Western Transportation Institute

Road Ecology Program

Steep Cut Slope Composting: Field Trials and Evaluation

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Purpose Statement

The purpose of the Steep Cut Slope Composting: Field Trials and Evaluation project sponsored by the Montana Department of Transportation (MDT) is to optimize cost-effective application rates of compost materials and compost retention techniques that increase the establishment of native plants on steep slopes.

Site Location

A test site approximately 25 kilometers west of Bozeman, MT along Montana Highway 84 with steep cut slopes of approximately 2 horizontal (H):1 vertical (V) with minimal vegetation provided an opportunity for the placement of treatment plots on both north-facing and south-facing slopes in November 2008 (Figures 1 and 2).

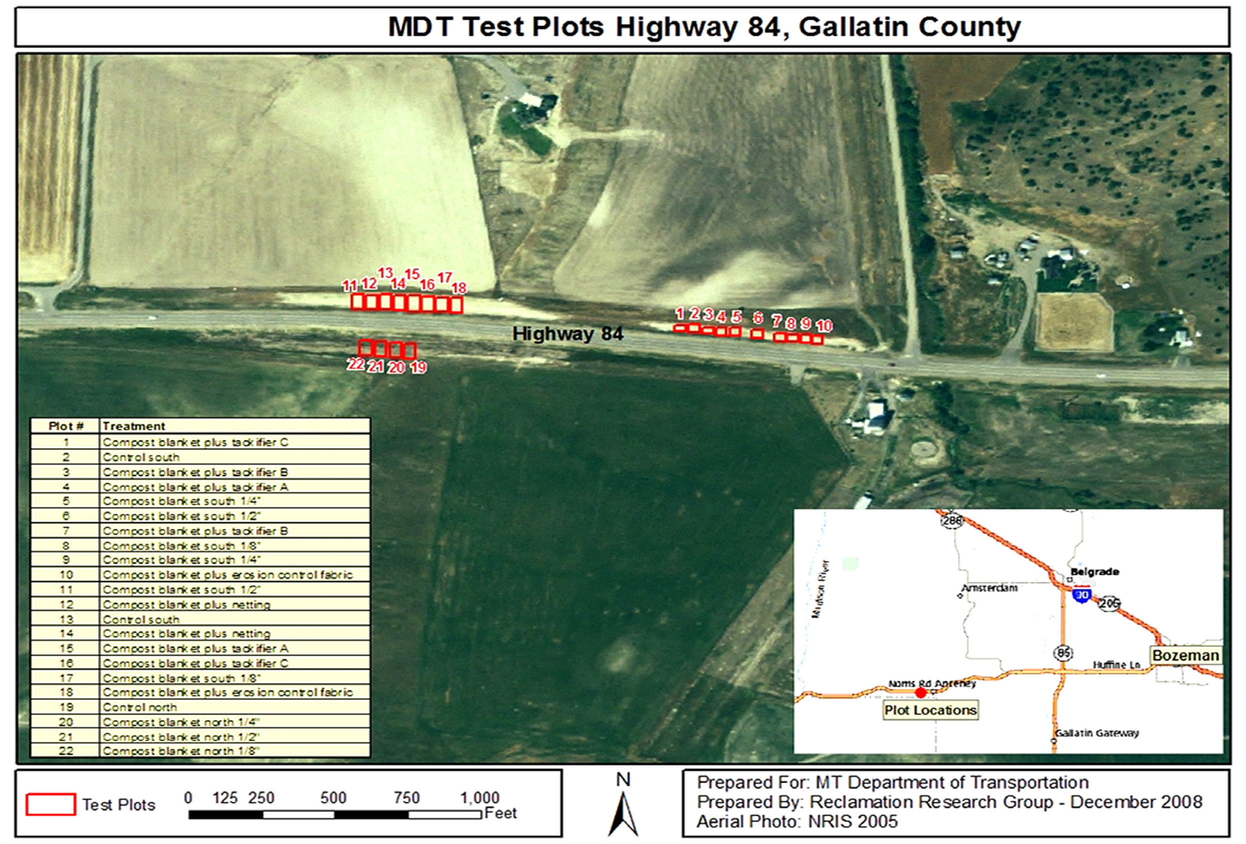

Figure 1: Site location map and test plot layout at research site, Montana Highway 84.

