



Summit CWMA 2020

UWSA - SGMA : 201903SGMA17

Seeding Trials Report Year One

Prepared November 2020

Prepared for

Utah Weed Supervisors Association
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PROJECT DESCRIPTION

The Summit CWMA UWSA-SGMA: Seeding Trials project was designed to address potential legacy effects of garlic mustard (*Alliaria petiolata*) a Class 1B State Listed Noxious Weed on soils and native plant germinations and establishment in forests and forest/sagebrush habitat. Garlic mustard is an aggressive invader that can displace natives, is allelopathic, does not provide quality forage for wildlife, kills larva of some butterfly species and suppresses the soil fungal community forest species rely on for resistance to stressors like drought and beetle kill. Forests that have been heavily invaded by garlic mustard are at greater risk of tree mortality which increases fire risk and watershed health concerns. These concerns have inspired a number of government agencies from local government to watershed protection and water providing companies to closely watch the spread of garlic mustard and its control in Summit County.

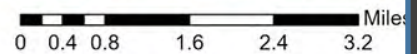
Invasion of garlic mustard into forested sage grouse habitat can reduce habitat quality by displacing forage

Project Site Locations within Summit County, UT



Summit County Garlic Mustard Revegetation Trials

The Summit County CWMA has been controlling garlic mustard in western Summit County since 2014. While populations have declined throughout the ISM project area, there are only three areas that are of substantial size that are appropriate for seeding trials. Toll Canyon, in the Summit Park Area, Rotary Park and Masonic Trail, in the Park City area, are located under forest canopy and have shown significant reduction in garlic mustard cover and density.



Map Created November 22, 2019
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Masonic Trail Location 2018 and 2019



species and altering the vegetation structure such that the mosaic of vegetation and bare ground essential to sage grouse would decline, if not disappear. Additionally, garlic mustard has been more recently found to move into open shrub and grassland habitats directly adjacent forest. Developing methods for increased resistance to invasion and restoration post garlic mustard control are important to prevent garlic mustard mediated impacts on sage grouse habitat.

The Summit County CWMA, includes several partners within Summit County and has partnered in the past with adjacent landowners in Salt Lake County Watersheds and now works with landowners in all adjacent counties. The CWMA has been treating garlic mustard in Summit, Salt Lake, Weber and Wasatch Counties as part of the Summit CWMA ISM Garlic Mustard Control Program from 2014 to present. This seeding trial project piggy backs on the long-term CWMA ISM Garlic Mustard program and their methods by using hand thinning/weeding of flowering garlic mustard plants and follow up herbicide application to control garlic mustard. Currently there is not an available biological control for garlic mustard in the United States. There is a promising insect being used in Canada, but it will not be available for a few years so other methods are necessary to address current garlic mustard populations and prevent further spread.

While current methods of herbicide and manual removal show some promise in containing and controlling garlic mustard, the rate at which garlic mustard can spread and its ability to move on wildlife makes eradication with these methods difficult. Development of seed mixes for reestablishment of resistant plant communities would provide an additional control method applicable in both non-federal and federal forests. The western publicly and privately-owned forests of Summit County are heavily invaded by garlic mustard and require additional control options to prevent spread to adjacent federal forested and sagebrush dominated lands.

The sites included in this project have been treated through the CWMA garlic mustard control program and are of particular interest because



Typical garlic mustard density that Summit CWMA would applying revegetation with native grasses to establish grass while controlling remaining garlic mustard rosette patches.

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Plots were established in late spring of 2020 at three locations: Masonic Trail (top), Rotary Park (middle) and Toll Canyon (bottom).

they have experienced significant reduction of garlic mustard.

In previous years, seeding of areas with reduced garlic mustard in sunny locations has shown success using slender wheat grass (*Elymus trachycaulus*) and mountain brome (*Bromus marginatus*). Unfortunately, these species have not been successfully established post garlic mustard treatment under forest and shrub canopy. It is unclear if this is due to shading, lack of necessary site preparation, low seeding rates in a single seeding event or soil legacy effects of garlic mustard allelopathic actions.

To begin to understand the limitations are for revegetation in the shaded forest and shrubland areas impacted by garlic mustard, the Summit CWMA established seeding trial test plots in three location in the Park City and Snyderville Basin areas of Summit County, UT. By testing three native grass seed mixes with and without soil amendments, we are testing if there is an option for increasing resistance of forested lands and increase resistance to reinvasion and expansion of garlic mustard into adjacent shrublands.

