USE OF MAN MADE AND NATURAL MATERIALS TO CONTROL EROSION AND ESTABLISH TURF

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Of all the material entering the nation's waterways by far the single greatest pollutant is soil sediment. The effects of sediment loading on water quality are enormous. Continual sediment loading of surface waters is known to be responsible for the loss of water storage capacity in municipal reservoirs, increased dredging of navigation channels, and the loss of numerous aquatic organisms such as oysters, fish, and submerged vegetation. On a per acre basis, the loss of sediment from construction sites far exceeds that from traditional agricultural land. A 1978, United States Geological Service study of the Anacostia River near Washington D.C. found that urban construction sites can contribute anywhere from 7 to 100 tons of sediment per acre annually. In contrast, the sediment load typically found at the edge of agricultural fields seldom exceeded 4 tons per acre on a yearly basis. Widespread construction within the rapidly growing urban and suburban areas of the Chesapeake Bay watershed has been implicated as a major source of sediment loading of the Chesapeake Bay.

Contractors attempt to control soil erosion, and off site sediment transport, at construction sites by hydroseeding or sodding bare ground slopes and waterways, or by using man made erosion control materials such as Curlex or Jute. Often, construction projects are started and completed within 3 to 4 months time. Thus, use of erosion or sediment control measures that involve the establishment of grass are likely to be only partially effective at controlling erosion and capturing sediment. In an attempt to overcome this short coming many contractors have began using man made erosion control materials in tandem with seeding to limit sediment losses. The effect of using man made materials in preventing sediment loss and promoting sod development of seeded areas has not been adequately investigated.

In 1991, a study was initiated at the University of Maryland to examine the effect of four man made erosion control materials on preventing soil erosion from two disturbed soil locations. One site was located on an 8% hillside slope having a fine sandy loam soil and the other, on 14 to 21% slope having a silt loam soil. Sediment loss from the four man made materials were compared with sediment loss from sodded, straw covered and bare soil areas on the same hillside. The effect of the man made materials and straw placed down at a rate of 2 to 3 tons per acre on the establishment of turf from seed was also investigated at the 8% slope site in 1991 and 1992.

The man made materials examined included a polyester netted coconut erosion control blanket from North American Green (C–125 blanket), a coconut–fiber woven rope strand mat from Belton Industries (D–700 mat), Curlex, which is a polypropylene netted non–woven mat of elongated fibers from American Excelsior, and Geojute, an open mesh net made of twine–like strands from Belton Industries.

Sediment losses were examined under natural rainfall conditions and under artificial rainfall conditions using a rainfall simulator. All areas except those covered with sod were kept free of vegetation during the evaluation period by periodically spraying the non sodded areas with glyphosate. After examining the erosion control effectiveness of each material at the 8% slope site, the establishment of turf from seed was evaluated by seeding areas at this site with a modified Maryland highway mix, then covering the seeded areas with straw or one of the man made materials. The highway mix consisted of 92% Kentucky 31 tall fescue, 2% Kenblue Kentucky bluegrass, 2% Canada bluegrass and 1% redtop. The mix was seeded at a rate of 60 pounds per acre on 4 October 1991. A 1.2 inch rainstorm on 5 October washed almost all the seed off the bare soil slope site areas. For this reason, the bare soil areas were re–seeded a second time on 9 October. Visual turfgrass surface coverage ratings were taken monthly from November to April and then every 2 to 3 weeks thereafter. The study was terminated on 30 July 1992 after turfgrass and weed shoot density data were collected from all treatment areas.

Under natural rainfall all materials examined provided excellent sediment control at both site locations. Sediment losses were reduced from 94 to 99% of the amount loss from the bare soil areas. Under highly reproducible simulated rainfall conditions, each area was subjected to a 3.8 inch per hour rainstorm for a time period necessary to cause runoff plus an additional 35 minutes. Sediment loss under these conditions from sodded areas was 2 to 19 times less than for any of the man made materials and 5 to 9 times less than for straw at the two sites.

