USDA

United States Department of Agriculture

Field Guide for Managing Russian Knapweed in the Southwest

Forest Service

Southwestern Region

TP-R3-16-13

February 2015

Cover Photos

Upper left: Steve Dewey, Utah State University, Bugwood.org
Upper right: Steve Dewey, Utah State University, Bugwood.org
Bottom center: Steve Dewey, Utah State University, Bugwood.org

Printed on recycled paper

Russian knapweed (*Rhaponticum repens* L., formerly *Acroptilon repens* L.

Sunflower family (Asteraceae)

Russian knapweed is an invasive plant that has been listed as a noxious weed in Arizona and New Mexico. This field guide serves as the U.S. Forest Service's recommendations for management of Russian knapweed in forests, woodlands, and rangelands associated with its Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also includes four national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Russian knapweed (synonyms: Turestan thistle, creeping knapweed, mountain bluet, Russian cornflower, hardheads) is an introduced, long lived, creeping perennial. This invasive weed is the most widely distributed of the various knapweed species. It is widespread in northern states including Colorado, Montana, and Wyoming and is currently becoming more common in New Mexico and Arizona. Russian knapweed can be distinguished from other knapweeds by its scaly, brown to black, spreading rhizomes and by its unique flowering bract features.

Growth Characteristics

- Long lived, creeping perennial; slow to establish but can spread rapidly once present; difficult to eradicate.
- Grayish-green rosette base; dense hairs; emerges in early spring.
- Erect branching stem, 18 to 36 inches tall, covered with cobwebby hairs.
- Brown to black, scaly rhizomes; long lived, deep vertical root system (grows to 20 feet deep or more).
- Flowers from June to September; pink to lavender, thistle-like, terminal flowers; urn-shaped flower heads, 0.25 to 0.5 inch in diameter; rounded bracts with papery tips.
- Reproduces mainly vegetatively via root buds near each scale on the rhizome; forms dense patches of cloned plants. Also produces seed (50 to 500 seeds per plant; viable for 2 to 3 years).
- Releases allelopathic chemicals that can inhibit growth of other plants; contains sesquiterpene lactones that are toxic to horses.
- Relatively shade intolerant.

Ecology

Impacts/threats

In dense stands, Russian knapweed develops into a near monoculture due to its ability to out-compete resident vegetation. Such monocultures can contribute to reduced wildlife presence and a decline in species diversity. This knapweed is toxic to livestock (especially horses), and its presence reduces forage availability.

Location

Russian knapweed adapts to a variety of soil types, including poorly drained and alkaline/saline soils. It prefers areas with moist but not excessively wet soils. It readily invades pastures, degraded croplands, alfalfa fields, rangeland, roadsides, riparian and runoff areas, river bottoms, drainages, and irrigated fields. Large populations are distributed extensively throughout northern New Mexico, and smaller populations are present in most central and southern counties of the State. In Arizona, Russian knapweed is a concern in northeastern and southeastern counties.

Spread

Although Russian knapweed produces seed, it spreads mainly through vegetative propagation that arises from adventitious buds along a creeping, perennial root system. Root fragments of 1 inch or more in length can produce new plants if the fragments are buried in soil to a depth no greater than 6 inches. Seed or root fragments may be introduced into new areas via waterways such as irrigation ditches, streams, or rivers. Russian knapweed may also spread through transported hay that is not certified to be weed free or through attachment of propagules that adhere to the

undercarriages of off-road vehicles and road maintenance equipment.

Invasive Features

Russian knapweed's competitiveness is believed to be related to its ability to release harmful allelopathic chemicals that can inhibit growth of other plants. As a possible result of allelopathic effects, revegetation efforts following Russian knapweed control are often hampered unless measures are taken to mitigate soil condition. The weed can also cause as much as an eightfold increase in zinc concentration in nearby soil surface layers as compared to upper layers of soils without knapweed.