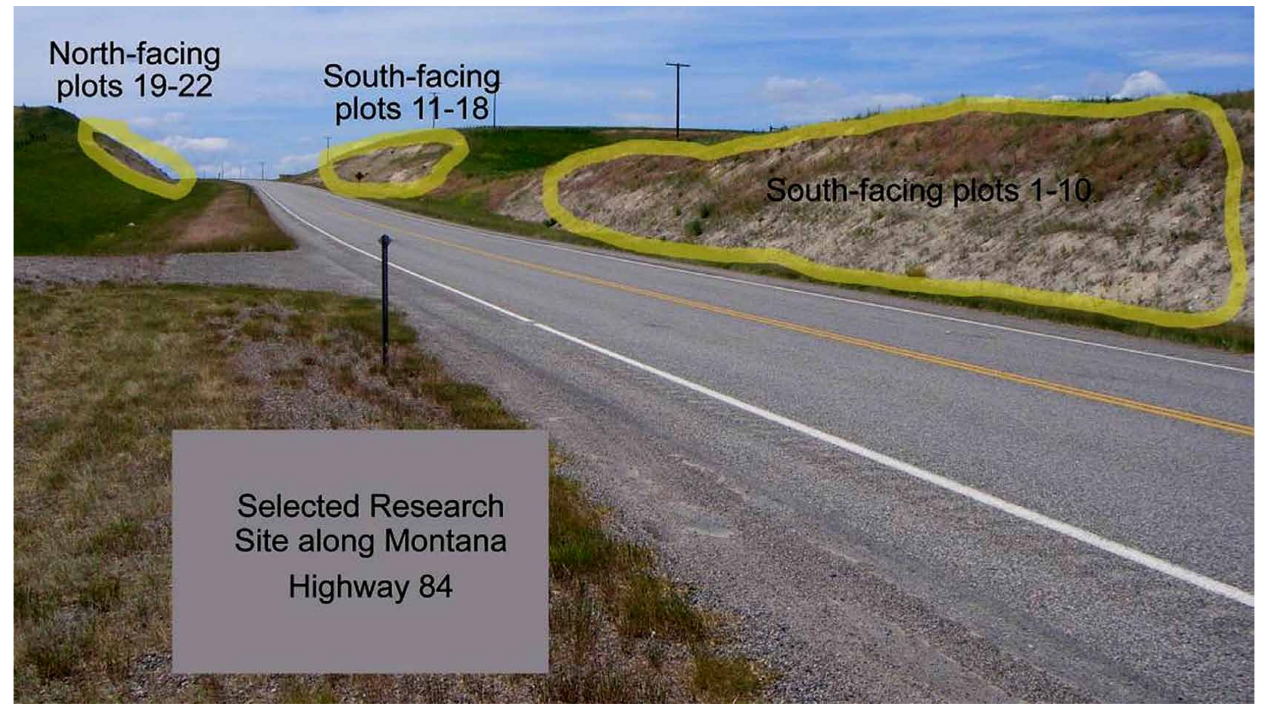

Figure 2: Roadside overview of research site location along Montana Highway 84. The slopes, 2 H:1 V, had been seeded in 2004 following reconstruction of this section of highway with minimal success of native vegetative cover.

Experimental Treatments

Treatments include compost blankets of three thicknesses - 0.32 cm, 0.64 cm, and 1.3 cm - applied over a seed mix of native grass species appropriate for the site. In addition, five compost retention techniques are being tested on 1.3 cm thick compost blankets: three different tackifiers (water soluble adhesives), plastic netting, and erosion control fabric (Table 1).

Table 1: Experimental design for compost research plots on MT Hwy. 84.

Treatment	# of Plots	Plot Aspect
Control Plots		
Control - no treatment	2	South-facing
Control - no treatment	1	North-facing
Varying Depths of Compost		
0.32 cm thick compost blanket	2	South-facing
0.64 cm thick compost blanket	2	South-facing
1.3 cm thick compost blanket	2	South-facing
0.32 cm thick compost blanket	1	North-facing
0.64 cm thick compost blanket	1	North-facing
1.3 cm thick compost blanket	1	North-facing
Compost Retention Treatments		
1.3 cm thick compost blanket + polymer emulsion liquid tackifier	2	South-facing
1.3 cm thick compost blanket + dispersable guar based tackifier	2	South-facing
1.3 cm thick compost blanket + plant based mulch tackifier	2	South-facing
1.3 cm thick compost blanket + plastic netting	2	South-facing
1.3 cm thick compost blanket + erosion control fabric	2	South-facing

Methods of Test Plot Construction

The test plots receiving compost of varying thickness were constructed using a 3-step process:

1. Seedbed preparation.
2. Seeding of plots with a native grass seed mix (Table 2) at a rate of 45 kilograms pure live seed (PLS)/hectare (40.2 pounds PLS/acre) via a broadcast seeder.
3. Compost applied using a blower truck to the appropriate depth (Figure 3).

Figure 3: Application of compost on a test plot using a blower truck.

The test plots receiving experimental compost retention measures were constructed using the above 3 step-process and than a compost retention measure was applied to the compost blanket using a hydromulch truck for water soluble tackifiers or stakes and sod staples for securing plastic netting and erosion control fabric.

