United States Department of Agriculture

Natural Resources Conservation Service | Plant Guide

Prickly Russian Thistle

Salsola tragus L.

Plant Symbol = SATR12

Common Names: Tumbleweed, Russian thistle, Tumbling thistle

Scientific Names: Salsola iberica (Sennen & Pau) Botsch. ex Czerep., *Salsola kali* L. ssp. *ruthenica* Soó, *Salsola kali* L. ssp. *tenuifolia* Moq., *Salsola kali* L. ssp. *tragus* (L.) Čelak., *Salsola pestifer* A. Nelson, *Salsola ruthenica* Iljin *nom. illeg.* (illegitimate name), *Kali tragus* (L.) Scop., *Kali soda* Moench *nom. illeg.*

Figure 1: Prickly Russian thistle measuring approximately three feet (0.9m) tall and five feet (1.5m) wide. May produce over 200,000 seeds. Photo C. Bernau, Great Basin Plant Materials Center (GBPMC).

Salsola australis R. Br. was considered a Prickly Russian thistle synonym until tests in the 2000's identified it as genetically distinct. (Ryan and Ayres 2000, Borger et al. 2008, Hrusa and Gaskin 2008, Ayres et al. 2009, Chinnock 2010).

Scientific names for Prickly Russian thistle are mired in confusion, with over 55 synonyms (Rilke 1999) and an uncertain number of misapplied names throughout the scientific literature (Mosyakin 1996). In 2007, Akhani et al. recommended splitting the polyphyletic genus *Salsola* into ten or more genera, confirming the opinions earlier expressed by Tzvelev (1993) and other authors. Akhani suggested *Kali tragus* for *S. tragus*, which saw some adoption until the Nomenclatural Committee voted to conserve *Salsola* at the 2017 XIX International Botanical Congress (Akhani et al. 2007, 2014; Mosyakin et al. 2014, 2017; Wilson 2017). The vote reverted *K. tragus* back to *S. tragus*.

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).

Prickly 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 southeastern Europe to Central Asia (probably also partly in northern Africa). It is an erect

Figure 2: Prickly Russian thistle is highly variable. These photos are flowering structures from three different plants found in the same location, all S. tragus. Stem venation color, bract and bracteoles length and coloration, and perianth size are some of the variation that exists. Photo C. Bernau, GBPMC.

(sometimes ascending or prostrate), rounded plant that can grow up to three feet (0.9 m) tall and six feet (1.8 m) in diameter (Fig 1). Its morphological characteristics are highly variable and may be expressed at any given location (Fig 2). Stems are opposite and many branched, often with red to purple longitudinal striations. Leaves are alternate, semi-succulent to succulent, 0.6-2 in (1.5-5 cm) long and 0.01-0.04 in (0.3-1 mm) thick, and end in a sharp spine. The plants are soft when immature, but as the plant matures it becomes stiff with sharp prickly spines. The root system consists of a taproot that can grow over 6 ft. (1.8 m) deep with extensive lateral roots over 5 ft. (1.5 m) long (Pan et al. 2001), though this may be stunted with competition (Boerboom 1995). Inflorescence is an open or somewhat condensed spike of a solitary flower or cluster of 2-3 flowers; clusters normally producing only a single developed fruit. Flowers are small, bisexual, with 3-5 stamens, 0.04-0.05 in (1.1-1.3 mm) long anthers, and a short style with 2 stigma branches. Flowers are subtended by a single 0.15-0.24 in (4-6 mm) long bract and two 0.09-0.20 in (2.5-5 mm) long slightly recurved bracteoles; all three rigid and sharply tipped (Fig 2, Fig 3). The undifferentiated perianth is five lobed, about 0.09-0.12 in (2.5-3 mm) long, and winged at midlength; typically with three well developed colorless translucent broad wings and two narrow wings. The upper half of the perianth becomes incurved over the fruit, sometimes forming a short and weak columnar beak. 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 (Welsh et al. 2003, Holmgren et al. 2012). Seed production is prolific but highly variable and dependent on plant size, with smaller plants producing seeds in the thousands and the largest plants capable of producing over 250,000 seeds (Dewey 1894, Young 1991).

