

Field Guide for Managing Dalmatian and Yellow Toadflaxes in the Southwest



Cover Photos

Top left: Dalmatian toadflax; Utah State University Archive, Utah State University, Bugwood.org

Top right: Dalmatian toadflax flower; Bob Nowierski, Montana State University, Bugwood.org

Bottom left: Yellow toadflax, David Powell, U.S. Forest Service, Bugwood.org

Bottom right: Yellow toadflax flower; Wendy Van Dyk Evans, Bugwood.org

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Dalmatian toadflax (*Linaria dalmatica* (L.) Mill. ssp. *dalmatica*)

Yellow toadflax (*Linaria vulgaris* Mill.)

Figwort family (Scrophulariaceae)

Dalmatian toadflax and yellow toadflax are invasive plants that have been introduced into the southwestern United States. Both species are listed in New Mexico as noxious weeds; however, only Dalmatian toadflax is listed in Arizona.

This field guide serves as the U.S. Forest Service's recommendations for management of Dalmatian and yellow toadflaxes in forests, woodlands, and rangelands associated with its Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also includes four national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Dalmatian toadflax (synonyms: broad-leaved toadflax, wild snapdragon) and yellow toadflax (synonyms: butter-and-eggs, common toadflax, toadflax, Jacob's ladder, common linaria, wild snapdragon) were brought from the Mediterranean region to the western U.S. as ornamentals

and have since escaped to become widely growing invasive plants. Currently, large infestations occur in California, Colorado, Washington, Oregon, Idaho, Montana, Nevada, Utah, and Wyoming. These short-lived perennials produce new plants from adventitious buds on a resprouting root system that is both extensive and deep. Flowers of both plants are snapdragon-like. While similar in appearance, Dalmatian toadflax grows taller and produces new plants mainly from seed whereas yellow toadflax spreads mostly from root buds. Table 1 lists growth characteristics of both toadflax species.

Ecology

Impacts/threats

These aggressive weeds are highly adaptable and can out-compete winter annuals or shallow rooted perennials for soil moisture. A high density of toadflax reduces the availability of quality forage and diversity of flora and fauna species. Dalmatian and yellow toadflaxes contain glucoside compounds that are poisonous, especially to cattle; however, these plants are typically not grazed by animals.

Table 1. Growth characteristics

Species	Life Span	Growth and Root Habit	Vegetative Appearance	Flower Appearance	Reproductive Method and Seed Appearance
Dalmatian toadflax	Short-lived perennial (generally < 5 years)	Averages 3 feet tall; up to 25 stems per crown during first year of growth; taproot and creeping lateral roots.	Waxy, blue-green oval to heart-shaped; leaves clasp upper stem; rough, woody stem at base that becomes smooth, waxy and herbaceous near the top.	0.75 to 1.5 inches long yellow, two-lipped flowers with an orange bearded throat and a long spur; flowers in leaf axils. Fruit 2 celled and irregular shaped.	Reproduces mainly by seed and partly by adventitious root buds. Black, sharply angled seeds that are slightly winged. Produces 500,000 seeds per plant.
Yellow toadflax	Same as above.	1.5 to 3 feet tall; has taproot and extensive system of vertical roots with creeping laterals. Grows in tight clumps.	Pale green, soft linear lanceolate leaves that are sessile and do not clasp stem; Upright, unbranched stem that is woody at the base and smooth at the tip.	1-inch long yellow flowers with 5 fused petals (2 upper lobes and 3 lower), an orange bearded throat, and a yellow spur; flowers in leaf axils. Fruit 2 celled and globe shaped.	Reproduces primarily by adventitious buds on lateral roots. Seeds are dark brown to black, long, flattened, and winged. Produces 30,000 seeds per plant.

Location

Disturbance favors toadflax establishment. Both species thrive in degraded areas such as roadsides, cleared lots and fields, gravel pits, heavily grazed rangeland, and riparian zones. These weeds often establish in naturally occurring openings within sagebrush, ponderosa pine, and other woodland or parkland plant communities at higher elevations. Dalmatian toadflax favors cool, semiarid climates and coarse, dry soils with a neutral pH. Yellow toadflax favors moist soils and can tolerate subarctic conditions. In New Mexico, Dalmatian toadflax is typically found at elevations between 5,000 and 6,000 feet, whereas yellow toadflax occurs at higher elevations between 6,000 and 9,500 feet. Infestations of both species are expanding in Arizona and New Mexico.

