SDSU Extension

iGrow Soybean

BEST MANAGEMENT PRACTICES

# Chapter 31:
# Common Broadleaf Weeds of South Dakota

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The effective management of broadleaf weeds can improve soybean yields. The purpose of this chapter is to discuss the biology and management of broadleaf weeds routinely found in South Dakota soybean fields. Characteristics of selected broadleaf weeds are in Table 31.1.

### Annual weeds

Weeds can be characterized by their life cycle. Annual weeds are those that germinate from seed every year and only live for a single season. Annual weeds can germinate during the spring, summer, or fall. Fall or very early spring-emerging weeds include field pennycress, horseweed (marestail), and evening primrose. Weeds that emerge in early to late spring (weeks prior to soybean planting) include common sunflower, Pennsylvania smartweed, ladysthumb, common lambsquarters, and giant ragweed. Weeds that typically emerge at or soon after soybean planting are common ragweed, velvetleaf, Russian thistle, redroot pigweed, and kochia. Annual weeds that emerge at the end of soybean planting include common cocklebur, wild mustard, black nightshade, venice mallow, and wild buckwheat. Weeds that typically emerge after soybean emergence include common waterhemp and buffalobur.

### Biennial weeds

These plants germinate from seed in the spring and overwinter as a rosette. The second year, the plant produces flowers and seeds. Examples of biennial weeds are biennial wormwood and common mallow.

### Perennial weeds

These plants can germinate from seed, and/or may produce new shoots from buds, roots, or rhizomes. The shoots from the buds can emerge very early and grow quickly due to the carbohydrate storage in the perennating structures. Perennials are often found and flourish in no-till systems. Examples of perennial weeds are Canada thistle, field bindweed, hedge bindweed, dandelion, volunteer elm tree, perennial sowthistle, and Jerusalem artichoke.

**Table 31.1. Characteristics of selected weeds.** Information on Weed Science Society of American (WSSA) herbicide groups is available at http://www.wssa.net/Weeds/Resistance/WSSA-Mechanism-of-Action.pdf.

| Weed Emergence | Weeds | Yield Loss | Notes |
|---|---|---|---|
| May overwinter from fall | Field pennycress | Low | May be a host to soybean cyst nematode. |
| May overwinter from fall | Horseweed | High | Resistant to WSSA Group 9 (glyphosate). |
| May overwinter from fall | Evening primrose | Low | No herbicde resistance reported. |
| Overwinter to late season emergence | Common mallow | Not reported | No resistance reported. |
| Early spring | Common sunflower | High | Resistant to WSSA Group 2 (ALS inhibitors). |
| Early spring | Smartweed | Moderate | Resistant to WSSA Group 5 (photosystem II inhibitors). |
| Early spring | Common lambsquarter | High | Resistance to WSSA Group 2 (ALS inhibitors) and 5 (photosystem II inhibitors). |
| Early spring | Giant ragweed | High | Resitant to WSSA Group 2 (ALS inhibitors) and 9 (glyphosate). |
| Early spring | Russian thistle | High | Resistant to WSSA Group 2 (ALS inhibitors). |
| Early spring | Canada thistle | High | Resistant to WSSA Group 4 (auxin type). |
| Early spring | Hedge bindweed | Low to moderate | No resistance reported. |
| Early spring | Dandelion | Low | No resistance reported. |
| Early spring | Volunteer elm | Not reported | No resistance reported. |
| Early spring | Perennial sowthistle | Not reported | No resistance reported. |
| Early spring | Jerusalem artichoke | High | No resistance reported. |
| Early spring | Kochia | High | Resistance to WSSA Group 2 (ALS inhibitors), 5 (photosystem II inhibitors), 9 (glyphosate), and 4 (auxin type). |
| Early spring to mid-summer | Wild buckwheat | Low to moderate | Tolerance to WSSA Group 9 (glyphosate) and 4 (auxin type). |
| Mid-spring | Common ragweed | Moderate to high | Resistance to WSSA Group 2 (ALS inhibitors). |
| Mid-spring | Velvetleaf | Moderate | Resistance to WSSA Group 5 (Photosystem II inhibitors). |
| Mid-spring | Redroot pigweed | High | Resistance to WSSA Group 5 (photosystem II inhibitors) and 2 (ALS inhibitors). |
| Mid-spring | Field bindweed | High | Tolerance to WSSA Group 9 (glyphosate). |
| Mid-spring to early summer | Common cocklebur | High | Resistance to WSSA Group 2 (ALS inhibitors). |
| Early summer | Wild mustard | High | No resistance reported. |
| Early summer | Black nightshade | High | Resistance to WSSA Groups 2 (ALS inhibitors), 5 (photosystem II inhibitors), and 22 (photosystem I inhibitors). |
| Early to mid-summer | Venice mallow | Low | Resistance not reported. |
| Early to mid-summer | Common waterhemp | Moderate to high | Resistance to WSSA Groups 2 (ALS inhibitors), 5 (photosystem II inhibitors), 9 (glyphosate), and 14 (PPO inhibitors). |
| Mid-summer | Buffalobur | Low to moderate | No resistance reported. |

***Field pennycress (Thlaspi arvense)***

**Time of emergence:** May overwinter as a rosette and bolt in the spring or emerge in the spring very early before, or just at planting.

**Life cycle and reproduction:** This annual plant reproduces from seed.

**Distinguishing characteristics:** Young plant is a rosette (like a dandelion). Older plants bolt and develop a flower stalk. Flower stalks have many branches. The flowers are very small and are generally white. Fruit is a silicle, broad and elliptical, and look like a "penny."

**Areas of infestation:** Found in roadsides and fields.

**Yield loss potential:** Historically, seldom dense enough to warrant control. However, this plant was shown to be a moderate alternate host to soybean cyst nematode (SCN) in Ohio studies (Venkatesh et al., 2000), so control is warranted. In the future, higher densities may become a problem as field pennycress is being examined as an alternative oil seed crop.