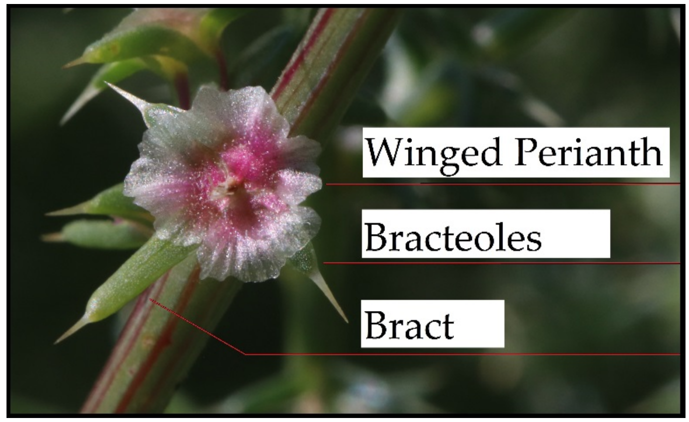

Figure 3: Prickly Russian thistle flower with Bract, Bracteoles, and Perianth labeled. Notice the upper half of the perianth in the center is incurved over the fruit, forming a short columnar beak. Photo C. Bernau, GBPMC.

Prickly Russian thistle typically matures in late summer to fall where, upon senescence, specialized abscission cells allow for a clean break at its base. The plant is then free to tumble in the wind to disperse seeds. The incurved tips of the persistent perianth prevent seeds from all dispersing immediately while the winged portion of the perianth assists in farther dispersal once the seed breaks away from the plant. Fresh seed germination is restricted by temperature, requiring a minimum day/night temperature of 68/41 °F (20/5 °C). Germination restrictions are relaxed over winter, allowing the seeds to germinate in virtually any soil temperature the following spring (Young 1991). Germination consists of the fully formed embryo simply uncoiling, and can be completed within minutes of contact with the proper temperature and as little precipitation as 0.1 in (0.25 mm; Young et al. 1995). 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 90% germinating in the first year and the remaining seeds typically surviving for less than two years (Boerboom 1995; Young et al. 1995).

Prickly Russian thistle readily hybridizes where sympatric with closely related species. Hybrids tend to show all variations of introgression. A hybrid between *S. tragus* and *S. australis,* identified as *S. ryanii*, is currently found only in California and is a fertile allohexaploid (n=54) with sterile offspring when backcrossed with the founding species (Hrusa and Gaskin 2008, Ayres et al. 2009, Mosyakin 2017). 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). The name *S. gobicola* Iljin was applied to hybrids of S. tragus and S. paulsenii (Rilke 1999).

Distribution: Prickly Russian thistle is an introduced species that can be found in every state in the USA except for Alaska and Florida. Its native range is from northern Africa east through Saudi Arabia, Pakistan, and Nepal and north into South-Eastern Ukraine, northeast China, and southeast Siberia (Rilke 1999). It has been introduced worldwide, most prominently in arid, semi-arid, and disturbed ecosystems in southern Africa, South America, and North America. Prickly Russian thistle is considered present in Australia by some sources, however, it has been determined that all herbarium records from western Australia are actually *S. australis,* and it is suspected that this is the case for all of Australia (Dr. Catherine Borger, personal communications, October 16, 2017).

Prickly Russian thistle was first introduced in the USA in the 1870s in Bonhomme County, South Dakota, in contaminated flax seed imported from Southwestern parts of the former Russian Empire (Ukraine or southwestern Russia; Dewey 1893, 1894). The wind tumbling seed dispersal mechanism meant that the seed could be spread for miles in a single season, with the newly completed transcontinental railroad moving it hundreds of miles. Within a few decades after introduction, it had spread nationwide in one of the fasted plant invasions in United State's history (Rilke 1999).

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site: https://plants.usda.gov/core/profile?symbol=SATR12

Habitat: Prickly Russian thistle is widely distributed and occurs in most habitats across the United States. It is highly adapted to arid and semi-arid ecosystems. It can be found in disturbed sites in ecosystems as varied as Salt Desert Scrub to Alpine (Howard 1992).

