Wildflowers! Inspired by nature

Fall 2013

... a UC resource for vegetation management in Southern California

Welcome to Wildflowers!

Issue #3 Fall 2013

Fall and Change

This issue includes two research updates on Sahara mustard that could change your outlook on managing this species. The first article address the question "which herbicides will control Sahara mustard?" The second article begins to evaluate "which chemical and mechanical methods of treatment are most efficient at reducing Sahara mustard?"

Fall Forecast

Unfortunately the fall forecast hasn't changed much from last year. The latest predictions from NOAA show a neutral El Niño pattern (http://www.elnino.noaa.gov/). Which means that there will likely not be an El Niño or a La Niña. Under these conditions our average rainfall totals tend to be variable. It could be a drought (as we had last year with El Niño neutral conditions), above average or just about average rainfall. The storm that rolled through in early October was enough to germinate some weeds and wildflowers inland, but wasn't strong enough to prompt widespread germination in the deserts.

In this issue:

Why Wildflowers? Because when I see those remaining fields of wildflowers, I am reminded of how beautiful our landscapes can be, and how with a little bit of coordination and work, our gardens, backyards, parks, forests, rights-of-ways, and preserves can mimic those landscapes. And besides most of Southern California was filled with spring-blooming wildflowers; it is what Southern California was and could be: Wildflowers!

UC CE

Measuring the effectiveness of four herbicides on controlling Sahara mustard

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Introduction

Sahara mustard (*Brassica tournefortii*) is a winter annual that is native to the Mediterranean, Middle East and North Africa. Since being introduced in the early 1900's to California it has spread across the entire desert southwestern US, from Texas to California and Southern Colorado to Mexico. Despite the desert implication in the common name, Sahara mustard has been expanding into non-desert areas of California as well. It can be found near the California beaches from San Diego to San Luis Obispo County and in the central valley along the I-5 corridor near Kings, Fresno and San Benito Counties. In addition there is a new specimen, collected in 2011, from Sacramento from an apparently healthy population in the urban area. This new location represents a range extension of over 150 miles from previously reported locations in the central valley.

Land managers have a wide variety of herbicides available to treat this species, yet few have been tested on this species. The effectiveness of four herbicides, at high and low doses, of controlling Sahara mustard in the desert of Southern California was tested.

The herbicides were glyphosate (active ingredient in Roundup promax), pelargonic acid (active ingredient in Scythe), chlorsulfuron (active ingredient in Telar), triclopyr (active ingredient in Garlon). These treatments were compared to hand pulling as well as an untreated control.

Background on herbicides

This experiment was designed to test four different types of herbicides to control Sahara mustard. Glyphosate is a broad-spectrum post-emergent (applied after weeds emerge) herbicide that can be applied to a variety of sites as directed on the label. Glyphosate is a systemic herbicide and is translocated through the plant. Pelargonic acid is a broad-spectrum post-emergent herbicide that is active on the surfaces of the plant where it is sprayed (i.e. a contact herbicide), it is not translocated throughout the plant. Chlorsulfuron is a broadleaf-specific herbicide that also suppresses or kills some grass species. It is used after weeds emerge (post-emergent), and also has pre-emergent properties (suppresses germinating plants). It is a systemic herbicide and moves through the plant. Triclopyr is another broadleaf-specific systemic herbicide that also suppresses or kills some grasses. It is used as a post-emergent herbicide.

Treatment	Density SM	% Cover SM	% Grass Cov	% Native Cov
Hand	8	4	28	28
Control	21	38	32	7
Glyphosate High	4	0.5	1	2.5
Glypohsoate Low	7	3	3	6.5
Pelargonic Acid High	10	6	12	6
Pelargonic Acid Low	20	23	31	12
Triclopyr High	0	0	35	0.001
Triclopyr Low	0.1	0.001	46	2.1
Chlorsulfuron High	1.4	0.3	44	0.25
Chlorsulforon Low	1.1	0.6	44	1.4

Table 1: Effectiveness of four herbicides, each at two different rates, on controlling Sahara mustard (SM), exotic grasses and native wildflowers. NOTE: Statistical differences are not shown, and some are provided in the text for clarity. Contact the author for statistical differences between treatments

Methods

Trials were conducted in Borrego Springs in 2010. There were 10 total treatments, each of the four herbicides were applied at a low and high rate (when controlling annuals) plus one plot was hand weeded and another was left untreated, and each block was replicated 4 times, totaling 40 plots. Each treatment was applied only once in the middle of the growing season. Cover and density of Sahara mustard was measured as well as the cover of grasses (nonnative) and native wildflowers at the end of the growing season.