Spread

Yellow toadflax produces shoots from underground stems as early as March from which new, independent plants can form later during the growing season. Seed viability in yellow toadflax is quite low; therefore, the spread and persistence of plants in the field are due mainly to vegetative reproduction. Unlike yellow toadflax, Dalmatian toadflax spreads vegetatively and by seed with shoots emerging from these two sources in early April through May. Seed viability for Dalmatian toadflax is high with germination rates near 75 percent.

Invasive Features

Yellow toadflax can grow new shoots on lateral roots as far as 10 feet away from the parent plant. A single Dalmatian toadflax plant can produce 500,000 seeds from July through October depending on location, aspect, and availability of water. Seeds are viable in the soil for up to 10 years, and roots are easily spread by machinery.

Management

Early detection and preventing a population from expanding is the first priority for managing Dalmatian and yellow toadflaxes. The seedling stage is most vulnerable, and

seedlings should be removed upon discovery. Once the root system is established, these plants are extremely competitive for water and resources; and they are difficult to control/eradicate. Management of established plants should focus first on smaller infestations in otherwise healthy sites, and measures should be taken to prevent seed formation and vegetative spread. Larger infestations are very difficult to manage and cannot be effectively controlled within a single year or by using only one method. Complete control will likely require 10 to 15 years of repeated treatment and followup management. The following actions should be considered when planning a management approach:

- Maintain healthy plant communities to reduce or limit toadflax infestations. This may involve using improved grazing management strategies to prevent overgrazing.
- Check hay and straw for presence of toadflax seed. Only certified weed-free hay and pellets should be fed to horses used in back-country areas.
- Detect, report, and eradicate new populations of toadflax as early as possible.
- Map known infestations. Keep annual records of reported infestations.
- Combine mechanical, cultural, biological, and chemical methods for most effective toadflax control.
- Implement monitoring and a followup treatment plan for missed plants and seedlings.

Table 2 summarizes management options for controlling Dalmatian or yellow toadflax under various situations. Choice of individual control method(s) for these toadflaxes depends on the degree and density of infestation, current land use, and site conditions (accessibility, terrain, microclimate, other flora and fauna present, etc.). Other important considerations include treatment effectiveness, overall cost, and the number of years needed to achieve control. More than one control method may be needed for a particular site.

Table 2. Management Options*

Site	Physical Methods	Cultural Methods	Biological Methods	Chemical Methods
Roadsides and noncrop areas	In level terrain, use repeated cultivation with disk or sweep-type cultivators about 8 to 10 times the first year followed by 4 to 5 times the second year. Follow up with chemical control.	Educate road crews to identify and report infestations along roads; implement requirements for vehicle operations.	Use beetles, moths, or weevils as classical biological control agents (see table 3). Effectiveness of biological control agents may be limited when disturbance from road operations interrupts an agent's life cycle.	Apply in fall during late flowering stages. Use truck or ATV-mounted spraying equipment. Wash under vehicle after application to prevent spread.
Rangelands	In level terrain, use repeated cultivation with disk or sweep-type cultivators about 8 to 10 times the first year followed by 4 to 5 times the second year. Follow up with chemical control.	Use certified weed-free hay. Check animals, clothing, and vehicles for seeds. Corral sheep for 11 days before moving to uninfested areas. Reseed treated areas if necessary to make desirable plants more competitive. Fertilization and/or irrigation may help establishment of desirable plants. Plant certified seed.	Use beetles, moths, or weevils as classical biological control agents (see table 3). Closely manage grazing to prevent overuse.	For extensive and dense infestations, use ground or aerial broadcast spraying. For less dense infestations, consider individual plant treatment with crews using backpack sprayers.
Wilderness and other natural areas	Repeated hand-pulling, digging, or hoeing for seedlings and regrowth. Anticipate need to repeat treatments and monitor for ~10 years.	Use certified weed-free hay. Check animals, clothing, and vehicles for seeds. Corral sheep for 11 days before moving to uninfested areas. Post signs warning visitors to inspect and remove seed from clothing, animals, and vehicles. Reseed treated areas if necessary to make desirable plants more competitive. Fertilization and/or irrigation may help establishment of desirable plants. Plant certified seed.	Same as above	Use backpack or hand-held sprayers. Broadcast spraying by aerial or ground methods may be used on thicker stands if allowed.

