Yellow Toadflax (*Linaria vulgaris*)

New Mexico State University Weed-Factsheet

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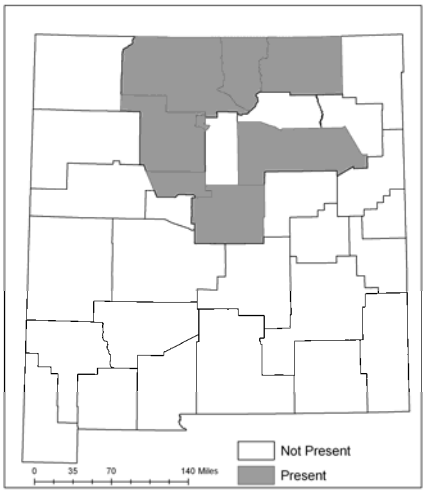
INTRODUCTION

Yellow toadflax, also known as butter and eggs, wild snapdragon, Jacob's ladder, and common toadflax, is a short-lived, creeping perennial herbaceous species found in the Figwort (Scrophulariaceae) family, currently invading New Mexico. It aggressively invades disturbed communities including roadsides, graded areas, abandoned lots, rangelands, and riparian communities, displacing native and desirable species. Although cattle avoid grazing the species, yellow toadflax contains a poisonous glucoside harmful to cattle if consumed in large quantities.

Yellow toadflax seedlings germinate in early May, while resprouts from underground stems appear as early as March. Lateral roots form adventitious buds which sprout and form into new independent plants. Yellow toadflax is a relatively short-lived perennial species with individuals surviving an average of 4 years. Flowers are formed in the axils of upper leaves from May through August and seeds are produced from July through October. Unlike Dalmatian toadflax, yellow toadflax seed viability is quite low, and relies on vegetative reproduction for most of its spread and persistence in the field.



Yellow toadflax is native to southeastern Europe and southwestern Asia. It was first introduced into the United States from Wales during colonial time as an ornamental species and to make yellow dye, and escaped from colonial gardens (Mitich 1993). It is a weed common in the eastern U.S., but found throughout the United States and Canada, with heavy infestations in Idaho, Montana, Oregon, and Washington (Saner et al. 1995). It is listed as a noxious weed in New Mexico, Arizona, Colorado, and Nevada. In New Mexico, it was first documented in 1961 in Sandoval county, and is currently widespread in the northern counties.

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IDENTIFICATION

Yellow toadflax stems grow 1-3 feet tall, are generally woody at the base and smooth near the tip. Leaves are soft, linear to linear lanceolate, sessile though not clasping, and pale green. They are generally about 1.0-2.5 inches long and 0.1-0.2 inches wide. Yellow flowers form in the axils of the upper leaves are approximately 1 inch long, and resemble those of the snapdragon with an orange bearded throat and a yellow spur. Flowering occurs from May through August with the youngest flowers forming at the tip of stems. As plants mature, fruit form that are brown, globed-shaped, two-celled, capsules. Seeds are long, flattened, dark brown to black in color, and winged.

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

	Dalmatian toadflax	**yellow toadflax**
Shoot emergence	April-May	May onwards
Leaves	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.
Stems	Average 3 feet tall	1-3 feet tall
Fruits	Irregularly shaped two-celled capsules	Globe shaped two celled capsules
Seeds	Black, sharply angled and slightly winged	Dark brown to black long, flattened, winged
Seed production	500,000 seeds/plant	30,000 seeds/plant
Seed viability	High viability with germination rates as high as 75%	Low viability with 10% germination rates under field conditions
Vegetative reproduction	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

