United States Department of Agriculture

Natural Resources Conservation Service

Plant Guide

Barbwire Russian Thistle

Salsola paulsenii Litv.

Plant Symbol = SAPA8

Common Names: Barbwire Russian thistle

Scientific Names: Kali paulsenii (Litv.) Akhani and Roalson, *Salsola pellucida* Litv., *Kali pellucida* (Litv.) Brullo, Giusso & Hrusa

Most Pre-1970s literature listed barbwire Russian thistle as *S. pestifer* A. Nelson, now recognized as a synonym of *S. tragus* L.. In 1967, barbwire Russian thistle was recognized as a distinct species (Beatley 1973, Mosyakin 1996).

Figure 1: Barbwire Russian thistle (Salsola paulsenii). Photo C. Bernau, Great Basin Plant Materials Center (GBPMC).

The name *Kali paulsenii* was recommended in 2007 and had some acceptance. A vote at the 2017 XIX International Botanical Congress reverted *K. paulsenii* back to *S. paulsenii* (Tzvelev 1993; Akhani et al. 2007, 2014; Mosyakin et al. 2014, 2017; Wilson 2017).

Description

General: Amaranth Family (Amaranthaceae; APG IV 2016). Alternatively, the Goosefoot family (Chenopodiaceae). The Goosefoot family is accepted as a distinct family by nearly all experts in this group (Hernández-Ledesma et al. 2015, Mosyakin and Iamonico 2017).

Barbwire Russian thistle is an introduced, C4 photosynthetic, warm season, annual forb that reproduces by seed. It is native to arid and semi-arid ecosystems in Southwest Russia and Central Asia (Aellen 1964). It is an erect (sometimes ascending), clump forming plant, that can grow up to two feet (60 cm) tall. Stems are stiff, sometimes yellowish-green, typically with one central stem and four or more longer cruciform primary branches at the base; forming a plant that is often wider than tall (Fig 2). Branches are alternate to subopposite, often with yellowish, red to purple longitudinal striations. Leaves are alternate, slightly flattened, 0.2-0.8 in (0.5-2 cm) long and 0.02-0.06 in (0.5-1.5 mm) thick, and end in a sharp spine. The plants are rigid with sharp prickly spines from seedling to maturity. Inflorescence is an interrupted spike of solitary flowers. Sometime 2-3 flowers in a tight cluster, but producing only a single fruit. Flowers are small, perfect, with 2-3 stamens, 0.02-0.03 in (0.5-0.7 mm) long anthers, and a short style with 2 stigma branches. Flowers are subtended by a single 0.2-0.36 in (5-9.2 mm) long bract and two 0.12-0.22 in (3-5.5 mm) long divaricately spreading to reflexed bracteoles; all three rigid and sharply tipped (Fig 3). The undifferentiated perianth is five lobed, about 0.09 in (2.5 mm) long, and winged at midlength; typically with three well developed colorless translucent broad wings and two very narrow (almost subulata) wings. The wings are large, 0.26-0.42 in (6.6-10.7 mm) in diameter, and is diagnostic of this plant in fruit (Beatley 1973, Welsh 2003, Hrusa 2017). The upper half of the perianth becomes

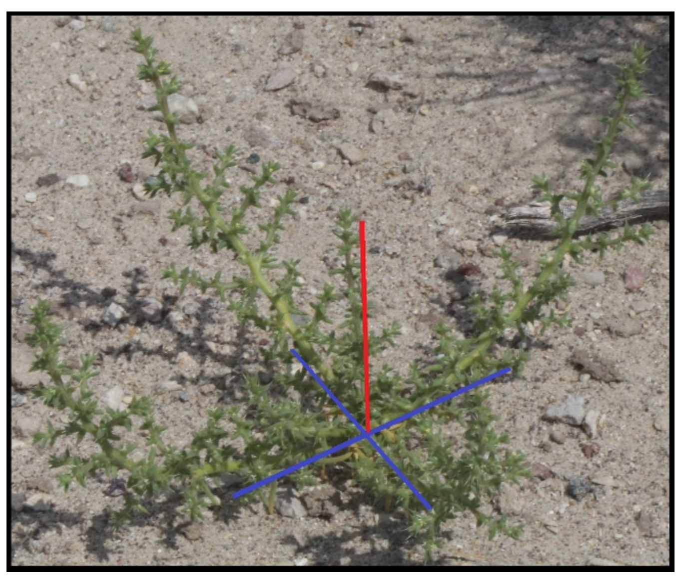

Figure 2: A yellowish-green barbwire Russian thistle with one central stem (Red line) and four longer, alternately branched, cruciform stems at the base (Blue lines); forming a plant that is wider than tall. Photo C. Bernau, GBPMC.

