

## Ecology and Management of Tansy Ragwort (*Senecio jacobaea* L.)

By

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**Figure 1. A tansy ragwort infested pasture. Photo by Eric Coombs, Oregon Department of Agriculture, available from Bugwood.org**

### Abstract

Tansy ragwort, a member of the Asteraceae taxonomic family, is a large biennial or short-lived perennial herb native to and widespread throughout Europe and Asia. Stems can grow to a height of 5.5 feet (1.75 meters), with the lower half simple and the upper half many-branched at the inflorescence. Reproductive stems produce up to 2,500 bright golden-yellow flowers. Capitula (flowerheads) arranged in 20-60 flat-topped, dense corymbs per plant are composed of ray and disc florets; both produce achenes containing a single seed. Rosettes formed of distinctive pinnately-lobed leaves attain a diameter of up to 1.5 feet (0.5 meter). First reported in Montana in 1979 in Mineral County, tansy ragwort has since spread into Flathead, Lincoln, and Sanders Counties. Soils with medium to light textures in areas receiving sufficient rainfall (34 inches or 860 millimeters/year) readily support populations of tansy ragwort. This species is a troublesome weed in decadent pastures, waste areas, clear-cuts and along roadsides. Tansy ragwort produces pyrrolizidine alkaloids - these can be lethal if ingested by cattle, horses and deer, but are less toxic to sheep and goats. Unchecked infestations can result in significant livestock losses, decreased pasture yields and increased management costs (see Figure 1).

Auxinic herbicides such as 2,4-D and picloram can provide effective control of tansy ragwort when applied to actively growing immature plants in the spring or fall. Grazing should be deferred at least three to four weeks after herbicide application to prevent livestock poisoning because spraying increases tansy ragwort's palatability. The tansy ragwort flea beetle

(*Longitarsus jacobaeae*) and the cinnabar moth (*Tyria jacobaeae*) reportedly provide regional biological control of tansy ragwort. Mowing is ineffective in controlling tansy ragwort because it stimulates vegetative growth and leaves below-ground roots intact. Prescribed burning during the reproductive stage may reduce populations. Grazing management and nutrient management promoting dense and continuous turf are important for control and prevention because tansy seedlings cannot establish on closed vegetation sites.



**Figure 2. Leaves, inflorescence, and flowers of tansy ragwort. Diagram or Graphic; Britton, N.L., and A. Brown. 1913. Illustrated flora of the northern states and Canada. Vol. 3: 542. Available from USDA PLANTS Database.**

## PLANT BIOLOGY

### Identification

Tansy ragwort is a winter annual, biennial, or short-lived perennial typically growing between 8-36 inches (20-80 centimeters) tall but can attain heights greater than 6 feet (175-200 centimeters) under optimal conditions. Rigid stems grow singly or in groups from an upright caudex (a short, woody, persistent stem at or just below the ground surface) with only the upper half of the stems branching at the inflorescence. Tansy ragwort additionally perennates via fragments of the numerous (50-100/crown) soft, fleshy roots that grow out horizontally and penetrate the soil to a maximum depth of 12 inches (30 centimeters).

Rosettes, either seedling or root bud in origin, are formed from distinctive stalked basal leaves 2.7-7.9 inches (7-20 centimeters) long, deeply and pinnately lobed with ovate, obovate, or narrow coarsely-toothed segments (see Figure 2). Leaves are either glabrous (without hairs) or with loose woolly down on the underside, especially during early development. Rosette leaves generally die back at or before flowering. Stem leaves are deeply bi- or tri-pinnatifid, arranged alternately on the stem and are reduced in size higher on the stem. Middle and upper stem leaves lack a petiole and slightly clasp the stem.