Management

Russian knapweed is quite difficult to control once established. Prevention, early detection, and eradication are the best management tools for controlling this noxious weed. Initial treatments to control Russian knapweed should attempt to remove as much of the knapweed population as possible, and secondary treatments will be necessary to remove remaining plants. Small knapweed stands on otherwise healthy sites should be eradicated first. Large knapweed infestations should be controlled and then eradicated when possible. The perimeter of large infestations should generally be treated first to prevent the infestation from spreading. As with other creeping perennial weeds, treated knapweed plants should be stressed sufficiently by control methods to cause depletion of stored nutrients in root systems. The following actions should be considered when planning an overall management approach:

- Maintain healthy plant communities and the presence of ground litter to prevent or limit knapweed infestations. This may involve using improved grazing management to prevent excessive grazing, and reseeding areas with desirable grasses and forbs after disturbance.
- Detect, report, and map known infestations. Keep annual records of reported infestations.
- Eradicate new populations of Russian knapweed as early as possible.
- Combine mechanical, cultural, biological, and chemical methods for most effective knapweed control.
- Implement a monitoring and followup treatment plan for missed plants and seedlings.
- Use certified weed-free seed and hay; use pellets for horses used in back-country areas.

Table 1 summarizes management options for controlling Russian knapweed under various situations. Choice of individual control method(s) for Russian knapweed depends on the degree and density of infestation, current land use, and site conditions (accessibility, terrain, microclimate, other flora and fauna present, etc.). Other important considerations include treatment effectiveness, overall cost, and the number of years needed to achieve control. More than one control method may be needed for a particular site.

Physical Control

A number of mechanical control methods for Russian knapweed have been examined, but most have shown limited effectiveness. In general, mechanical control methods need to be combined with chemical spraying for long-term management of Russian knapweed.

Manual Methods

Hand pulling or digging – Hand pulling or hoeing can be effective for small, less established infestations of Russian knapweed if repeated annually over multiple years. Removal is generally easier and more effective in late spring when soil is moist and plants are beginning to bolt (but before seed set). It is very important to pull up all parts of the plant, especially the roots. Wear gloves and properly dispose of debris by burning or bagging and burying in a landfill to prevent spread.

Mechanical Methods

Tillage – Shallow cultivation or tillage without herbicide spraying as a followup treatment should be avoided since

Table 1. Management options*

Site	Physical Methods	Cultural Methods	Biological Methods	Chemical Methods
Roadsides, fence lines, or noncrop areas	Mow at 2 to 3 week intervals during growing season but before seed set. Follow up with an herbicide application in the fall.	Avoid driving vehicles and equipment through infested areas; wash if travel through these areas is unavoidable. Educate road crews and others to identify and report infestations.	A gall-forming nematode (*Subanguina picridis*) may be available in some western states including New Mexico.	Use truck or tractor-mounted spraying equipment to broadcast treat. Wash underneath vehicle after application to prevent spread.
Rangeland, pasture, or riparian corridors	Deep cultivation (12 inches) repeated over 3 years can be effective. Shallow cultivation/tillage is not recommended as severed root fragments may regrow. Burning is ineffective and may contribute to further knapweed dominance.	Use certified weed-free seed and hay. Use pellets for horses in backcountry areas. Check animals, clothing, and vehicles for seeds. Always evaluate the need to reseed with native perennial grass when considering knapweed control.	Closely manage grazing to prevent overuse. Consider grazing heavily infested sites in late summer or early fall rather than spring. Maintain litter cover to reduce knapweed germination. A gall-forming nematode (*Subanguina picridis*) may be available in some western states including New Mexico.	In areas difficult to access, an ATV-mounted sprayer or backpack unit may be the most practical application methods. Wash underneath vehicle after application to prevent spread.
Wilderness, other natural areas, and/or small infestations	Hand pulling, hoeing, or digging must remove all root stock to be effective; wear gloves for pulling; pull when soil is moist; most effective on newly established plants.	Use certified weed-free seed and hay. Use pellets for horses in backcountry areas. Check animals and clothing for seeds. Post signs warning visitors to remove seeds after passing through infested areas. Always evaluate the need to reseed with native perennial grass when considering knapweed control.	Same as above.	Use backpack or hand-held sprayers. Broadcast spraying with ground methods may be used on thicker stands if allowed. Remove seed from clothing to prevent spread.

