

# STEVE'S Weed of the Month

## Dalmatian Toadflax

**Dalmatian Toadflax** is a **Class B Weed**. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal.

**Dalmatian toadflax** (*Linaria genistifolia* ssp. *dalmatica* L.) is native to the Mediterranean region, specifically the Dalmatian Coast of Croatia. Dalmatian toadflax was probably introduced to North America in the late 1800's as an ornamental. The first record of toadflax in Washington State dates back to the 1920's, when the species was collected near Spokane. Dalmatian toadflax spreads both by seeds and roots. Dalmatian toadflax is a perennial that grows up to 4 feet tall. Waxy green leaves are heart shaped, 1 to 3 inches long, and clasp the stem. Flowers are approximately 1 inch long, yellow, often tinged with orange or red, and similar in shape to a snapdragon. Flowering occurs from midsummer to fall; but 97% of the seed is produced in the first five weeks of flowering. Dalmatian toadflax must be cross-pollinated and pollination occurs primarily by long-tongued bumble bees. Flowers are visited by some moths; but their pollination success is unknown while Honey- and short-tongued bees often bite into the spur for nectar and so circumvent pollination. Seeds are produced in a ½-inch pod and are irregularly wing angled.

Photos by: Bob Nowierski



Mature Dalmatian toadflax plants are strongly competitive. Studies indicate that plots without Dalmatian toadflax may produce two and a half times as much grass as plots with toadflax (Robocker 1974). Mature plants are especially competitive with shallow-rooted perennials and winter annuals. Because of its competitive ability, Dalmatian toadflax is a concern in pasture and rangelands, as well as in natural areas, where it may out compete more desirable, native species.



**Reproduction:** Dalmatian toadflax is a perennial species that spreads by horizontal or creeping rootstocks and by seed. A mature plant can produce up to 500,00 seeds, which are primarily dispersed by wind. The seeds may live up to ten years in the soil (Robocker 1974; Morishita 1991). Most seedlings emerge in the spring when soil temperature reaches 8° C at 2.5 cm. Germination in the fall is probably limited by soil water content, as well as possibly seed dormancy (Robocker 1974).

## Management

Successful management of the toadflax species requires integrating as many management strategies as possible into the program design. This is especially important for the toadflaxes, because of their high genetic variability. This variability results in localized populations that respond differently to the same herbicides, management methods, biological control agents, and environmental conditions. Management programs for Dalmatian toadflax should emphasize equally the prevention of seed formation and vegetative spread, while programs for yellow toadflax can emphasize control of vegetative spread with secondary emphasis on prevention of seed formation.

**Prevention:** Because the toadflax species are expensive, labor-intensive, and extremely difficult to manage once infestations become established, preventing infestations from occurring is time- and cost-effective. New infestations of toadflax originate from seeds or vegetative buds on root pieces; therefore, keeping seeds and contaminated materials or equipment out of uninfested areas is a good strategy.

Farm operations, outdoor recreation, and other human activities can transport seeds into uninfested areas. Seeds can be transported on ATV's, construction equipment, vehicles, agricultural machinery, tires, and by livestock. Check and clean equipment before moving into uninfested areas.

When moving livestock from infested to uninfested areas, hold them in corrals or small pastures until viable seeds have had time to pass through the digestive tract. Hold cattle six days and sheep 11 days, monitor these holding areas regularly for seedling establishment. Avoid purchasing feed or seed that could be contaminated with weed seeds.

**Mechanical and Physical Control:** Pulling toadflax by hand can be effective for small infestations, especially in sandy soils or when soils are moist. Pulling each year for five to six years is necessary to deplete the remaining root system of reserves. Try to follow lateral roots to their ends. The site must be revisited for 10 to 15 years to remove seedlings produced from dormant seeds.

Because established infestations of yellow toadflax spread mainly by roots, physical removal can limit spread.

Mowing is not recommended for any of the toadflax species, since it does not affect root reserves or buried seeds, nor is it feasible on most sites. Hand-removal of the flowering tops from the plants is a marginal strategy even for very small infestations.

**Cultural Controls:** Intensive clean cultivation can effectively control Dalmatian toadflax. A successful approach includes at least a two year effort, with eight to ten cultivations in the first year and four to five cultivations in the second year (Morishita 1991; Butler and Burrill 1994). Cultivation should begin in early June and be repeated so that there are never more than seven to ten days with green growth visible (Butler and Burrill 1994). Since Dalmatian toadflax seedlings do not compete well for soil moisture against established winter annuals and perennials, control efforts should include attempting

to establish and manage desirable species that will compete with toadflax (Morishita 1991; Butler and Burrill 1994).

Active growth of the toadflax species during all seasons enhances the competitiveness of the species. However, the initial vulnerability of toadflax seedlings often enables well-adapted plant species to out compete toadflax seedlings. In cropland, barley appears to inhibit vegetative reproduction of yellow toadflax to some extent. Rangeland in excellent condition can out-compete many germinating toadflax seedlings.