Results and Discussion

Sahara mustard was readily killed by all four herbicides and hand pulling was effective as well. The low rate of pelargonic acid was not significantly different from the control plots. Rates of Sahara mustard control significantly increased with increasing amounts of herbicide applied, there was better control with higher application rates. However,

Glyphosate: Pro - Controls Sahara mustard and grasses, moderate wildflower preservation Con - Moderate wildflower reduction
Pelargonic Acid: Pro - Controls Sahara mustard, moderate wildflower preservation Con - Also reduces wildflowers, moderate-low grass control
Chlorsulfuron: Pro - Excellent control of Sahara mustard Con - High reductions in wildflowers, grasses unaffected
Telar: Pro - Excellent control of Sahara mustard Con - High reduction in wildflowers, grasses also unaffected
Hand Weeding: Pro - High control of Sahara mustard, preserves the most wildflowers Con - No reduction of non-targeted weeds, some Sahara mustard missed
Untreated: Pro - No time and labor commitment Con - Reduces wildflowers, while Sahara mustard and other weeds proliferate

Table 2: Advantages and disadvantages of each treatment

there was a direct tradeoff in preserving native wildflowers: higher application rates also killed more wildflowers. Grass cover (mainly *Schismus* spp., Mediterranean grass) was significantly lower with applications of glyphosate compared with applications of chlorsulfuron and triclopyr. This result is expected, glyphosate is known to control both broadleaved plants and grasses, while the latter two herbicides primarily control dicots. Hand pulling was very effective at preserving wildflowers, but did not significantly reduce the cover or density of Sahara mustard compared to glyphosate treatments. Other weeds present on the site were not targeted with hand pulling and continued to grow largely unaffected.

Not treating an area allows Sahara mustard to outcompete the native wildflowers and it eventually kills a significant portion of the wildflower population. Wildflowers were best preserved with hand weeding. It is also interesting to note that applications of glyphosate and pelargonic acid were able to preserve a similar cover of wildflowers as untreated plots. Applying the proper rate of glyphosate or pelargonic acid herbicides will reduce Sahara mustard cover by 80-90% and retain the same cover of wildflowers as in untreated plots. In other words, proper applications of some herbicides can preserve as many wildflowers compared to untreated plots and still significantly reduce Sahara mustard and other weeds.

Tradeoffs

Each method of weed management represents a tradeoff. The broadleaf specific herbicides significantly reduced Sahara mustard in one application, and yet those herbicides significantly reduced most of the wildflowers present and are not effective at controlling some invasive grasses when compared to pelargonic acid and glyphosate. These broadleaf herbicides represent an excellent choice when mustard densities are high, wildflower populations are low and invasive grasses are not present. There is also the potential that these herbicides can be used for multiple years and local wildflower seed could be introduced or left to germinate from the seed bank when Sahara mustard is eradicated from the site. Future research will be needed to explore these options.

The use of broad-spectrum herbicides (glyphosate and pelargonic acid) poses another tradeoff, while control of Sahara mustard was acceptable it was not complete, nor was it significantly different from hand pulling, thus there is the possibility that a follow up treatment will be required to stop seed production with any of these treatments. Wildflower preservation was similar to untreated plots and with the application of glyphosate grass control was significantly higher than any other treatment.

Conclusion

It appears that Sahara mustard can be readily controlled with several different types of herbicides Herbicides that are approved for reducing other mustard species also controlled Sahara mustard in this study. It is possible that other herbicides listed as broad spectrum or controlling broadleaved plants including mustards will control Sahara mustard, however further tests will be required to determine the details of this possibility.

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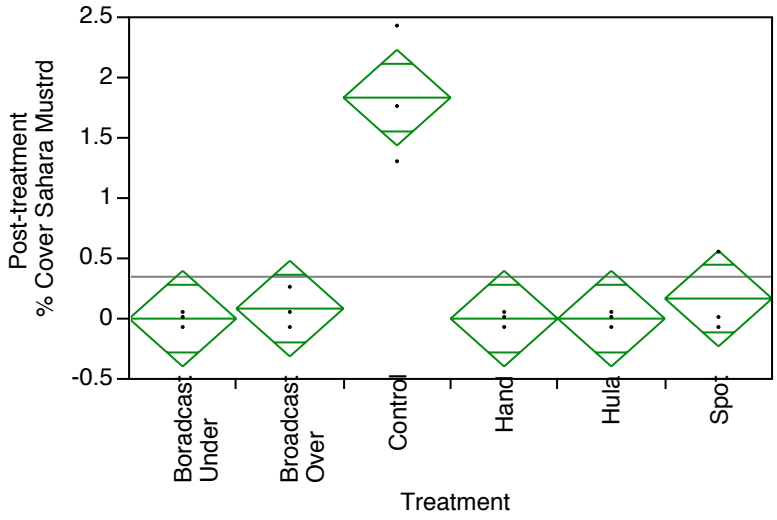

Table 3: Cover of Sahara mustard

Finding an Efficient Method of Controlling Sahara Mustard

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Controlling annual weeds requires a significant investment in resources each year until the seed bank is depleted. Annuals must have dormant seeds that can survive inhospitable conditions. This is in contrast to the control of some woody perennials, where a large investment reduces biomass and less effort is required in subsequent years. In addition, annual plants can cover and dominate vast tracts of land in Southern California. This large scale significantly adds to the cost of controlling annual weeds. Sahara mustard is no different, it dominates many portions of the California deserts and is encroaching on inland, coastal and central regions of the state.