* Choice of a particular management option must be in compliance with existing regulations for land resource.

this practice often leads to an increase in knapweed dominance. Disking or plowing cuts roots into fragments that can survive desiccation and promote further spread. See the "Control Strategies" section for more information.

Mowing – If repeated continually throughout the growth season, mowing will suppress shoots and flowers; however, mowing will not reduce Russian knapweed populations.

Prescribed Fire

Burning as a single control method is not recommended. New plants from roots are quickly produced after fire which often leads to increased dominance by Russian knapweed. However, fire may be used as a secondary treatment in combination with other control methods, such as disposal of debris.

Cultural Control

Prevention, early detection, and plant removal are critical for preventing Russian knapweed establishment. Land managers, road crews, and the local public should be educated on identification of knapweed species so that they can help report all suspected infestations. Vehicles, humans, and livestock should be discouraged from traveling through infested areas. A program to check and remove seed from vehicles and livestock after travel through infested areas

should be implemented to help stop dispersal. To prevent seed from being transported by irrigation canals, use weed screens on irrigation water intakes inside infested areas if possible.

Reseeding with native perennial grass after disturbance should always be considered in controlling knapweed. Tillage should be used before reseeding to alleviate any remaining allelopathic effects from Russian knapweed on soil condition.

Biological Control

Grazing

Livestock (including cattle, sheep, and goats) normally will not graze Russian knapweed due to its bitter flavor; however, animals may graze the weed lightly during early growth. The weed is especially toxic to horses and should not be grazed by them. The time of grazing preferred for pastures infested with Russian knapweed should occur during late summer, early fall, or winter. Use grazing to encourage perennial grass growth and competition against Russian knapweed. Reduce grazing pressure in early spring when grasses are first starting to grow and allow grasses to tiller and produce seed. Utilization of knapweed by livestock should be carefully monitored, and heavy grazing should be avoided.

Classical Biological Control

Table 2 lists some potential biological control agents that can affect Russian knapweed. Although biological control agents may weaken Russian knapweed populations, they have not been shown to reduce them. A gall nematode (*Subanguina picridis)* has been released in northwestern New Mexico to help control Russian knapweed. It forms galls on stems, leaves, and root crowns. Several other biocontrol agents such as a gall-forming wasp (*Aulacida acroptilonica*) and a rust fungus (*Puccinia acroptili*) are currently being evaluated but have not yet been released.

Agents used for biological control in southwestern states should be adaptable to arid environments and local conditions. Public, tribal, and private land managers may obtain biological control agents for release directly from local offices of the USDA Animal and Plant Health Inspection Service (APHIS) when the agents are available. Other sources for biocontrol agents include private companies or locally developed insectaries. A permit must be obtained from APHIS before biological control agents can be transported across state boundaries. Regulations and permit applications (PPQ 526 permit forms) pertaining to interstate shipment of biological control agents can be found at http://www.aphis.usda.gov/ppq/permits/. Although biological control agents may be collected and released within a given state without a permit from APHIS, the state's Department of Agriculture or Agricultural Extension Service should be consulted for any regulations relating to movement of these agents inside the state.

Table 2. Classical biological agents

Species	Type of Agent	Site of Attack/ Impact	Use/Considerations for Release	Remarks
Subanguina picridis	gall-forming nematode	stems, leaves, and root crowns	Readily spreads for long distances without assistance.	Successfully established in Washington, Colorado, Montana, Oregon, Utah, and Wyoming.
Aulacidea acroptilonica	gall-forming wasp	stems	Currently being researched	
Puccinia acroptili	rust fungus	roots	Currently being researched	

Chemical Control

Russian knapweed is best controlled with a selective, postemergent herbicide. Typically, the main herbicide entry into the plant is through the leaves and stems; but certain herbicides can enter through the roots. Control results can vary due to weather and plant growth stage. Herbicides generally provide significant reduction of a knapweed population with a single application; however, followup treatment should always be anticipated.

