides to actively growing orange hawkweed plants from the early season rosette stage through bud stage is more effective than late-season applications to the rosettes. Herbicides effective on orange hawkweed include products containing aminopyralid, clopyralid and 2,4-D with dicamba. Use the maximum label rate.





Perennial sowthistle *Sonchus arvensis*



OSU Extension Slide Set Archives, The Ohio State University, Bugwood.org

Perennial sowthistle resembles a tall, gangly dandelion and is most easily identified in August when in flower. Sowthistle is prevalent in Juneau, Anchorage and

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Aminopyralid	0.1 pound active ingredient/acre	Milestone	7 ounces/acre
Clopyralid	0.5 pound acid equivalent/acre	Transline	1.3 pints/acre
2,4-D with Dicamba	2 pounds acid equivalent/acre 2,4-D and 0.25 pounds acid equivalent/acre Dicamba	Escalade	2–5 pints/acre
Glyphosate	3 pounds active ingredient/acre	Roundup	3 quarts/acre

Fairbanks and is found in smaller patches in other areas around Alaska.



Caleb Slemmons, University of Wisconsin, Stevens Point, Bugwood.org

Manual: Hand pulling or digging sowthistle is not effective except for small infestations, and all roots must be removed. Plants will regenerate from root fragments.

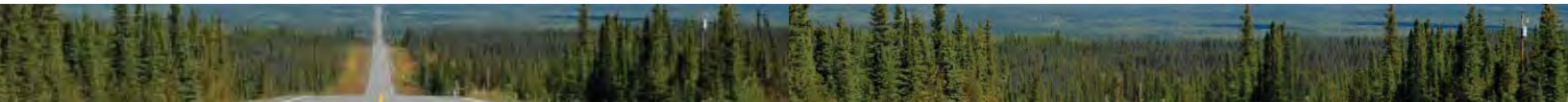
Mowing: Complete mowing activities before flowering to prevent equipment from spreading seed. Mowing multiple times in the summer season will control, but not eradicate, perennial sowthistle.

Grading: Grading will spread root fragments to new areas.

Herbicides: Control of perennial sowthistle is effective at multiple times of the year, depending on the active ingredient used. Products containing aminopyralid, and clopyralid as the primary active ingredients are effective in the early summer or fall. Products containing glyphosate or 2,4-D with dicamba are most effective when used while the plant is bolting (shoots elongating and beginning to form flowers) or in the fall. Applications of any of these products in the fall are enhanced by mowing midsummer, which may also prevent seed production.

● Infested Region





Reed canarygrass, *Phalaris arundinacea*



Photo courtesy of Alaska Association of Conservation Districts

Reed canarygrass was introduced as a forage crop and for erosion control to much of Southeast Alaska and the road system-connected portions of the northern and central regions of Alaska. Reed canarygrass spreads by roots and seeds, becoming a problem when it invades stream banks and wetlands. Control work should focus on keeping reed canarygrass out of areas near streams and wetlands.

Manual: Hand pulling or digging reed canarygrass is not effective unless done for a small infestation and all roots are removed.

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Imazapyr	1 pound acid equivalent/acre	Habitat	4 pints/acre
Glyphosate	3.1 pounds active ingredient/acre	Aqua-master	2.3 quarts/acre

Weed barriers: Use of tarps and weed barriers for control has mixed results. Control is increased by laying barriers 2 feet beyond the infestation and controlling the edges manually or with chemicals.

Mowing: Reed canarygrass seed production may be reduced or eliminated if the plant is mowed at least twice during the growing season. Mowing will not eradicate an infestation. To prevent spreading seeds and contaminating equipment, do not mow mature plants.

