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Field Guide for Managing Russian Knapweed in the Southwest

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Cover Photos

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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 both 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 administers 4 national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Russian knapweed (synonyms: hardheads, Turestan thistle, creeping knapweed, mountain bluet, Russian cornflower) is an introduced, long-lived, creeping perennial. It 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; relatively shade intolerant; 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; has sesquiterpene lactones that are toxic to horses.

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.

Site/Distribution

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.

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. 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 by attachment of propagules that adhere to 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 eight-fold 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. The following action measures 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.
- Use certified weed-free seed, mulch, hay, and fill materials; use pellets to feed horses in backcountry areas.
- Eradicate new populations of Russian knapweed as early as possible.
- Detect, report, and map large infestations. Keep annual records of reported infestations.
- Combine mechanical, cultural, biological, and chemical methods for most effective control.
- Implement a monitoring and follow-up treatment plan for missed plants and seedlings.

Table 1 summarizes some management options for controlling Russian knapweed under various situations. Further details on these management options are explained below. Choice of individual control method(s) for Russian knapweed depends on the extent 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 limited effectiveness. In general, mechanical control methods need to be combined with chemical spraying for long-term management of Russian knapweed (see the "Integrated Control Methods" section below for further information).

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 by bagging and burying in a landfill to prevent spread.

Mechanical Methods

If using machinery to manage Russian knapweed, the equipment should be cleaned after use to prevent movement of root fragments and seed into un-infested areas.

Tillage – Shallow cultivation or tillage without herbicide spraying as a follow-up treatment should be avoided since 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. If feasible, tillage may be used before reseeding to alleviate residual allelopathic effects in soil from the knapweed.

Mowing – If repeated continually throughout the growing season, mowing will suppress shoots and flowers. However, mowing by itself will not reduce Russian knapweed populations.

Table 1. Management options*

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Roadsides, fence lines, or non-crop areas	Mow at 2 to 3 week intervals during growing season but before seed set. Follow up with an herbicide application in the fall.	Use seed, mulch, and fill material certified to be weed-free. 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 wasp and a gall midge are recommend as classical biocontrol agents if available.	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 seed and forage hay certified to be weed-free. 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.	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 wasp and a gall midge are recommend as classical biocontrol agents if available.	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 seed and forage hay certified to be weed-free. Use pellets for feeding 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 the land resource.

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. Seed and materials used for mulch, forage, or fill should be certified to be weed-free; pellets may be used to feed horses in backcountry areas.

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 systems, use weed screens on water intakes within infested areas if possible. Reseeding with native perennial grasses after disturbance should always be considered in controlling knapweed.

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

There are three approved classical biocontrol agents for Russian knapweed (table 2). 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; however, this biocontrol agent does not spread unaided and significant Russian knapweed reductions have not been observed in areas where it has been established. Two newer biocontrol agents, a gall-forming wasp (*Aulacida acroptilonica*) and a gall midge (*Jaapiella ivannikovi*) are now becoming more readily available. Impacts on Russian knapweed populations have been demonstrated by the gall midge.

Organisms (insects, pathogens, etc.) used as biocontrol agents in southwestern States should be adaptable to arid environments and local conditions. Public, tribal, and private land managers may obtain biocontrol agents for release directly from local offices of the USDA Animal and Plant Health Inspection Service (APHIS) when these agents are available. Other sources for biocontrol agents include locally developed insectaries or private companies.

A permit must be obtained from APHIS before biocontrol agents can be transported across State lines. Regulations and permit applications (PPQ 526 permit forms) pertaining to interstate shipment of biocontrol agents can be found at *https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/regulated-organism-and-soil-permits/sa_apply/ct_plantpest_howtoapply*. Although biocontrol agents may be collected and released internally in a given State without an APHIS permit, the State's department of agriculture or agricultural extension service should be consulted for any regulations relating to movement of these agents within the State.

Table 2. Classical biocontrol agents approved for Russian knapweed

Species	Type of Agent	Site of Attack/Impact	Use/Considerations for Release	Remarks
Subanguina picridis	gall-forming nematode	Galls reduce biomass and seed production stems, leaves, and root crown.	Impacts limited to plants on moist sites. Low impact and inability to spread unaided prevent this biocontrol agent from being cost-effective.	Not recommended for new releases
Aulacida acroptilonica	gall-forming wasp	Galls stunt plants, reduce seed production.	Populations still limited in US with minor impacts Parasitism of gall wasps has been observed. Releases best done by rearing out adults so parasites are excluded.	Recommended for new releases or redistribution.
Jaapiella ivannikovi	gall midge	Larval galls stunt plants, reduce seed production significantly	Populations are still limited.	Recommended for new releases with lab colonies or field redistributions by moving infested plants or rearing adults.