protruding over the fruit, forming a long and stiff columnar beak (Fig 4). The fruit is a tightly coiled immature embryo (2n=36) covered by a thin membrane. It lacks stored energy reserves or any complex covering, though it is enclosed in the persistent perianth (Holmgren et al. 2012). Seed production is variable with average sized plants producing 600 seeds; rarely exceeding 1000 seeds (Evans and Young 1980).

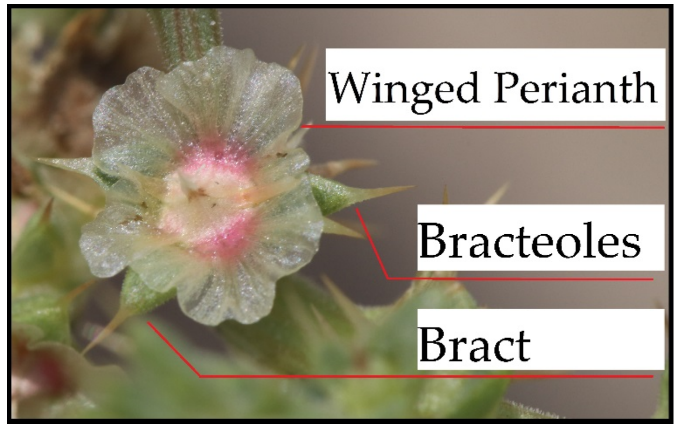

Figure 3: Barbwire Russian thistle flower with bract, bracteoles, and perianth labeled. Notice the upper half of the perianth in the center is incurved over the fruit, forming a short columnar beak. Photo C. Bernau, GBPMC.

Barbwire Russian thistle typically matures in late summer to fall. It does not have specialized abscission cells at its base and does not tumble in the wind as a tumbleweed. This is in contrast to several other members of the *Salsola* genus. Instead, barbwire Russian thistle's mature seeds readily fall and accumulate beneath the parent plant where the sheltered microclimate assists in germination the following spring (Kostivkovsky and Young 2000). Fresh seed germination is restricted by temperature, requiring a minimum day/night temperature of 28.4/86 °F (-2/30 °C). Seed stratification occurs over winter, allowing the seeds to germinate in virtually any soil temperature the following spring (Young and Evans 1979). Germination is rapid and consists of the fully formed embryo simply uncoiling, and can be completed within minutes of contact with the proper temperature and little precipitation. Should the embryo desiccate prior to uncoiling, it can return to dormancy until suitable moisture is available (Wallace et al. 1968). Seeds are not persistent, with over 85% germinating in the first year and the remaining seeds typically surviving for less than three years (Evans and Young 1980). Germination on bare soil is as low as 39% and increases significantly with litter or soil coverage (Young and Evans 1979).

Figure 4: Barbwire Russian thistle flower with the long and stiff columnar beak labeled. The beak is a prominent characteristic of this species and is formed by the upper half of the perianth protruding over the fruit. Photo C. Bernau, GBPMC.

Barbwire Russian thistle readily hybridizes with *S. tragus* where sympatric, typically 4000-6200 ft. (1200-1900 m) elevations in arid and semi-arid ecosystems. Hybrids were given the name *S. gobicola* Iljin (Rilke 1999) and tend to show all variations of introgression. One complex hybrid, nicknamed *Salsola paulsenii* lax because of a lax tip on the perianth, has genetic markers of *S. tragus, S. paulsenii, S. australis*, and unique genetic markers that may represent a lack of genetic sampling or a fourth unknown species. It is of interest because it is hexaploid (2n=54) and might be a new species (Arnold 1972, McGray et al 2008, Ayres et al. 2009).

