

Project Title – Field Evaluation of Mulches for Establishing Vegetation on Steep Slopes

Project Coordinator and/or Principal Investigator (PI)

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Abstract – Straw and tackifier has been the standard practice for mulching disturbed areas in order to establish ground covers. However, there are a multitude of other mulches which are available which may be more effective at both controlling erosion and establishing vegetation. Many of these have been tested for erosion control capabilities, but this usually does not include tests of germination and growth of the vegetation being established. When such tests are conducted, it is usually in greenhouses or other areas which are irrigated. We have been conducting tests of some of these products on steep slopes (3:1 or greater) with no irrigation. This project will continue that work as part of a Master of Science thesis and will result in recommendations on mulches for ground cover establishment.

Introduction – New products and methods for erosion control are continually introduced to the market. It is important that both designers and regulatory agencies have an independent evaluation of these products in order to be assured of their effectiveness. This project will provide funding for a graduate student to summarize current work on field evaluations we have and are conducting, as well as related studies.

Background - Ground cover is an effective way to reduce erosion and prevent sedimentation from disturbed soils in North Carolina. Vegetation is the principal method for stabilizing exposed soils throughout the state (NCDENR, 1999). Grasses are the most common vegetation used though shrubs and trees are also effective for erosion control. Grass growth and survival is dependent on soil moisture, temperature, and structure as well as light, microorganisms and sowing depth (Bellotti and Blair, 1989; Heydecker 1973). Heydecker (1973) found that less than optimal soil conditions existing on agricultural sites reduced

germination and survival of grass seedlings. The acid, infertile subsoil exposed on construction sites is less than optimal for plant growth and amendments such as mulch and polyacrylamides improve grass establishment (NCDENR, 1999; Cook 1986).

Mulches have reduced erosion and improved soil conditions on agricultural fields for decades. Mulches promote grass establishment and favor seedling growth because they improve soil conditions. Bruce (1995) reported that erosion controlled by mulches has a two-fold advantage of reducing soil loss and protecting grass seeds and soil amendments from being washed away. Furthermore, mulches moderate soil temperature, protect seeds, reduce evaporation losses, dissipate rainfall impact, and help prevent soil crust formation (Turgeon, 2002; Singer et. al 1981; Bruce et. al. 1995). The North Carolina Erosion and Sediment control program promotes the use of straw, wood fiber, wood chips, jute net, excelsior mats, and several other types of mulch for erosion control and vegetation growth promotion on construction sites (NCDENR, 1999). Mulch and seed combination were reported to reduce turbidity of runoff by 61% on average regardless of PAM use (Hayes et al., 2005; McLaughlin et. al, 2002).

Straw mulch is found to be one of the most effective erosion control measure in agricultural production (Fullen, 1999; Zuzle 1993). Singer et. al. (1981) reported that straw mulches reduced sediment detachment and transport to zero with 100% cover and Meyer found erosion reduced by one half to one third of bare soil control plots depending on the amount of soil covered. Singer et al. 1981 established a linear relationship between sediment detachment/transport and the amount of mulch cover. Mannering et. al. (1995) found that mulches of wheat straw eliminated almost all of the runoff and controlled erosion at rates of 1, 2, and 4 tons per acre by reducing raindrop impact. Argument between the influence of straw mulch on reducing runoff and runoff velocity exists (Zuzle et. al 1993; Meyer, 1970). Meyer (1970) found a 49% decrease in runoff and Zuzle et al. (1993) found no change in runoff or runoff velocities. Straw not only reduces raindrop impact but also encourages grass establishment by reduced runoff, increased infiltration and improved soil conditions (Turgeon, 2002).