Chemical Control

Russian knapweed is best controlled with a selective, post-emergent 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, follow-up 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 follow-up spot treatment, but these treatments may create a bare ground situation.

Each herbicide product will have different requirements and restrictions according to the label. Read and understand the label prior to any application. Aquatically approved herbicide formulations and surfactants must be used in or near water. 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.

Herbicide Application

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. Precautionary measures 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.

Table 3. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example[1]	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution)[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.	Wait 2 months to reseed perennial grasses. 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.
Aminocyclo-pyrachlor + chlorsulfuron	Perspective	4.75–8 ounces	Add 5–9 grams of dry flowable powder to each 1 gallon water.	Most effective in late fall after frost.	A selective blend of active ingredients labeled for non-crop 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 (cont.)

Common Chemical Name (active ingredient)	Product Example[1]	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution)[2]	Time of Application	Remarks
Aminocyclo-pyrachlor + metsulfuron methyl	Streamline	4.75–9.5 ounces	Add 5–9 grams of dry flowable powder to each 1 gallon water.	Most effective in late fall after frost.	A selective blend of active ingredients labeled for non-crop 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.[4] 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.[4] 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 follow-up 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 follow-up spot treatment. Direct spray or use a wipe method when desirable plants are present. This herbicide is a non-selective amino acid inhibitor. In addition to spray drift, nontarget plants may also be killed or injured by imazapyr through runoff, residue movement in soil, or root exudates from treated plants.

[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] Spray solution is the herbicide/water ratio in a spray mix that may be used for spot treatment with backpack or hand-held sprayers. The amount of product applied during an annual growing season must not exceed the maximum application rate per acre as specified by the product label – refer to the product label for the site type and application.

[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.

Herbicides may be applied by a wiping method, backpack or hand-held 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. Any equipment used to spray herbicide should be calibrated.

For individual plant treatment (IPT), the foliage should be wetted thoroughly in the fall with a backpack sprayer, wiper, or sponge applicator (apply until it begins to run off). When using picloram or another post-emergent 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 solution of glyphosate 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.

Integrated Control Methods

An integrated management strategy that combines control methods as necessary should always be implemented when possible to reduce or eradicate Russian knapweed. As with other creeping perennial weeds, the combination of control methods selected to treat knapweed should substantially deplete stored nutrients in the root system. As an example, a **mechanical method-herbicide** treatment sequence may be used for some sites. 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 follow-up monitoring and spot treat any new or re-growing plants. Grazing should also be managed to favor establishment of perennial grasses.

Management 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.

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. Russian knapweed populations growing in small isolated patches on otherwise healthy sites should have first priority for treatment, especially eradication. Large knapweed infestations should be controlled and then eradicated when possible. For heavily infested areas, plants at the perimeter should generally be treated first to prevent the infestation from spreading. The larger, denser cores of the infested area should be addressed in the final stage of treatment.

Before spraying herbicide or using classical biocontrol agents for Russian knapweed, evaluate each area closely to determine if seeding may be necessary or if the plant community will return naturally. Seeding is not typically needed when native grasses are still common beneath Russian knapweed, as grasses will increase rapidly in the following seasons after treatment. The following strategies may be considered to restore native plant communities infested with Russian knapweed:

- **Strategy for infested sites with an adequate grass understory present** – Spray a selective herbicide in the fall 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 seasons 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 infested sites with little grass understory** – Consider planting a mixture of native grass, shrub, and forb seed. Control Russian knapweed first by herbicide spraying in fall and use tillage at a later time if feasible 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 to 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.

In most cases, at least two or more consecutive years of field treatments will be necessary to eliminate or substantially reduce Russian knapweed infestations. Since it is ordinarily useless to treat an area only one time without retreatment, sufficient resources must be allocated for the area where control is attempted. After initial treatment, it is especially important that resources are also available to respray or retreat the treated area as necessary. Previously treated areas should be continuously monitored to detect recovering Russian knapweed. Failure to perform follow-up monitoring and adapt control methods as needed could result in recolonization by Russian knapweed and a return to pretreatment levels of invasion.

Adaptive Management

A persistent, long-term commitment 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 approach 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 and measures,
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 is 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.

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Suggested Web Sites

For information on invasive species:

National Invasive Species Information Center

http://www.invasivespeciesinfo.gov/

Invasive.org

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

For information about calibrating spray equipment: NMSU Cooperative Extension Service Guide A-613, *Sprayer Calibration*. Available at http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online: http://www.cdms.net/

For more information or other field guides, contact:

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

Or visit the Southwestern Region's website for invasive species:

http://www.fs.usda.gov/goto/r3/invasivespecies