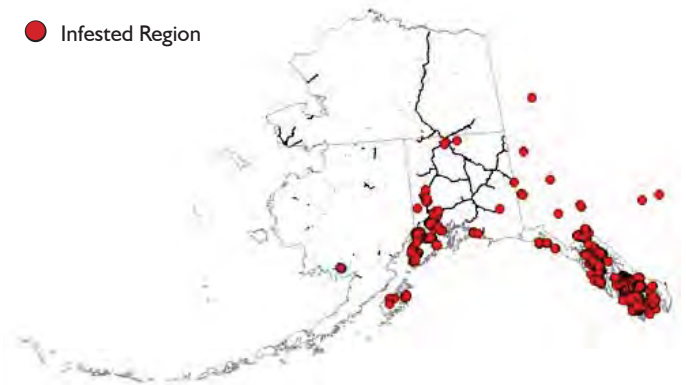


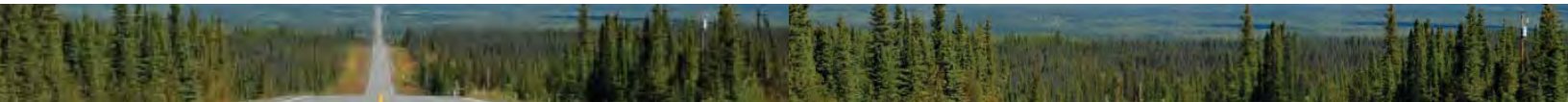
Photo courtesy of Alaska Association of Conservation Districts

Grading: Grading will spread root fragments to new areas.

Herbicides: Chemical control of reed canarygrass is effective in spring and fall on actively growing plants. Late-season applications are enhanced by mowing mid-summer, which starves roots of carbohydrates. Use the maximum label rate for products containing imazapyr or glyphosate. Take care to avoid spraying desirable vegetation, as products listed are not selective. The examples provided are formulations approved for use when contact with water is expected.

● Infested Region





Spotted knapweed, *Centaurea stoebe*



Rare in Alaska, spotted knapweed should be reported (see page 10) whenever found to help with eradication efforts. Knapweed is usually found near pullouts and areas where equipment or vehicles were staged or parked. If found, avoid the area completely.

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
2,4-D	2 pounds acid equivalent/acre	Whiteout	4.3 pints/acre
Clopyralid	0.5 pound acid equivalent/acre	Transline	1.3 pints/acre
Aminopyralid	0.1 pound acid equivalent/acre	Milestone	7 ounces/acre
Glyphosate	4.05 pounds active ingredient/acre	Aqua-master	3 quarts/acre

Manual: Small infestations of spotted knapweed are effectively controlled with hand pulling prior to seed set. Knapweed should be pulled twice each growing season until eradicated.

Mowing: Spotted knapweed can be mowed from the bud stage to early flowering stage. To prevent spreading seeds and contaminating equipment, do not mow mature plants. Mowing will not eradicate the infestation unless seed production is prevented every year until all plants are gone.

Grading: Seeds remain viable in the soil for several years and grading will move them to new areas.

Herbicides: Herbicide products with active ingredients such as 2,4-D, clopyralid, glyphosate and aminopyralid will control knapweed. Most chemical controls are best applied to rosettes in the fall or early spring using maximum label rates.



Photo courtesy of Michael Rasy, University of Alaska Fairbanks, Bugwood.org



Photo courtesy of Michael Shephard, USDA Forest Service, Bugwood.org





White sweetclover, *Melilotus albus*



Photo courtesy of University of Alaska Anchorage Archive, Bugwood.org



Photo courtesy of Richard Old, XID Services, Inc., Bugwood.org

Sweetclover will line roadsides when left unmanaged.

Prevalent on road systems and in some gravel pits, sweetclover invades glacial floodplains, burned areas and trails. When present in high densities, it inhibits establishment of willow.

Active ingredient	Active ingredient or acid equivalent rate	Product	Product rate
Chlorsulfuron	5.9–11.7 grams active ingredient/acre	Telar XP	0.5–1 ounces/acre
Triclopyr	6–9 pounds acid equivalent/acre	Garlon 3A	0.25–3 gallons/acre
2,4-D	1.85–3.7 pounds acid equivalent/acre	Whiteout	4–8 pints/acre
Aminopyralid	0.06–0.1 pound acid equivalent/acre	Milestone	4–7 ounces/acre

Manual: Hand pulling is possible, but it is labor intensive. Pulling after mowing, or pulling plants that are not controlled by herbicide treatments, will aid in eradication efforts.