Yellow toadflax reproduces by both seed and vegetative growth from underground roots. Mature plants can produce up to 30,000 seeds annually (McClay 1992), although generally only about 40-50% of the seeds are viable and 10% germinate under field conditions (Clements and Cavers 1990, Saner et al. 1995). Seedlings can begin producing vegetative shoots from root buds as early as 2-3 weeks after germination, and lateral roots can spread several yards away from the initial plant. Yellow toadflax seed dispersal begins in August, and continues through the winter. Although wind was initially thought to be an important dispersal mechanism, studies have shown that 80-90% of the seeds fall within 18 inches of the parent plant (Nadeau and King 1991). Wind dispersal is only important when entire floral stalks break from the plant and roll across the

landscape (Lajeunesse 1999). Seeds appear to be more important in the establishment of new infestations, although in arable lands, root fragments that cling to farming equipment can also begin new infestations. Lateral roots and root fragments play the dominant role in establishment and expansion of infestations of yellow toadflax, as seed viability and germination are low for this species.

MANAGEMENT

Preventing the establishment of populations of yellow toadflax is the most 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. Seedlings are poor competitors and highly susceptible to dehydration, therefore are the easiest stage to control. Once the root system is established, these species are extremely competitive for water and resources, and are difficult to control/eradicate. Management should primarily focus on controlling vegetative spread for yellow toadflax, and secondarily focus on preventing seed formation.

Physical/Mechanical/Cultural

Hand-pulling small infestation of yellow toadflax can be an effective way of controlling the species, especially if established in a sandy or moist soil. Pulling must continue for 5-6 years to remove all root fragments including lateral roots. Physical removal of root fragments is quite effective at deterring spread, but the site must be revisited for 10-15 years to assure the removal of seedlings produced from dormant seeds (Lajeunesse 1999). Mowing and burning are ineffective at controlling either toadflax species as they do not affect the root stocks or buried seeds. Cultivation can be used to control toadflax species where feasible although it must be done repeatedly as plants can re-sprout from root fragments as small as 0.5 inches. Parker and Peabody (1983) found that cultivation repeated every 7-10 days with sweep-type cultivators, repeated for 2 years can effectively eradicate these species. Well adapted rangeland 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) should effectively outcompete yellow toadflax. In croplands, barley has been shown to inhibit vegetative reproduction of yellow toadflax as well (Nadeau and King 1991). Overgrazing of fields by cattle can increase the spread of toadflax infestations as the toadflax species are generally not grazed. If animals are used to manage yellow toadflax they should be held in corrals 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).

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 and reduce seed production in yellow toadflax by 85-90% (Rees et al. 1996). *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 alone and in combination with seeding of competitive species can control yellow toadflax. Most herbicide treatments are recommended at the flowering stage, with seeding of desirable competitive species the following spring. Herbicide control of yellow toadflax can vary dramatically because of the large genetic variation within the species. Even when herbicide treatments appear successful, follow-up may be necessary every 3-4 years for as long as 12 years to eradicate the species. See table for a list of herbicides available. Use lower 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 yellow Toadflax

Herbicide	Active Ingredient	Rate of Herbicide	Timing of application	Comments
Tordon*	picloram	1-2 qt/A	Flowering to fall; Especially effective after first hard frost	• Residual herbicide • Selective • Retreatment for several years may be required.
Telar	chlorsulfuron	2-3 oz/A + 0.25%v/v non-ionic surfactant	Flowering or in the fall	• Residual herbicide • Selective • Persistent in high pH soils • Retreatment for several years may be required.
Banvel, Clarity, Vanquish	dicamba	2-4 qt/acre	Flowering or in the fall	• Residual herbicide • Selective • Retreatment for several years may be required.
Many[1]	glyphosate[1]	3-4 lbs ai/acre	Early bloom	• Nonselective • Will suppress in current year, but abundant regrowth will occur the following year.
Plateau + MSO	imazapic + methylated seed oil	8-12 fl oz/A + 1 qt methylated seed oil	Fall after a hard frost	• Residual herbicide • Selective • Use lower rate when cool season grasses are present.

[1] Many types of this herbicide are available for use.
* Indicates product is a restricted use pesticide in New Mexico

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WEBLINKS

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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