

Date: May 23, 2014
Re: Goathead Research Summary
For: Bikeways and Trails Facility Plan
By: Susan Kelly and Diane Scena

INTRODUCTION

This paper was prepared for the City of Albuquerque Parks & Rec, Park Management Division as part of a project to facilitate discussions among agencies in the Albuquerque area regarding maintenance procedures along the bike trails.

GOATHEADS

Goatheads (Puncture Vine, *Tribulus terrestris*) are the single biggest complaint of trail users regarding on-going maintenance. Puncturevine produces many burrs with sharp spines that can injure humans and animals, as well puncture bicycle tires. Goatheads are classified both as a summer annual and a tap-rooted herbaceous perennial – annual in our Central New Mexico climate as plants cannot tolerate freezing. Good soil moisture and warm temperatures are needed for germination. They may start flowering within 3 weeks of germination and continue flowering through the summer. A week after each flower blooms, it is followed by a burr. Each burr has two stout spines and contains two to four seeds. A single plant can produce up 200-5000 seeds in one growing season. Seeds are viable for 5-7 years, or longer. In the spring of 2014, the seed bank is enormous because of tremendous goathead germination and growth in response to the heavy rains of the previous July.

ERADICATION

This paper summarizes four methods of eradication. There are no quick and long-lasting solutions. Two methods currently being used with limited success are mechanical and chemical. Removing the plants when they are in the early stages of growth is most effective, but given that timing of germination is highly variable and dependent upon temperature and moisture, this is no easy feat. Long-term control of puncturevine can be achieved by reducing the amount of seeds in the soil. This is best accomplished by removing plants before they produce seeds (i.e., before or at the time of flowering) and continuing to do so over several years.

A third method, competition from other more desirable plants which shade and crowd out the goathead plants, is one of the most successful methods of control. An additional method, biological, has also been proposed.

An integrated approach using all available options, carefully timed, with persistent and constant monitoring, will reduce the population but will never entirely eliminate goatheads. City of Albuquerque Open Space Division, which has a full time worker to manage about 6 miles of the Paseo del Bosque Trail, has managed to reduce the goathead population over a long period because of his ability to stay on top of the problem. Another feature of this

premier Albuquerque trail that helps to combat the problem, are the healthy stands of native grasses along the trail. Limited manpower on much of the urban trail network affects the ability of maintenance personnel to monitor and respond at the critical time.

METHODS

Mechanical: This involves the cutting and removal of the growing, ground hugging vine. It is a time consuming process that should be performed before the plant's seeds mature. If the cut plants have mature seeds, care should be used in handling so as to not drop and distribute the seeds. Goathead plants are too flat for mowing to be effective, and where the plants are within reach of a mower, mowing tends to scatter the seeds. Mechanical removal requires monitoring throughout the pre-seeding time.

Chemical: Read the label! Chemicals mentioned in the footnote below are from various sources, but herbicide usage and proper application procedures should follow the label and be applied by a licensed pest control applicator, if restricted. Questions can be confirmed with the Pesticide Compliance trainer. Effective weed control is highly dependent on timing. Limited manpower affects the ability to apply herbicides at the optimum time. Overall, the better approach is to establish native grasses and limit the use of herbicides (discussed in the next section).

Steve Baca, NMSU Pesticide Compliance trainer, said that because pre-emergents work on the seed and the goathead has such a large seed, that pre-emergents are not very effective. This may explain why City of Albuquerque's use of pre-emergents in the summer of 2013 failed to prevent the huge outcrop that developed in August/September. Steve Baca said it might be possible to use a higher concentration of chemical, but this may be undesirable for many reasons. The most effective time to use herbicide is to catch the plants when they have just begun growing and are still small and apply post-emergent.¹

Competition: Good stands of native grasses and plants along the trails significantly reduce the goathead problem. The parties we've interviewed broadly agree that if we can get native grasses and other desirable native plants (ones that don't require irrigation and a lot of mowing) established next to the asphalt trails, the use of herbicides can be reduced over time, the weed problem can be abated, and the trails will be more pleasant to users, both aesthetically and practically. Thick stands of native grasses and other herbaceous natives have the added benefit of protecting the trail shoulder from erosion.

¹ The following information is from the University of California, Davis (see citation). Park Management Division's licensed pest control applicators with assistance from the Pesticide Compliance trainer should independently review and make decisions regarding appropriate application: Products containing oryzalin, benefin, trifluralin will provide partial control of germinating seeds. They must be applied prior to germination. Products containing 2,4-D, glyphosate and dicamba are most effective when small and young. 2,4-D and dicamba will harm broadleaves; glyphosate will kill or injure most plants, so use only as spot treatment or on solid stands of weeds. The post-emergent herbicide Aquamaster (Rodeo) is an approved aquatic pesticide being used by AMAFCA and MRGCD which can be used as needed where there is bare ground, monotypic stands of goatheads, or spot application is done selectively with care to avoid natives.