The project is a two-year trial, however, the CWMA will continue to visit sites annually beyond the two years of the project to assess longer-term success. If this project identifies species that will establish in previously garlic mustard dominated sites, this seeding method would be used in the Summit CWMA ISM garlic mustard program extensively as reductions of garlic mustard continue. In addition, project methods and results are being shared with other land

managers dealing with garlic mustard. Outreach to the local residents has been done through informational signs and conversations with residences as they pass by project sites while work is being conducted. Residents that knew their property had garlic mustard and were interested in help with control were signed up with the Summit CWMA Garlic Mustard Control Program. Those with low percent cover were also provided native grass seed left over from the Summit CWMA Pollinator Health ISM Grant.

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METHODS

Prior to seeding, the sites and adjacent area was treated with 2, 4D amine (64 oz/ac) and MSM 60 (1.5 oz/ac) to control fall germinated and newly germinated garlic mustard seedlings spring 2020. Partner landowners also treated adjacent land (8ac) for noxious weeds other than garlic mustard to maintain proper trial conditions and maintain progress of their noxious weed programs. Additional treatments occurred in fall 2020 and will be applied again spring 2021 as needed. Toll Canyon and Rotary Park have been consistently treated spring and most falls for the last five years. In some years these sites were treated a third time if a mid-summer germination was observed. Additionally, these sites were hand weeded to thin flowering plants in the spring for up to 3 years. These sites had large, uniform populations originally and in 2019 had limited, patchy populations. The Masonic Trail site was first treated in 2018 when it was weeded to thin flowering plants then treated with herbicide three times in 2018 and twice in 2019. The garlic mustard population at this site was a complete understory









Garlic mustard percent cover and control history for study sites.

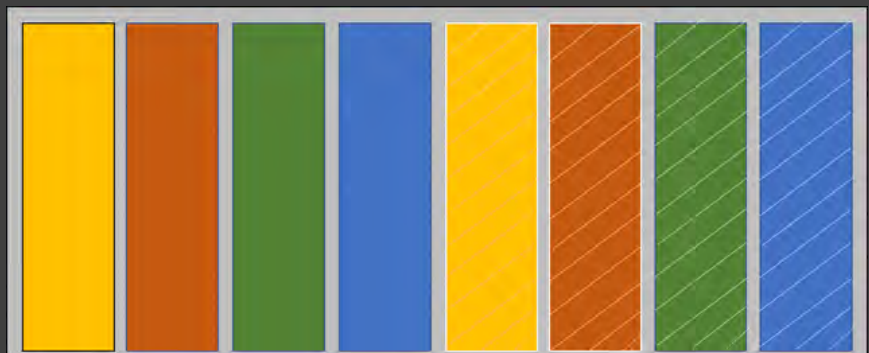
	First Year Treated	Percent Cover First Year Treated	Percent Cover in 2019	Percent Cover Spring 2020	Percent Cover Fall 2020
Toll Canyon	2015	75	30	5	7
Masonic Trail	2018	95	15	3	0
Rotary Park	2014	100	20	.15	0

monoculture in 2018 and in 2019 and 2020 it was limited to small patches of seedlings and a few rosettes.

Soil amendments were applied late spring to early summer depending on timing of snowmelt. Rotary Park and Masonic Trail were snow free several weeks prior to Toll Canyon so had a longer growing season. Spring soil amendments at Rotary Park consisted of a thin layer of compost to aid in moisture retention and soil–seed contact and half of the treatments were additionally treated with biochar. In the case of Masonic Trail and Toll Canyon, the distance required to hike the amendments in led us to decide to try amending with biochar only as it is far less dense than compost so easier to get into the sites. The reasoning was that logistics often prevent use

Experimental Design

	Seed Mix 1 Only (SM1)
	Seed Mix 2 Only (SM2)
	Seed Mix 3 Only (SM3)
	Compost Only (C)
	Seed Mix 1 Plus Biochar (SM1B)
	Seed Mix 2 Plus Biochar (SM2B)
	Seed Mix 3 Plus Biochar (SM3B)
	Compost Plus Biochar (CB)



Seed Mix Compositions

#1: Native Grass Seed Mix for Shade

10% Slender Wheatgrass (*Elymus trachycaulus*)

20% Streambank Wheatgrass (*Elymus lanceolatus*)