Adaptation

Prickly Russian thistle is a shade intolerant initial colonizer adapted to well drained soils in a wide variety of ecosystems. It is most prolific in arid to semi-arid ecosystems and can be found at elevations from below sea level to 8,500 ft. (0-2590 m). Prickly Russian thistle tends to be less adapted to arid ecosystems below 4,000 ft. (1219 m) than barbwire Russian thistle (*Salsola paulsenii;* Bernau 2018) and can be replaced by it in those areas (Evans and Young 1980). Prickly Russian thistle is adapted to alkaline and saline soils, which allows it to grow in areas that naturally have reduced vegetation. Prickly Russian thistle is a poor competitor and is often replaced by other vegetation after a few years of dominance. In most ecosystems, it relies on frequent disturbance to maintain its population.

Uses

Agriculture: Prickly 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 production in semi-arid and arid ecosystems (Fowler and Hageman 1978, Hageman et al. 1988). Prickly Russian thistle seeds are high in protein and fiber, and seed meal has been shown to increase weight gain in mice trials (Coxworth et al. 1969). Agricultural potential has not yet been realized as Prickly Russian thistle is considered a pest rather than a commodity crop. However, Prickly Russian thistle hay production during the American dustbowl is credited with saving the cattle industry throughout North America (Young 1991, Holmgren et al. 2012). Kansas alone produced 400,000 tons of thistle hay in 1934 (Cave et al. 1936). Currently there is a small niche commercial market selling Prickly Russian thistle as decorations, ornaments, craft material, movie props, and gag gifts.

Pollinators: Despite possessing small flowers, Prickly Russian thistle is a source of pollen for a wide variety of insects; such as bees, flies, moths, and butterflies (Fig 4). It is a larval host plant of the introduced Western Pygmy Blue, *Brephidium exilis*, which is the smallest butterfly in North America.

Figure 4: Prickly Russian thistle pollinators. Left-Right, Top-Bottom: Prickly Russian thistle flower with pollen laden anthers and spilled pollen on bract; Wasp (Crabronidae); European Honey Bee (Apis mellifera); Hover Fly (Syrphidae); Female Sweat Bee (Lasioglossum sp.); Pygmy Blue (Brephidium exilis), underwing view; Pygmy Blue, top-wing view; Male Sweat Bee (Lasioglossum sp.). Identified by Dr. Joseph Wilson (Utah State University) and Dr. Kevin Burls (University of Nevada Reno; Nevadabugs.org). Photo C. Bernau, GBPMC.

Wildlife: Prickly Russian thistle has value 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. The stems and leaves are eaten by bison, deer, elk, pronghorn, and prairie dogs. 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.

Human Use: Prickly Russian thistle is edible to humans. Young shoots and tips may be eaten raw or cooked like greens (Tull 2013). In his book, The Worst Hard Time, Timothy Egan documents the Lowerys, a family of five that sustained themselves largely on "canned tumbleweeds" during the American dustbowl. The county they lived in, Cimarron County, Oklahoma, "declared a Russian thistle Week, with county officials urging people who were on relief to get out to fields and help folks harvest tumbleweeds." (Egan 2006: pg. 162). Prickly Russian thistle contains small amounts of oxalates, which may cause oxalate poisoning if eaten in abundance. Be absolutely certain of a plant's identity and latest binomial nomenclature prior to consumption.

Landscape Restoration: While Prickly Russian thistle is often an invasive species that can negatively impact rangeland and agricultural landscapes, in some cases it may have value in landscape restoration. That restoration value tends to depend on the presence of mycorrhizal fungi in the soil. Prickly Russian thistle does not form associations with mycorrhizal fungi. Rather, it is infected by the fungi and often killed by it. This fungal food source increases the population of mycorrhizal fungi, allowing it to infect more thistle roots and continue increasing in population. Eventually mycorrhizal associating vegetation will colonize the area in the next stage of plant succession. The increased mycorrhizal fungi population can facilitate the transition and accelerate the rate of re-vegetation (Allen and Allen 1988, Howard 1992, Johnson 1998). In addition, Prickly Russian thistle may act as a nurse plant for native vegetation and protect small plants from grazing. This may be particularly useful in highly degraded landscapes.