All herbicides recommended in table 3 will effectively control Russian knapweed when properly applied. Selective herbicides used for effective control of Russian knapweed include picloram, aminocyclopyrachlor, aminopyralid, and clopyralid. Picloram is a restricted-use pesticide and should not be used near waterways or whenever the water table is near the surface. Glyphosate or imazapyr can be used for followup spot treatment, but these treatments may create a bareground situation.

Precautions should be taken if nontarget plants (including woody species) need to be protected. This includes situations where spray drift, soil erosion, or water movement potentially could occur. Each herbicide product will have different requirements and restrictions according to the label. Read and understand prior to any application. To prevent development of resistance in Russian knapweed for repeated treatments, the label should be consulted for guidelines on rotating herbicide active ingredients. Consult the registrant if you have questions or need further detail.

The most effective period to spray Russian knapweed generally is in the fall (preferably after a frost) when rosettes begin to emerge or mature plants appear dormant (grey stems, no leaves). Spraying earlier may provide only short-term control. Herbicides may be applied by backpack sprayers, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. In situations where Russian knapweed is dense and widespread, aerial application by fixed wing or helicopter aircraft should be considered.

Table 3. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example[1]	Product Example Rate per Acre (broadcast)	Backpack Sprayer Treatment Using Product Example[2]	Time of Application	Remarks
Picloram[3]	Tordon 22K	1–2 quarts	1–3%	Most effective in late fall after frost. Apply 1 pt/acre if used in combination with cultivation and reseeding.	May be used in combination with 2,4-D.[4] Restricted use herbicide that is selective although persistent. Picloram may pose a risk to groundwater in permeable soils or in areas where the water table is near the surface. Wait 2 months to reseed perennial grasses.
Aminocyclopyrachlor + chlorsulfuron	Perspective	4.75–8 ounces	Add 5–9 grams of dry flowable powder to 1 gallon water.	Most effective in late fall after frost.	A selective blend of active ingredients labeled for noncrop use (includes natural areas such as wildlife management areas, wildlife habitats, recreation areas, campgrounds, trailheads, and trails). Persistent; selective for broad-leaved plants; may cause temporary injury to some grass species. May also be used on public, private, and tribal lands as part of an early detection and rapid response (EDRR) in treating infestations of invasive weed species.

Table 3. Herbicide recommendations (continued)

Common Chemical Name (active ingredient)	Product Example[1]	Product Example Rate per Acre (broadcast)	Backpack Sprayer Treatment Using Product Example[2]	Time of Application	Remarks
Aminocyclopyrachlor + metsulfuron methyl	Streamline	4.75–9.5 ounces	Same as above.	Same as above.	A selective blend of active ingredients labeled for noncrop use (includes natural areas such as wildlife management areas, wildlife habitats, recreation areas, campgrounds, trailheads, and trails). Persistent; selective for broad-leaved plants and certain brush species; may cause temporary injury to some grass species. Can be used in riparian areas. May also be used on public, private, and tribal lands as part of an early detection and rapid response (EDRR) in treating infestations of invasive weed species.
Aminopyralid	Milestone	4–6 fluid ounces	5–10%	Spring and summer at bud to flowering growth; or in late fall on dormant plants.	May be used in combination with 2,4-D. Use higher rate on older stands; late fall treatment of dormant plants can be very effective. Add 0.25–0.5 percent nonionic surfactant for mature plants or for adverse conditions. Labeled for use up to water's edge. No grazing restrictions.
Clopyralid	Curtail	1–2 quarts	1–3%	Bud to full bloom or in late fall after frost.	May be used in combination with 2,4-D. Can be used on rangeland, irrigated pasture, or meadows but not directly to water. Wait 30 days to reseed perennial grasses.
	Reclaim, Transline	1–1-1/3 pints	1–3%		
Glyphosate	RoundUp, many products	4–4.8 quarts	2%	Late bud to early flower; late summer or fall.	Use primarily as followup spot treatment. Direct spray or use a wipe method when desirable plants are present.
Imazapyr	Arsenal	2 pints	1%	Anytime plants are growing or in the fall after frost.	Use primarily as followup spot treatment. Direct spray or use a wipe method when desirable plants are present. In addition to overspray, nontarget plants may also be killed or injured by root transfer of imazapyr between intertwined root systems.