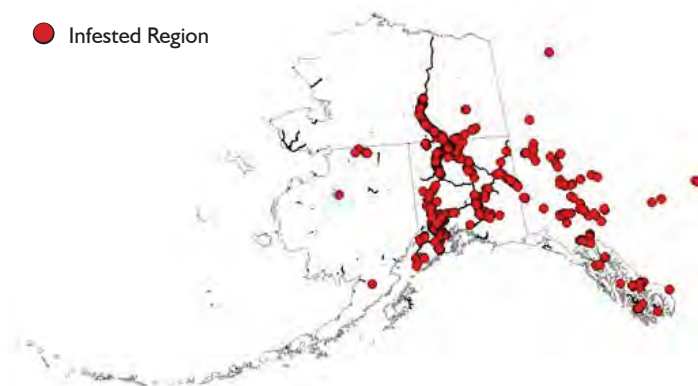
Remove sweetclover from equipment yards.
Photo courtesy of Alaska Division of Agriculture

Mowing: Mow 1 inch from ground before maturity or the beginning of flowering. Repeated mowing will reduce, but not eliminate, seed production. When mowing is combined with revegetation efforts, eradication may be achieved.

Grading: Early spring grading of infested roadsides can kill first-year sweetclover plants, but grading will spread seed. If possible, start at the end of the infested section of roadside and work toward the center of the infested section.

Herbicides: Chlorsulfuron provides the most thorough control. To avoid selection for resistant populations, rotate repeated applications with different modes of action or consider tank mixing two products. Make applications in spring or summer to seedlings or plants in early bud to flower stage. Use chlorsulfuron, triclopyr, 2,4-D or aminopyralid.

● Infested Region





Woody Vegetation

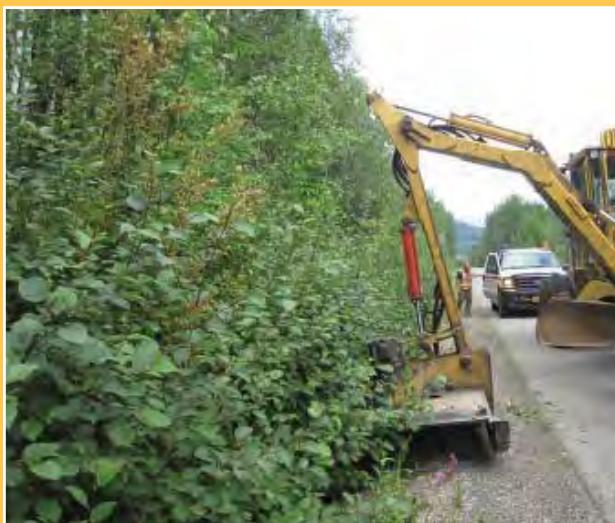


Photo courtesy of Brett Nelson, Alaska Department of Transportation and Public Facilities

Safety along a roadside is the main issue when determining which woody vegetation should be removed. Woody vegetation reduces sight distance along roadways and attracts animals such as moose. All woody vegetation that endangers the public should be removed as soon as possible. A thorough understanding of the species to be controlled and consideration of proper timing is important with any control method to reduce damage, minimize visual impact and be cost effective.