Livestock: Prickly Russian thistle can provide forage for cattle, horses, and sheep. The nutritional value of this forage is considered fair when young and is higher once the plant has dried. It is a high source of vitamin A and phosphorous (Howard 1992). It is most palatable in spring when young or in winter when the dead spines are softened by moisture. In some locations, it is viewed as security for livestock when more palatable options are not available. During the dust bowl, Prickly Russian thistle was hayed for cattle feed, as it was one of the few plants that was abundantly available (Cave et al. 1936). Welsh et al.'s 2003, A Utah Flora, describes the plant as poisonous due to oxalates, however, several other sources say it is nutritious and palatable (Dewey 1894, Blaisdell and Holmgren 1984, Howard 1992, Mosyakin 2003, Holmgren et al. 2012). 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. around New Mexico and found 6 collections to have potentially toxic levels (>2%) of nitrate.

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 and potassium 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 *Salsola sativus* (syn. *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:

This plant 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, Department of

Natural Resources, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines

Prickly Russian thistle can be planted in late fall or early spring. Optimal temperature for germination is 44-50 °F (6.7-10°C), but it can germinate in virtually any temperature once it overwinters. Prickly Russian thistle should be planted in a weed free bed as it is a poor competitor and shade intolerant. Planting depths is optimal less than 1 in (2.5 cm) and should be no deeper than 3 in (7.5 cm; Young et al. 1995). Broadcast seeding can be effective, however, 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

Prickly Russian thistle management has typically focused on control and eradication for both rangeland and agricultural settings. For both, minimizing disturbance and providing for competing vegetation tends to be an effective strategy. Prickly Russian thistle is shade intolerant and a poor competitor that takes advantage of disturbed sites for growth. If competing vegetation is established and maintained, and disturbance is minimized, then thistle populations may start to decline. In rangelands 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. Prickly Russian thistle is also palatable when young, so adjusting grazing strategies to take advantage of thistle as forage may be useful.

Minimizing disturbance may be difficult in an agricultural setting where disturbance may be necessary. Planting competing vegetation in field margins and unused acres may reduce Prickly Russian thistle pressure and reduce on-site recruitment from off-site seed sources. Infested fields can be treated by herbicide or carefully timed tilling, though no-till strategies may be worth considering.

Environmental Concerns

Prickly 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.

Prickly Russian thistle is able to rapidly colonize harsh environments and disturbed landscapes throughout the United States. It is specifically a problem in arid and semi-arid ecosystems. The tumbling seed dispersal mechanism can spread seed for miles, which makes controlling seed sources difficult. Herbicide may be effective in controlling Prickly Russian thistle, but chemical resistance has been documented.

Prickly Russian thistle is an agricultural pest. It infests fields, reducing crop yields, and it can harbor harmful crop pests. One such pest is the curly top virus, which is transmitted to adjacent vegetation via infected leafhoppers. This virus negatively impacts crops such as sugar beets and tomatoes. In addition, the dead tumbleweeds damage infrastructure such as blocking fences and clogging irrigation ditches and canals (Fig 5).

Figure 5: Infrastructure damage from Prickly Russian thistle. Left: Prickly Russian thistle choking an irrigation canal with debris stacked 3ft (0.9m) high and far into the distance. Right: Prickly Russian thistle piled against a fence for the entire length of the fence. Photo C. Bernau, GBPMC

Prickly Russian thistle is a problem for human safety. As the dead plants tumble they become flying road debris, annually causing several car accidents nationwide. A 2014 outbreak in Colorado became such a nuisance, with clogged roads and buried houses, that two counties declared a state of emergency. The dead tumbleweeds are highly flammable and threaten structures that they rest against (Fig 6). Burning tumbleweeds are particularly problematic as they can bounce over fire lines and escape containment. Prickly Russian thistle pollen negatively impacts human health, with breathing issues and hay fever 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 Prickly Russian thistle. In the 1970s, two moths, *Coleophora klimeschiella* and *C. parthenica*, were released as biocontrols. They have since become naturalized in America, thriving on the Prickly Russian thistle host, but they have been ineffective in controlling it. There are currently an Eriophyd mite (*Aceria salsolae*; Smith 2005, Smith et al. 2009) and two fungal pathogens (*Colletotrichum gloeosporoides*; Bruckart et al. 2004, *Uromyces salsolae*; Hasan et al. 2001) in development as potential biocontrols.