Bright yellow, showy flowers arise only on the pedicel (branch) ends; outer pedicels are progressively longer than inner pedicels and form flat- or round-topped, dense and compact corymbs (see Figure 3). Capitula (flowerheads) 12-25 millimeters in diameter and numbering

20-60 per corymb have 13 dark-tipped bracts 3-4 millimeters long, and are composed of both ray and disc florets. There are 13 achene (small fruit) producing ray florets with rays (petals) 8-2 millimeters long. Disc florets are numerous and produce both pollen and achenes. The number of capitula and achenes produced per plant is highly variable.

Single seeds are contained within each achene; achenes produced from ray florets shed their pappus, are glabrous, and have a thick pericarp (skin), whereas achenes produced from disc florets retain their pappus, are pubescent with short hairs (trichomes) along prominent ribs and are lighter in weight than ray achenes. The pappus, composed of numerous white 'hairs' 6 millimeters in length, is attached to the top of the achene; its resemblance to a white beard explains the origin of the genus name, *Senecio*, derived from the Latin *senex* for "old" or "old man".

Tansy ragwort can be distinguished from native *Senecio* congeners by its comparatively larger size and exaggerated pattern of leaf dissection. Although tansy ragwort superficially resembles common tansy (*Tanacetum vulgare*), it differs significantly in flower composition, producing capitula with both ray and disc florets whereas common tansy flowers are composed solely of disc florets.

Other common names for tansy ragwort include stinking willy and staggerwort. In the United Kingdom *Senecio jacobaea* has formed hybrids with *Senecio aquaticus*, *Senecio cineraria*, and *Senecio alpinus*.



**Figure 3. Tansy ragwort flowers. Photo by Michael Shephard, USDA Forest Service, available from Bugwood.org**

## Life History

Tansy ragwort's life history is typical of biennial plant species: it reproduces for the most part by seed; it overwinters in the seed or rosette stage; and it passes through one growing season in the vegetative rosette stage before becoming reproductively mature. However, because both the root and the caudex of this species have the capacity to form perennating buds under environmental or mechanical stress, tansy ragwort has the vegetative regenerative capacity of a perennial. A study of 179 plants in Australia found 2% were annuals, 45% biennials, and 39% were perennials. A separate study in England found 8% of the study plants were annuals, 39% were biennials, and 53% were perennials. Tansy ragwort has been observed as a true perennial by continuing to grow after flowering, particularly after disturbance. An Oregon study reported 20% of the tansy ragwort plants in a population were true perennials.

Tansy ragwort has four distinct life history stages: seeds, seedlings, rosettes, and flowering plants. The viability of a tansy ragwort seed crop is about 80%. The seeds have no mechanisms of innate dormancy other than the relatively thick pericarp on ray floret achenes which is believed to delay germination by a few days. The maximum potential for germination is reached when achenes leave the flowerhead: however, experimentation showed this potential did not significantly decrease after three years of storage under field conditions. Most seeds germinate in the late summer or early autumn, but seeds lying dormant throughout the winter will germinate at the beginning of the growing season in the spring. Ideal temperatures for germination range between 41-86° F (5-30° C). Soil moisture influences germination: at any given temperature an increase in soil moisture increases germination and the optimum temperature for germination changes as soil moisture changes (maximum germination is reached at a lower temperature when soil moisture is high). Vegetative cover may inhibit germination and frost, drought, or burial may induce dormancy. Seeds buried in soil deeper than 0.75 inch (2 centimeters) remain dormant. Light is required for germination. Studies showed 24% of seeds buried for six years maintained their viability. Also, seeds buried up to 2 centimeters deep had a higher germination rate than seeds left on the soil surface, most likely because moisture is consistently greater below the soil surface than on the surface. Seeds subjected to drought or cold temperature shock had delayed germination; the longer the shock, the longer the delay.

Seedling establishment and survival are variable, the largest determinant of survival being the amount of vegetative cover. In experimental garden plots two months after seeding tansy ragwort, no seedlings survived in plots with long grass or in plots with short but continuous turf, whereas seedling survival was greater in cleared or woodland areas than grassy areas. Grazed pastures on Prince Edward Island, Canada, had about eight times more tansy ragwort plants than ungrazed pastures.