Hydraulically applied mulch and excelsior (wood fiber) mats are an age old seeding practice believed to reduce erosion and influence vegetation establishment. These types of mulches control erosion and improve soil environments similar to like straw mulches. Paschke et. al (2000) found that excelsior mulch treatments showed higher percent plant cover. Excelsior mats are comparable to straw and preferred because they are free of weed seeds but the wood fiber have not been found to promote germination as much as straw in turfgrass applications (Turgeon, 2002). Hallock et. al (2002) did not find suitable ground cover establishment for erosion control when tackifiers were used in comparison to straw and reported that tackifiers were not as effective as plant cover. This contrasts previous reports by Beard (1973) that excelsior forms a thick and uniform cover in comparison to straw and is as effective as a ground

cover and for seed germination. Hydraulically applied mulch has provided adequate turfgrass establishment in moist environments and enhanced soil conditions favors grass growth and reduced erosion (Button, 1962; Beard 1973). Hydroseeding has been found to establish ground cover of fescue in only 15 days and seed that took two to three weeks germinated within a week (Erosion Control, 2000). The Soil and Water Restoration Group reported that plant density was double conventional hydroseeding when seeds were applied first and then fiber was hydraulically applied.

Polymers have recently been used to reduce erosion on construction sites. Two studies have found that polyacrylamide (PAM) use also influenced grass growth on disturbed soils. Tobiasson et al found that PAM not only prevented erosion and sedimentation but that the polymer increased pore space and infiltration that may have been responsible for increased grass germination (Tobiasson et. al. 1996; Cook et. al. 1986; McLaughlin, 2002; McLaughlin and Brown, 2006). The PAM improved the hydromulched seed performance and together reduced turbidity by 94- 99%. Cook et. al. (1986) found that liquid PAM improved sweet corn and alfalfa emergence compared to granular PAM on soils that crusted. Furthermore, soil physical conditions were not improved PAM but the soil aggregates were stabilized so that erosion was reduced and infiltration was improved (Cook et. al. 1986). McLaughlin et. al. (2002) found that sediment was reduced by over 95% at high doses of several PAMs tested.

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Narrative: The project has direct utility in the Piedmont of North Carolina, and elsewhere when similar slopes are being stabilized. Tests have been and are being conducted in both the Raleigh and the Charlotte areas.

Deliverables, Methods, and Procedures: Slopes on active construction sites are selected for test sites. These are often on NC DOT projects as they tend to generate large areas of steep slopes, and the NC DOT staff have been willing to provide these areas for our testing. At each test site, plots are established with varying lengths and widths depending on the available slope area. Lengths range from 20' – 40' and widths from 10' – 20', which provides an area large enough to encompass typical erosion processes. Treatments are applied with 3-5 replications each, again depending on the area available. Seed, fertilizer, and lime are applied at the NC DOT recommended rate for the area and time of year.

The mulches included in our tests are straw, excelsior, a cotton-based hydromulch, and wood fiber hydromulch (both standard and engineered). In addition, treatments including the application of polyacrylamide (PAM) are included, with a minimum of a straw + PAM treatment. The PAM rates are 20-30 lb per acre, although recently we have only used the 30 lb per acre rate as a standard. To date we have established test areas at six locations and we plan to establish two more later this year.

Data collected from each plot includes vegetation cover (%) at one or more points in time after treatment application, usually once the vegetation has grown to 4-6". This is done by having at least three different evaluators independently rate individual plots, and averaging their scores. In addition, biomass is determined by selecting three random locations within each plot and cutting the vegetation on 10 x 10 cm areas. The samples are composited by plot and dried at 105° C until constant weight. All of this data is statistically analyzed by treatment for comparison. A summary of all of the data collected will be provided, including recommendations for product evaluation for use in North Carolina.

Project Milestones:

January 1, 2008 – March 2008: Summarize and evaluate study data.

April 2008: Complete final report and recommendations.

Duration of Project: January 1, 2008 – April 30, 2008

Detailed Project Budget

Description	Amount
Salaries and Wages	
Graduate Student	\$6,222.64
Indirect Costs (15%)	\$ 933.40
Total	\$7,156.04

Matching funds – Tuition and fees for Spring 2008 will be paid from departmental funds.

Indirect Costs: Standard rate per agreement with NC DENR.

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