* Choice of a particular management option must be in compliance with existing regulations for land resource.

Physical Control

Physical methods to control toadflax should focus on destroying the root system. Surface treatments (such as cutting or mowing) used to reduce flowering and seed production can suppress toadflax populations but will not kill the plants.

Manual Methods

Hand pulling, digging, or hoeing can be effective for seedlings or small infestations of toadflax. These methods are easier if done in sandy or moist soils. Removal of the root is very difficult but is necessary for maximum effectiveness. These treatments should be repeated several times per growing season, and the site should be revisited

for many years to assure new plants have not grown from dormant seed. Proper disposal of debris is important to reduce further spread. If flowers or seed are present, they will continue to mature. Therefore, debris should be destroyed by burning or else bagged and removed from the site. If flowers or seed are not present, plants may be pulled and left onsite.

Mechanical Methods

Mowing, chopping, or cutting plants can suppress toadflax; but these practices are not generally recommended since new shoots can resprout rapidly from adventitious root buds in response. Repeated cultivation with a disk or a sweep-type cultivator can be effective if done for 2 or more consecutive years. However, mechanical control with these two implements is typically limited to agronomic settings since the terrain must be suitable for their use. Starting in May or June, cultivation should be done through the growing season as often as required to eliminate green growth. Do not allow new growth to be visible for longer than 7 to 10 days before repeating cultivation. Generally, 8 to 10 cultivations are required during the first season and at least 4 to 5 times in the second year. Consider reseeding the next spring or fall with a variety of desirable perennial forage species of varying root depths and growth habits. It will probably be necessary to use a followup chemical treatment to control new toadflax seedlings and resprouting of roots. Plan to periodically monitor the treated site for as many as 10 years, and then spot treat or hand pull plants as they emerge.

Prescribed Fire

Wildfire or controlled burns can destroy toadflax canopies, but plants taller than 2 inches tend to have well-developed roots and are usually not killed by heat from fire. Typically, there is prolific sprouting from Dalmatian and yellow toadflaxes after fire; therefore, burning is not recommended. However, burning Dalmatian toadflax seedlings less than 2 inches high with a propane torch has been used with some success in Oregon and eastern Washington.

Cultural Control

Early detection and plant removal are critical in preventing establishment of Dalmatian and yellow toadflaxes. Land managers, the local public, and road crews should be educated in identifying these species (especially in the seedling stage) so they can help report all suspected infestations. Farm, rangeland, and outdoor recreation equipment can transport seeds; care should be taken to clean the equipment thoroughly before moving from infested areas to uninfested areas. If possible, weed screens should be used on irrigation water intakes in infested areas to prevent seed transportation in ditches or canals. Reseeding of treated areas may help establish desirable competitive plants if native plants are not already present. However, native grasses generally increase rapidly in the season following herbicide treatment.

Biological Control

Grazing

Toadflaxes contain glucosides that are poisonous to livestock when consumed in high quantity, but animals typically avoid eating these species. Care should be taken not to overgraze infested areas since overgrazing allows toadflax plants to become more competitive and abundant than desirable grazed species. Short-term, intensive grazing by sheep during spring and late season can suppress Dalmatian toadflax and limit seed production as shown by field trials in Montana. However, followup herbicide treatments were still needed to control toadflax further.

Classical Biological Control

Several insect species have been investigated and permitted for release in the United States as biocontrol agents for both Dalmatian and yellow toadflaxes. Table 3 lists agents recently released in southwestern states; however, the long-term success of these agents is largely unknown. For further information on biological control of Dalmatian and yellow toadflaxes, see Wilson et al. (2005) in the “References and Further Information” section of this field guide.