Once established, seedlings form flattened rosettes that are effective competitors. The large rosette leaves are able to cover neighboring plants, thereby suppressing their growth. When the rosette leaves die, sites are opened for tansy ragwort seed germination. One study found seedling establishment was over four times higher on sites opened by dying rosettes than on sites in surrounding vegetation. Alkaloids produced by rosettes may have the allelopathic effect of suppressing other plants. Rosette leaves die when plants flower.

Plants typically flower during the second year of growth. Flowering has been reported to begin as early as June and to last as late as mid-November. It is believed rosettes must achieve some minimum size before flowering can begin, and the probability of flowering increases as rosette

size increases. Floral expansion is rapid and florets are receptive to pollination as soon as the floret is fully expanded. Hymenopteran (bee/wasp) and dipteran (fly) insect species are the primary pollinators of tansy ragwort. Seeds disperse throughout the fall. Rosettes that do not flower continue to grow into the fall accumulating storage carbohydrate important for winter survival. Carbohydrate content of the plant is highest going into winter.

## **Habitat**

Tansy ragwort tolerates a wide range of habitats and environmental conditions but is generally found on mesic sites with cool, wet, cloudy weather. It grows on many soil types but usually on lighter, well-drained loamy or sandy soils. It normally does not grow where there is a high water table or on soil with high acidity. In Europe it naturally occurs in sand dune, woodland, and grassland communities. In North America it is found in pastures, forest clearings, and waste places and is often associated with Canada thistle (*Cirsium arvense*), common St. Johnswort (*Hypericum perforatum*), and yellow toadflax (*Linaria vulgaris*).

## **Spread**

The pappus on the achene of tansy ragwort facilitates wind dispersal. However, achenes are generally considered to be poor wind dispersers and studies suggest 60% of tansy ragwort seeds fall within seven feet (2 meters) of the parent plant with only 0.5% of seeds produced actually becoming wind borne. One dispersal study found that all achenes fell within 46 feet (14 meters) of the parent plants. Seeds can also disperse by water movement, through the digestive tract and adhering to livestock and other animals, and viable seeds have been collected from bird droppings. Original infestations in North America are believed to have arrived in soil used as ship's ballast. Tillage equipment used in fields where tansy ragwort occurs can spread root and caudex fragments within the field and to fields where the equipment is subsequently used. In Montana, tansy ragwort has established on logging sites and clearings, implicating equipment used for logging as a long-distance spread vector. The showy flowers may encourage people to transplant or seed tansy ragwort into gardens from which it can spread to pastures and native plant sites.

## **Impacts**

Tansy ragwort can reduce forage yields by as much as 50% in pastures. Pyrrolizidine alkaloids are present in all plant parts. Cattle, deer, horses and goats consuming either growing plants or tansy ragwort in silage and hay store these alkaloids in their livers. Even if symptoms are not evident or are minor in nature, the cumulative storage of alkaloids can result in reduced weight gain, liver degradation, reduced butterfat content of cow's milk, and sudden death in apparently healthy animals. Alkaloids in tansy ragwort pollen also taint honey, making it bitter, off-color and unmarketable.

## **MANAGEMENT ALTERNATIVES**

### **Herbicide <sup>1/</sup>**

Tansy ragwort can be controlled using auxinic herbicides (mimics of auxin, a naturally-occurring plant growth regulator). The best timing of application is when tansy ragwort is actively growing in the rosette stage either in the spring or mid-fall. Herbicides are less effective after

plants have bolted to produce flowers. In most cases reapplication of herbicide or integration with other control methods will be needed for sustained population reductions. The amine, low-volatile ester, or emulsifiable acid formulations of 2,4-D are effective when applied at 2 lb. a.e./ac. (two pounds acid equivalent per acre). Always check the herbicide label to confirm formulation and proper usage of the product before applying. When using 4 lb. a.e./gal. (four pound acid equivalent per gallon) formulation, apply the mixed product at a rate of 2 qt./ac. (two quarts per acre).