Distribution: Barbwire Russian thistle is an introduced species that can be found in arid and semi-arid ecosystems in Oregon, California, Nevada, Utah, Arizona, Colorado, New Mexico, and Texas. Its native range is from the southwestern Russia to Central Asia (Aellen 1964, Rilke 1999, Mosyakin 2017). It is most abundant in Middle Asia in sandy soils such as the Karakum or Kysylkum deserts (Kostivkovsky and Young 2000). It is rarely reported as an alien in Europe, and it had its first documented occurrence in the Ukraine in 2017 (Mosyakin 2017).

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site: https://plants.usda.gov/core/profile?symbol=SAPA8

Habitat: Barbwire Russian thistle is widely distributed in the American Southwest. It can be found in the Sagebrush Steppe, Salt Desert Scrub, Mojave Desert, Sonoran Desert, Chihuahuan Desert, and coastal regions. Barbwire Russian thistle is not an agricultural pest, but it can invade arid rangelands.

Adaptation

Barbwire Russian thistle is adapted to sandy soils and disturbed landscapes in arid ecosystems below 6200 ft. (1900 m). It has an affinity for soil derived from limestone (Evans and Young 1980) and prefers to grow under the canopies of trees and shrubs (Kostivkovsky and Young 2000). It has several adaptations that make it competitive in arid ecosystems, such as early maturation and seed dispersal, less specific temperature requirements for seed germination, and low water requirements. These adaptations give barbwire Russian thistle a competitive advantage against Saltlover (*Halogeton glomeratus*) and *S. tragus* in arid ecosystems below 4000 ft. (1220 m; Young and Evans 1979, Evans and Young 1980, Young et al. 1999). Barbwire Russian thistle germination success can be as low as 39% (Young and Evans 1979). However, arid ecosystems tend to be sparsely vegetated and barbwire Russian thistle's low germination success is enough to give it a competitive edge. Those advantages are less effective above 4000 ft. (1220 m) or in semi-arid ecosystems where *S. tragus*' abundant seed production and high germination success can out compete barbwire Russian thistle (Evans and Young 1980).

Uses

Agriculture: Barbwire Russian thistle is extremely water efficient and is known to produce relatively high yields with minimal water resources. As such, there is some potential for hay or forage production in semi-arid and arid ecosystems. In 1978, Fowler and Hageman conducted a forage study with barbwire Russian thistle, *S. tragus*, and hybrids. They concluded that *S. tragus* was superior for forage due to the degree of spininess and growth patterns. Hageman et al. (1988) conducted a study of 514 individual plant selections from five states around New Mexico that included barbwire Russian thistle, *S. tragus*, *S. collina*, and possible hybrids. The generalized results were highly variable, but indicated good nutrition when young with low risk of oxalate and nitrate poisoning. Agricultural potential has not yet been realized as barbwire Russian thistle is considered a pest rather than a commodity crop.

Human Use: Barbwire Russian thistle is edible to humans. Young shoots and tips may be eaten raw or cooked like greens. Barbwire Russian thistle contains small amounts of oxalates, which may cause oxalate poisoning if eaten in abundance (Tull 2013). Be absolutely certain of a plant's identity prior to consumption.

Landscape Restoration: While barbwire Russian thistle is an invasive species that can negatively affect rangeland ecosystems; in some cases it may have value in landscape restoration. Barbwire Russian thistle can be used to vegetate extreme conditions such as alkali soils, mine tailings, and populations were even found in Nevada's nuclear test sites. Barbwire Russian thistle does not form mycorrhizal associations. Rather, it is infected by mycorrhizal fungi (Meshkov 2015) which may reduce the barbwire Russian thistle's fitness while increasing the mycorrhizal fungi population. The increase in mycorrhizal fungi population may facilitate the germination, growth, and survival of native vegetation that does form mycorrhizal associations (Allen and Allen 1988). In addition, barbwire Russian thistle can out compete the poisonous invasive weed Saltlover and the invasive *S. tragus* (Young et al. 1999).