However, establishing native grasses and forbs without irrigation is highly dependent on rainfall and other weather variables. The first step is to protect and encourage existing stands of native plants as much as possible during initial construction or reconstruction. Reclamation seeding should be required along newly constructed or rebuilt trails (reference most recent City Standard Specifications for native seeding along trails.) Establishment may require protection from foot traffic. Other management practices impact the health of native vegetation and its ability to out-compete weeds along the trails. These include mowing height (which should be no shorter than 4-6”), mowing frequency (no more than 3 times per year), and minimizing soil disturbance. Knowledge of plants is critical, allowing for selective control of undesirables, while protecting desirable plants.

Biological control: Two weevils, *Microlarinus lareynii* and *M. lypriformis*, native to India, France and Italy, were introduced into the United States as bio-control agents in 1961. Both species of weevils are available for purchase from biological suppliers. Weevils can keep populations in check, but suppression is cyclic and not always effective.

- *Microlarinus lareynii* is a seed weevil that deposits its eggs in the young burr or flower bud. The larvae feed on and destroy the seeds before they pupate, emerge, disperse and start the cycle over again. Its life cycle time is 19 to 24 days.
- *Microlarinus lypriformis* is a stem weevil that has a similar life cycle, excepting the location of the eggs, which includes the undersides of stems, branches and the root crown. The larvae tunnel in the pith where they feed and pupate. Adults of both species overwinter in plant debris. Although the stem weevil is slightly more effective than the seed weevil when each is used alone, the weevils are most effective if used together and the puncture vine is moisture-stressed.

More research is required re: suitability in our climate. The NMSU Extension Service reported “that Dr. Gerald Nielsen at NM Dept. of Ag. released the weevils in a test program in the mid- to late-1960s. The stem weevil failed to establish, apparently. The seed weevil seems widely established but not that impressive.” Extension agents we spoke with are not aware of any successful introductions in NM since that time. The Extension agents also reported having checked with Kerry Bryan, the State Plant Health Director with USDA-APHIS-PPQ. who said, in the event someone wants to bring in their own seed weevils for their use, they need to file a ‘526 form’ which is the official request for approval of interstate shipment of biological agents, beneficials included.²

² Further informal communication with extension service regarding the seed weevil include: Rear it from some puncture vines you pull or cut (the whole thing at the root) and place into a ‘rearing bag.’ An empty bird seed bag works. Put a couple of table-cloth sized weeds in the bag, fold over the opening, staple it, put it into a room temperature, dry situation and wait a month or two. The seed weevils can complete their life cycles in about a month. The weevils might be hard to see until you get used to their tiny size (abt 3-4mm) and pale color (about the same as the dried seeds). If you’re lucky, maybe 2-5% of seeds will have weevils. I think they acclimatized for the most part but are not especially aggressive seed finders. According to some ‘old timers’ at several release locations in southern NM, the seed weevils were supposed to be amazingly effective the first few years after release and establishment---but then their impact dropped off significantly. Probably due to several factors---mainly who wants to give these weeds over a month to flower and set seed, especially when they set seed now when barely an inch across? “Physical removal is a necessity in yards with kids or

Finally, as comes with no surprise, the internet is full of anecdotal information about how to handle goathead problems. Several ideas are offered below³ but they should be taken with a grain of salt since they came off the web --or perhaps more to the point, a teaspoon of vinegar!

In conclusion, one concept is the idea of creating some test sections for learning about what strategies might be effective for the long term – with a goal of establishing native grasses and forbs. Attached are ideas for potential test sections.

pets. You can get some nasty wounds and infections from punctures in your feet as well. Then, more recently, some effective herbicides came along. However, there's still plenty of puncturevine left for everyone."

³ Yahoo answers: what is the best way to get rid of goatheads in your garden without killing everything else: "Pulling them before they flower and then go to seed is a really good idea. We fight them where I live (thanks to new construction for bringing them to us). Also, if you spray them with vinegar mixed with some dish soap (so it sticks to the plant), this works well. Just don't let the vinegar get on other vegetation. The vinegar dehydrates the plant (works especially well if the plant is small and on a hot day)."

From Homesteading today.com

"Its a long term battle and you never really win. if you see yellow flowers you lost round one. spray with 2-4-D every two weeks or get some weeder ducks. the saying goes that it takes seven years to kill a single plant. 5% vinegar solution works. You have to keep after it."