10% Mountain Brome (*Bromus marginatus*)

20% Fringed Brome (*Bromus ciliates*)

20% Alpine Bluegrass (*Poa alpine*)

20% Rocky Mountain Fescue (*Festuca saximontana*)

#2: Native Grass Seed Mix for Shade

10% Slender Wheatgrass (*Elymus trachycaulus*)

10% Mountain Brome (*Bromus marginatus*)

20% Blue Wildrye (*Elymus glaucus*)

20% Prairie Junegrass (*Koeleria macrantha*)

20% Tufted Hairgrass (*Deschampsia cespitosa*)

20% Spike Trisetum (*Trisetum spicatum*)

#3: Native Mountain Grass Seed Mix

20% Slender Wheatgrass (*Elymus trachycaulus*)

20% Streambank Wheatgrass (*Elymus lanceolatus*)

20% Mountain Brome (*Bromus marginatus*)

14% Blue Wildrye (*Elymus glaucus*)

9% Big/Sandberg Bluegrass (*Poa secunda*)

5% Arizona Fescue (*Festuca arizonica*)

5% Prairie Junegrass (*Koeleria macrantha*)

5% Tufted Hairgrass (*Deschampsia cespitosa*)

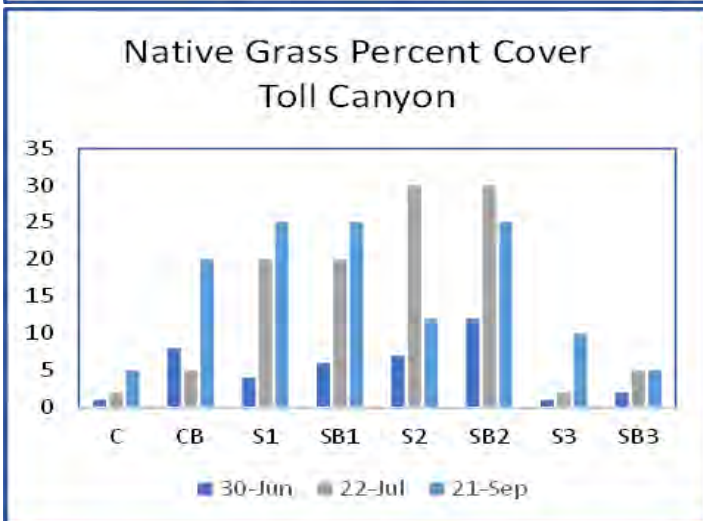
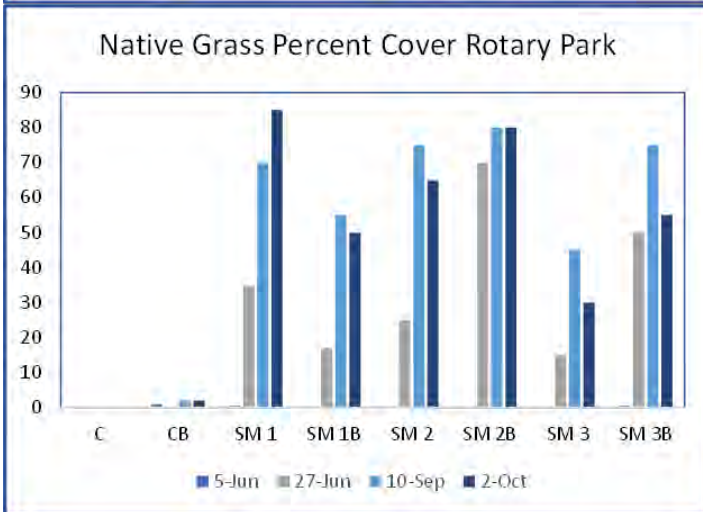
of methods developed from small plot trials, so choosing the more logistically feasible approach of carrying in only biochar lent itself to support higher likelihood of other land managers incorporating the method. After analyzing year one data, it was clear there was a significantly lower impact of seeding trials and amendment in the Masonic Trail and Toll Canyon sites. Because we could not rule out compost as a cause of this difference from Rotary Park, compost was added to these sites during the fall treatment so all sites received similar fall treatments.

Following soil amendments, three native grass mixes were hand broadcast and gently raked into the appropriate plots in both spring and fall of 2020. An additional seeding may occur again spring 2021 if establishment is poor. Seed was hand broadcasted and raked in.

