FIELD AND HEDGE BINDWEED:
IDENTIFICATION AND BIOLOGICAL CONTROL

Field Bindweed (*Convolvulus arvensis* L.) and Hedge Bindweed (*Calystegia sepium* [L.] R. Br.)

Introduction

Field bindweed (*Convolvulus arvensis*) and hedge bindweed (*Calystegia sepium*) are similar-looking, weedy vines problematic in North America. Field bindweed is native to Europe and Asia and was introduced to the United States by 1739, likely as a contaminant of crop seed. Hedge bindweed consists of numerous subspecies native to North America and temperate regions worldwide (Brummitt [2012] 2020). The species as a whole was recognized as weedy in the United States by 1889 (Littlefield and Tipping 2004). Both field (Figure 1) and hedge (Figure 2) bindweed are highly competitive for nutrients and water, and both form large mats that smother crop plants, fencerows, and forest understories.

Figure 1. Field bindweed forms dense mats that smother underlying vegetation. Photo: Jennifer Andreas, WSU Extension.

Figure 2. Hedge bindweed forms dense mats that smother underlying vegetation. Photo: Rachel Winston, MIA Consulting.

Differentiating Field and Hedge Bindweed

Several other species resemble field and hedge bindweed, including morning glories in the genus *Ipomoea*, false hedge bindweeds in the genus *Calystegia*, and wild buckwheat (*Fallopia convolvulus*). These are differentiated from field and hedge bindweed in Figure 3. Only field and hedge bindweed are highly problematic weeds in the PNW. This publication highlights key traits used to differentiate field and hedge bindweed from each other and describes the history and current status of the bindweed biological control program in the United States.

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Habitat

Field bindweed is well-adapted to many different habitats but is dominant on dry, fertile soils in open and disturbed areas, including abandoned fields, roadsides, orchards, and gardens. Hedge bindweed is also adapted to differing habitats but is especially problematic in moist, fertile soils where it is commonly found on fencerows, ornamental plantings, and woodland edges (Littlefield and Tipping 2004). In the Pacific Northwest (PNW), hedge bindweed is primarily found west of the Cascade Mountains. Field bindweed is generally found east of the Cascades but can also be a problem in agricultural fields and gardens in western Washington and Oregon.

Growth

Both field and hedge bindweed are weedy vines that spread by seeds and rhizomes (horizontal underground stems). Hedge bindweed tends to crawl up structures and other vegetation, whereas field bindweed often grows prostrate, although it may climb upward if plants or suitable structures are available. New stems sprout from rhizomes throughout the growing season. Peak germination of seeds is in late spring or early summer, but seeds may germinate throughout the growing season with sufficient moisture (Jacobs 2007). While both species form extensive root systems with lateral roots often exceeding 10 ft (20 ft for field bindweed), the roots of field bindweed tend to extend deeper into the soil (up to 10 ft), allowing field bindweed to withstand drought conditions better than hedge bindweed (Jacobs 2007). Flowering occurs from midsummer to late autumn, with most flowers lasting only one day. Seeds are readily transported by water, birds, and other animals (Winston et al. 2014). Some may germinate immediately, while others may stay viable in the soil for up 50 years (Morishita et al. 2005). Stems die back to the root crown when temperatures dip below freezing.

Stems and Leaves

Field and hedge bindweed stems grow either prostrate on the ground or by twining up manmade structures or other vegetation. Field bindweed stems are slender, green, and twisted (Figure 4a), and grow up to 6 ft long. Hedge bindweed stems are often reddish-tinged, only slightly twisted (Figure 4b), and grow up to 10 ft long. The leaves of both species are alternate along the stem and shaped like an arrowhead or spade. Leaves of both species are often variable in how rounded and angled their basal lobes can be. In general, the basal lobes on field bindweed leaves are more pointed than those on hedge bindweed. Field bindweed leaves have more rounded tips than hedge bindweed and are up to 2½ in long, although they are typically closer to 1 in long (Figure 4c). Hedge bindweed leaves have basal lobes more squared off or rounded than field bindweed, end in a more pointed tip (Morishita et al. 2005), and typically grow up to 5 in long (Figure 4d).