SOURCES

- Gannett-Fleming/Alta draft Albuquerque Bikeways and Trails Master Plan Update
- UC Davis ucipm.ucdavis.edu/PMG/WEEDS/puncturevine.html
- http://en.wikipedia.org/wiki/Tribulus_terrestris
- NMSU Cooperative Extension Service:
 - Steve Baca, NMDA/NMSU, NMSU Pesticide Compliance trainer, 505-362-1392. SBaca@nmda.nmsu.edu
 - Cheryl Kent, County Horticulture Agent, Bernalillo County Cooperative Extension Service, 505.243.1386, kent@ad.nmsu.edu
 - Jim Wanstall, NMDA State Noxious Weed Coordinator, jwanstall@thuntek.net 505-269-7761
- Andrew Torn, COA Clean Cities, 857-8060
- Tony Barron, COA Open Space Division
- Kurt Wagener, AMAFCA
- Larry Caudill, Albuquerque Environmental Health Department (retired)
- NMDOT Tom Kratochvil, P.E., Assistant District Engineer, tom.kratochvil@state.nm.us
- Park Management Division, personal communications with various representatives

ATTACHMENT:

TESTING WEED CONTROL STRATEGIES

There is broad agreement among the parties we've interviewed so far that if we can get native grasses and other desirable native plants that don't require irrigation and a lot of mowing established next to the asphalt trails, the use of herbicides can be reduced over time, the weed problem can be abated, and the trails will be more pleasant to users, both aesthetically and practically. However, establishing native grasses and forbs without irrigation is highly dependent on rainfall and other weather variables. The first step is to protect existing stands of native plants as much as possible during initial construction or reconstruction.

Pilot Project

We think it worthwhile to consider potential ideas for test sections to try different strategies for weed control/establishment of native grasses and plants in narrow areas along existing trails. We have discussed some ideas with PMD, and they are briefly described below, but they need to be fleshed out, and designed and implemented by Park Management personnel or a contractor. These would include various combinations of soil prep (including ways of removing or reducing the existing weed seed bank), seeding of native grasses and forbs, and mulching (principally based on City of Albuquerque reclamation seeding specifications). This is intended for the 2-3' recovery zone adjacent to the trail.

Potential locations:

- Consider ease of access, ability to keep pedestrians and other traffic off re-vegetated area, and testing different soil types
- Use aerials of locations with notations of treatments.
- Some potential locations: Parkway Channel (low traffic right of way, but not an urban trail), Amole (Gibson/98th), Snow Vista Channel, Bear Arroyo trail between Jefferson and the North Diversion Channel and various locations of new trail construction associated with 50 mile loop or other new or renovated trail project.

Weed seed removal alternatives:

- Cut and remove dried weeds and blow debris off trail (current practice)
- Burn dried weeds Use a hand torch, only in safe area, with water tank close by or cut dried plants and burn seeds with a torch.
- Use herbicide. Use post emergent when goatheads sprout or cut and use herbicide to prevent new growth Protect desirable vegetation.
- Remove top 2" +/- of soil. Also provides space for mulch.

Biological control of goatheads:

- There may be potential for biological control of goatheads using the stem weevil and/or seed weevil, but this will require much more research re: suitability in our climate. The NMSU Extension Service reported “that Dr. Gerald Nielsen at NM Dept. of Ag. released the weevils in a test program in the mid- to late-1960s. The stem weevil failed to establish, apparently. The seed weevil seems widely established but not that impressive.” Extension agents we spoke with are not aware of any successful introductions since that time.

Soil prep and seeding:

- Follow the City Specifications for Native Grass Seeding, using at least 2 X City Specs for PLS. Use drill seeder, crimper where space allows. Use rototilling, hand broadcasting, raking over, where ROW doesn't allow. If proposed revisions aren't adopted at time of installation, obtain permission to use them.

Mulches:

- Test various mulches – gravel, wood chips, hydro-mulch with tackifier, crimped straw, if space allows. Gravel mulch appears to be the most promising for non-irrigated native seeding, but it isn't suitable in areas with steep slopes toward the trail.

Results of pilot project/test sections:

- Monitor test plots over a 2-4 year period. Use results to guide funding for a system-wide rehab project. Have a landscape architect develop plan for establishing system over time.

Sample concept for re-veg test section:

1. Using a blade (motor grader), shave off the top several inches. (Idea is to have seed bed below top of asphalt).
2. Rip area next to trail.
3. Disc or rototill.
4. Hand-broadcast native grass seed mix @ 2X PLS in city specs. Include Indian Rice grass as it will germinate with winter moisture, and no 4-wing salt bush or other shrubs which might impede sight distance or encroach on trail clearance area.
5. Rake it in or chain drag it.
6. Lay down gravel mulch one stone/one layer thick 85-95% coverage. You can do this if done carefully with a small bobcat loader. Aggregate: 3/4" Crushed with 2 fractured faces (minimum).
7. Water once to settle the dirt and seeds
8. Depending upon location, will need signs/other mechanisms to keep foot traffic off.

Advantages:

- Gravel mulch doubles the effective rainfall, but need to be sure that it is not going to slough off onto trail.
- For existing trails, PM has this equipment in smaller sizes that could be used in narrow space next to trail

Additional thoughts for management after germination:

- Mow high – no shorter than 4-6”, no more than 3x per year. If vegetation and grasses in some locations start to crowd into the trail and narrow the clear width for travel, address with alternative mowing schedule.
- Practice selective weed control. Provide basic training in ID and recognition of a few true weed species. Reduce the use of herbicides, which kill everything.
- Protect established desirable grasses, wild flowers and shrubs. Reseed all disturbed areas. Don't scrape to control weeds.