Plots ranged in size based on the usable size of the study site. Often dense patches of trees or other habitat variations were present that would likely confound results if these structures were included in a single plot. Plots are 4x10ft at Rotary Park, 4x15ft at the Masonic Trail and 4x20ft at Toll Canyon. Irrigation to support seedling establishment was provided using a backpack sprayer at sites not close enough to a water source or lack roads for trucks. The Masonic Trail and Toll Canyon sites required watering with the backpack sprayer but the Rotary Park site had direct access to a faucet so watering was done by hose. Watering occurred every other day for the first 4 weeks, then was reduced to 3 times a week for one week, then twice a week for three weeks and then only as needed due to extreme heat until mid-September when watering was discontinued.

Monitoring included photo point data collected at the plot level and additional photo points throughout the season when percent cover data were collected. Photos were taken along transects running the length of each plot every 5ft following protocol similar to that developed by the ISM Monitoring program so photos are available for analysis if other data suggest the additional labor cost of analyzing the photos will significantly aid in explaining results. Data points in EDDMaps for these project sites were updated for 2020.

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Percent cover data for all sites includes cover of native grasses already present at the site prior to plot establishment and the seedlings resulting from the seeding trial. Note Y-axis scales significantly differ between sites.

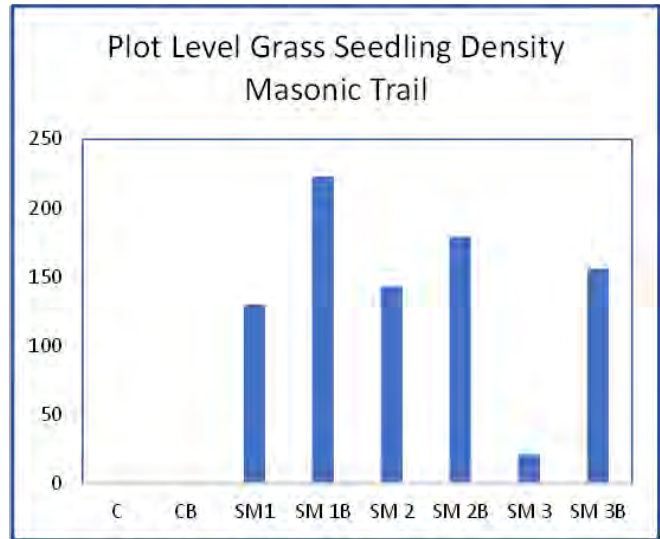
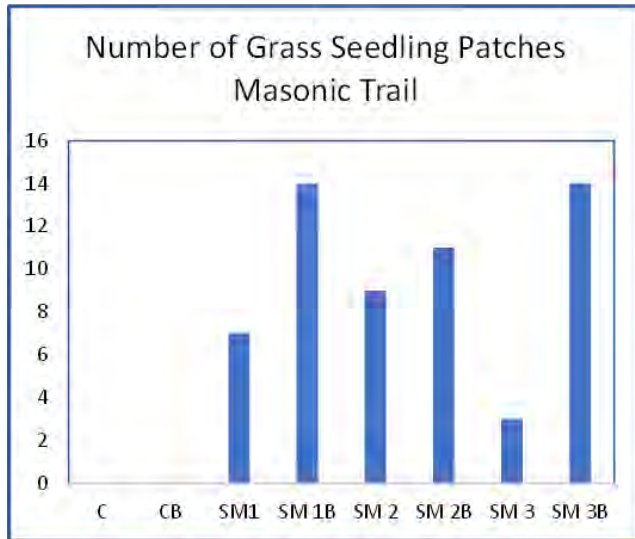
RESULTS

In general, a number of factors appear to be important to establishing grasses post garlic mustard control including forest type, irrigation level, site microclimate humidity, seed limitations, seeded species, and soil amendments. A single year of data collection can not clearly answer our questions as two of the sites were slow to show grass seedlings and overall percent cover attributed to grasses was limited. 2020 was a drier than average year and seeding occurred after snow melt that could have been an important water source for germinating grasses had already passed. An additional year of data following a fall seeding may help to separate out the most important factors and allow us to begin applying the proper combination of methods to the appropriate forest types and canopy densities.

Each of the sites were in different forest types. The Masonic Trail is under a maple dominated forest island surrounded by sagebrush shrubland, the Rotary Park site is within an aspen stand and Toll Canyon is within a conifer forest. Each forest was characterized by different levels of forest floor light, presence of and density of a forest understory plant community and soil characteristics.