Seed Mix

A native seed mix was developed by MDT comprised of cool season perennial grasses adapted to climatic conditions found at the site (Table 2).

Table 2. Seed mix provided by MDT for use on test plots.

Species	Scientific Name	Cultivar	Percent of Mix by Weight
Slender Wheatgrass	*Elymus trachycaulus*	Pryor	12.77
Canada Wildrye	*Elymus canadensis*		20.64
Sheep Fescue	*Festuca ovina*	Covar	6.45
Bluebunch Wheatgrass	*Pseudoroegneria spicata*	Goldar	32.93
Green Needlegrass	*Stipa viridula*	Lodorm	9.38
Indian Ricegrass	*Achnatherum hymenoides*	Nezpar	16.29

Compost

Compost was procured from Rocky Mountain Compost in Billings, MT by Quality Landscape Seeding of Plains, MT. The compost was standard reclamation compost screened so that pieces were smaller than 1 cm (<3/8 in).

Five Compost Retention Treatments

Three Tackifiers

Three different commercially available tackifiers were applied in a water solution by a hydromulch applicator after the compost was blown onto the test plots, they are:

- a polymer emulsion with bonding agents specifically engineered and formulated to bond soil and compost particles together. It forms a protective, flexible film that eliminates dust, prevents mud, and controls erosion;
- a dispersible guar based tackifier comprised of a complex formulation of high quality water-soluble polysaccharide and other proprietary ingredients made from natural non-toxic ingredients; and,
- a plant-based mulch tackifier manufactured from Psyllium or Plantago husk powder which contains a naturally evolved mucilloid that is an effective adhesive.

Erosion Control Fabric

The erosion control fabric is comprised of a 70 percent agricultural straw and 30 percent coconut fiber blend matrix that meets federal specifications for an extended term erosion control blanket. It was placed on top of the compost and held in place with wooden stakes and metal sod staples.

Plastic Mesh Netting

This was a green colored lightweight plastic netting material that is not biodegradable; it was placed on top of the compost and held in place with metal sod staples (see Figure 4).

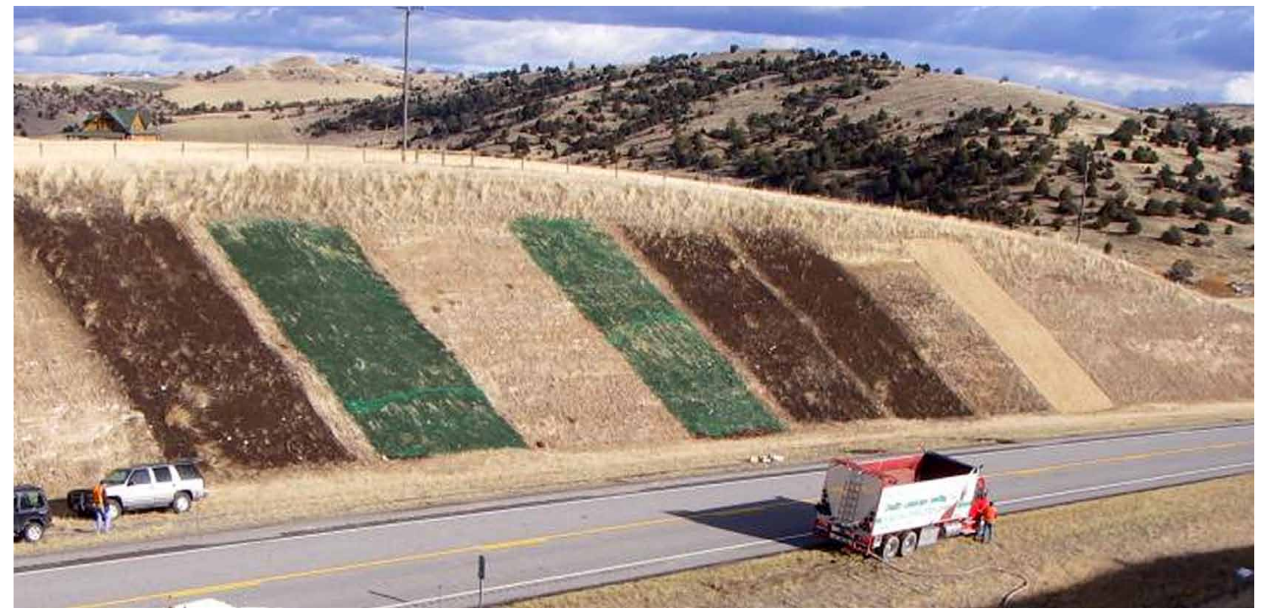

Figure 4: View of eight south-facing plots receiving varying depths of compost and/or a compost retention treatment. Note the green plots are the plastic netting and the plot furthest to the right (east) received erosion control fabric.