Figure 6: Home in Victorville, California (April 2018), buried by Prickly Russian thistle. This is a nuisance to home owners as well as a significant fire hazard. Photo by James Quigg with the Victor Valley Daily Press.

Herbicide: There are a wide variety of herbicides that have been effective at controlling Prickly 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 Prickly Russian thistle establishment and invasion. Prickly Russian thistle is a prolific initial colonizer. It will recolonize treated sites if those sites remain unoccupied by competing vegetation.

Herbicide resistance can develop if a chemical is overused. Herbicide resistant Prickly Russian thistle 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 reported resistant species is actually *Salsola tragus*. Glyphosate and sulfonylurea resistance has been reported for Prickly Russian thistle in the Pacific Northwest (DiTomaso 2013, Spring 2017), Canadian prairie provinces reported resistance to sulfonylurea and imidazolinone (Morrison and Devine 1994), and resistance to triazines is suspected (DiTomaso 2013). 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 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 Prickly Russian thistle. Fire may aid in spreading and increasing Prickly Russian thistle since germination and survival is increased in disturbed sites and it readily colonizes those disturbed sites from off-site sources. Prickly Russian thistle is also a fire hazard, with highly flammable standing dead plants and plants piled on fences, against buildings, and in gullies. There is also the risk of ignited plants tumbling over fire lines, preventing wildfire containment.

Soil health: Prickly Russian thistle does not form mycorrhizal associations with any fungi. Instead, mycorrhizal fungi invade the Prickly Russian thistle's roots causing reduced growth and eventual death. In disturbed landscapes with depleted top soil there is a dearth of mycorrhizal fungi. Strategies that reduce disturbance and improve soil health may work to increase mycorrhizal fungi and thus reduce Prickly Russian thistle populations. In an agricultural system these strategies may include reduced-till or no-till, cover crops, and/or soil amendments that include mycorrhizal fungi.

Targeted Grazing: Targeted grazing may be a useful strategy in controlling Prickly Russian thistle. The plant is considered fair forage with adequate nutrition (Dewey 1894, Blaisdell and Holmgren 1984, Howard 1992, Mosyakin 2003, Holmgren et al. 2012). It is most palatable in early spring before sharp spines form upon flowering. 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 Prickly Russian thistle has oxalates that may become toxic, especially for sheep, if eaten in abundance (Boerboom 1995, Welsh et al. 2003). Nitrate poisoning, while rare, may also be an issue (Hageman et al. 1988).

Tillage: Tillage can be an effective control since the seeds have almost no soil dormancy and typically do not survive or emerge from depths greater than 3 in. This would need to be repeated annually until the seed bank is depleted (<2 years). For best results, delay spring tilling until after the initial flush of Prickly Russian thistle seedlings. Tillage also disturbs the soil, which makes the area more susceptible to reinvasion. It may be necessary to follow up tillage with additional plantings to prevent reinvasion.

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Citation

Bernau, C.R. and E.P. Eldredge. 2018. Plant Guide for Prickly Russian Thistle (*Salsola tragus* L.). USDA-Natural Resource Conservation Service, Great Basin Plant Materials Center. Fallon, Nevada 89406.

Published April 2018

Edited:

11April2018 Reviewers included Dr. Sergei L. Mosyakin, Director of the M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine and President of the Ukrainian Botanical Society; Dr. John F. Gaskin, PMRU Research Leader and Research Biologist at USDA-ARS; and Dr. Margaret Smither-Kopperl, Dr. Ramona Gardener, Derek Tilley, Deb Koziol, and Patti Novak-Echenique at USDA-NRCS.

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