Native grass establishment was greatest under the aspen stand of Rotary Park. This site seemed to have more light, less plant biomass/O horizon and was associated with a stream. The other two forest types had similar germination rates to one another

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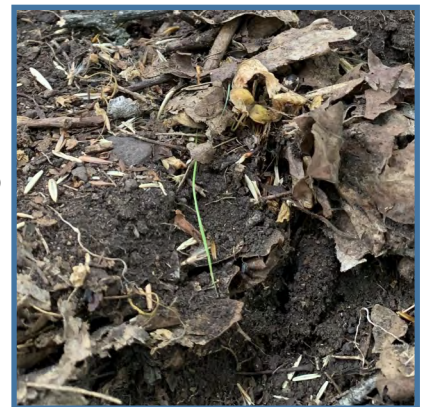


Masonic Trail had the second highest rate of native grass germination and seedling patches and seedling density at the plot level support the overall native grass percent cover results that suggest these sites are to some degree seed limited.

but far less than Rotary Park plots and were darker than the Rotary Park site. Collection of percent canopy or light levels at ground level may be included next season to get accurate measurements of available light differences between sites and plots within a site. Additionally, the Toll Canyon site had a thick layer of organic matter, primarily partially decomposed evergreen needles that may have prevented seed from gaining necessary seed-soil contact.

The higher degree of grass seedling establishment at Rotary Park in comparison to the other sites may also reflect differences in water available to plots and the importance of irrigation for establishment. Because this site had a faucet near by, these plots received twice the volume of water during a single watering event than the other sites. This site is also adjacent an irrigated lawn and a creek so the microclimate in general was more humid and thus more conducive to seedling survival.

The most striking result was that plots that were seeded showed greater percent cover and native grass seedling density than the control (no seeding) plots with one exception. In the Toll Canyon plots, seed mix 3 was similar to native grass percent cover in the control and biochar plots indicating the soil amendment may prove equally beneficial as application of seed mix 3. It may also be that this seed mix contains species that already have a healthy seedbank present in the Toll Canyon soils. The result for all other sites and seed mixes suggests that seed availability may be one of the limiting factors in



Grass seedlings were denser in plots with compost and/or biochar (bottom) versus no amendments (top).

Project Partners

Funding Partners

- Utah Weed Supervisors Association
- Utah Department of Agriculture and Food (ISM Funding)
- Ecology Bridge
- Snyderville Basin Special Recreation District

Landowner Partners

- Park City Municipal Corporation
- Snyderville Basin Special Recreation District

Summit County CWMA Members

- Crescent Ridge Condo HOA
- Deer Valley Resort
- Ecology Bridge
- Ground Solutions
- Historic Glenwood Cemetery
- Park City Municipal Corporation
- Jeremy Ranch HOA
- Pinebrook Master HOA
- Ranch Place HOA
- Salt Lake County
- Snyderville Basin Special Recreation District
- Sun Peak HOA
- Summit County
- Summit Park and Timberline HOAs
- Swaner Eco Center
- The Colony HOA
- Utah State University Extension
- Utah Olympic Park - Park City
- Vail Resorts
- Woodward School

reestablishment of natives. This was most evident at the Rotary Park site where percent cover of native grasses was approximately 25% lower in the control sites and the plot with lowest cover among seeded plots (Seed mix 3 no amendments). These sites have had a long history of garlic mustard dominance which may have extended beyond the seedbank longevity of many native grasses leaving a limited seedbank from which recruitment would be expected to naturally occur.

Between the seed mixes, mixes 1 and 2 which were mixes specifically created to be more tolerant of shade showed more success in this first year. The third seed mix had the greatest rates of germination in the Rotary Park site which may be a result of the higher light levels associated with the aspen grove compared to the denser canopy of the maple and conifer forests of the other sites. Grass seedlings established but did not mature enough to be identified in this first year so we are not able to identify which species were most successful.