**Effective management:** Control in late fall or as the overwintering population prior to soybean planting. ALS inhibitor (WSSA Group 2) (if not resistant) herbicides provide good to excellent control and may be used in combination with glyphosate (WSSA Group 9) in the fall or as a burndown prior to planting. In the cases where resistant biotypes may be a problem, the use of tillage, crop rotation, and post emergence cultivation may be required.

**Herbicide resistance:** ALS-resistant biotypes have been reported in Canada.

**Figure 31.1. Field pennycress seedling, rosette, and mature plant.** (Photos courtesy of Michael Moechnig, SDSU)

***Horseweed (Conzya canadensis)***
**Time of emergence:** May overwinter as a rosette and bolt in the spring or emerge in the spring very early before, or just at planting.

**Life cycle and reproduction:** This annual weed reproduces by seed.

**Distinguishing characteristics:** The plant has numerous linear, hairy (although some are plants are without hair) leaves crowded on the stem. The flowers are very small and are generally white.

**Areas of infestation:** Tolerates drought conditions well.

**Yield loss potential:** Historically, seldom dense enough to warrant control. With resistant biotypes (seen in South Dakota, Indiana, Nebraska, and Ohio), the problems with this weed have become worse in recent years. High densities in soybean have had >80% yield loss.

**Effective management:** Control overwintering population in the spring prior to planting. PPO inhibitor (WSSA Group 14) and ALS inhibitor (WSSA Group 2) (if not resistant) herbicides provide good to excellent control. In the cases where resistant biotypes may be a problem the use of tillage, crop rotation, and post emergence cultivation may be needed.

**Herbicide resistance:** This weed typically has been sparse in fields. In South Dakota, biotypes of glyphosate (WSSA Group 9) resistant horseweed have been documented. However, biotypes in neighboring states have been documented that are resistant to other herbicides including photosystem II inhibitors (WSSA Group 5, metribuzin), glyphosate (WSSA Group 9), ALS inhibitors (WSSA Group 2), and paraquat (WSSA Group 22). These biotypes and their quick spreading nature make this weed very problematic.

**Figure 31.2. Horseweed seedlings, young plants, and mature plant.** (Photos, Michael Moechnig, SDSU)

***Evening primrose (Oenothera sp.)***
**Time of emergence:** May overwinter as a rosette and bolt in the spring or emerge in the spring very early before, or just at, planting.

**Life cycle and reproduction:** Winter annual, or early spring emergence. The plant reproduces by seed.

**Distinguishing characteristics:** There are 20 species of primrose in the Great Plains. The plants that emerge in the fall overwinter as a rosette. Leaves are lance-like to oblong and are hairy. The plant has numerous linear, hairy (although some are plants are without hair) leaves on the stem. The flowers are yellow to reddish yellow. The fruit is a cylindrical capsule tapering at the tip.

**Areas of infestation:** Often found in reduced tillage systems. Tolerates drought conditions and sandy soil types. This plant is being explored as an alternative oil seed crop.

**Yield loss potential:** Historically, this plant is not dense enough to warrant control.

**Effective management:** Control overwintering rosette population prior to planting. Many studies suggest glyphosate + 2,4-D as a preplant burndown application if this weed is a problem. Use other control methods such as tillage, crop rotation, and post-emergence cultivation for management.

**Herbicide resistance:** No herbicide resistance reported at this time; however, the plant may be difficult to control with typical soybean herbicides.

**Figure 31.3. Evening primrose rosette, flower, and seed capsule.** (Photos, Michael Moechnig, SDSU)

***Common mallow (or Roundleaf mallow) (Malva neglecta)***

**Time of emergence:** This plant reproduces from seeds and can behave as an annual, winter annual, or under warmer conditions as a biennial, or short-lived perennial. Seedlings emerge in several flushes throughout the season.

**Life cycle and reproduction:** This plant reproduces by seed. However, if the winter is mild or if the site is protected, the plant may be longer lived and survive more than one season.

**Distinguishing characteristics:** The first true leaves of seedlings are round. The leaves, which are hairy, are alternate and oval to kidney-shaped with wavy, lobed edges. The plant is prostrate to the ground, but may grow taller than 1.5 feet. It may also be vine-like and spreading. Fruit is disk-shaped and flattened with a cheesewheel appearance.

**Areas of infestation:** Rare in cultivated fields although heavy infestations may occur. Deep, taprooted plant that can survive drought and cold temperatures.

**Yield loss potential:** Soybean yield reduction has not been assessed. However, when present the plant can cause problems in cutter bars at harvest due to the vining characteristic of the plant.

**Figure 31.4. Common mallow solitary plant and plants in a soybean infestation.** (Top: photo, Michael Moechnig, SDSU); bottom: Plant Pathology, Physiology, and Weed Science, Virginia Tech at http://www.ppws.vt.edu)

**Effective management:** Common mallow can be controlled preplant with 2,4-D; however, soybean planting must be delayed by at least seven days. Pre-emergent herbicides containing PPO inhibitors (WSSA Group 14) are recommended for control. Post-harvest control with PPO inhibitors (WSSA Group 14) + glyphosate (WSSA Group 9) was an effective combination in NDSU trials, whereas glyphosate alone was not. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** No resistant biotypes of this plant have been reported at this time.

***Common sunflower (Helianthus annuus)***
**Time of emergence:** Typically early; weeks before soybean planting.

**Life cycle and reproduction:** This annual weed reproduces by seed.

**Distinguishing characteristics:** The cotyledon is oval to spatulate in shape. The leaves are alternate with toothed margins. As the plant matures, the stem, which is covered with stiff hairs, becomes many branched and has characteristic yellow flowers.

**Areas of infestation:** Typically occurs in drier areas of South Dakota, although some infestations may be found in wetlands.

**Yield loss potential:** One of the most highly competitive plants with soybean (often ranked #1 in competitive ability) with up to 70% yield reductions even at relatively low densities.