Flowers

Flowers of both species occur on stalks growing from leaf axils, where leaves attach to stems. They have five petals completely fused together, giving them a funnel or bell shape. Flowers of both species are typically white but may vary from fully white to deep pink (Figure 4e–h). Field bindweed flowers are up to 1 in across and have two small bracts located on the flower stem, ½ to 2 in below the flower base (Figure 4i). Hedge bindweed flowers are 2–3 in across (Littlefield and Tipping 2004) and have two large bracts directly enclosing their base (Figure 4j).

Fruits and Seeds

Both species produce egg-shaped capsule fruits (Figure 4k–l) that are less than ⅓ in across for field bindweed and ½ in across for hedge bindweed. Each capsule contains up to four dark brown, wedge-shaped seeds (Jacobs 2007).

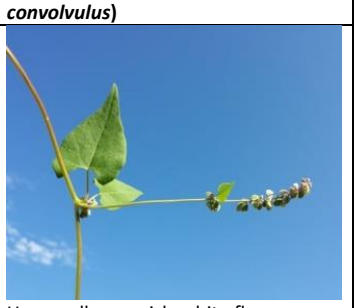
	Morning glories (*Ipomoea* species)	**False hedge bindweeds (*Calystegia* species)**	**Wild buckwheat (*Fallopia convolvulus*)**
Differences from field and hedge bindweed	 Most morning glories flowers are pink, purple, or blue varying to white; many have annual growth habits, larger leaves, roots that are fibrous or tuberous, or a combination of the above	 Most false hedge bindweeds occur outside of the PNW; of those within the PNW, most have smaller leaves not strongly arrowhead-shaped, differently sized and shaped bracts, or have much larger flowers	 Has small, greenish-white flowers, an annual growth habit, only slightly twisted stems, a papery sheath that encircles the stem at the base of the leaf, and fibrous roots

Figure 3. Key traits for differentiating similar species from field and hedge bindweed (Littlefield and Tipping 2004; Morishita et al. 2005). Photos: *Ipomoea batatas* Forest and Kim Starr, Starr Environmental, CC BY 4.0; *Calystegia occidentalis* ssp. *occidentalis* Barry Breckling, CC BY-NC-SA 3.0; *Fallopia convolvulus* Stefan.lefnaer, CC BY-SA 4.0.