Livestock: Barbwire Russian thistle can provide forage for cattle, horses, and sheep. In its native range, it is considered good forage for sheep and camels and nutritious for cattle in the fall when covered in seeds (Kostivkovsky and Young 2000). The nutritional value of this forage is considered fair when young, but may be less palatable than *S. tragus* due to its stiff spines. In some locations, it is viewed as security for livestock when more palatable options are not available. Oxalate and nitrate concentrations are highly variable and highest in younger plants, but are typically below toxic levels. Oxalate poisoning is rare and may be more of a problem for sheep than cattle (Hageman et al. 1988, Boerboom 1995). Nitrate poisoning is also rare. Hageman et al. (1988) evaluated 70 collections of *Salsola* spp. and found six collections to have potentially toxic levels (>2%) of nitrate.

Pollinators: Barbwire Russian thistle is a source of pollen for a wide variety of insects; such as bees, flies, moths, and butterflies. It is a larval host plant of the introduced Western Pygmy Blue, *Brephidium exilis*, which is the smallest butterfly in North America.

Wildlife: Barbwire Russian thistle has value both for wildlife habitat and food. The plant can provide shelter for small mammals, reptiles, and birds, while it is nutritious and palatable to a wide variety of herbivores. Young plants are the most palatable, but standing dead are consumed when softened by moisture. Seeds are readily consumed by a variety of birds and small mammals. Heteromyid rodents in particular consume a large amount of seed (Longland 2007).

Ethnobotany

Salsola species have been used since antiquity in the production of glass and soap. *Salsola* accumulates salts when grown in sodium-rich soils. The plants are burned and the ash mixed with water to create a solution high in sodium carbonate. The water is extracted and boiled off, leaving behind sodium carbonate of varying purity. The sodium carbonate is then used to reduce the melting point of sand to make glass, or mixed with oil or fat to make soap. Glass objects dating back to 2500 BC have been found in Syria and a Babylonian clay tablet dated to 2200 BC listed water, cassia oil, and alkali (sodium carbonate and/or potassium carbonate) as ingredients for soap. This process remained relatively unchanged since antiquity. Kingzett (1877) reported that the quality of ancient Egyptian glass was similar to 19th century crown glass from England.

Prior to 1793, sodium carbonate was produced primarily from the ashes of salt adapted plants. At this time, Spain was a major producer of sodium carbonate, cultivating *Salsola soda* (syn. *Soda inermis*), *Salsola kali*, and *Halogeton sativus* for this purpose. The industry was viewed as critical to Spain's economy, and they created laws forbidding the export of seeds; punishable by death (Kingzett 1877).

In 1793, French chemist Nicolas Leblanc invented a new process for creating sodium carbonate through the use of salt, limestone, sulfuric acid, and coal. Shortly thereafter the global production of sodium carbonate shifted away from plant based products.

Status

Weedy or Invasive:

Barbwire Russian thistle may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult the PLANTS Web site (http://plants.usda.gov/), your local NRCS Field Office, state's department of natural resources, your Cooperative Extension Service office, or state agriculture department regarding its status and use (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines

Barbwire Russian thistle can be planted in late fall or early spring. Optimal temperature for germination is 28.4/86 °F (-2/30 °C), but it can germinate in virtually any temperature once it overwinters. Barbwire Russian thistle should be planted in a weed free bed. Planting depths is optimal at less than 1 in (2.54 cm) and should be no deeper than 3 in (7.5 cm; Young and Evans 1979). Broadcast seeding can be effective, however, germination on bare soil can be as low as 39% (Young and Evans 1979) and crusting of the soil or soil compaction issues may prevent seedling establishment.

When seed cleaning it may be difficult to remove the seed from the chaff. One effective method is to sink the seed in hexane, which results in the chaff floating for easy removal (Coxworth et al 1969).

Management

Barbwire Russian thistle management has typically focused on control. Minimizing disturbance and providing for competing vegetation tends to be an effective strategy. If competing vegetation is established and maintained, and disturbance is minimized, then barbwire Russian thistle populations may start to decline. This may include adjusting grazing rotations, strategic water and mineral placement, or herding strategies. Planting high traffic areas with resilient vegetation may also be useful. Barbwire Russian thistle is also palatable when young, so adjusting grazing strategies to take advantage of thistle as forage may be useful.