Addition of soil amendments appears to have increased native grass germination and cover in general, however there are a few site specific instances where the amendment may have either not aided in or hindered germination. Seed mix 1 seems to show less response to the application of soil amendments while seed mix 3 showed a positive response to amendments except in Toll Canyon. Research suggests that biochar may aid in binding non-native plant allelopathic chemicals. The ability to bind these chemicals added to the ability of biochar to increase soil moisture holding capacity could increase the success of seeded species establishment. The Rotary Park site showed the least benefit of soil amendments. This is likely because the site had access to water levels the others did not so the benefits of water availability provided by biochar and/or compost may not

Masonic Trail 2020 Treatment Photos

Treatment

Revisit 1

Revisit 2

Fall 2020

Control



Control + Amendment



Seed Mix 1



Seed Mix 1 + Amendment



Masonic Trail 2020 Treatment Photos

Treatment

Revisit 1

Revisit 2

Fall 2020

Seed Mix 2



Seed Mix 2
+ Amendment



Seed Mix 3



Seed Mix 3
+ Amendment



Rotary Park 2020 Treatment Photos

Treatment

Revisit 1

Revisit 2

Fall 2020



Rotary Park 2020 Treatment Photos

Treatment

Revisit 1

Revisit 2

Fall 2020

Seed Mix 2



Seed Mix 2
+ Amendment



Seed Mix 3



Seed Mix 3
+ Amendment



Toll Canyon 2020 Treatment Photos

Treatment

Revisit 1

Revisit 2

Control



Control
+ Amendment



Seed Mix 1



Seed Mix 1
+ Amendment



Toll Canyon 2020 Treatment Photos

Treatment

Revisit 1

Revisit 2

Seed Mix 2



Seed Mix 2
+ Amendment



Seed Mix 3

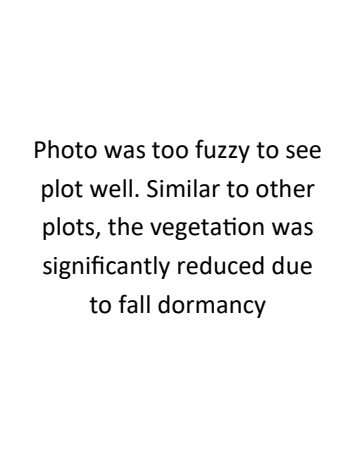


Photo was too fuzzy to see plot well. Similar to other plots, the vegetation was significantly reduced due to fall dormancy

Seed Mix 3
+ Amendment



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FINANCIALS

The Summit CWMA Seeding Trials project was allotted a total of \$16,000 over two years. In the first year, \$8,164.92 of that budget has been spent to control garlic mustard, establish and maintain plots, monitor and assess data and produce a year end report. The details of expenditures is in the table below as well as matches provided by partners and additional grants. State ISM funds and partner in-kind matches primarily paid for control of all noxious weed species in the area adjacent the study plots and along trails (wildlife and human), roads and waterways that could transport seed into the plot area. The combination of partner matches resulted in a 52% match.

Project Budget Year One

Contributor	Labor	Equipment	Chemical	BioControl	Other	Total
CWMA/County	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
ISM Garlic Mustard Grant 2019-2020	\$2,938.75	\$0.00	\$0.00	\$0.00	\$0.00	\$2,938.75
Snyderville Basin Special Recreation District	\$4,470.00	\$0.00	\$0.00	\$0.00	\$0.00	\$4,470.00
Park City Municipal Corporation	\$1,032.50	\$0.00	\$0.00	\$0.00	\$0.00	\$1,032.50
Ecology Bridge LLC	\$0.00	\$0.00	\$0.00	\$0.00	\$488.50	\$488.50
Subtotal Match	\$8,441.25	\$0.00	\$0.00	\$0.00	\$488.50	\$8,929.75
UWSA Grant	\$5,907.50	\$1,557.42	\$0.00	\$0.00	\$700.00	\$8,164.92
Total	\$14,348.75	\$1,557.42	\$0.00	\$0.00	\$1,188.50	\$17,094.67

CONCLUSION

Seeding with native grasses provides increased native grass establishment following significant reduction of garlic mustard in forests. The mix of grass species used is important and a second season may allow us to identify which of the species in the mixes were most successful. That said, after one year, the shade mixes show greatest promise. In addition to seeding, incorporation of soil amendments can increase seedling establishment and survival particularly in maple and conifer dominated forests. Because we did not include compost at the Masonic and Toll Canyon sites for logistic reasons, we may have reduced the impact of the amendment in our spring treatment. Best practices for biochar amendments is to activate the biochar by adding a nutrient and microbial mix or incorporating it in compost. By not activating the biochar in these two sites we also may have reduced potential for impacts of biochar. Adding compost to the fall treatments will aid in determining the potential benefit of a soil amendment next season.