



## Dalmatian Toadflax (*Linaria genistifolia* ssp. *Dalmatica*)

### New Mexico State University Weed-Factsheet

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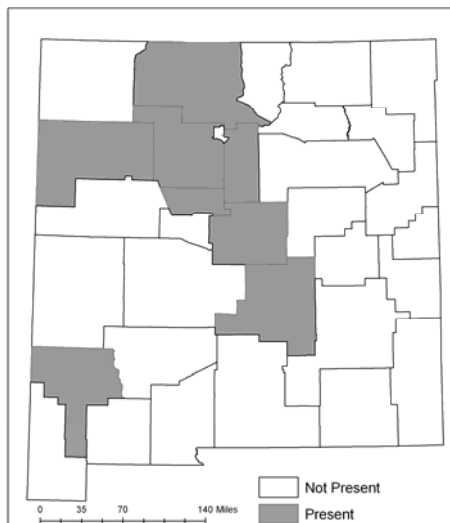
Jennifer A. Erskine Ogden and Mark J. Renz, New Mexico State University<sup>1</sup>

#### INTRODUCTION

Dalmatian toadflax, also known as broad-leaf toadflax, is a short-lived, creeping perennial herbaceous species in the figwort (scrophulariaceae) family. It aggressively invades disturbed communities including roadsides, graded areas, abandoned lots and fields, clear cuts, rangelands, and riparian communities, displacing native and desirable species. Although cattle avoid grazing this plant, Dalmatian toadflax contains a poisonous glucoside harmful to cattle if consumed in large quantities. Sheep and goats, however, can graze this species without any harm from the glucoside.



Dalmatian toadflax shoots emerge from early April through May. Horizontal roots produce adventitious buds that can form new plants. Flowers are found in the axils of the leaves from May through August and seeds are produced from July through October. Although most seeds are dropped within the first year, erect dead stems can hold viable seeds for two years.



Dalmatian toadflax is native to the Mediterranean region, and was brought to the western US as an ornamental species in 1874 (Alex 1962). Currently, large infestations occur in California, Washington, Oregon, Idaho, Montana and Wyoming. It is listed as a noxious weed in New Mexico, Colorado, Arizona, and Nevada. In New Mexico, it was first documented in 1971 in Lincoln county, and is currently found in most northwestern counties, as well as 3 southern counties. Invasions have been common at higher elevations, but Dalmatian toadflax can establish along riparian areas as it is currently invading the bosque in Albuquerque.

<sup>1</sup> Department of Extension Plants Sciences; Phone (505) 646-5280; email [markrenz@nmsu.edu](mailto:markrenz@nmsu.edu)

## IDENTIFICATION

Dalmatian toadflax stems are typically 3 feet tall, with individual plants producing up to 25 stems in the first year of growth. Stems are rough and woody at the base becoming smooth, waxy and herbaceous toward the top. Leaves are also waxy with a bluish green color, ovate to heart shape but sometimes lanceolate, 0.5 to 2.3 inches long, with smooth margins. Leaves are alternate and clasping on the upper portion of the stem. Dalmatian toadflax produces both taproots and creeping roots, with adventitious buds forming new individuals. Roots can grow 4-10 feet deep and can extend 10 feet from the parent plant.



Flowers resemble snapdragons with petals ranging from 0.75 to 1.5 inches long. Flowers are two-lipped, yellow with an orange, bearded throat and a long spur. Flowers mature from the lower part of the stem upwards, therefore various stages of flowering and fruiting can be present on an inflorescence (Parker and Peabody 1983). Fruits are two-celled capsules with many irregularly-shaped sharply angular, slightly winged, black seeds.

Table 1: Differences in growth and reproduction in Dalmatian and yellow toadflax.

