PUNCTUREVINE

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Puncturevine

Introduction

Puncturevine (*Tribulus terrestris* L.) (Figure 1) is also commonly referred to as tackweed, puncture weed, Mexican sandbur, Texas sandbur, goathead, caltrop, and bullhead. This non-native plant of the southern Europe and Mediterranean region likely showed up in the United States and later the PNW due to seed movement. Since its introduction, human activity and animals have introduced and spread the plant throughout much of the United States and Pacific Northwest.

Puncturevine fruits (Figure 2) resemble the caltrop, a metal device used in medieval warfare which was placed on the ground with one spike up to slow advancing armies. This weed is a member of a small genus composed of about 12 species in the Caltrop family (Zygophyllaceae). The genus name, *Tribulus*, derives from the Greek word *tribolus*, "spiny plant," which refers to the spiny fruits (American Heritage Dictionary 2016).

This publication is intended to assist growers, crop advisors and pesticide applicators to effectively manage this weed.

Identification

Stems are green to reddish or brownish, pubescent, radiate from a central axis, and may extend ten feet. Although normally prostrate, puncturevine may grow almost upright in dense crop stands. Cotyledon leaves are elliptical shaped and have a main midrib. The compound leaves are opposite and are divided into five to eight pairs of pubescent leaflets, each about 1/4 to 1/2 inch long and oval in shape (Figure 3). Yellow flowers are 1/3 to 1/2 inch wide with five petals borne in the leaf axils. Fruits consist of five wedge shaped segments or burs, each with two short spines 1/5 to 1/3 inch long and numerous smaller prickles.

Figure 1. Mature, flowering puncturevine plant. Photo by Richard Old, http://www.xidservices.com/.

Figure 2. Puncturevine fruit. Photo by Dale Whaley, Washington State University Extension.

Figure 3. Puncturevine leaves and leaflets. Photo by Dale Whaley, Washington State University Extension.

Habitat

Puncturevine grows well in dry, loose, sandy soils, and prospers near sand dunes or eroded windblown soil found at field margins. It also grows in heavier soils, especially if they are fertile and moist, or on compacted soils, such as those found along roadsides or in playgrounds (Figure 4).

Puncturevine is seldom a serious weed in intensively cropped fields. Continued disturbance, such as tillage, will not allow the plant to go to seed. However, if the weed successfully infests crops such as lima beans or peas, the burs can be difficult to remove from the seed. Puncturevine can also be a serious problem in perennial crops, such as asparagus, forage crops, and tree and vine crops. It usually is reported first near agricultural communities or railroad yards and can often be found in hay, straw, or manure.

The stiff, sharp spines are a nuisance on bare ground sites, such as road shoulders, railroad rights-of-way, school grounds, barn lots, and areas normally used for parking and storage. The spines can injure people and pets and can puncture bicycle tires and inflated balls.

Figure 4. Roadside infestation of puncturevine. Photo by Dale Whaley, Washington State University Extension.

Growth and Reproduction

Puncturevine is a summer annual plant. The plant has a deep, somewhat woody taproot (Figure 5), which obtains moisture for growth under conditions unfavorable for most other plants. Puncturevine also requires less water than many other plants. When compared to a crop like sorghum, puncturevine required 211 lb of water to produce 2.2 lb of dry matter versus 661 lb of water to produce the same amount of plant dry matter (Nikolova and Vassilev 2011).

Puncturevine reproduces from seeds formed in woody, spiny fruits with five segments that split when mature (Figure 6). Each segment, or bur, contains one to four seeds separated by the same woody tissue found in the outer walls of the fruit. The seed nearest the pointed end of the bur is the largest and usually germinates first. The other seeds germinate in order of their position in the bur when conditions are conducive. Puncturevine does not readily emerge from soil depths greater than two inches.

Figure 5. Puncturevine root structure. Photo by Dale Whaley, Washington State University Extension.

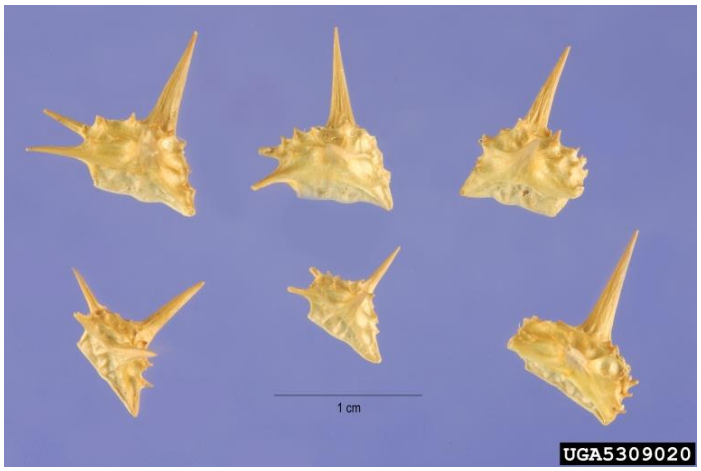

Figure 6. Mature puncturevine burs. Photo by Steve Hurst, USDA NRCS PLANTS Database, Bugwood.org.