The amount of time needed before runoff was observed from the sodded areas was 1.6 to 7.8 times longer than for any of the other erosion control materials. The total amount water lost as runoff during the 35 minute period following the initiation of runoff was greatest in the bare soil, and least in the sod covered areas at both locations. The amount of applied rainfall that ran off the sod covered slopes at the 8 and 14 to 21% slope sites was 26 and 40%, respectively. At the 8% slope site, the straw covered areas had the second lowest amount of runoff (59%), while at the 14 to 21% slope site the C–125 blanket was second most effective material in reducing runoff (61%). Bare soil runoff at the 7% and 14 to 21% slope sites averaged 87% and 80%, respectively.

Visual ratings of seeded areas at the 8% slope site revealed no material reduced turfgrass establishment when compared to the bare soil areas (Table 1 and 2). In contrast, covering the hillside with the C–125 blanket, or with 2 to 3 tons per acre of straw, accelerated hillside vegetative establishment. In the case of the straw covered areas, shoot density counts showed that most of the increase in vegetation within these areas was due to the presence weeds such as white clover and mouseear chickweed and in the fall of 1991, oats. Analysis of the individual turfgrass species shoot density data revealed that straw inhibited the establishment of Canada bluegrass and had the lowest number of total turfgrass shoots per unit area of any of the materials evaluated.

The C–125 blanket had the highest shoot density of any material, however, differences between all materials were not statistically significant. The C–125 blanket provided a thin uniform cover over the soil surface which kept the seed moist and evenly distributed over the soil surface during seed germination. This resulted in this material having the most uniform turfgrass establishment of all materials. The Curlex material also provided uniform soil coverage of the soil surface but its several inch thickness appeared to delay fall seedling growth. The D–700 mat swelled upon wetting which caused parts of this mat to lump up and pull away from the soil. This resulted in some down slope movement of the seeds beneath this mat causing much of the seed to germinate in clumps within the sections of the mat that did not swell up away from the soil surface.

The results of our work indicate that sod, by reducing hillside runoff, provides the most effective means of controlling erosion of any of the materials we examined. However, all materials did an excellent job controlling erosion and none reduced the rate of turfgrass establishment when compared to seeding bare ground. For this reason, other factors such as slope steepness, cost of the material, anticipated traffic over the site and the availability of water should be considered before selecting an erosion control material.

Table 1. Average percent vegetative cover for five erosion control materials placed on a 8% hillside slope seeded with a modified Maryland State Highway mix on 4 October 1991. The average for each material is based on visual ratings collected between 8 November 1991 and 23 July 1992.

Erosion control material	Average percent cover over evaluation period
Straw	37.8 A+
C–125 (blanket)	25.6 B
Geojute	22.4 BC
Curlex	19.1 CD
Bare soil*	19.1 CD
D–700 (mat)	14.6 D

+ Means followed by the same letter are not statistically different at the P=0.05 level using Duncan's Multiple Range Test.

* Following a 1.2 inch rainstorm on 5 October, bare soil areas were seeded a second time on 9 October at the initial 60 pound $acre^{-1}$ rate seeding rate.

Table 2. Final percent vegetative cover for five erosion control materials placed on a 8% hillside slope seeded with a modified Maryland State Highway mix on 4 October 1991. The values for each material are based on visual ratings collected on 23 July 1992.

Erosion control material	Final percent cover
Straw	86.7 A+
C–125 (blanket)	78.3 AB
Geojute	76.7 AB
Curlex	70.0 BC
Bare soil*	58.3 C
D–700 (mat)	58.3 C

+ Means followed by the same letter are not statistically different at the P=0.05 level using Duncan's Multiple Range Test.

* Following a 1.2 inch rainstorm on 5 October, bare soil areas were seeded a second time on 9 October at the initial 60 pound $acre^{-1}$ rate seeding rate.