	<b>Dalmatian toadflax</b>	<b>yellow toadflax</b>
<b>Shoot emergence</b>	April-May	May onwards
<b>Leaves</b>	Waxy blue green color, ovate to heart shaped; clasping upper portion of stem. 0.5-2.3 inches long	Pale green, linear to linear lanceolate; sessile but not clasping. 1-2.5 inches long, 0.1-0.2 inches wide.
<b>Stems</b>	Average 3 feet tall	1-3 feet tall
<b>Fruits</b>	Irregularly shaped two-celled capsules	Globe shaped two celled capsules
<b>Seeds</b>	Black, sharply angled and slightly winged	Dark brown to black long, flattened, winged
<b>Seed production</b>	500,000 seeds/plant	30,000 seeds/plant
<b>Seed viability</b>	High viability with germination rates as high as 75%	Low viability with 10% germination rates under field conditions
<b>Vegetative reproduction</b>	Root buds and lateral growth begins 9 weeks after germination	Root bud and lateral root growth begins 2-3 weeks after seed germination

## REPRODUCTION AND SPREAD

Dalmatian toadflax spreads through both seed production and vegetative reproduction from buds on creeping roots. A single plant can produce 500,000 seeds annually (Robocker 1970), with seed production occurring from July through October, depending on the plant's location, aspect, and the availability of water. While some seed germination can occur in the fall, most occurs in the spring (April-May), with rates as high as 75% (Robocker 1970). High seed germination rates often occur after adult plants have been treated at a site because of the increased light availability and disturbance, even if a pre-emergent herbicide is used (Lejeunesse 1999). Seeds that germinate in the fall produce rosettes that survive through the spring when floral stalks are produced. Seeds are viable in the soil for up to 10 years, and seeds can be spread by machinery. Wind dispersal of individual seeds is minimal with most seeds falling below the parent plant. Dried floral stalks retaining seed can



remain on the plant for up to two years. These stalks can break off and blow across a landscape and disperse seeds (Lajeunesse 1999).

Adventitious buds also form on perennial roots. These buds can appear within 9 weeks after germination, and begin vegetative spread (Bakshi and Coupland 1960). Vegetative shoots from roots are typically the first to emerge in the spring, before desirable plant species, and can grow with little water. However, new populations of Dalmatian toadflax are typically established by seeds. Root fragments caused by machinery have been documented to be the cause of new infestations, but to a lesser degree than seeds. Individual Dalmatian toadflax plants live an average of 3-5 years, and patches can persist for 13 years or more under favorable conditions.

## MANAGEMENT

Both Dalmatian and yellow toadflax are genetically diverse and difficult to control. Preventing the establishment of populations of Dalmatian toadflax is the most time and cost effective way of controlling this species. Farm, rangeland, and outdoor recreation equipment can transport seeds, and should be cleaned thoroughly before moving from infested areas to un-infested areas. Livestock can also transport seeds. Cattle should be held in corrals for six days and sheep for 11 days before moving from an infested area to an un-infested area so that viable seeds can pass through their systems (Lajeunesse 1999). The seedling stage is most vulnerable in both Dalmatian toadflax and yellow toadflax, and where seedlings are found, they should be immediately removed. Once the root system is established, these species are extremely competitive for water and resources, and are difficult to control/eradicate. Management of Dalmatian toadflax should focus on both the prevention of seed formation and the prevention of vegetative spread as both factors are equally important in establishing populations.

### *Physical/Mechanical/Cultural*

Pulling small infestation of Dalmatian toadflax by hand can be an effective way of control, especially if established in a sandy or moist soil. Pulling must continue for 5-6 years to remove all root fragments, and lateral roots should be followed and removed from the soil. The site should be revisited for many years (10-15 years) to assure the removal of seedlings produced from dormant seeds as well (Lajeunesse 1999). Mowing and burning are ineffective at controlling either toadflax species as they do not affect the root stocks or the buried seeds. Cultivation can be used to control this plant where feasible. Parker and Peabody (1983) found that cultivation repeated every 7-10 days, repeated for 2 years can effectively eradicate these species. Machinery needs to be cleaned well to prevent the spread of root fragments to un-infested areas. Well adapted species can be highly competitive with toadflax seedlings. A combination of toadflax control with seeding of a variety of species with different phenologies and rooting systems (shallow, intermediate, and deep rooted species) can effectively outcompete germinating Dalmatian toadflax seedlings. Care must be taken to not overgraze areas as this has been shown to increase the spread of toadflax infestations. Since animals typically do not graze toadflax species, the plants become more competitive and abundant than the grazed species. However this can vary with animals as preliminary field studies in Montana have shown that sheep can help suppress stands of Dalmatian toadflax and limit seed production. When 1000 ewes and lambs were placed in hilly rangeland with Dalmatian toadflax cover ranging from