Table 3. Classical biological control agents

Species	Type of Agent	Site of Attack	Impact	Use/Considerations for Release
<i>Brachyterolus pulicarius</i>	beetle	shoot and flower	Adults feed on shoot tips and axillary buds; lays eggs in buds; larvae feed on immature seeds. Can reduce seed set by 74 percent.	Well established in the Northwest. Impacts both toadflaxes.
<i>Calophasia lunula</i>	moth	leaves	Active in larval stage; defoliates leaves, thereby reducing seed production and root carbohydrate levels.	Established in Idaho, Montana, and Washington. Impacts both toadflaxes. More effective if used in combination with stem boring weevils.
<i>Eteobalea intermediella</i>	moth	root	Adults lay eggs in lower leaf axils at base of yellow toadflax and on nonflowering Dalmatian toadflax stems. Larvae bore into stem or root.	Impacts both toadflaxes.
<i>Rhinusa antirrhini</i> (formerly <i>Gymnaetron</i>)	weevil	seed capsule	Adults eat leaf buds, young leaves, and young shoot tips. After bloom, adults eat floral tissue and lay eggs in floral ovaries; larvae eat seeds.	Well established in the Northwest. Impacts both toadflaxes.
<i>Rhinusa netum</i> (formerly <i>Gymnaetron</i>)	weevil	seed capsule	Similar to <i>R. antirrhini</i> . Both species impact seed production and may reduce toadflax by 85 to 90 percent.	Impacts both toadflaxes.
<i>Rhinusa linariae</i> (formerly <i>Gymnaetron</i>)	weevil	root	Adults feed on stem tissue and sap, lay eggs in root crown near soil surface; larvae form galls and feed on root.	Impacts both toadflaxes.

Agents used for biological control in southwestern states should be adaptable to arid environments and local conditions. Public, tribal, and private land managers may obtain biological control agents for release directly from local offices of the USDA Animal and Plant Health Inspection Service (APHIS) when the agents are available. Other sources for biocontrol agents include private companies or locally developed insectaries. A permit must be obtained from APHIS before biological control agents can be transported across state boundaries. Regulations and permit applications (PPQ 526 permit forms) pertaining to interstate shipment of biological control agents can be found at <http://www.aphis.usda.gov/ppq/permits/>. Although biological control agents may be collected and released within a given state without a permit from APHIS, the state's Department of Agriculture or Agricultural Extension

Service should be consulted for any regulations relating to movement of these agents inside the state.

Chemical Control

Herbicide spraying can be an important component for restoring rangeland infested with Dalmatian and yellow toadflax. Before spraying, evaluate each area closely to determine if seeding may be necessary or if the plant community will return naturally. Seeding is not typically needed when native grasses are common beneath toadflax as grasses will increase rapidly in the following season after spraying (i.e., spray release). If seeding is needed following a spray treatment, then additional herbicide treatment can be used to complement seeding of desirable competitive species.

Most herbicide treatments are recommended for application during the flowering or postflowering stage in fall. Yellow toadflax is usually more difficult to control with herbicide spraying than Dalmatian toadflax, although repeated treatments over several years are often needed to control either species. Followup monitoring and spot treatment of toadflax regrowth and seedlings should be anticipated for at least 3 to 4 years and possibly longer if complete eradication of toadflax is desired.

All herbicides recommended in table 4 will control or suppress both toadflax species when properly applied, although these herbicides may also impact nontarget species such as forbs, shrubs, or trees. Control results will vary due to weather variables and the plant's growth stage, so special care should be taken to follow label directions closely. Each herbicide product will have different and unique requirements and restrictions according to the herbicide label. Read and understand the label prior to any application. Consult the registrant if you have questions or need further details.

Table 4. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example ¹	Product Example Rate per Acre (broadcast)	Backpack Sprayer Treatment Using Product Example ²	Time of Application	Remarks
Picloram ³	Tordon 22K	1–2 quarts	0.5–1%	Late flower to post-bloom stage in the fall.	Persistent, selective herbicide. Re-treatment for several years may be required. Labeled for rangeland use.
Dicamba	Banvel, Clarity, Vanquish	1–2 quarts	3–5%	Same as above.	Same as above
Chlorsulfuron	Telar XP	2–2.6 ounces	Consult label	Same as above.	Apply as a high volume foliar spray using a minimum of 24 gallons of water per acre.
Aminocyclopyrachlor + chlorsulfuron	Perspective	7.5–8 ounces	Add 5–9 grams of dry flowable powder to 1 gallon of water. Consult label for directions.	Apply to fall rosettes for best control.	Persistent; selective; may cause temporary injury to some grass species. Labeled for noncrop use.
Imazapic	Plateau	8–12 fluid ounces Plateau + 1 quart methylated seed oil (MSO)	0.25–1.5%	Same as above.	Persistent, selective herbicide. Re-treatment for several years may be required. Use lower rate when cool season grasses are present.