Tansy ragwort is listed on the following herbicide labels at rates in parentheses: picloram (1-2 qt./ac.), aminopyralid (5-7 oz./ac.), metsulfuron (0.5-1 oz./ac. with nonionic surfactant at 0.5%), and chlorsulfuron (1-3 oz./ac. with nonionic surfactant at 0.5% volume to volume). Metsulfuron and chlorsulfuron should not be applied where soil pH is greater than 7.9 because under these conditions chemical breakdown is slow resulting in extended residual activity that increases the risk of off-site movement of the chemical and non-target plant injury. Consult individual herbicide labels for other possible soil pH restrictions.

Herbicides are most effective where competitive desired plants are present to fill voids in the plant community following successful tansy ragwort control. However, herbicide injury to non-target desirable broadleaved plants and some grasses should be expected; consult product labels for further information on potential non-target injury. To avoid non-target injury, apply herbicides in the fall after desired plants are dormant for the winter. This tactic is most effective when using herbicides with low residual activity. Always follow label instructions to reduce toxicity or other unintended risks to humans and the environment, and to confirm potential grazing and replanting restrictions. Consult your local County Extension agent or weed coordinator for herbicide recommendations in your area. Herbicide treatments typically increase the concentration of water-soluble carbohydrate in tansy ragwort, making it more palatable to livestock and thereby increasing the risk of alkaloid poisoning. Grazing should therefore be deferred for 3-4 weeks after herbicide application.

## **Hand Pulling**

Hand pulling and digging that extracts all of the caudex and fleshy rootstock is an effective method to temporally reduce tansy ragwort on small-scale infestations and scattered plants either as new invaders or those persisting after herbicide treatments. Pulling rosette and flowering plants will reduce seed set. Follow-up management will be needed to eliminate plants regenerating from root fragments or seed. Protective gloves are recommended to be worn as a precautionary measure by anyone handling tansy ragwort.

## **Mowing**

Mowing is not an effective control for tansy ragwort. Rosettes are flat to the ground and may be missed by the mower blade, and when clipped, vegetative reproduction is stimulated. Mowing when plants bolt to flower may temporarily reduce seed production; however, plants will survive to flower again. A dispersal study found achenes dispersed as much as two and a half times

<sup>1/</sup> **Any mention of specific products in this publication does not constitute a recommendation by the NRCS. It is a violation of Federal law to use herbicides in a manner inconsistent with their labeling.**

farther on mowed sites than where the natural vegetation remained. However, in Switzerland, frequent mowing promoted fast-growing grass species and was associated with reduced occurrence of tansy ragwort. Mowing to maintain vigorous grassland communities may help prevent tansy ragwort invasion.

### **Tilling**

The roots and caudex of tansy ragwort have the ability to regenerate after they are broken-up by tilling. Therefore, tillage has the potential to spread tansy ragwort and is not recommended by itself. The disturbance of tillage can create a favorable environment for tansy ragwort growth and reproduction by reducing competitive perennial plants. Tillage should be combined with herbicide management and followed by revegetation with desired, competitive plants.

### **Irrigation**

Tansy ragwort thrives under mesic conditions and therefore irrigation is not recommended as a control by itself. Where tansy ragwort invades irrigated pastures and hayland, carefully planned irrigation management will stimulate the competitiveness of the forage crop and when combined with nutrient, forage harvest, and grazing management practices will help prevent the re-establishment of tansy ragwort after other control practices are applied.