[1] Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with Russian knapweed.

[2] Herbicide/water ratio - As an example, a gallon of spray water with a 3 percent mixture is made by adding a sufficient volume of water to 4 ounces of liquid herbicide until a volume of 1 gallon is reached (4 oz/gal ÷ 128 oz/gal = 0.03 or 3 percent). For dry formulations, particulates should be added to sufficient water as specified by the label until the required concentration or volume of spray water is reached.

[3] Restricted use pesticide - A certified applicator's license is required for purchase and use of these pesticides.

[4] 2,4-D is a restricted use pesticide in New Mexico only.

Control Strategies

The key to successful Russian knapweed control is long-term planning, integrated management, monitoring treated areas on an annual basis, and possibly reseeding in order to encourage competition from desirable plants, especially perennial native grasses. Planning and treatments to control Russian knapweed should be designed to meet specific site conditions. An integrated management strategy that combines control methods as necessary should be implemented to contain, reduce, or eradicate Russian knapweed populations. As discussed in the "Management" section of this guide, Russian knapweed populations growing in small isolated patches on otherwise healthy sites should have first priority for treatment. For heavily infested areas, plants at the perimeter should be treated first. The larger, denser cores of the infested area should be addressed in the final stage of treatment. Failure to perform followup monitoring and treatment may result in recolonization of Russian knapweed and a return to a pretreatment level of invasion.

The following strategies should be considered to contain and reduce populations of Russian knapweed:

- **Mechanical–herbicide strategy** – One example of a combined control strategy is to mow or disk at 2 to 3 week intervals during growing season, then apply herbicide to knapweed regrowth in the fall. Consider reseeding the area shortly thereafter with competitive perennial grasses. Perform followup monitoring and spot treat any new or regrowing plants. Grazing should be managed to favor establishment of desirable perennial grasses.
- **Individual plant treatment for sparse infestations or followup** – Use a backpack sprayer, wiper, or sponge applicator per the herbicide label to administer spot treatment in the fall. For individual plant treatment (IPT), the foliage should be wetted thoroughly (apply until it begins to run off). When using picloram or another postemergent herbicide, spray an extra 10 to 15 feet around the infested area to ensure control of root, sprouts, and/or seedlings. A wiping or direct spray method using a 2 percent glyphosate solution may be used when plants are in bloom but before seed matures. This approach is most appropriate when other desirable broadleaved plants are present. Areas treated with glyphosate can be reseeded after 3 days.
- **Strategy for an infestation with an adequate grass understory present** – Spray selective herbicide in autumn to control Russian knapweed and allow native grasses to return naturally in the next growing season. Defer grazing on areas sprayed for one or more growing season to allow grasses to increase and gain a competitive advantage. Monitor sprayed areas carefully for 2 or 3 years and spot spray returning Russian knapweed plants.
- **Strategy for an infested site with little grass understory** – Consider planting with a mixture of native grass, shrub, and forb seed. Control Russian knapweed first by herbicide spraying in fall and later cultivate to bury allelopathic plant residue. Follow up with planting by late fall to allow seed to take advantage of any early spring moisture that may be available. To use less seed and ensure more successful establishment, consider seeding with a grain drill. A no-till, rangeland drill may be necessary on particularly rocky, steep, or hard sites. Select native perennial grass species according to individual site conditions and moisture availability. Periodically monitor the next growing season for newly emerged Russian knapweed seedlings and spot treat them.

Adaptive Management

A persistent commitment over many years is required for successful control of Russian knapweed. Therefore, realistic goals and objectives should be established to manage Russian knapweed infestations occurring extensively throughout a given landscape. To improve

long-term success, consider using an adaptive management strategy with the overall goal of restoring desirable plant communities. The stepwise process for adaptive management involves:

1. Assessment of the overall weed problem,
2. Establishing management goals and objectives,
3. Implementation of control strategies,
4. Monitoring the effectiveness of management actions,
5. Evaluating actual outcomes in relation to expected results, and
6. Adjusting practices as necessary.