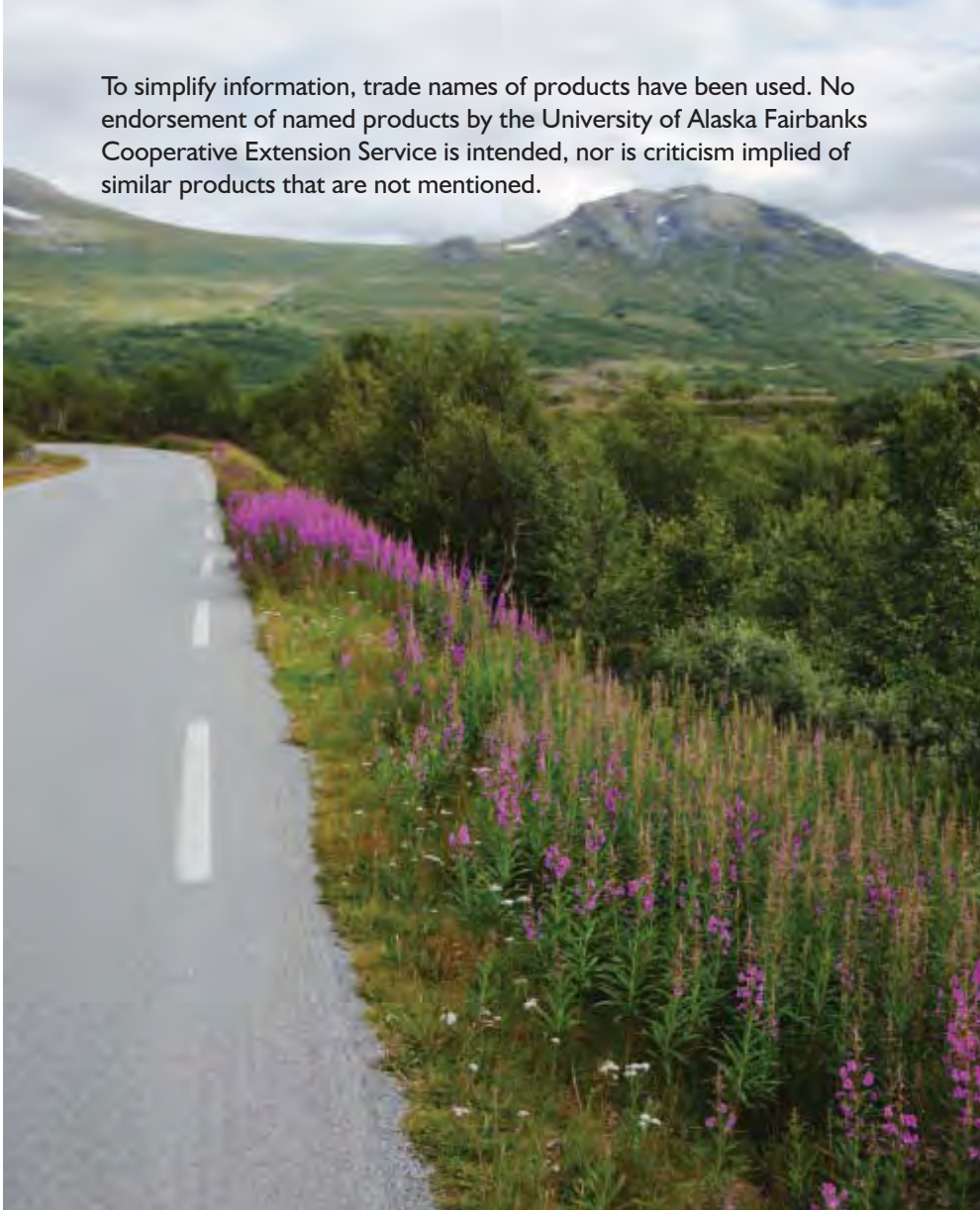
Mechanical: In many cases, mowing most of the existing vegetation is effective; it may be necessary to chop or hand cut large trees and mow smaller brush. This removal should be performed in coordination with other target species control methods. Attention should be paid to growth the development stage of target species and removal should be performed well before plants mature and set seed to eliminate seed spread. Removal of woody vegetation prior to chemical control methods may be necessary to ensure good coverage of target species.

Herbicides: Where mechanical removal is not practical, herbicides may be applied. Generally, the best control of woody vegetation occurs when most of the sap is not flowing up the tree or after the plant is fully leafed. Broadcast applications are effective for controlling brush and trees along roadsides. Active ingredients commonly used on foliage as broadcast applications to control woody vegetation are included in the table opposite. See product label for additional application methods and rates.

Active ingredient	Active ingredient or acid equivalent/acre	Product brand	Product rate
Glyphosate	5.4 pounds active ingredient/gallon	Accord XRT II	2 gallons/acre
	4 pounds active ingredient/gallon	Roundup Pro	2.0 percent solution
	5.5 pounds active ingredient/gallon	Roundup Pro Max	1.5percent solution
2, 4-D	3.7 pounds active ingredient/gallon	Weedone LV6	0.67 gallon/acre
	0.5–1.5 pounds acid equivalent/acre	Arsenal Powerline	2–6 pints/acre
Triclopyr	2–8 pounds acid equivalent/acre	Garlon 4	1–2 gallons/acre
	3–9 pounds acid equivalent/ acre	Garlon 3A	1–3 gallons/acre
Triclopyr + 2, 4-D	1.5 pounds acid equivalent triclopyr/acre and 3.0 pounds acid equivalent 2,4-D/acre	Crossbow	1.5 gallons/acre or 1.5 percent solution



To simplify information, trade names of products have been used. No endorsement of named products by the University of Alaska Fairbanks Cooperative Extension Service is intended, nor is criticism implied of similar products that are not mentioned.



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