### **Fertilization**

Tansy ragwort is found on pastures of low to moderate nutrient status in Switzerland, which is part of its native range. A Swiss study found the amount of plant-available nitrogen was one of the most important factors predicting the occurrence of tansy ragwort. The model developed from that study predicted a fivefold reduction in the risk of tansy ragwort occurrence by doubling the application of nitrogen from about 50 lb./ac. to 100 lb./ac. On cultivated pastures and hay meadows, nutrient management is important to maintaining the competitiveness of desired perennial grasses. Nutrient management combined with judicious use of herbicides and crop rotation is recommended where tansy ragwort invades non-native pastures and hay meadows.

### **Prescribed Burning**

Fire is reportedly effective in killing reproductive tansy ragwort plants and achenes. Fire is also used to maintain the vigor and density of grassland communities by burning excess plant litter and possibly increasing soil fertility. Fire can therefore be used as a preventative measure or in combination with other control methods to reduce tansy ragwort populations. On forested sites and clearings, the disturbance caused by fire may create openings favorable to tansy ragwort invasion.

### **Grazing Management**

The way grazing is managed is an important factor influencing localized presence and distribution of tansy ragwort in its native range. In the Swiss study referred to in the **Fertilization** section above, continuously grazed pastures were 11 times more likely to be infested by tansy ragwort than pastures managed under rotational grazing because the former management regime resulted in more openings in the grass canopy where tansy ragwort could establish. Pastures that had greater than 25% uncovered soil had a 40-fold greater risk of tansy

ragwort occurrence than pasture with less than 25% bare ground. Prescribed grazing that maintains a continuous grassland community is recommended both for the prevention of tansy ragwort invasion and in pastures where it is already being controlled.

Tansy ragwort leaves and flowers exceed the standard protein and digestibility requirements for sheep. In addition, sheep seem immune to the plant's toxic alkaloids, and are willing grazers of young plants. In New Zealand, intensive sheep grazing is the predominant management approach for tansy ragwort; the weed generally does not occur where sheep are regularly stocked. In an Oregon grazing study, tansy ragwort seed production was prevented and plant mortality was attributed to sheep grazing in the summer following cattle had grazing in the spring. A separate study found tansy ragwort plants subjected to 75% defoliation were able to compensate fully five months after treatment when grown without competition. When grown in competition with Richardson's fescue (*Festuca rubra*), there was no re-growth after 75% defoliation. These studies suggest sheep grazing is effective in controlling tansy ragwort where it grows in a competitive grassland community.

## **Biological Control**

### **Cinnabar moth**

Biological control of tansy ragwort in the U.S. was initiated in 1959 with the California release of the cinnabar moth, *Tyria jacobaeae* L. (Lepidoptera: Arctiidae). This agent is now well-established in California, Oregon, Washington, and in northwestern Montana. The cinnabar moth flourishes in lower elevation (below 3,000 ft./900 meters) open canopy areas with warm, sunny summers and large, high-density infestations of tansy ragwort. Adult moths are 0.60-0.88 in (15-22 millimeters) long with a wingspan of 1.08-1.40 inches (27-35 millimeters) and have a distinctive appearance: the black forewing is marked by a few irregularly-shaped crimson spots and a crimson line along the outer edge of the wing while the hind wing is entirely crimson (see Figure 4). Cinnabar moths typically emerge by late spring, mate and finish depositing eggs by mid-summer. Moths can be roused into flight during daylight hours when host vegetation is disturbed. Eggs are laid on the underside of rosette leaves in small groups. The eggs hatch after several weeks' development and emerging larvae begin feeding on foliage closest to the hatch site. The damaging larval stage of this agent is easily recognized by its alternating bands of bright orange and black (see Figure 5). Pupation begins in late summer when the fully-grown fifth-instar larvae seek out suitable sites in debris or soil, or under bark; the cinnabar moth overwinters as a 0.80-1.00 inch (20-25 millimeters) long dark reddish-brown pupa.