¹ Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with toadflax.

² Herbicide/water ratio - As an example, a gallon of spray water with a 3 percent mixture is made by adding a sufficient volume of water to 4 ounces of liquid herbicide until a volume of 1 gallon is reached (4 oz ÷ 128 oz/gal = 0.03 or 3 percent). For dry formulations, particulates should be added to sufficient water as specified by the label until the required concentration or volume of spray water is reached.

³ Picloram is a restricted use pesticide. A certified applicator's license is required for purchase and use.

The best performing herbicides for toadflax control are chlorsulfuron (e.g., Telar XP) and picloram (e.g., Tordon 22K) either alone or in combination. Other herbicides listed in table 4 will control toadflax, but plants often recover from a single treatment so anticipate that spraying may need to be repeated. Herbicide control experiments with Dalmatian toadflax in northern Colorado and southern Wyoming showed Telar XP at 2 oz/a gave excellent control over 5 years while Tordon 22K at 2 pt/a gave good control. Treatments made on yellow toadflax were somewhat site dependent and required higher rates of Telar XP (2.5 to 3 oz/a) or Tordon 22K (2 to 4 pt/a) to be effective. When mixing Telar XP, use a quality nonionic surfactant (NIS) or silicone-based adjuvant at the labeled rate. According to the Colorado-Wyoming study, control of yellow toadflax with Telar XP can be improved by using methylated seed oil at 1 percent v/v instead of a NIS, but injury to native forbs and shrubs may increase.

Herbicides shown in table 4 may be applied by backpack sprayers, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. For individual plant treatment (IPT), wet the foliage and stems thoroughly with a single nozzle, hand held or backpack sprayer. Consult the herbicide label for mixing directions.

Control Strategies

Because treatment situations can vary, management of either Dalmatian or yellow toadflax on a particular site must involve detailed planning. A management plan should be developed that considers the condition and composition of native plants together with a combination of methods necessary for toadflax control. Initial treatments should attempt to eliminate live toadflax plants and disrupt seed and/or root production as much as possible. Later treatments should strive to enhance establishment and competition of native plants to further reduce toadflax populations. Failure to perform followup monitoring and management may result in recolonization and return to pretreatment levels of invasion.

Adaptive Management

Toadflax species are difficult to control, and it should be anticipated that ongoing management will be required for many years. Therefore, realistic goals and objectives should be established to manage toadflax infestations occurring extensively throughout a given landscape. To improve long-term success, consider using an adaptive management strategy with the overall goal of restoring desirable plant communities. The stepwise process for adaptive management involves:

1. Assessment of the overall weed problem,
2. Establishing management goals and objectives,
3. Implementation of control strategies,
4. Monitoring the effectiveness of management actions,
5. Evaluating actual outcomes in relation to expected results, and
6. Adjusting practices as necessary.

Steps of this process should be repeated in sequence as part of a continuous learning cycle that improves management planning and strategy by learning from the outcomes of previous management actions. In general, an adaptive management strategy may be considered to be successful if:

1. Stakeholders are actively involved and remain committed to the process,
2. Monitoring and assessment are used to adjust and improve management decisions, and
3. Management goals and/or objectives for the resource are being achieved.