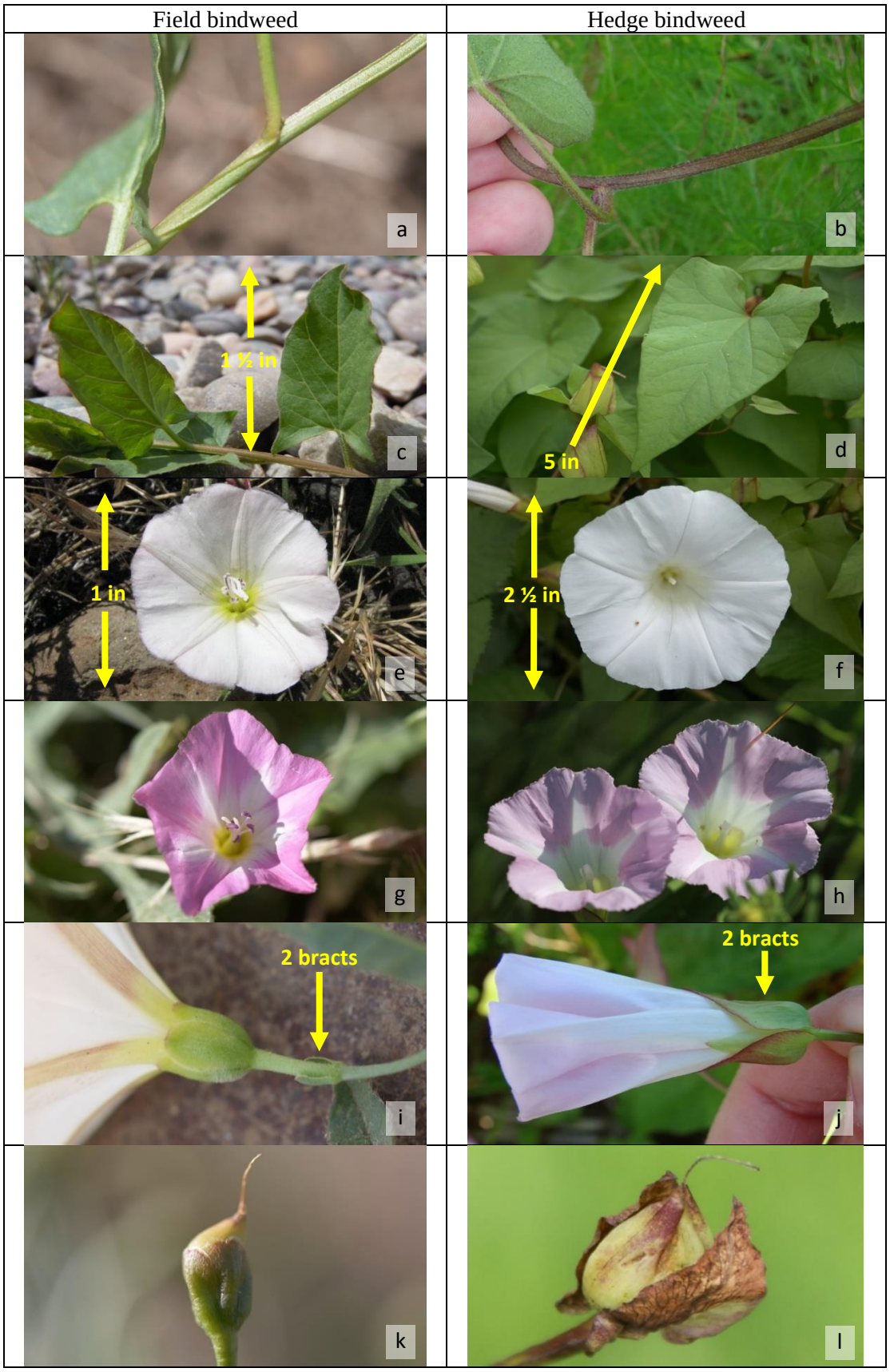


Figure 4. Key features of field bindweed (left column) and hedge bindweed (right column). Photos: a,d,f,g,i,k: Rachel Winston, MIA Consulting; b: Rebekah D. Wallace, University of Georgia, Bugwood.org, CC BY 3.0 US; c: Matt Lavin, Bozeman, Montana, CC BY-SA 2.0; e,j: Jennifer Andreas, WSU Extension; h: Rob Routledge, Sault College, Bugwood.org, CC BY 3.0 US; l: Krzysztof Ziarnek, Kenraiz, CC BY-SA 4.0.

Biological Control

Several species of insects and mites that are native to North America feed on field and hedge bindweed (Morishita et al. 2005). Many of these species have limited impact, and intentionally redistributing them in North America has failed to control either bindweed species (Winston et al. 2019). Other insects and mites have greater impacts; however, they also feed on more desirable, related morning glory and sweet potato species, so redistribution cannot be considered. Consequently, a classical biological control program was initiated in the 1980s. This program has focused primarily on field bindweed. Thus far, two species have been introduced from field bindweed's native range to the United States and were subsequently redistributed to control hedge bindweed.

*The Bindweed Moth (*Tyta luctuosa*)*

Description and life cycle

Adults are less than ½ in long with a wingspan around 1 in wide. They are dark brown with four large, white spots, one on each wing (Figure 5a). The white spots on the hind wings form a wide band that sometimes becomes narrowed. Adults emerge in late spring and lay eggs on growing field bindweed stems. After hatching, larvae feed on leaves and flowers (Winston et al. 2014). While high densities of larvae defoliate bindweed in experimental settings, densities that high have never been observed in the field. Larvae are typically less than 1½ in long and are a drab brown color with a dark brown line along the side with two wavy lines above it (Figure 5b). There are two generations per year of the bindweed moth in the PNW. Second generation adults emerge in late summer. Overwintering occurs in both the larval and adult stage in soil litter.