Roving groups (10-30 individuals) of the gregarious larval stage of this agent aggressively feed on the leaves, flowers and apical meristems of bolting tansy ragwort, leaving plants stripped of all foliage. Larval feeding can lead to significant reductions in seed production and stand density, although impact varies considerably. The larval stage of this agent is optimal for redistribution onto uncolonized infestations of tansy ragwort. Caterpillars are easily collected by shaking plants over collecting pans (such as kitty litter trays); retain larvae under cool, dry and uncrowded conditions in ventilated (with pin holes) containers provisioned with fresh host plant material for as short a period as possible before releasing. Because endogenous toxic alkaloids sequestered from tansy ragwort are present in both the larval and adult stage of this agent, implications for livestock health and management should be carefully considered when choosing sites for releasing the cinnabar moth.

The efficacy of the cinnabar moth alone in controlling tansy ragwort is limited with successful control reported only when larval defoliation was accompanied by favorable environmental factors (frost). Although this agent is highly effective in combination with the ragwort flea beetle, its deployment has been surrounded by controversy. Non-target attack on the exotic weed common groundsel *Senecio vulgaris*, two native species *Senecio triangularis* and *Packera pseud aurea* (formerly *Senecio pseud aureus*) and the ornamental silver ragwort, *Senecio bicolor*, have been reported when moth population densities outstrip local tansy ragwort resources.



**Figure 4. Cinnabar moth. Image: Eric Coombs, Oregon Department of Agriculture. Available at Bugwood.org**



**Figure 5. Larval stage of cinnabar moth. Image: Eric Coombs, Oregon Department of Agriculture. Available at Bugwood.org**

## Ragwort seed fly

The ragwort seed fly *Botanophila seneciella* Meade (Diptera: Anthomyiidae) was first introduced to the U.S. in California in 1966 and was the first tansy ragwort agent to become well-established east of the Cascades. *Botanophila seneciella* was released to additively improve tansy ragwort biocontrol by bolstering the low levels of control realized with the cinnabar moth. Adult flies (see Figure 6), 0.20-0.28 inch (5-7 millimeters) in length, emerge in spring and deposit eggs on tansy ragwort flower buds through early summer. The 0.16-0.24 inch (4-6 millimeters) long creamy-white larva tunnels into the flowerhead and throughout the receptacle, eventually moving back up to the seed head. Evidence of infestation by this agent is obvious: larval feeding generally destroys all seed within mined seed heads, and flowers under attack are typically marked by frothy spittle. Mature larvae exit host seed heads in late summer to pupate in the soil. The ragwort seed fly overwinters as a dark brown 0.2 inch (5 millimeters) long pupa. Because this agent shares the same habitat preferences as the cinnabar moth, their joint release is often marked by resource competition for favorably located host plants. The seed fly usually loses out because the moth's phenology allows it to begin ovipositing earlier so that caterpillars have generally stripped all flowerheads from plants in open canopy areas by the time the seed fly is ready to begin oviposition. Reproductive success is significantly reduced when resource competition forces the fly to lay eggs on host plants located in moist, shaded areas. This agent has self-distributed comprehensively throughout the Pacific Northwest; redistribution is generally unnecessary but if desired is best accomplished by transplanting fly-infested plants in late spring.



**Figure 6. Ragwort seed fly - adult. Image: Eric Coombs, Oregon Department of Agriculture. Available at Bugwood.org**

## Ragwort flea beetle

The light gold-colored ragwort flea beetle (see Figure 7), *Longitarsus jacobaeae* Waterhouse (Coleoptera: Chrysomelidae), first introduced to the U.S. in 1969, is now established in Montana, Washington, Oregon, and California. Intensive foliar feeding by adult flea beetles, termed "shot holing," is a clear indicator of whether or not a tansy ragwort stand has been colonized by this

agent. Ragwort flea beetles introduced to the U.S. before 2002 were collected in Italy; the so-called Italian strain of this agent is credited with exceptional control and continued suppression of tansy ragwort infestations west of the Cascades. A Swiss strain of this agent with a completely different phenology than the Italian strain and believed to be better adapted to higher elevations, colder winters and shorter growing seasons typical of tansy ragwort infested areas east of the Cascades was released in Montana in 2002.