Although not considered a prolific seed producer, depending on which month it germinates, a plant growing by itself without competition may produce 10,000 to 14,000 seeds (Boydston 1990).

The spiny fruit segments facilitate seed spread throughout the environment. Large and small seed spines are arranged at different angles so that no matter how the seed falls, at least one spine usually points upward to meet the unwary foot, hoof, or vehicle tire (Figure 7). The sharp spines easily penetrate leather, rubber tires, skin, or other surfaces, and may be transported long distances before being knocked or picked off.

In the field, germination and emergence starts in the spring when average soil temperatures at a depth of nearly one inch reach 59°F (15°C) for at least two weeks and continue until frost (Boydston 1990). Seedlings tend to emerge in flushes following rainfall or irrigation. New seed is mostly dormant, and less than 10% will germinate the year after production. Flowers appear as early as three weeks after germination, and fruits with viable seed appear one to two weeks later.

Toxicity

This weed can injure the feet, hides, mouths, eyes, and digestive tracts of livestock. Puncturevine contains several saponin toxins which may lead to photosensitization in sheep. These substances enter the blood stream and are carried to skin cells, sensitizing them to sunlight. Photosensitization symptoms appear on the lips, ears, and around the eyes, followed by swelling of the head. It has also been shown to cause liver damage to ruminants (Guide to Poisonous Plants 2018).

Management Strategies

Even though puncturevine can form large infestations, sometimes rather quickly, this plant can be effectively managed using a number of different control tactics (Table 1). To better understand how different methods and tools can be used in an Integrated Vegetation Management plan, WSU created a new video on integrated weed management. While the video

Figure 7. Puncturevine seed(s) attached to shoes. Photo by Eric Coombs, Forestry Images.

highlights various weed management tools in agroecosystems, the same principles apply to other managed or unmanaged areas.

Prevention, Early Detection, and Rapid Response

The first line of defense for any weed management program should be prevention. Puncturevine spreads by seed, so limiting the production and spread of seed will prevent new seed from entering the soil seed bank. One way to greatly impact the spread of this plant is by checking bicycle, stroller, and vehicle tires, or the bottoms of shoes, for burs that may have become attached. If found, simply remove the burs and *throw them in the garbage before leaving the area*.

Table 1. Control options for puncturevine infestations.

Method/Tool	Technique/Timing	Advantages	Disadvantages
Hand pulling, Digging	Immediately when new plants/infestations emerge.	Inexpensive; can eliminate young plants quickly.	Time-consuming for large infestations; must get all the roots; requires repeated visits and monitoring for 4–5 years.
Cultural	Plant desirable grasses, forbs, or both prior to puncturevine emergence.	This can impact weed populations through plant competition.	May take time to establish significant competitive vegetation.
Herbicides	Spray a pre-emergent in late February or early March. Spray post-emergent when plants are actively growing. Add 2, 4-D to suppress seed development (unless prohibited by label).	Can significantly suppress or kill plants; some products provide residual control.	Expensive (when dealing with large infestations); timing is important.
Biocontrol	Release insects prior to egg laying and when the plants are actively growing.	Cost-effective; decreases plant vigor and reproduction; self-perpetuating; best for inaccessible areas.	Establishment can be difficult. Slow initial impact; insects are susceptible to cold winters, fire; subject to predators; not recommended for small infestations.

If plants have started to produce burs, do not just pull them and leave them at the site where you discovered your shoes or equipment had burs on it. Even if they look green, some viable seed may have already been produced. Properly dispose of the plants in the same manner mentioned above. Periodically check areas throughout the growing season for any new emerging weeds.

Once weeds have been successfully controlled, it is important to remember that there may be a significant number of spiny burs lying on the surface waiting for conducive environmental conditions to germinate. One technique to combat this is to roll up a towel, tape both ends, and use it to sponge the ground where the infestation occurred. After the burs have stuck to the towel, it can be properly disposed of. This method of prevention works well for small areas. For larger areas, an old piece of carpet can be drug around to achieve the same outcome.

Cultural Control

Puncturevine grows best along field borders and roadsides where plant competition is often limited. To discourage puncturevine infestation, plant a desirable grass along field borders and leave the grass undisturbed.

Physical and Mechanical Control

Puncturevine plants can be easily controlled by hand-pulling or by digging or hoeing. When hand-pulling, avoid just pulling off the radiating stems of plants. Roots left behind will likely produce additional stems. Try using a hand trowel or shovel to remove as much of the root as possible. This can sometimes be a challenge, especially if the ground is hard. Watering the soil before digging or hand-pulling, or choosing to wait until after a rain event, can help soften the soil up, thereby making it easier to pull up the whole plant.