**Effective management:** In SDSU trials, pre-emergent herbicides are rated only as fair to good for control. Many post-emergent ALS inhibitor (WSSA Group 2) herbicides are rated as providing excellent control of common sunflower (if not resistant, see below). Glyphosate (WSSA Group 9) and glufosinate (WSSA Group 10) also give excellent control, if the appropriate GMO soybean type is planted. Tillage, crop rotation, and post-emergence cultivation should also be considered as management tools to reduce stand numbers.

**Herbicide resistance:** Common sunflower biotypes have been reported to be resistant to ALS inhibitor (WSSA Group 2) herbicides in neighboring states.

**Figure 31.5. Common sunflower seedling and mature plant with flowers.** (Photos, Michael Moechnig, SDSU)

***Smartweed sp. (Pennsylvania smartweed and Ladysthumb) (Polygonum sp.)***
**Time of emergence:** Typically early; weeks before soybean planting.

**Life cycle and reproduction:** This native annual plant reproduces by seed.

**Distinguishing characteristics:** The cotyledon is linear to oar-shaped. The leaves are alternate in arrangement with the leaf surface smooth to slightly hairy. Nodes on the stem are swollen (jointed) stem with a papery sheath at each node (ochrea). Flowers are pink and the inflorescence type is a raceme.

**Areas of infestation:** Typically occurs in wetter areas of South Dakota fields.

**Yield loss potential:** Moderate loss (~15%) at higher densities.

**Effective management:** In SDSU trials, pre-emergent herbicides in the ALS inhibitor (WSSA Group 2); photosystem II inhibitor (WSSA Group 5); and PPO inhibitor (WSSA Group 14) groups have been rated as good for control. Many post-emergent ALS inhibitor (WSSA Group 2) herbicides are rated as good and Basagran® (bentazon) (WSSA Group 6) is rated as providing excellent control of smartweed sp. Glyphosate (WSSA Group 9) and glufosinate (WSSA Group 10) also provide good control if the appropriate GMO soybean type is planted. Tillage, crop rotation, and post-emergence cultivation should also be considered as management tools to reduce stand numbers.

**Herbicide resistance:** Smartweed biotypes have been reported to be resistant to photosystem II inhibitor herbicides (WSSA Group 5) in neighboring states.

**Figure 31.6. Smartweed seedling, young ladysthumb plant (note purple coloration about midleaf), ochrea (papery sheath located at the nodes), and raceme inflorescence with pinkish flowers.** (Photos, Michael Moechnig, SDSU)

*Common lambsquarters (Chenopodium album)*
**Time of emergence:** The first flush typically emerges early, usually before soybean planting; however, several flushes of lambsquarters can occur with emergence continuing through early summer.

**Life cycle and reproduction:** This annual weed reproduces by seed.

**Distinguishing characteristics:** Emerging plants are very small. Leaves are opposite and covered with a mealy powder, especially on the underside. The stems are erect, may have green or red stripes, and can grow to almost 6 feet tall under certain conditions. The flowers are nonshowy and without petals.

**Areas of infestation:** Found in disturbed sites

**Yield loss potential:** Up to 40% soybean yield reductions reported at densities of 0.5 plants/ft$^2$ if early emerging plants are left uncontrolled.

**Effective management:** Pre-emergent broadleaf herbicides—including PPO inhibitors (WSSA Group 14) and ALS inhibitors (WSSA Group 2)—provide good control in SDSU trials. Post-emergent herbicides work best on very young plants although most give no greater than "good" control. Herbicides used on GMO soybeans also provide no better than "good" control. This weed is very difficult to control after the 6" stage of growth. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** Biotypes of this plant have been reported to be resistant to ALS inhibitors (WSSA Group 2) and photosystem II inhibitors (WSSA Group 5). Reduced sensitivity to glyphosate (WSSA Group 9) has been reported in some populations.

**Figure 31.7. Common lambsquarters seedling and young plants.** Note the range in plant size distribution on a single sampling date. (Photos, Michael Moechnig, SDSU)

*Giant ragweed (Ambrosia trifida)*
**Time of emergence:** The first flush typically emerges early, usually before soybean planting; if weather turns warm, usually germination ends.

**Life cycle and reproduction:** This annual weed reproduces by seeds.

**Distinguishing characteristics:** Cotyledons are spatulate (spoon-shaped). Leaves are opposite and divided into three to five lobes. The stems are erect, branched, and can grow to almost six feet tall under certain conditions. The flowers are nonshowy and without petals.

**Areas of infestation:** Typically found at disturbed sites that have moist soil.

**Yield loss potential:** Up to 40% soybean yield reductions reported at densities of 0.5 plants/ft$^2$ if early emerging plants are left uncontrolled.

**Effective management:** Pre-emergent broadleaf herbicides—including PPO inhibitors (WSSA Group 14) and ALS inhibitors (WSSA Group 2)—provide good control in SDSU trials. Post-emergent herbicides in these groups also give fair to excellent control. Glyphosate (WSSA Group 9) gives excellent control if resistance is not a problem. Overuse of the same chemical should be avoided to maintain the effectiveness of the herbicide. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** Biotypes of this plant have been reported to be resistant to ALS inhibitors (WSSA Group 2) in many states, and glyphosate (WSSA Group 9) has been reported in some populations in Minnesota, Iowa, and Nebraska. Biotypes resistant to both ALS and glyphosate have also been reported.

**Figure 31.8. Giant ragweed seedling, young plant, and mature plant.** (Photos, Michael Moechnig, SDSU)

***Russian thistle (Salsola iberica)***

**Time of emergence:** Typically emerges early, before soybean planting.

**Life cycle and reproduction:** This annual weed reproduces by seeds.

**Distinguishing characteristics:** Seedlings have threadlike leaves and resemble a small pine tree. Leaves of older plants become spine-like with the leaf surface from smooth to hairy. The plant has small, nonshowy flowers. The entire plant breaks off at the base and disperses seed as it tumbles in the wind (plant also known as tumbleweed).