**Grazing:** Overgrazing by cattle in spring, can increase establishment of toadflax because, seedlings can more effectively compete with grazed plants for soil moisture and other resources. Timing of grazing is important in developing and maintaining competitive, desirable plant communities. Grazing strategies will be less effective in restricting expansion of established stands, because of toadflax's deep, competitive roots.

However, preliminary results of field trials in Montana show that sheep can be used to help suppress stands of Dalmatian toadflax and limit seed production. In these studies, 1,000 ewes and lambs were placed in a hilly rangeland area of moderate to heavy infestations with Dalmatian toadflax densities of 25% to 100% of existing vegetative coverage. Approximately 35% to 45% of the toadflax foliage was stripped, including the terminal 6 to 10 inches of plant stems. Although initially the sheep only nibbled at the plants, in two to three weeks they were consuming Dalmatian toadflax regularly, even though other forages were present. In these studies, the sheep did well and showed good weight gain.

Burning is usually not effective for the toadflaxes, because root buds and buried seeds are unaffected. Burning can increase the competitiveness of the toadflax by removing desirable plants. Removal of top growth can also stimulate production of vegetative shoots.

**Chemical Controls:** Effectiveness of herbicides used to manage the toadflax species is highly variable, partly because of the plants' high genetic variability. The waxy leaf surface of Dalmatian toadflax provides a protective barrier that hinders herbicide uptake in some cases. Soil type is also important, since it is more likely that the herbicide will leach below the plant root zone on sites with sandy soils or soils low in organic matter, especially in stands in which lateral roots are very close to the soil surface.

Even when herbicide treatment of toadflax appears to be effective, long-term control may not be achieved and reinvasion may occur. It is necessary to treat an infestation every three to four years for as long as 12 years to eradicate the weed on sites where herbicides are effective.

**Herbicides:** Picloram, picloram + 2,4-D and imazapic all provide effective control, although repeated applications may be necessary to achieve complete control.

**More information can be found in the  
PNW Weed Management Handbook**

**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. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

**Biological Controls:** All insect species that have been released for control of Dalmatian toadflax also attack yellow toadflax, and are intended as biological control agents for that species, also.

As of 1998, several species of insects have been released on Dalmatian toadflax, including a defoliating moth (*Calophasia lunula*), an ovary-feeding beetle, and two seed capsule-feeding weevils (*Gymnaetron antirrhini* and *Gymnaetron netum*). A stem-boring weevil and a root-boring moth have been released in Canada and the United States.

There are 35 insects apparently restricted to the genus *Linaria*: 14 flower or fruit-feeders, 8 root-feeders, 7 stem-feeders, and 6 leaf-feeders. The Balkans, which is the center of origin for broad-leaved toadflax, has been surveyed, but not the NE Mediterranean center of diversity for the section *Speciosae* to which *L. genistifolia* and *L. dalmatica* belong. Nine specialized toadflax agents have been released in Canada or are naturalized (P. Harris and R. DeClerck-Floate, 2005).

**1. *Mecinus janthinius*:** A stem mining weevil that reaches outbreak populations 3-5 years after release. Adult feeding kills most shoot tips which almost prevents flowering and eliminates the niche for flower and seed-head insects. All up-right stems are attacked with up to a 100 larvae in large primary stems. A consequence is that the prostrate stems are small and often short-lived, and plants regenerating in the spring are small and presumably vegetative reproduction is reduced. Most seed (67%) germinates in the first year and although longevity is up to 10 years, there is little left after five years. Thus density should decline 8-10 years after weevil release and with it, the density of *M. janthinius*.

**2. *Brachyterolus pulicarius*:** A flower-feeding beetle that arrived adventitiously in Saskatchewan in the early 1950s from the east to breed on *Linaria vulgaris* and *L. genistifolia*. In Montana cage-studies, it reduced *L. dalmatica* seed production by 67-93%.

**3. *Calophasia lunula*:** A leaf defoliating moth released in 1962. It attacks Dalmatian toadflax, but is more common on *L. vulgaris*. It has not controlled either weed.

**4 & 5. *Eteobalea intermediella* and *E. serratella*** are root-feeding moths released in 1992. *Eteobalea serratella* was shown to weaken *L. vulgaris*, particularly when growing in competition with a crop (Volenberg, D.S., et. al. 1999).

**6. *Rhinusa antirrhini*:** A gall-forming seed head weevil. Its niche in *L. genistifolia* is rapidly being destroyed by *M. janthinius*.

**7. *Rhinusa linariae*:** A root-gall former approved for release in 1995.

**8. *Rhinusa neta*:** An adventive non-gall forming seed feeder. It is possible, that like some other species of *Rhinusa*, *R. neta* is preferably parasitic on the seed galled by other *Rhinusa spp.*, although it can develop on ungalled seed.

**Questions:** contact [Steve Van Vleet](#) or phone (509) 397 - 6290

## References

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