Biological Control

Two species of weevils, a seed-feeder, *Microlarinus lareynii*, and a stem-miner, *M. lypriformis*, were introduced in Washington for puncturevine control in 1961 (Piper 1984). The seed weevil was later introduced into Oregon in 1963 but did not become

established. Both species were reintroduced in Jackson, Wheeler, Malheur, Grant, and Wallowa counties in Oregon in 1983. A thriving population was documented once at one of the sites in Jackson County. Both species are commonly found in the Umatilla-Hermiston area in Umatilla County, Oregon. Attempts to establish the weevils in Franklin, Grant, and Whitman counties failed. It was originally thought that the weevils could not tolerate cold winter temperatures (Piper 1984). However, the seed weevil was detected in Benton County, Washington in 2003 and has since been found at locations around the Kennewick area (personal observation). Locations that can support populations of either weevil should incorporate them where appropriate. The CABI (Centre for Agriculture and Biosciences International) in Switzerland is responsible for identifying and developing new biological control agents. So, there may be hope of a better agent in the future.

Chemical Control

Chemical control is generally not necessary in landscapes as infestations are generally small and can be controlled mechanically. However, in agricultural settings where infestations can become quite large, physical or mechanical means of control are not practical. These situations require the use of herbicides to effectively control puncturevine.

Several herbicides are effective for controlling puncturevine (Morishita and Lyons 2018). Consult individual labels to determine whether they can be used in non-crop or cropping systems (Table 2).

Table 2. Herbicide options and recommendations. Note: Some of these herbicides have state restrictions on their use.

Chemical Name (active ingredient)	**Product Example**	**Application Type (varies by label)**	**Application Timing**
2,4-D amine or 2,4-D Ester	Weedar 64, Amine 4, Hi-Dep, LV 6	Turf Crop Non-Crop	Postemergence
Aminocyclopyrachlor	Perspective	Non-Crop	Apply prior to spring germination (preemergence) or early postemergence
Bentazon + Imazamox	Varisto	Crop	Postemergence
Bromacil	Hyvar	Non-Crop	Apply prior to spring germination (preemergence)
Bromacil + diuron	Krovar I DF	Non-Crop	Apply prior to spring germination (preemergence)
Bromoxynil	Maestro 4EC	Crop Non-Crop	Postemergence
Carfentrazone	Quicksilver	Turf	Postemergence
Chlorsulfuron	Telar XP	Crop Non-Crop	Apply prior to spring germination (preemergence)
Dicamba	Banvel	Turf Crop Non-Crop	Apply prior to spring germination (preemergence)/ postemergence

Chemical Name (active ingredient)	Product Example	Application Type (varies by label)	Application Timing
Dimethaline salt of dicamba and 2, 4-D	Weedmaster	Crop Non-Crop	Postemergence
Dimethylamine salt of 2-methyl-4-chlorophenoxyacetic acid	MCPA Amine	Crop Non-Crop	Postemergence
Diquat dibromide	Diquat	Crop Non-Crop Landscape	Postemergence
Fomesafen	Reflex	Crop	Postemergence
Glufosinate	Tide Glufosinate 280 SL	Crop Non-Crop Landscape	Postemergence
Glyphosate	Roundup or other products containing glyphosate	Landscape Turf Crop Non-Crop	Postemergence
Imazapic	Plateau	Non-Crop Turf	Postemergence
Imazamox	Clearcast Imazamox 120SL	Non-Crop Crop	Postemergence
Imazapyr	Arsenal	Non-Crop	Pre- or postemergence
Imazethapyr	Pursuit	Crop	Early postemergence
Indaziflam	Esplanade 200SC	Non-Crop	Apply prior to spring germination (preemergence)
Metsulfuron methyl	Tide MSM 60	Crop Non-Crop	Pre- or postemergence
Norflurazon	Solicam	Crop	Apply prior to spring germination (preemergence)
Oryzalin	Oryzalin	Crop Non-Crop	Apply prior to spring germination (preemergence)
Oxyfluorfen	Oxyfluorfen 2E	Crop	Pre- or postemergence
Paraquat	Gramoxone SL	Crop Non-Crop	Postemergence

Chemical Name (active ingredient)	Product Example	Application Type (varies by label)	Application Timing
Pendimethalin	Prowl	Crop	Apply prior to spring germination (preemergence)
Sulfometuron methyl and Chlorsulfuron	Landmark XP	Non-Crop	Apply as a pre- or very early postemergence when seedlings first appear
Topramezone	Impact	Crop	Postemergence

Note: For chemical rates, refer to individual product labels or 2019 PNW Weed Management Handbook (Peachey 2019).

Seedlings emerge during the growing season when water is available via precipitation or irrigation. So, if the herbicide you are using does not persist in the soil, make additional applications to control seedlings after each rainfall or irrigation event. Consult your product label for minimum reapplication intervals.

For bare ground treatment, apply soil residual herbicides in the late fall or early spring when rainfall can move the herbicide into the soil. However, too much moisture may leach the herbicide below the germinating seedlings, preventing control.

In cropping systems, make spring applications of residual herbicides in February or early March prior to puncturevine germination. Time applications prior to rainfall events if possible as they can help incorporate herbicides into the soil profile. A single herbicide application rarely provides season-long control, so plan accordingly.

Use pesticides with care. When mixing or applying herbicides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

For additional information on puncturevine and other noxious weeds, visit the state Noxious Weed Control Board website for Idaho, Oregon, or Washington, or contact your local Extension office.

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