Managers and practitioners that control annual plants can spend significant amount of resources controlling annual plants for several years. Thus finding efficient means of reducing Sahara mustard is helpful for control programs. I conducted an experiment measuring the effectiveness and the efficiency of several different methods of controlling Sahara mustard.

Methods

Six different treatments were evaluated to examine the efficiency of mechanical and chemical methods at reducing the abundance of Sahara mustard. The treatments were to hand pull, stirrup hoe (aka hula hoe), spot spray with herbicide (glyphosate), broadcast spray herbicide over shrubs and broadcast spray herbicide under shrubs (glyphosate). The broadcast treatment was divided by spraying under or over shrubs to determine if there was a significant cost to avoiding spraying shrubs as well as determining if a low application of glyphosate inadvertently killed large perennial shrubs. The amount of glyphosate required to kill a herbaceous annual, like Sahara mustard, is much less than that required to kill some perennial shrubs, thus a potential middle ground is possible where enough herbicide is applied to an area that will kill annuals, yet will only injure perennial shrubs.

Plots were 50’ x 80’ long (approx. 0.1 ac) to provide an accurate comparison of the time required to treat a sizable infestation of Sahara mustard. Each set of 6 treatments was replicated 3 times for a total of 18 plots.

Data was collected on time spent applying treatments as well as percent cover of Sahara mustard, invasive grasses, wildflowers and other plants.

Results and Discussion

Rainfall in spring 2013 was enough to germinate a cohort of wildflowers and Sahara mustard. However late spring proved to be dry and hot, prompting an early flowering period of mostly small plants, approximately 4” diameter.

All treatments were equally effective at reducing Sahara mustard cover (table 3). This was likely because the plants were small and after treatments the plants were stressed by the dry weather. This is in contrast to the previous study (above) where there were differences in the effectiveness of treatments (see table 1).

In general, mechanical methods of Sahara mustard removal were far less efficient compared to chemical methods at reducing the cover of this weed (table 4 below). Hand weeding was the slowest method and broadcast applications of herbicide were most efficient. There was no significant difference between the time spent applying herbicides over and under shrubs. However, shrub mortality will be measured in spring 2014.

Stirrup hoeing was 30% faster than hand weeding and appears to be an appropriate alternative to hand weeding where rocks do not inhibit the use of a hoe. Spot spraying was

Looking ahead:

In the next issue of WIldflowers-

Unique and unusual places in Southern California.

Table 4: Number of hours per person to clear one acre of Sahara mustard at 2-5% cover for six different treatments. Letters indicate significant differences between treatments.

	hr/acre/ person	
Hand weeded	6.1	A
Hula hoe	4.2	B
Spot spray	2.3	C
Herbicide Over Shrubs	0.7	D
Herbicide Under Shrubs	0.9	D
Untreated control	0.0	E

50% more efficient than hoeing. Both methods left a significant amount of non-target weeds (invasive grasses and filaree, *Erodium cicutarium*), because only Sahara mustard was targeted with these two methods.

Preservation of wildflowers was similar between treatments. This was likely because the abundance of wildflowers was very low at the end of the season. Under years with closer to average precipitation the effects of broadcast herbicides at reducing some of the wildflowers compared to mechanical treatments might be comparable to the previous study (see table 1). Spot spraying, hand pulling and stirrup hoeing while generally considered targeted or selective methods, reduced some wildflowers when the wildflowers were growing within large clumps of Sahara mustard.

Conclusion

Chemical treatments were the most efficient use of labor. Spot spraying was less efficient than broadcast spraying and hand pulling was the most labor consuming method. Using a low application rate of herbicide was able to preserve some wildflowers, which presumably added to the seed bank. Hand weeding seems appropriate when treating small areas of Sahara mustard infestation, or when a stirrup hoe cannot be used. Stirrup hoeing appears beneficial in situations where herbicides cannot be used or when a manager must pay for labor because its more efficient to stirrup hoe mustard then hand pull. A stirrup hoe would be impractical when Sahara mustard plants are large and have a very thick taproot or when working on rocky ground.

NOTE: When working with herbicides always follow all label directions, wear appropriate safety equipment, follow all applicable local, state and federal regulations. Product names are not an endorsement of that product and are for identification purposes only.

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Thanks for reading and keep your weeds to yourself,

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