References and Further Information

- Butler, M.D. and L.C. Burrill. 1994. Yellow Toadflax and Dalmatian Toadflax. A Pacific Northwest Extension Publication PNW135. Available at http://weeds.nmsu.edu/pdfs/yellow_toadflax_factsheet_11-06-05.pdf (accessed May 2010).
- Cardina, J., C. Hern, T. Koch, and T. Webster. Undated. Ohio Perennial and Biennial Weed Guide. Published by Ohio State University Extension. Available at <http://www.oardc.ohio-state.edu/weedguide/default.asp> (accessed April 2010).
- Davison, J.C., E. Smith, and L.M. Wilson. 2007. Livestock Grazing Guidelines for Controlling Noxious Weeds in the Western United States. A Western Region Sustainable Agriculture, Research and Education Project. Publication EB-06-05. Available at http://www.cnr.uidaho.edu/rx-grazing/Livestock_Graizng_Guidelines%28Davison_et_al.%202007%29.pdf (accessed May 2010).
- Douglas County Weed Division. 2005. Integrated Weed Management of Dalmatian Toadflax. Castle Rock, CO. Available at <http://www.douglas.co.us/publicworks/operations/documents/DalmationToadflax.pdf> (accessed May 2010).
- Duncan, K., K. McDaniel, and M. Renz 2005. Chemical Weed and Brush Control for New Mexico Rangelands. Las Cruces: New Mexico State University College of Agriculture and Home Economics and Cooperative Extension Service. Pp. 6. Available at http://aces.nmsu.edu/pubs/_circulars/CR_597.pdf
- Hansen, R. Dalmatian and Yellow Toadflax. 1997. In C.R. Weeden, A.M. Shelton, and M.P. Hoffman. 1997. Biological Control: A Guide to Natural Enemies in North America. Cornell University, NY. Available at <http://www.nysaes.cornell.edu/ent/biocontrol/weedfeeders/toadflax.html> (accessed May 2010).
- Invasive Plant Atlas of the United States. Available at <http://www.invasive.org/weedus/index.html> (accessed May 2010).
- Jeffries, A. Undated. Toadflax Control Methods in the Methow Valley. Methow Valley Citizens Council Projects. Available at <http://www.methow-valley-citizens-council.org/projects/LIDA/lida.htm> (accessed May 2010).
- Ogden, J.A.E. and M.J. Renz. 2005. Dalmatian Toadflax (*Linaria genistifolia* ssp. *dalmatica*). New Mexico State University Department of Plant Extension Sciences, Las Cruces, NM. Available at http://weeds.nmsu.edu/pdfs/dalmatian_toadflax_factsheet_11-06-05.pdf (accessed May 2010).
- Ogden, J.A.E. and M.J. Renz. 2005. Yellow Toadflax (*Linaria vulgaris*) New Mexico State University Department of Plant Extension Sciences, Las Cruces, NM. Available at http://weeds.nmsu.edu/pdfs/yellow_toadflax_factsheet_11-06-05.pdf (accessed May 2010).
- USDA NRCS. 2010. The PLANTS Database. National Plant Data Center, Baton Rouge, LA. Available at <http://plants.usda.gov> (accessed 25 May 2010).
- Whitson, T.D. (ed.), et al. Weeds of the West. Western Society of Weed Science in cooperation with Cooperative Extension Services. University of Wyoming, Laramie, WY. Available at <http://plants.usda.gov/java/invasiveOne?pubID=WSWS> (accessed March 2010).
- Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. Available at <http://www.doi.gov/initiatives/AdaptiveManagement> (accessed April 2011)

Wilson, L.M., S.E. Sing, G.L. Piper, R.W. Hansen, R. De Clerck-Floate, D.K. MacKinnon, and C.B. Randall. 2005. Biology and Biological Control of Dalmatian and Yellow Toadflax. USDA Forest Service FHTET-2005-13. Morgantown, WV. Available at <http://www.fs.fed.us/foresthealth/technology/pdfs/Toadflax.pdf> (accessed Feb. 2011).

Zouhar, K. 2003. *Linaria* spp. In Fire Effects Information System (Online). U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at <http://www.fs.fed.us/database/feis/>. (accessed May 26, 2010).

Suggested Web Sites

Herbicide labels online:

<http://www.cdms.net/labels/msds/lmdefault.aspx>

Encycloweedia Datasheets by California Department of Food and Agriculture:

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

**For more information
or other field guides, contact:**

USDA Forest Service
Southwestern Region
Forest Health
333 Broadway Blvd., SE
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Or visit:

<http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies>

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