Status in the United States

The bindweed moth was introduced from Italy and released on field bindweed in numerous states beginning in 1987. It was released on hedge bindweed in 1991 but failed to establish (Winston et al. 2019). Though it has established on field bindweed in a few northwestern states, populations are too limited to have any impact (Winston et al. 2014). Additional research is needed to understand why it has established so poorly despite multiple releases. Given its lack of availability and impact, this biocontrol agent is not recommended as an effective control measure for bindweed.

*The Bindweed Gall Mite (*Aceria malherbae*)*

Description and life cycle

Nymph and adult stages are similar. Both are worm-like with two pairs of legs, and both have yellowish, translucent bodies (Figure 6a). Mites are tiny and are best seen through a microscope. Consequently, it is their damage that is more useful for identifying their presence. Adults emerge in early spring and feed on field bindweed, forming galls on actively growing leaves, leaf stems, and stem tips. Galls are characterized by the discolored folding and twisting of leaves along the midrib where mites feed (Figure 6b,d,e). Attacked stem tips fail to elongate and form clusters of stunted leaves. Attacked plants also experience a reduction in flowering (Figure 6c). Adults lay eggs within the galls and produce multiple generations per year. Overwintering occurs in both the nymphal and adult stage on field bindweed root buds.

Status in the United States

The bindweed gall mite was introduced from Greece and released on field bindweed in numerous states beginning in 1989. It was released on hedge bindweed in 1993 and 2010 but establishment is believed to have failed, and it is not considered a viable management tool for this species (Winston et al. 2019). Although it is established on field bindweed in numerous western and midwestern states, its abundance, attack levels, and

Figure 5. The bindweed moth adult (a) and larva (b). Photos: a: Eric Coombs, Oregon Department of Agriculture, Bugwood.org, CC BY 3.0 US; b: USDA ARS, Bugwood.org, CC BY 3.0 US.

Figure 6. The bindweed gall mite adult under magnification (a) and damage to field bindweed leaves and stems (b,c,d,e). Heavily infested plants have extreme leaf and stem twisting and deformation (b,c,d) while lighter infestations may only cause slight damage to leaves (e). Photos: a: USDA-ARS, Bugwood.org, CC BY 3.0 US; b,c,d,e: Jennifer Andreas, WSU Extension.

impact vary dramatically from place to place. There has been no impact at some sites and greater than 90% decrease in aboveground plant biomass at others (Winston et al. 2014). Reasons for this variability are not understood, but mite populations are known to be impacted by climate (they appear to do better under hot, dry conditions) and plant resistance. In the Pacific Northwest, the most successful impacts have occurred at sites with extreme heat and low moisture (e.g., steep hillsides in southeastern Washington and Idaho); nevertheless, the mite's efficacy varies even under these conditions. The mite does not appear to thrive at sites that are irrigated nor at sites west of the Cascade Mountains, possibly because of moderate temperatures and increased precipitation. More research is needed to understand what is causing the variability of the mite's impact in North America.

Additional releases are warranted with the intent of finding some sites and conditions where the bindweed gall mite can thrive. This mite can be redistributed by collecting galls from attacked plants and intertwining galled material around young, healthy growth of uninfested field bindweed plants in new locations when field bindweed is actively growing. Mowing or clipping bindweed infestations a week or two prior to release provides fresh growth for mites to transfer onto and begin feeding. Establishment can be monitored the following season by observing galls on new bindweed growth. Once established, mite populations can be encouraged to multiply by mowing the field bindweed infestation throughout the growing season.

Future Biological Control Agents

Because neither of the two biocontrol agents established in the United States are controlling field bindweed at all locations, the search for additional agents has been reinitiated in Europe. While no new agents are currently available, significant progress has been made in identifying and studying new candidates. Additional research is currently on hold pending available funding. Because noticeable biocontrol impacts to field bindweed may take several years, for either the two established species or any new agents approved in the future, additional control methods are currently warranted for most bindweed infestations.

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