Adult Italian-strain ragwort flea beetles emerge briefly in spring before returning to the soil to estivate (summer dormancy) until prompted by late summer/early fall rains to begin mating. Eggs laid from October through November produce slender white larvae 0.08-0.16 inch (2-4 millimeters) in length that feed throughout the winter on the host plant roots. Larvae leave the roots in the spring to pupate in the soil. Pupae are white and 0.08-0.16 inch (2-4 millimeters) long.

Swiss-strain adult flea beetles emerge from their pupation sites in the soil in late spring to early summer and begin feeding, mating and laying eggs immediately. Development in the eggs of Swiss-strain beetles is delayed through the rest of that summer, fall and winter and does not begin until the following spring. Larvae feed on and in tansy ragwort roots until pupating in the fall. The Swiss strain of the ragwort flea beetle is unique in that it overwinters both in the egg and pupal stage. Adults of both strains are 0.08-0.16 inch (2-4 millimeters) in length with the males approximately 0.04 inch (1 millimeter) shorter than the females.

Tansy ragwort rosettes appear to be the most susceptible stage of the weed to flea beetles as significant control is realized from both larval root mining and adult foliar feeding that specifically targets vegetative (pre-reproductive) plants. The adult stage of the flea beetle is best suited to successful collection for redistribution, either by vacuum collection or sweeping, October-November for the Italian strain and mid-summer for the Swiss strain.



**Figure 7. Ragwort flea beetle - adult. Image: USDA ARS European Biological Control Laboratory. Available at Bugwood.org**

## **Revegetation**

The information presented above strongly suggests tansy ragwort is not competitive in a closed plant community. Control of tansy ragwort regardless of method will most likely be short term where competitive plants are absent. In western Montana, tansy ragwort commonly invades in forest communities after logging because the disturbance associated with logging creates

favorable establishment sites and the logging equipment often serves as a vector of spread. Seeding rapidly establishing perennial plants after logging is therefore extremely important to preventing or reducing the severity of tansy ragwort infestations. In forage crop fields, crop rotation can facilitate tansy ragwort control while keeping the crops vigorous and competitive.

Plant species selected for revegetating disturbed sites likely or known to be infested by tansy ragwort should be appropriate for management objectives, adapted to site conditions, and competitive with the weed. Management objectives will determine if forage species or native species should be seeded and specific species mixture components. The environmental conditions of the site, including precipitation, soil texture and depth, slope and aspect, will affect species establishment. On native rangeland, a diversity of perennial grass and forb species that occupy many niches over time and space will most fully utilize available resources and compete effectively with tansy ragwort. Refer to [Montana Plant Materials Technical Note 46](#), 'Seeding Rates and Recommended Cultivars,' and Extension Bulletin EB19 'Dryland Pasture Species for Montana and Wyoming' for seeding rate guidance and revegetation species selection. State, area, and field resource specialists can help determine the most appropriate, site-specific species mix and timing of seeding for local conditions.

### **Integrated Pest Management (IPM)**

Tansy ragwort thrives on disturbed ground with open sites in the plant community. On hay ground, IPM practices include crop rotation, nutrient management, irrigation management (where available), and forage harvest management to maintain a competitive closed plant community. New infestations of tansy ragwort should be aggressively controlled using hand pulling and/or broadleaf herbicide. On pastures and rangeland, herbicide application should be combined with prescribed grazing. Multi-species grazing with cattle and sheep will provide more uniform utilization than single-species grazing. In the spring, grazing sheep first to target tansy ragwort before grazing with cattle will prevent accidental poisoning of cattle. When tansy ragwort plants are mature, cattle will avoid them. Severe infestations should only be grazed by sheep. Forest clearings should be revegetated and monitored for new infestation after logging operations. Roadways, trails, and irrigation ditches should be maintained weed free.

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