25%-100%, approximately 35-45% of the foliage including the upper 6-10 inches of plant stem (and inflorescence) were consumed in 2-3 weeks (Lajeunesse 1999).

### *Biological control*

Eight insects have been introduced and approved by the USDA-APHIS-PPQ for release as biocontrol agents for both Dalmatian and yellow toadflax in the United States with varying success. *Brachypterolus pulicarius*, a shoot and flower feeding beetle can reduce seed set on attacked plants by 74% (McClay 1992). *Gymnaetron antirrhini*, and *Gymnaetron netum*, both seed-capsule feeding weevils, have been shown to impact seed production in these species. *Calophasia lunula*, a moth introduced from Eurasia, has been shown to defoliate up to 20% of a plant (Montana State University 2000). Currently none of these agents have been released in New Mexico.

### *Herbicides*

Herbicides used exclusively and in combination with seeding of competitive species can control Dalmatian toadflax. Most herbicide treatments are recommended at the flowering stage, with seeding of desirable competitive species the following spring. Herbicide control of Dalmatian toadflax can vary because of the large genetic variation within the species, its ability to grow in a variety of climates, and because of the waxy covering on its leaves and stems. Even when herbicide treatment appears successful, follow-up every 3-4 years for as long as 12 years is necessary to eradicate the species. See table 2 for a list of herbicides available. Use lower recommended rate when plants are growing in sandy soils. **It is important to read the herbicide label BEFORE making any application, as different herbicides will have different requirements and restrictions.**

**Table 2. Herbicide options for management of Dalmatian toadflax**

Herbicide	Active Ingredient	Rate of Herbicide	Timing of application	Comments
Tordon 22K*	picloram	1-2 qt/A	Flowering or in the fall; especially effective after first hard frost	<ul style="list-style-type: none"> <li>• Residual herbicide</li> <li>• Selective</li> <li>• Retreatment for several years may be required.</li> <li>• Best control occurs when area re-seeded with competitive grasses</li> </ul>
Telar	chlorsulfuron	2-3 oz/A + 0.25% (v/v) non-ionic surfactant	Flowering to fall	<ul style="list-style-type: none"> <li>• Residual herbicide</li> <li>• Selective</li> <li>• Persistent in high pH soils</li> <li>• Retreatment for several years may be required.</li> </ul>
Many compounds	glyphosate <sup>1</sup>	3-4 lbs ai/acre	Early bloom	<ul style="list-style-type: none"> <li>• Nonselective</li> <li>• Will suppress in current year, but abundant regrowth will occur the following year.</li> </ul>
Banvel, Clarity, Vanquish	dicamba	2-4 qt/acre	Pre-bloom to flowering stage	<ul style="list-style-type: none"> <li>• Residual herbicide</li> <li>• Selective</li> <li>• Retreatment for several years may be required.</li> </ul>

<sup>1</sup> Many products containing this active ingredient are available.

\* Indicates product is a restricted use pesticide in New Mexico

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## WEBLINKS

<http://www.nbsc.nau.edu?FNF/Vegetation/Exotics/linariatitle.html>

<http://tncweeds.ucdavis.edu/esadocs/documnts/linadal.pdf>

<http://www.unce.unr.edu/publications/FS02/FS0296.pdf>

<http://www.ext.colostate.edu/pubs/natres/03114.pdf>

<http://www.cdfa.ca.gov/phpps/ipc/weedinfo/linaria.htm>