Environmental Concerns

Barbwire Russian thistle is considered an invasive species and may be listed as Noxious in your area. Please consult the PLANTS Web site (http://plants.usda.gov/) and your state's Department of Natural Resources for this plant's current status prior to planting.

Barbwire Russian thistle is able to rapidly colonize harsh environments and disturbed landscapes at mid and low elevations below 6200 ft. (1900 m) throughout the southwestern United States. It is specifically a problem in sandy arid ecosystems. It is considered a rangeland pest and often out competes more palatable native vegetation and reduces forage for wildlife and livestock.

Barbwire Russian thistle is not an agricultural pest and is not known to contaminate agriculture fields or reduce crop yields. It is also not a host to the beet leafhopper that can infest *S. tragus*, thus transmission of the curly top virus to crops is typically not a problem (Beatley 1973). Since it does not disperse seeds through tumbling, it does not pose any of the human or infrastructure threats as described for *S. tragus* (Bernau and Eldredge 2018). However, dense populations may pose a risk for spreading wildfire and pollen production may cause hay fever issues in some individuals (Wodehouse 1945).

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read labels and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products which may be equally effective.

Biocontrol: As of yet, no biocontrol agent has been effective in controlling barbwire Russian thistle. Smith (2005) found that an Eriophyd mite (*Aceria salsolae)* could reduce barbwire Russian thistle size by 34-50% and has since concluded that the mite poses no significant risk to non-target plants in North America (Smith et al. 2009). In the 1970s, two moths, *Coleophora* *klimeschiella* and *C. parthenica*, were released as biocontrols specifically for *S. tragus*. They have since become naturalized in America, thriving on their target host, and likely utilize barbwire Russian thistle to some degree. They have been ineffective in controlling *S. tragus* or related species. Two fungal pathogens (*Colletotrichum gloeosporoides*; Bruckart et al. 2004, *Uromyces salsolae*; Hasan et al. 2001) are in development as potential biocontrols for *S. tragus*. If released, it is likely they will have some impact on barbwire Russian thistle.

Herbicide: There are a wide variety of herbicides effective at controlling barbwire Russian thistle (DiTomaso et al. 2013). Preemergence herbicides are best applied in late winter to early spring. Post emergence systemic and broad spectrum herbicides tend to be most effective for young seedlings to mature plants prior to flower. Non-selective herbicides may negatively impact non-target species, which may increase the potential for barbwire Russian thistle establishment and invasion. Barbwire Russian thistle will recolonize treated sites if those sites remain unoccupied by competing vegetation.

Herbicide resistance can develop if a chemical is overused. Herbicide resistant *Salsola spp.* populations have been reported for a wide variety of chemicals. However, due to *Salsola*'s taxonomic confusion in the literature, it is difficult to know if the resistant species is actually barbwire Russian thistle. There are several strategies for preventing and managing weed resistance (See Beckie 2006 and Beckie and Harker 2017). Please consult your local agricultural extension specialist or county weed specialist to learn what works best in your area, and always read and follow all herbicide labels.

Mechanical: Hand pulling is effective with small infestations. Mowing is not very effective as it tends to result in low growing plants that still produce seed. Mowing after seed set will spread the infestation.

Prescribed Fire: Prescribed fire is not an effective tool in controlling barbwire Russian thistle. Fire may aid in spreading and increasing barbwire Russian thistle since germination and survival is increased in disturbed sites.

Targeted Grazing: Targeted grazing may be a useful strategy in controlling barbwire Russian thistle. The plant is considered fair forage with adequate nutrition (Blaisdell and Holmgren 1984, Fowler and Hageman 1978). It is most palatable in early spring. Palatability returns after senescence when the sharp spines are softened by moisture. Heavy grazing prior to flowering may reduce seed production and decrease future thistle recruitment. Some caution is needed as barbwire Russian thistle has oxalates that may become toxic, especially for sheep, if eaten in abundance (Fowler and Hageman 1978). Nitrate poisoning, while rare, may also be an issue (Hageman et al. 1988).

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Individuals who are deaf, hard of hearing or have speech disabilities and you wish to file either an EEO or program complaint please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

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For any other information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, persons should either contact the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish or call the State Information/Hotline Numbers.
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