Figure 5: View of ten south-facing plots that are on the east end of the research site.

Figure 6: View of four north-facing plots received varying depths of compost. The furthest plot to the east (left) as shown in the image is a control plot without compost application.

Methods for Evaluating Performance of Compost Retention and Vegetation Response

Data collection objectives include assessing vegetation establishment, soil erosion, and the retention of applied compost. Ground cover and erosion will be monitored once during the first growing season (2009) and twice during the second growing season (2010).

Vegetation monitoring will estimate seedling emergence and density during the first growing season and will report stems per unit area by life form/morphological class (i.e., perennial grasses, perennial forbs, annual grasses, annual forbs, and shrubs). Canopy cover will be estimated during the first and second growing seasons and will be reported per unit area by life form/morphological class.

The percent of compost cover retained using five different treatments will be estimated during the first growing season (2009).

Seedling density for the first season, compost cover for the first season, and vegetative canopy cover for both growing seasons (2009 and 2010) will be determined using 20 cm x 50 cm metal 'Daubenmire' frames at 10 randomly selected sites along a diagonal transect of each test plot. These same selected sampling sites will be revisited for measurements during each time interval.

Preliminary Results: Compost Retention and Vegetation Response in 2009

The test plots were visited on 28-30 July 2009 to measure vegetative response and to determine what percent of the compost blankets remained. Reported here are the first growing season's measurements of the native perennial grass canopy cover (Tables 3 and 4). Other measurements for forbs, weeds and other plants were also recorded, but these were not in the seed mix used during plot construction in November 2008. Also reported is the mean percent compost cover for each of the compost blankets of varying thickness and the five compost retention techniques (Tables 3 and 4).

Table 3: Summary of compost retention and native perennial grass cover measurements on steep south-facing slopes, MT Highway 84.

Test Plot Treatment	Mean % Compost Cover n=2	Mean % Native Perennial Grass Cover n=2
Control	0	8
0.32 cm thick compost blanket	14	15.5
0.64 cm thick compost blanket	42.5	23.5
1.3 cm thick compost blanket	40	19.5
1.3 cm thick compost blanket + polymer emulsion liquid tackifier	31	18
1.3 cm thick compost blanket + dispersable guar based tackifier	63	14.5
1.3 cm thick compost blanket + plant based mulch tackifier	47.5	15
1.3 cm thick compost blanket + plastic netting	53	23
1.3 cm thick compost blanket + erosion control fabric	96.5	21.5

Table 4: Summary of compost retention and native perennial grass cover measurements on steep north-facing slopes, MT Highway 84.

Test Plot Treatment	% Compost Remaining	% Vegetation Cover Native Perennial Grasses
Control	0	8
0.32 cm thick compost blanket	45	16
0.64 cm thick compost blanket	60	24
1.3 cm thick compost blanket	75	12

Discussion of Preliminary Results

The measurements of compost during the first growing season, July 2009, on the south-facing or environmentally harshest sites indicate that four of the five compost retention techniques increased the mean percent compost cover from those plots that received no treatment (Table 3). The plots receiving the polymer emulsion liquid tackifier (mean = 30% compost cover) did not perform as well as the untreated 0.32 cm thick compost blanket (mean = 41% compost cover). The best technique to retain compost was the erosion control fabric (mean = 96.5% compost cover), a common practice currently used by highway departments. A cheaper alternative, the dispersible guar based tackifier, was the next best compost retention technique at 63% mean compost cover (Table 3).

On north-facing sites, compost cover retention increased with increasing thickness of the compost blanket applied (Table 4). This result is not unexpected. However, increased compost retention levels did not necessarily equate into higher vegetative cover (Table 4).

The north-facing plots retained higher levels of compost than their equivalent treatments on south-facing plots: 45% versus 14% for 0.32 cm thick compost, 60% versus 42.5% for 0.64 cm thick compost, and 75% versus 40% for 1.3 cm thick compost (Tables 3 and 4). This is likely the result of higher snow retention on the north-facing slopes. Increased depths and duration of snow cover resulted in the compost being less available to wind scour.

Although all life forms/morphological classes were estimated in July 2009, only native perennial grass canopy cover was reported here (Table 3). Native perennial grass canopy cover, regardless of compost depth or compost retention treatment, varied between the relatively narrow values of 15.5% and 23.5% (Table 3) on the harsh south-facing slopes. The control sites that were seeded but received no compost had substantially less mean canopy cover (8%). These results indicate that compost added to the test plot, regardless of depth, appears to aid in vegetative establishment and growth.

Acknowledgements

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