**Areas of infestation:** Russian thistle flourishes on dry sites. It is very drought and salt tolerant.

**Yield loss potential:** Up to 60% soybean yield reductions reported depending on density.

**Effective management:** Pre-emergent herbicides give excellent control. Post-emergent herbicides work best on very young plants; however, little or no control is achieved after the plant becomes spiny. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** Biotypes have been reported to be resistant to ALS inhibitor (WSSA Group 2) herbicides.

**Figure 31.9. Russian thistle seedling and mature plant.** (Photos, Michael Moechnig, SDSU)

*Canada thistle (Cirsium arvense)*
**Time of emergence:** Root buds can produce seedlings that typically emerge before soybean planting. Seedlings can be found later as the soil warms.

**Life cycle and reproduction:** Perennial plant with a deep extensive root system. Infestations are spread through root pieces, although seedlings often are found in fields. Canada thistle is a noxious weed in South Dakota.

**Distinguishing characteristics:** Emerging plants from seed are very small. The stems are erect, ridged surfaces, stems are hollow. Leaves are alternate and margins have short spines. Under certain conditions, the height of Canada thistle can exceed four feet. The plants have imperfect flowers, with male and female colonies. Flower color is white to purple.

**Areas of infestation:** Typically found at disturbed sites.

**Yield loss potential:** Up to 40% soybean yield reductions reported depending on density.

**Effective management:** Herbicides can control seedlings, but older plants should be treated with herbicide when plants are in the bud stage or in the fall after the first frost. Roundup Ready®soybean has helped in controlling this weed even in areas with previously high densities.

**Herbicide resistance:** Biotypes of Canada thistle in Europe have been reported to be resistant to auxin-type growth regulator (WSSA Group 4) herbicides.

**Figure 31.10. Canada thistle seedling and young plants from rhizomes.** (Photos, Michael Moechnig, SDSU)

*Hedge bindweed (Calystegia sepium)*
**Time of emergence:** Typically emerges early, before soybean planting.

**Life cycle and reproduction:** This perennial vine-type plant reproduces by seeds and rhizomes.

**Distinguishing characteristics:** Seedlings have kidney-shaped cotyledons and the leaves have a long petiole and pointed tip. The flowers are large, funnel-shaped, and are white to pink in color.

**Areas of infestation:** Often found at disturbed sites.

**Figure 31.11. Hedge bindweed seedling, plant as it begins to vine, and leaves and flowers.** (Photos courtesy of http://www.forestryimages.org/images/192x128/1552284.jpg,The Weed Science Society of America)

**Yield loss potential:** This plant is not as aggressive as field bindweed. However, it can cause problems during harvest.

**Effective management:** Prevention and cultural control should be implemented in addition to chemical management. PPO inhibitor-type herbicides (WSSA Group 14) and Basagran® (bentazon) (WSSA Group 6) have been reported to burn down vines during early growth. The addition of 2,4-DB has been reported to enhance herbicidal activity. High temperatures, high humidity, and good soil moisture help with control. Spot spray after harvest and if regrowth occurs.

**Herbicide resistance:** To date, herbicide resistance has not been reported.

***Dandelion (Taraxacum officinale)***
**Time of emergence:** Typically emerges early, before soybean planting. Seeds can germinate throughout the season if moisture is adequate.

**Life cycle and reproduction:** Perennial reproducing by seeds and regrowing from tap roots.

**Distinguishing characteristics:** Basal rosette with long, lanceolate-lobed leaves. Milky juice throughout the plant. Bright yellow inflorescence arranged in heads.

**Areas of infestation:** Most problematic in no-till and minimum till fields.

**Yield loss potential:** This plant is not as aggressive as other perennials due to its low-growing rosettes.

**Effective management:** Prevention and cultural control should be implemented in addition to chemical management. Preplant burndown treatments with glyphosate (WSSA Group 9) or combinations of paraquat (WSSA Group 22) with photosystem II inhibitors (WSSA Group 5) could be used. 2,4-D + paraquat as a preplant burndown has provided excellent control. If 2,4-D is used, soybean planting must be delayed by at least seven days. Post-harvest herbicide applications should be considered for long-term control.

**Herbicide resistance:** To date, herbicide resistance has not been reported.

**Figure 31.12. Photos of dandelions, seedling and plant with flower.** (Photos, Michael Moechnig, SDSU)

***Volunteer elm (Ulmus sp.)***

**Time of emergence:** Typically emerges early, before soybean planting. Seeds can germinate throughout the season if moisture is adequate.

**Life cycle and reproduction:** This perennial reproduces by seeds and regrowth from sprouting perennial tissues.

**Distinguishing characteristics:** Leaves alternate and toothed with serrated margins. Dark green upper leaf surface; pale green lower surface. Twigs are flexible. Extensive shallow root system when young.

**Areas of infestation:** Because it may escape from roadside areas, it often invades fields from the edges. This weed is most problematic in no-till and minimum-till fields and it can grow quite rapidly if undisturbed.

**Yield loss potential:** This plant is not as aggressive as other perennials and little research has been done to examine harvest losses.

**Effective management:** Prevention and cultural control should be implemented in addition to chemical management. There is little information from any University trials on control in soybean. However, preplant burndown treatments with glyphosate (WSSA Group 9) or combinations of paraquat (WSSA Group 22) with photosystem II inhibitors (WSSA Group 5) may be tried along with 2,4-D + paraquat; however, if 2,4-D is used soybean planting must be delayed by at least seven days

**Herbicide resistance:** To date herbicide resistance has not been reported.

**Figure 31.13. Image of volunteer elm.** (Photo, Michael Moechnig, SDSU)

***Perennial sowthistle (Sonchus arvensis)***

**Time of emergence:** Typically emerges early from rhizomes. Young plants can start from creeping roots almost any time during the year. Seeds can germinate throughout the season if moisture is adequate.

**Life cycle and reproduction:** This perennial reproduces from seeds and regrowth from tap and creeping roots. Perennial sowthistle is a noxious weed in South Dakota.

**Distinguishing characteristics:** This plant has a dandelion-like rosette and it bolts to produce a flower stalk. It has a smooth stem, milky juice, and whitish coating on the leaf surface. It has long, lobed leaves with spiny edges and a yellow flower that is dandelion-like.

**Areas of infestation:** It commonly escapes from roadside areas to the field boundaries. It is most problematic in no-till and minimum-till fields.

**Yield loss potential:** This plant can form dense colonies; however, little research has been done to examine harvest losses.

**Effective management:** Prevention and cultural control should be implemented in addition to chemical management. Preplant or pre-emergence applications with ALS inhibitor (WSSA Group 2) provides fair to good control. ALS inhibitors when applied in the early to mid-rosette stage provide suppression to fair control. GMO glyphosate-resistant soybean could be treated with glyphosate to provide suppression.

**Herbicide resistance:** To date, herbicide resistance has not been reported in perennial sowthistle, but other species of sowthistle have been reported to be ALS inhibitor (WSSA Group 2) resistant.

**Figure 31.14. Clockwise from top left: Perennial sowthistle rosettes, plant with flowers and seeds, leaf base near the stem, asexual reproduction by producing satellite plants from rhizome growth, and control of plant using Classic® herbicide.** (Photos courtesy of www.courses.missouristate.edu; Weed Science Society of America; ag.ndsu.nodak.edu; minidoka.id.us; and omafra.gov.on.ca)

***Jerusalem artichoke (Helianthus tuberosus)***
**Time of emergence:** Typically emerges early from tubers with many plants appearing in a small area.

**Life cycle and reproduction:** This perennial reproduces by seed, tubers, and rhizomes.

**Distinguishing characteristics:** Jerusalem artichoke has a sunflower-like rosette appearance, leaves that are opposite, and yellow ray and pale yellow disk flowers. This plant's height can exceed ten feet.

**Areas of infestation:** Typically found in wet soils in fields that use no-tillage or minimum tillage.

**Yield loss potential:** This plant is can be extremely aggressive due to its tall stature. Yield losses of almost 100% have been reported in oat and corn crops.

**Effective management:** Prevention and cultural control should be implemented in addition to chemical management. Suppression can be achieved with glyphosate (WSSA Group 9) in glyphosate-resistant soybean, although two or more applications are needed. ALS inhibitor herbicides post-applied may also give suppression. Split applications of ALS herbicides provide better control than a single application. Make applications when the plant is less than eight inches tall and has fewer than eight leaves. If a second application is applied, apply 14 to 21 days later.

**Herbicide resistance:** To date herbicide resistance has not been reported in Jerusalem artichoke.

**Figure 31.15. Jerusalem artichoke seedlings and mature plants.** (Photos courtesy of Weed Science Society of America and floridata.com)

***Kochia (Kochia scoparia)***
**Time of emergence:** Typically emerges very early, before soybean planting.

**Life cycle and reproduction:** This annual weed reproduces from seeds.

**Distinguishing characteristics:** Seedlings can be very small with over 1000 present in a 1 $ft^2$ area. Leaf margins are fringed with hair, whereas the leaf surfaces range from being without hair to being highly pubescent. Wind-blown plants will disburse seed in the fall.

**Areas of infestation:** Kochia is generally found in disturbed sites.

**Yield loss potential:** Up to 40% soybean yield reductions have been seen in South Dakota trials depending on density and time of emergence.

**Effective management:** Pre-emergent broadleaf herbicides often give season-long control. Post-emergent herbicides work best on very young plants. Plants are difficult to control after the 6" stage of growth. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** Biotypes of kochia have been found to be resistant to many herbicide types including ALS inhibitors (WSSA Group 2) in South Dakota; glyphosate (WSSA Group 9); auxin-type growth regulators (WSSA Group 4); and photosystem II inhibitors (WSSA Group 5).

**Figure 31.16. Kochia seedling and older plants.** (Photos 1 and 3 courtesy of PNW weed book; Photo 2 courtesy of Weed Science Society of America)

***Wild buckwheat (Polygonum convolvulus)***

**Time of emergence:** Typically early, before planting or just at planting. Late flushes may occur depending on soil temperature and moisture conditions.

**Life cycle and reproduction:** This annual weed reproduces from seeds.

**Distinguishing characteristics:** An ochrea (white to brown sheath) is located at the base of each leaf on the stem. This plant is often confused with the perennial, field bindweed. Triangular seeds, ochrea, very small flowers, heart-shaped leaves, and root structure that is shallow and lacks root buds and rhizomes all help distinguish wild buckwheat from field bindweed.

**Areas of infestation:** Often grows well in wet field areas, whereas field bindweed is often found in dry sites.

**Yield loss potential:** Depending on density, wild buckwheat can reduce yields by 30%. At low densities, it has a minimal impact on yield. However, the vines twining up soybean plants may become tangled in harvest equipment. High water content of wild buckwheat seeds may lead to spoilage in grain bins.

**Effective management:** When applied, pre-emergence to soybean, saflufenacil (WSSA Group 14, a PPO inhibitor) gives fair to good control. Some sulfonylurea type herbicides (WSSA Group 2) and Ignite® (WSSA Group 10) in LibertyLink® soybean applied post-emergence give fair to good control. Tillage, crop rotation, and post-emergence cultivation may be management tools to reduce stand numbers.

**Herbicide resistance:** No resistance reported, but this plant tolerant to glyphosate and 2,4-D (in 2,4-D-resistant soybean varieties). The tolerance to glyphosate makes wild buckwheat a problem even in glyphosate-resistant soybean varieties.

**Figure 31.17. Wild buckwheat seedling, stem showing ochrea (sheath surrounding the stem at the node), and inflorescence.** (Photos, Michael Moechnig, SDSU)

*Common ragweed (Ambrosia artemisiifolia)*
**Time of emergence:** The first flush of common ragweed typically emerges just before soybean planting.

**Life cycle and reproduction:** This annual weed reproduces by seed.

**Distinguishing characteristics:** Cotyledons are spatulate (spoon-shaped). Leaves are opposite on the lower stem and alternate on the upper stem. The leaves are finely divided. The stems are erect, branched, and grow to one to two feet. The flowers are nonshowy and without petals.

**Areas of infestation:** This weed is typically found in disturbed sites.

**Yield loss potential:** Soybean yield reductions are typically less than 10% at moderate densities, but can be severe at high densities or if the plants grow taller than the soybean canopy.

**Effective management:** Pre-emergent broadleaf herbicides—including PPO inhibitors (WSSA Group 14) and ALS inhibitors (WSSA Group 2)—provide good control in SDSU trials. Post-emergent herbicides in these groups also give fair to excellent control. Glyphosate (WSSA Group 9) gives excellent control if resistance is not a problem. Overuse of the same chemical should be avoided to maintain the herbicide effectiveness. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** Biotypes of this plant have been reported to be resistant to ALS inhibitors (WSSA Group 2) in many states. In South Dakota, glyphosate resistant biotypes (WSSA Group 9) have been documented.

**Figure 31.18. Common ragweed seedlings at several growth stages and mature plant above the soybean canopy.** (Photos, Michael Moechnig, SDSU)

*Velvetleaf (Abutilon theophrasti)*
**Time of emergence:** Typically velvetleaf emerges shortly after soybean planting starts.

**Life cycle and reproduction:** This annual weed reproduces from seeds.

**Figure 31.19. Velvetleaf seedling and mature plant.** (Photos, Michael Moechnig, SDSU)

**Distinguishing characteristics:** Seedlings have round cotyledons and alternate heart-shaped leaves. Leaves are covered with soft hairs giving it a "velvet" feel. The plant can grow above the soybean canopy and can reach six feet in height.

**Areas of infestation:** Found in productive fields and roadsides.

**Yield loss potential:** Soybean yields can be reduced 20% in moderate infestations (1- 2 plants/ft$^2$).

**Effective management:** In South Dakota trials, pre-emergent PPO inhibitor herbicides (WSSA Group 14) and bleaching herbicides (WSSA Group 13) have provided excellent control. Post-emergent PPO herbicides also can provide good to excellent control. It should be noted that glyphosate only provides fair to good control of velvetleaf.

**Herbicide resistance:** Biotypes in Minnesota and other areas have been reported to be resistant to photosystem II inhibitor (WSSA Group 5) herbicides.

***Redroot pigweed (Amaranthus retroflexus)***
**Time of emergence:** Typically redroot pigweed emerges before and just at soybean planting.

**Life cycle and reproduction:** This annual weed reproduces from seeds.

**Distinguishing characteristics:** Cotyledons thin and linear. Leaves are lance-like with alternate arrangement and the lower surface is hairy. The stems are stout and the lower portion is reddish (hence the name redroot). Seeds are black, shiny, and numerous. A large plant can produce over 800,000 seeds. This plant may hybridize with other Amaranthus species, with hybrid plants having highly variable physical characteristics.

**Areas of infestation:** Redroot pigweed is often found in disturbed areas that have high soil nutrient levels.

**Yield loss potential:** Depending on density and when emergence occurred, soybean yield losses can be as high as 55%.

**Figure 31.20. Redroot pigweed seedling, leaf underside, and young plants.** (Photos, Michael Moechnig, SDSU)

**Effective management:** Many different pre-emergent and post-emergent herbicides that are PPO inhibitors (WSSA Group 14), and ALS inhibitors (WSSA Group 2) have provided excellent control in SDSU trials. Care must be taken as some resistant biotypes have been reported in other states. An integrated program combining cultivation and appropriate herbicides should facilitate effective redroot pigweed control.

**Herbicide resistance:** Biotypes of redroot pigweed have been shown to be resistant to photosystem II inhibitor (WSSA Group 5) and ALS inhibitor (WSSA Group 2) herbicides.

***Field bindweed (Convolvulus arvensis)***
**Time of emergence:** Field bindweed emerges in the late spring to early summer. Plant regrowth from rhizomes occurs early in the season. Seed germination occurs later.

**Life cycle and reproduction:** This perennial plant has deep spreading roots, and it can reproduce from rhizomes or seeds.

**Distinguishing characteristics:** Leaves are arrow-shaped on a twining stem. The root system can be extensive. Flowers are white to pink and bell- or trumpet-shaped.

**Areas of infestation:** This plant grows well in dry soils.

**Yield loss potential:** Up to 50% soybean yield reductions reported depending on density. The vining nature of the plant can cause problems with harvest equipment.

**Effective management:** Combination of cultivation (if done often enough), chemical control, and competitive crops.

**Herbicide resistance:** Tolerant of glyphosate (WSSA Group 9) applications. Biotypes have been reported to be resistant to auxin-type growth regulator (WSSA Group 4) herbicides.

**Figure 31.21. Field bindweed seedling and mature plants.** (Photos courtesy of Pacific Northwest Weed Handbook)

***Common cocklebur (Xanthium strumarium)***
**Time of emergence:** Common cocklebur typically emerges at the end of soybean planting.

**Life cycle and reproduction:** Common cocklebur is an annual plant that reproduces from seeds.

**Distinguishing characteristics:** Cotyledons of the seedling are linear and thick, shiny green. Leaves are alternate and large with wavy margins. Seeds are in burs that stick to animal coats.

**Areas of infestation:** Typically occurs in wet field areas where soybean growth is poor.

**Yield loss potential:** Highly competitive with soybean with up to 70% yield reductions reported even at relatively low densities. Because soybean does not grow well in areas where common cocklebur does, the yield losses are compounded.

**Effective management:** In SDSU trials, pre-emergent herbicides provide only fair to good control. Post-emergent ALS inhibitor (WSSA Group 2) herbicides provide excellent control (if not an ALS-resistant biotype). Glyphosate (WSSA Group 9) provides excellent control in Roundup Ready® soybean. Tillage, crop rotation, and post-emergence cultivation should also be considered as management tools to reduce stand numbers.

**Herbicide resistance:** Cocklebur biotypes have been reported to be resistant to ALS inhibitor (WSSA Group 2) herbicides.

**Figure 31.22. Common cocklebur seedling and mature plants in soybean.** (Photos, Michael Moechnig, SDSU)

***Wild mustard (Brassica kaber)***

**Time of emergence:** Typically emerges later, during, or after soybean planting.

**Life cycle and reproduction:** Wild mustard is an annual plant that reproduces from seeds.

**Distinguishing characteristics:** Seedlings have kidney-shaped cotyledons. Leaves alternate, few hairs. Bright yellow flowers with four petals. Fruits are long and linear.

**Areas of infestation:** This plant is often found in disturbed sites.

**Yield loss potential:** Densities of 1 plant/ft$^2$ can reduce soybean yields 40%.

**Effective management:** Prevention and cultural control should be implemented in addition to chemical management. Pre-emergence and post-emergence herbicides that are PPO inhibitors (WSSA Group 14) or ALS inhibitors (WSSA Group 2) have provided excellent control in SDSU trials. 2,4-DB has been reported to also provide excellent control.

**Herbicide resistance:** Herbicide resistance has not been reported.

**Figure 31.23. Wild mustard seedling and patch with flower heads.** (Photos, Michael Moechnig, SDSU)

***Black nightshade (Solanum ptychanthum)***
**Time of emergence:** Typically emerges at the end of soybean planting.

**Life cycle and reproduction:** This annual weed reproduces from seeds.

**Distinguishing characteristics:** Cotyledons of the seedling are ovate, green on upper surface, and purple on lower surface. Leaves are alternate and oval in shape with few hairs, and they may have holes due to flea beetle feeding (although not effectively controlled by the insect). The flowers are white to bluish, and the seeds are in berries, with each containing 50 to 100 seeds. The juice of the berry stains soybean seeds, which reduces their value.

**Areas of infestation:** Typically occurs in disturbed sites.

**Yield loss potential:** Yield losses of 80% can result from moderate infestations (1 plant/$ft^2$). In addition, the berry juice can stain the seed reducing its value. When berry juice is mixed with chaff, the combination can plug the combine.

**Effective management:** In SDSU trials, good to excellent control when using pre-emergent applications of PPO inhibitors (WSSA Group 14) or ALS inhibitors (WSSA Group 2). Excellent control is reported with a few of the ALS inhibitors (WSSA Group 2) when used post-emergence, although others in this group are rated as poor (see specific labels for details). Glyphosate (WSSA Group 9) provides good control in Roundup Ready® soybean. Tillage, crop rotation, and post-emergence cultivation should also be considered as management tools to reduce stand numbers.

**Herbicide resistance:** Black nightshade biotypes have been reported to be resistant to ALS (WSSA Group 2) and photosystem II inhibitors (WSSA Group 5), as well as photosystem I inhibitor herbicides (WSSA Group 22, e.g., paraquat).

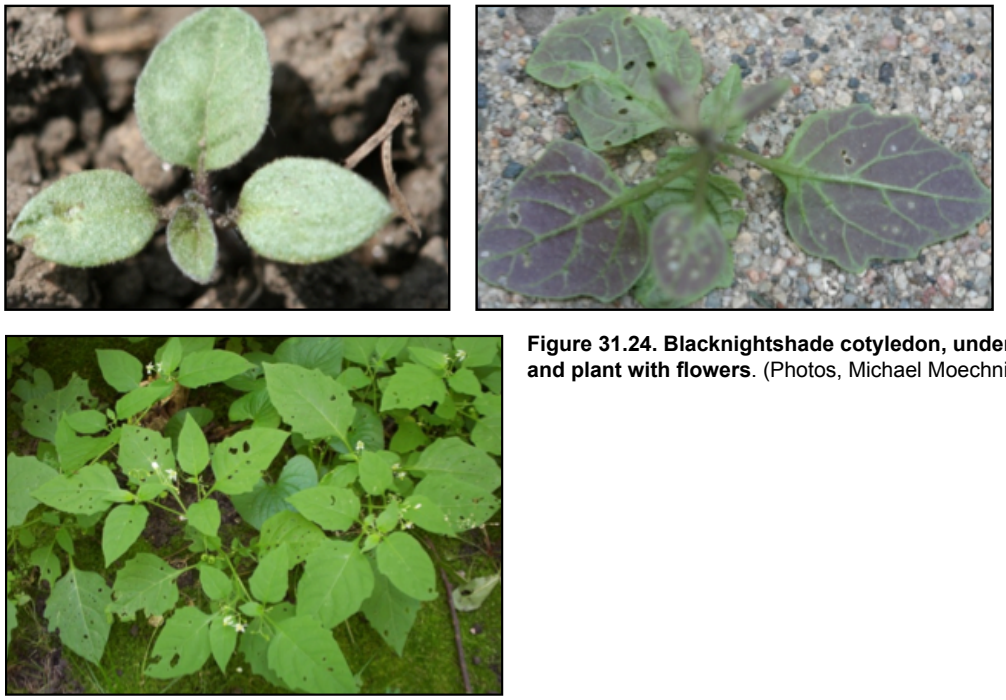

**Figure 31.24. Blacknightshade cotyledon, underside of young plant, and plant with flowers**. (Photos, Michael Moechnig, SDSU)

*Venice mallow (Hibiscus trionum)*
**Time of emergence:** Typically emerges at the end of soybean planting.

**Life cycle and reproduction:** This annual weed reproduces from seeds.

**Distinguishing characteristics:** Cotyledons of the seedling are round. Leaves are alternate with three to seven distinct lobes. Leaf surface with hairs. Flowers are white to pale yellow. Fruits are inflated capsules.

**Areas of infestation:** Typically occurs in disturbed sites. The plant is drought tolerant and can grow in gravely and acid soils.

**Yield loss potential:** Usually low (<5%) yield loss at moderate infestations, although season-long competition can increase this loss.

**Effective management:** In SDSU trials, good to excellent control when using pre-emergent applications of PPO inhibitors (WSSA Group 14). Post-emergence herbicides that provide excellent control include contact photosynthesis inhibitors (WSSA Group 6) and some ALS inhibitors (WSSA Group 2). Glyphosate (WSSA Group 9) and glufosinate (e.g., Ignite®) (WSSA Group 10) provide excellent control in their respective GMO soybean types. Tillage, crop rotation, and post-emergence cultivation should also be considered as management tools.

**Herbicide resistance:** None reported at this time.


**Figure 31.25. Venice mallow seedling and late-season plant with flowers and seedpods.**
(Photos, Michael Moechnig, SDSU)

***Common waterhemp (Amaranthus rudis)***
**Time of emergence:** This weed typically emerges late in the season after soybean emergence.

**Life cycle and reproduction:** Common waterhemp is an annual plant that reproduces from seeds.

**Distinguishing characteristics:** The first true leaves of seedlings are more lance-like than the oval leaves seen on redroot pigweed. Leaf surfaces are not hairy. This plant has male and female plants. The inflorescence of the female plant is more highly branched than the inflorescence of the redroot pigweed plant. In SDSU trials, the female plant has been shown to produce over one million shiny black seeds if early germinating plants are not controlled. Plants that emerge after V5 of soybean may produce 200 seeds or fewer per plant.

**Areas of infestation:** This plant grows well in disturbed areas with high fertility.

**Yield loss potential:** Up to 55% soybean yield reductions reported depending on density and emergence date.

**Effective management:** Common waterhemp is difficult to control and often is seen after layby operations; some resistant biotypes have been reported in other states. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** Biotypes of this plant have been reported to be resistant to ALS (WSSA Group 2), PPO (WSSA Group 14), photosystem II inhibitor (WSSA Group 5) herbicides, and glyphosate (WSSA Group 9).

**Figure 31.26. Common waterhemp seedlings and late season infestation in soybean.** (Photos, Michael Moechnig, SDSU)

**Figure 31.27. Comparison of redroot pigweed (left) and common waterhemp (right) inflorescence.** (Photos courtesy of Weed Science Society of America)

***Buffalobur (Solanum rostratum)***
**Time of emergence:** Buffalobur typically emerges after soybean emergence.

**Life cycle and reproduction:** This annual plant reproduces from seeds.

**Distinguishing characteristics:** The first true leaves of seedlings are lance shaped. Leaves are many lobed, alternate. Leaf surfaces and stems are spiny with long yellow spines. The spiny capsules hold the fruit.

**Areas of infestation:** Buffalobur grows best in well-drained disturbed soils. It does not grow well in wet soils.

**Yield loss potential:** Typically buffalobur is found as scattered plants and soybean yield reduction is low to moderate depending on density and emergence date.

**Effective management:** Buffalobur can be controlled post-emergence with PPO inhibitors (WSSA Group 14). Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** No resistant biotypes of this plant have been reported at this time.

**Figure 31.28. Buffalobur seedling, young plant, and mature plant showing yellow flowers and spiny nature of the plant.**
(Photos 1 and 2 courtesy of University of Minnesota and Photo 3 courtesy of natronacountyweeds.com)

***Biennial wormwood (Artemisia biennis)***

**Time of emergence:** From seed, although named biennial wormwood (implying vegetative stage first year and reproductive stage the second), the plant may behave as an annual, flowering later in the first year of growth. Typically emerges in late June to early July after soybean planting.

**Life cycle and reproduction:** This biennial plant reproduces from seeds.

**Distinguishing characteristics:** The first true leaves are finely divided, and are often mistaken for common ragweed. Biennial wormwood has sharp leaf edges and are hairless, whereas common ragweed has rounded leaf edges with hairs. Rosette type growth of the vegetative plants. Flower stalk can grow up to six feet tall and produce over 400,000 seeds/plant.

**Areas of infestation:** This plant grows well in disturbed, poorly drained soils.

**Yield loss potential:** Soybean yield reduction can be up to 40% with 1 plant/ft$^2$. If the infestation is high, yield losses can approach 100%.

**Effective management:** Biennial wormwood can be controlled pre-emergence with PPO inhibitors (WSSA Group 14) and translocated photosystem II inhibitors (WSSA Group 5). Post-emergence herbicides include contact photosystem II inhibitors in WSSA Group 6, and in GMO soybean glyphosate (WSSA group 9) and glufosinate (WSSA group 10) herbicides. Herbicide applications must be done before the plant is 3" tall, as tolerance to all herbicides becomes an issue. Prevention and cultural control should be implemented in addition to chemical management.

**Herbicide resistance:** No resistant biotypes of this plant have been reported at this time.

**Figure 31.29. Biennial wormwood seedling, inflorescence, and mature plant.** (Photos, Michael Moechnig, SDSU)

## References and additional information

Herbicide resistance links. Available at http://www.wssa.net/Weed/Resistance

Information on Soybean cyst nematode alternative hosts: Venkatesh, R. et al. 2000. Weed Tech. 14:156-160

Other weed science information available at: Weed Science Society of America. http://www.wssa.net/Society/

Photo references include: Pacific Northwest Weed Management Handbook. Available at http://pnwhandbooks.org/weed/; Floridata.com http://www.floridata.com/lists/contents.cfm; omafra.gov.on.ca; ag.ndsu.nodak.edu; minidoka.id.us; Center for Invasive Species and Ecosystem Health available at http://bugwood.org/.

Summary of herbicide mechanism of action according to Weed Science Society of America (WSSA). Available at http://www.wssa.net/wp-content/uploads/WSSA-Mechanism-of-Action.pdf

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