Steps of this process should be repeated in sequence as part of a continuous learning cycle that improves management planning and strategy by learning from the outcomes of previous management actions. In general, an adaptive management strategy may be considered to be successful if:

1. Stakeholders are actively involved and remain committed to the process,
2. Monitoring and assessment are used to adjust and improve management decisions, and
3. Management goals and/or objectives for the resource are being achieved.

References and Further Information

Beck, K.G. 1998 (rev. 2008). Russian Knapweed. Colorado State University Extension Natural Resource Series no. 3.111. Available at http://www.ext.colostate.edu/pubs/natres/03111.pdf (accessed April 2010).

California Department of Food and Agriculture. Encycloweedia Datasheets: Russian Knapweed. Available at http://www.cdfa.ca.gov/phpps/ipc/weedinfo/acroptilon.htm (accessed April 2010).

DiTomaso, J.M. and E.A. Healy. 2007. Weeds of California and Other Western States. University of California Agriculture and Natural Resource Publication 3488. Pp. 175–178. Available at http://books.google.com/books (accessed April 2010).

Dow AgroSciences. 2004. Milestone Factsheet. Available at http://www.dowagro.com/range/products/milestone.htm (accessed April 2010)

Duncan, K., K. McDaniel, and M. Renz. 2005. Chemical Weed and Brush Control for New Mexico Rangelands. Las Cruces: New Mexico State University College of Agriculture and Home Economics and Cooperative Extension Service. 9 pp.

Lym, R.G. 2004. Know Your Knapweeds. NDSU Extension Service Publication W-1146 Available at http://www.ag.ndsu.edu/pubs/plantsci/weeds/w1146.pdf (accessed April 2010)

McReynolds, K.H. and L.D. Howery. 2001. Public Education, Mapping and Early Action to Control Russian Knapweed in Southeastern Arizona. Journal of Extension vol. 39 2. Available at http://www.joe.org/joe/2001april/a2.php (accessed April 2010).

Northam, E. and W. Meyer et al. 2009. Non-Native Invasive Plants of Arizona. Produced by Conservation Districts and RC&D Areas of Arizona and the University of Arizona Cooperative Extension. Peer reviewed publication No. AZ1482. Available at http://cals.arizona.edu/pubs/natresources/az1482.pdf (accessed April 2010).

Renz, M.J. 2005. Russian Knapweed (Acroptilon repens). NMSU Extension Weed Factsheet. Las Cruces, NM.

Renz, M and F. Sholedice. 2006. Troublesome Weeds of New Mexico. Las Cruces: New Mexico State University College of Agriculture and Home Economics and Cooperative Extension Service. pp. 30-31. Available at http://www.emnrd.state.nm.us/fd/Publications/documents/NMTroublesomeWeeds.pdf

USDA Plants Database. 2010. Available at http://plants.usda.gov/index.html (accessed April 2010).

Whitson, T.D. et al. (ed.) Weeds of the West. Western Society of Weed Science in cooperation with Cooperative Extension Services, University of Wyoming. Available at http://plants.usda.gov/java/invasiveOne?pubID=WSWS and http://ndweeds.homestead.com/russianknapweed.html (accessed April 2010).

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. Available at http://www.doi.gov/initiatives/AdaptiveManagement (accessed April 2011)

Wilson, L.M. and C.B. Randall. 2003. Biology and Biological Control of Knapweed (Getting to Know Knapweeds). USDA Forest Service FHTET-2001-07. 2nd edition. Available at http://www.invasive.org/weeds/knapweed/chapter1.html (accessed March 2010).

Suggested Web Sites

For information on invasive species:

http://www.invasivespeciesinfo.gov/

http://www.invasive.org/weedus/index.html

For information about calibrating spray equipment:

NMSU Cooperative Extension Service Guide A-613 Sprayer Calibration at http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online:

http://www.cdms.net/LabelsMsds/LMDefault.aspx

For more information or other field guides, contact:

USDA Forest Service
Southwestern Region
Forest Health
333 Broadway Blvd., SE
Albuquerque, NM 87102

Or visit:

http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies