



NIGHTSHADE

Biology and Control in the Pacific Northwest

PNW0588

Introduction

Weed species in the Solanaceae, or nightshade family, cause some of the most serious weed-related problems in Pacific Northwest (PNW) agriculture. The most common members of this family found in PNW cropland are the annuals hairy nightshade (*Solanum physalifolium* Rusby, formerly *S. sarrachoides* Sendtner), black nightshade (*S. nigrum* L.), and cutleaf nightshade (*S. triflorum* Nutt.). Bittersweet nightshade (*S. dulcamara* L.), a semi-woody, twining perennial, is more of a problem in perennial crops and non-cropland. These nightshades reduce yield and quality in many crops, but are particularly troublesome in beans, peas, and potatoes. Nightshade control is difficult because the weeds are so widely adapted, their seeds germinate throughout the growing season, and they are tolerant to many commonly used herbicides.

Weedy nightshades are doubly troublesome, because berries and foliage may be toxic to livestock and humans who inadvertently consume them.

Distribution

Hairy nightshade is considered by botanists to be native to South America, cutleaf nightshade to North America, and bittersweet nightshade to Eurasia, but black nightshade is not so easily pinned down. Most botanists and the Weed Science Society of America (WSSA) recognize one species that was introduced to the PNW from Europe (*Solanum nigrum*) and two species native to eastern North America (eastern black nightshade, *S. ptychanthum* Dunal, and American black nightshade, *S. americanum* P. Mill.). Other botanists consider *S. nigrum* variety *virginicum* L. to be the single native species and *S. nigrum*



Figure 1. Hairy nightshade.



Figure 2. Hairy nightshade flowers and berries.



Figure 3. Black nightshade flowers.



Figure 4. Black nightshade berries.



Figure 5. Cutleaf nightshade.

var. *nigrum* L. as the introduced variety from Europe. This varietal split is based primarily on the chromosome number in each cell of the plant: the variety *virginicum* is diploid (two copies of each chromosome in each cell) while the variety *nigrum* is hexaploid (six copies of each chromosome in each cell). In this bulletin, we will use the WSSA-approved nomenclature for these nightshade species.

Hairy nightshade is easily the most common of our annual nightshades. It can be found in substantial infestations throughout the PNW. Black nightshade is less widespread in the PNW. It was first introduced in the early part of the 20th century near Portland and has since infested areas of western Oregon and Washington, parts of central Washington and adjacent Oregon, and areas as far east as the Treasure Valley of Oregon and Idaho. Cutleaf nightshade is found mainly in arid and semiarid areas of the PNW, where it occasionally is a severe problem in cropland. Bittersweet nightshade usually is found along waterways throughout our region, and often grows in moist soils near old residences and farmsteads where it was originally cultivated as a hardy ornamental. Eastern and American black nightshade have been only sporadically reported in PNW states.

Identification

Hairy nightshade stems are weakly erect, but they often rest against surrounding vegetation to achieve heights of about 2 feet. Leaves are about 3 inches long, either smooth-margined or shallowly lobed, roughly egg-shaped in outline (attached at the broad end), and with an elongate tip. Stems and leaves bear dense, soft, widely spreading hairs on the stems, and are usually gland-tipped, giving the plant a "sticky" feel. Clusters containing four to six flowers are borne on the stem between the leaves rather than from the leaf axils. Flowers are star-shaped and measure about 1/4-inch wide with five white petals surrounding a cluster of yellow anthers in the center. Fruits measure about 1/4 inch in diameter at maturity and each is conspicuously capped by the calyx. The berries of hairy nightshade turn a mottled yellowish-brown to black at maturity.

Black nightshade plants may grow up to 3 feet tall and are usually erect. Black nightshade bears shallowly lobed, egg-shaped leaves that may reach 4 inches long. Stems and leaves are not generally hairy, although the upper surface of the leaves may bear some rough, sparse hairs. Flower clusters normally contain about three or four flowers which are borne on the stem between the leaves rather than from the leaf axils. Flowers are star-shaped, about $\frac{1}{2}$ -inch wide, and bearing five white to bluish-white petals around a cluster of yellow anthers in the center. Berries are dark purple or black at maturity and measure about $\frac{1}{3}$ inch in diameter. The calyx does not continue to grow after flowering, so it remains at the base without noticeably capping the fruit. Black nightshade can hybridize with hairy nightshade to produce offspring with substantial hybrid vigor. **American black nightshade** and **eastern black nightshade** closely resemble black nightshade, differing primarily in the “thinness” of the leaves and the degree to which the sepals are bent backwards (or “reflexed”) from the fruit.

Cutleaf nightshade has a rather prostrate growth habit and rarely grows more than 1 foot tall except when supported by surrounding vegetation. Leaves measure from $\frac{1}{2}$ to 2 inches long and all are deeply lobed, usually more than halfway to the midrib. Most leaves and stems are only sparsely hairy. Clusters of up to about three flowers are borne on the stem between the leaves rather than from the leaf axils. Like hairy nightshade, cutleaf nightshade flowers are star-shaped, about $\frac{1}{3}$ -inch wide, with five white petals around a cluster of yellow anthers in the center. Cutleaf nightshade berries are about $\frac{1}{2}$ inch in diameter and remain green at maturity. The calyx grows to cover about half of each berry, although the tips tend to spread away from the sides of the fruit. One of the major distinguishing characteristics of the plant is its disagreeable odor, which is missing from the other *Solanum* species discussed in this bulletin.

Bittersweet nightshade is a woody, somewhat viny, perennial with stems sometime reaching 10 feet. Leaves are dark green (sometimes purplish) in color and are up to



Figure 6. Cutleaf berries.

Photo courtesy of Corey Ransom, Utah State University.



Figure 7. Bittersweet nightshade.



Figure 8. Bittersweet nightshade berries.

4 inches long. Most leaves are three-lobed, with the terminal lobe being by far the largest and roughly egg-shaped in outline. The two lateral lobes are smaller and thinner, extending at right angles from the petiole. Unlobed leaves are slightly heart-shaped in outline. Flowers are borne in 10- to 25-flowered clusters on stems about 2 inches long. The five petals are light purple to blue in color, surrounding the bright yellow anthers in the center of each flower. The petals tend to bend backward toward the stem. Fruits are egg-shaped, about 1/2-inch long, and progress from green to orange to shiny red at maturity. The calyx remains very small and is not prominent on the berries.

Other “Nightshades”

Several other regional weed species that are members of Solanaceae are sometimes called nightshade. Deadly nightshade (*Atropa belladonna*), also known as belladonna, is a perennial species generally found only in ornamental plantings. Silverleaf nightshade (*Solanum elaeagnifolium*) is a prickly, deep-rooted, creeping perennial which is most frequently a problem on rangelands. Buffalobur (*S. rostratum*) is an exceptionally spiny annual weed species with watermelon-like leaves and bright yellow flowers. This species is frequently reported but not widely established.

A few other important weed species in Solanaceae are found in the PNW. Among these are longleaf groundcherry (*Physalis longifolia*), a creeping perennial that bears its fruits within a papery husk; matrimonyvine (*Lycium halimifolium*), a troublesome thorny perennial; horsenettle (*Solanum carolinense*) which is also a spiny perennial; and black henbane (*Hyocyamus niger*), a perennial and toxic weed.

Garden huckleberry or wonderberry (*Solanum melanocerasum* All.) is a cultivated species very similar to black nightshade that bears reliably nontoxic berries that are used for pies and preserves. Garden huckleberry does not interbreed with black nightshade and is not considered to be weedy.

Finally, a widely-planted ornamental species often called bittersweet (*Celastrus scandens* L.), also known as false-bittersweet or waxwork, may be confused with bittersweet nightshade because of their similar common names. This plant, belonging to the plant family Celastraceae, is a twining shrub native to eastern North America and is unrelated to true nightshades. It grows to 25 feet tall, has ovate leaves with serrated margins, and bears orange capsule-like fruits that split at maturity to reveal crimson-coated seeds. Interestingly, the fruits of this unrelated species are also suspected to be poisonous if eaten in quantity.

Biology

Hairy, cutleaf, and black nightshade are tap-rooted annuals, starting each year from seed. They are notorious for invading disturbed land, particularly moist, fertile farmland. Bittersweet nightshade is a rhizomatous perennial, spreading both by rhizomes and seed. Nightshades thrive on soils with high nitrogen levels. Generally, these species do not tolerate moisture stress well and are usually not serious problems on nonirrigated range lands. Cutleaf nightshade, however, is native to the dry regions and has become a serious weed problem in many dryland crop production areas in the PNW.

Nightshade seeds are dormant for several months after maturity. After the first winter, most seeds germinate within a year or two. Some seeds, particularly those buried deeply, survive ten or more years in the soil. In warm areas of the PNW, the majority of nightshade seedlings begin to appear in late April and continue to emerge through June. Few nightshade seedlings emerge during July, but germination and growth resumes again in August. Late-emerging nightshades may not compete vigorously with crops, but they can interfere with harvest, contaminate the crop, and produce seed which will create weed infestations in the future.

Cropping practices, weed control practices, and nightshade growth characteristics have all contributed to the spread of nightshades. Previously clean fields become infested with

nightshade from contaminated field equipment, livestock feed, natural seed dispersion, and irrigation water.

Toxicity

Although all parts of these nightshade species are considered poisonous, toxicity is thought to vary tremendously based upon environment, plant part, degree of maturity, and genetic makeup of the individual weed. Foliage of many species of *Solanum* (including potatoes) has been shown to contain toxic levels of solanine, a toxic alkaloid. While all plant parts are toxic to some degree at all stages of growth, the greatest solanine concentrations are present in seedlings, growing tips, and immature berries. Drying and moderate heating do not destroy toxic alkaloids, but ripe fruits are usually less poisonous than green fruits. Generally, small concentrations (1% or less) of nightshade plants in hay or other animal feed have not caused problems, but a safe amount has not been established. Heavily contaminated hay and silage should not be fed to livestock. Toxicity is not determined by the concentration or amount in hay, but rather by the amount of nightshade that an animal consumes relative to its body weight. Nightshade consumption ranging from 0.1 to 3% of body weight has been sufficient to poison horses, cattle, sheep, swine, chickens, and ducks. Goats have been reported to display some tolerance to the nightshade alkaloids, at least in silverleaf nightshade.

Bittersweet nightshade is probably the most likely of these *Solanum* species to poison humans. Both foliage and fruits contain solanine as well as the toxic glycoside dulcamarine (which, incidentally, is similar in action to atropine, found in the closely-related belladonna), but the greatest concern is the pretty berries that are so attractive to children. When green in color, berries are roughly twice as toxic as when red and fully ripe; 200 red berries are considered a fatal dose for adults. Children rarely eat that many, so nightshade poisonings rarely cause death, but they may cause other very unpleasant symptoms, including nausea,

diarrhea, headache, weakness, drowsiness, fever, sweating, and seizures. Vomiting may also occur and, in fact, may help to eliminate unabsorbed toxin from the stomach. Vomiting as a treatment is most effective if induced immediately after the berries are eaten. This can be done with syrup of ipecac, a useful home emergency medicine. Doctors treat significant poisonings with lavage (flushing the intestinal tract), activated charcoal, and with the antidote physostigmine, a plant extract.

Crop Damage

Although light infestations of nightshades do not usually cause serious yield losses, heavy infestations will compete with the crop plants for available light, moisture, and soil nutrients. Nightshades can cause serious problems during harvest of several crops, such as green peas and snap beans. The nightshades do not dry as rapidly as many crop plants and are not killed by light frosts in the fall. The rotors, screens, and augers of combines become clogged by the sticky mass of nightshade stems, leaves, berries, and soil. Dry beans, peas, and lentils may become coated with berry juice that stains the seed and causes soil particles, weed seeds, and chaff to adhere to it. Seeds in this condition flow poorly and are prone to mold and other postharvest storage problems if not cleaned properly. Dirty or stained dry bean or pea seed lots may be difficult or impossible to sell and prices may be discounted severely. In addition, because of the danger of ingestion of toxic alkaloids, green peas are rejected if nightshade berries are found above a threshold level in a harvested lot.

Desiccants used to kill potato vines do not dry nightshade berries. In fact, nightshade plants growing beneath potato vines often flourish after vine desiccation. The foliage of nightshades present at potato harvest can clog digger blades and chains, making tuber recovery and separation of vines and tubers difficult. Heavy nightshade infestations in potato fields may prolong harvest, especially if the potatoes have not been defoliated. Nightshades are also hosts for many plant

pests (such as Colorado potato beetle and the late blight fungus) and may cause insect, disease, and nematode problems to increase in potatoes and other rotation crops.

Control—Cropland

Crop rotation is an important tool in nightshade control. Crops that compete vigorously with nightshades should be included in the rotation. No species, including nightshades, is immune to the suppressive effects of shading. Crops that do not shade the ground rapidly can allow nightshades to grow and develop faster than the crop. Every effort should be made to avoid cultural conditions that allow unimpeded growth, development, and seed production by nightshades. These include early spring planting of row crops followed by widely-spaced cultivation operations, which leave soil open at the time when most nightshade seeds germinate. Wide row or plant spacing also may result in increased germination of nightshades and other summer annual weed species. Finally, reduction of seed populations in the soil is critical to long-term nightshade control. Nightshade control in every year of the entire rotation is important to reduce the soil seed supply, and nightshade plants must never be allowed to mature their seed.

In addition, it has been shown that herbicides should also be rotated from year to year. Using the same herbicide every year may increase the population of soil microorganisms that break down that herbicide. This results in a more rapid break-down of that product, which results in poorer weed control. Overuse of a single herbicide mode of action also allows weeds that are tolerant or resistant to that particular herbicide to increase. For example, nightshades are slightly to highly tolerant to the commonly used herbicides pendimethalin (Prowl), trifluralin (Treflan), and metribuzin (Sencor). These herbicides are effective in controlling other weed species, so they may actually allow nightshade to grow with less weed competition, resulting in greater nightshade seed production. Over time, overuse of these herbicides will increase nightshade infestations. For these reasons, the

best control of nightshades is obtained when crop rotation, crop selection, and mechanical and chemical control are used together.

For example, it is known that nightshade seeds do not normally germinate until mid- to late spring. Thus, fall- or winter-seeded crops may help limit nightshade infestations. In places where soil populations of nightshade seed are high, growers should consider planting winter grain during two to three years of a rotation. A healthy stand of winter wheat will provide strong competition and shading of the soil surface at the time when nightshade seeds germinate. Further, nightshade seedlings that do begin to grow can be effectively controlled by small grain herbicides such as bromoxynil (Buctril), 2,4-D, dicamba (Clarity), and clopyralid + 2,4-D (Curtail), any of which can dramatically reduce nightshade seed production. For heavy nightshade infestations, use the higher herbicide rates allowed on the label, and consider herbicide combinations.

The three annual nightshade species are not controlled equally well by any given herbicide. Black nightshade has been hard to control with EPTC (Eptam) but is more easily controlled with metribuzin (Sencor) than hairy and cutleaf nightshades. Hairy nightshade is controlled by rimsulfuron (Matrix), but cutleaf nightshade is not. Black nightshade is more easily controlled by triflurosulfuron (UpBeet) or s-metolachlor (Dual Magnum) than is hairy nightshade, while phenmedipham + desmedipham (Betamix) is generally better on hairy nightshade than on black nightshade. At the highest labeled rate, dimethenamid-p (Outlook) provides good to excellent black and hairy nightshade control, while ethofumesate (Nortron), cycloate (Ro-Neet), and pyrazon (Pyramin) provide fair to good nightshade control. Often, herbicide combinations are required when multiple nightshade infestations occur. For example, rimsulfuron + metribuzin will control hairy nightshade in potatoes, but addition of EPTC to the mix may be necessary to adequately control cutleaf nightshade, or addition of s-metolachlor may be needed to adequately control black

nightshade. See the *PNW Weed Management Handbook*¹ for current recommendations for chemical control of hairy, cutleaf, and black night-shade in various crops.

Control—Non-cropland

Since bittersweet nightshade is a perennial, it usually causes the most concern in non-cropland situations and most control questions involve how to kill well-established plants. Application timing is a very important factor to consider when attempting to control established perennials with herbicides. Most foliar herbicides translocate, or move inside the plant, in the same direction as do carbohydrates; these plant sugars are either manufactured in the leaves during photosynthesis or come from stored starch in the roots. Since most carbohydrates flow from the roots to the shoots during early growth in the spring, herbicides applied at that time will remain mostly in the leaves and poor root kill will result. These translocating herbicides are most active when applied to foliage at a time when plants are actively growing, often just prior to flowering. Sugar export from leaves to roots is usually high at this time, resulting in good herbicide movement in the plant and optimized root kill. A second period of peak carbohydrate flow from leaves to roots often occurs in the fall, when the plant is storing starch in preparation for the initial flush of

growth the next spring. Treat plants in the fall before leaves begin losing their green color for best results. Water-stressed plants will not be controlled as well as plants growing on moist soil, so applications should be timed following onset of fall rains.

Several non-crop herbicides are active on nightshade family plants. Auxinic herbicides (such as 2,4-D, dicamba (Banvel or Weedmaster), clopyralid (Curtail), picloram (Tordon), and others are among the best foliar-applied materials. Applications of these products provide good to excellent control of bittersweet nightshade and related species. Other herbicides also show good activity, including glyphosate (Roundup and others), imazapyr (Arsenal), and imazapic (Plateau). See the *PNW Weed Management Handbook* for current recommendations for chemical control on non-cropland sites.

One caution: bittersweet nightshade is often found growing in or adjacent to water. When using herbicides in a riparian or wetland situation, **be certain** that no terrestrial herbicide is sprayed into or over water, or in such a way that it may move into water. When controlling bittersweet nightshade in these wet sites, it is best to select a herbicide labeled for aquatic use. In addition, the applicator is required to be properly licensed and obtain proper permitting from state governmental agencies prior to spraying aquatic sites.

¹*Pacific Northwest Weed Management Handbook*. Compiled annually by Ray D. William and Andrea G. Dailey. Extension & Station Communications, Oregon State University, Corvallis, OR. Available at WSU Bulletins, Washington State University; 1-800-723-1763 or at <http://pubs.wsu.edu>.

By Timothy W. Miller and Robert Parker, WSU Extension weed scientists

Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Pacific Northwest Extension publications are produced cooperatively by the three Pacific Northwest land-grant universities: Washington State University, Oregon State University, and the University of Idaho. Similar crops, climate, and topography create a natural geographic unit that crosses state lines. Since 1949, the PNW program has published more than 550 titles, preventing duplication of effort, broadening the availability of faculty specialists, and substantially reducing costs for the participating states.

Published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by Washington State University Extension, Oregon State University Extension Service, University of Idaho Extension System, and the U.S. Department of Agriculture cooperating. Extension programs, activities, materials, and policies comply with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, national or ethnic origin; physical, mental, or sensory disability; marital status, sexual orientation, and status as a Vietnam-era or disabled veteran. Washington State University Extension, The Oregon State University Extension Service, and University of Idaho Extension are Equal Opportunity Employers. Evidence of noncompliance may be reported through your local Extension office. Trade names have been used to simplify information; no endorsement is intended. Published September 2006. \$2.00. PNW0588