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STABILIZATION OF NEWLY CONSTRUCTED ROAD BACKSLOPES BY MULCH AND GRASS-LEGUME TREATMENTS

by

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ABSTRACT

Amounts of soil loss from an unprotected newly constructed backslope were two to four times greater than loss from a comparable slope 5 years after construction. Of six roadside treatments studied, the two showing consistently large amounts of soil loss during the first critical rainy period were the only ones without a straw mulch covering.

In an earlier study,[1] five different mulch and grass-legume applications to a 5-year-old road backslope were equally effective in eliminating erosion. Only the untreated control plots showed appreciable amounts of soil movement during the first year of measurement. At that time, it was hypothesized that erosion rates from freshly constructed backslopes are generally substantially higher. Consequently, such slopes may offer considerably more resistance to stabilization, especially during the critical first year after construction.

The present study was conducted to test this hypothesis, not only to provide information on the stability of new slopes but also to aid in formulating measures to minimize soil loss. Experimental design and treatments are essentially the same as those described in the 1967 report, the principal difference being that these plots were established in

[1] C. T. Dyrness. Grass-legume mixtures for roadside soil stabilization. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-71, 19 pp., illus. 1967.

the fall following road construction.

METHODS

In late August 1967, two blocks of six backslope plots each were established along a road in the Blue River District of the Willamette National Forest. The road, constructed during the early summer of 1967, is at an elevation of 3,100 feet. The soil (Slipout series) is imperfectly drained and exhibits a clay loam surface grading into a silty clay subsoil. Parent material is largely greenish tuffs and breccias.

Five grass-legume mixtures and a control were replicated twice. Plots were 6 feet wide and as long as the backslope--generally about 20 to 25 feet. Species composition and amounts applied of the seed mixtures are shown in table 1. With the exception of the control plots, all plots received a blanket application of ammonium phosphate fertilizer (16-20-0) at the rate of 400 pounds per acre both at the time of seeding (August 1967) and the following April (1968). Treatments were as follows: (1) control--slope left untouched, (2) mulch only--wheat straw mulch applied at the rate of 2 tons per acre, (3) Blue River District mixture--seed at the rate of 25 pounds per acre applied without mulch, (4) Oregon Highway mixture--seed at the rate of 40 pounds per acre and straw mulch at the rate of 2 tons per acre, (5) experimental mixture No. 1--43 pounds per acre of seed and 2 tons per acre of straw mulch, and (6) experimental mixture No. 2--43 pounds per acre of seed and 2 tons per acre of straw mulch.

Soil movement on the plots was evaluated by a slope profile measurement technique.[2] At the time of each measurement, percentage of vegetative cover on each plot was also estimated. Initial slope profile measurements were made soon after plot establishment in September 1967, and subsequent measurements were made in April, June, and September of 1968.

RESULTS AND DISCUSSION

Although these plots were seeded early in the fall, plant growth was rather severely limited prior to and during the cold, wet, winter months. Amounts of grass and legume cover remained relatively low until April. However, only 2 months later, all seeded plots were virtually fully protected by plant cover (table 1). Therefore, the growth of seeded species during the fall and winter months apparently provides insufficient cover for soil stabilization, at least at moderate to high elevations.

Soil losses or gains during the first rainy season following road construction are shown in table 2 in the April column. With the exception of one plot of experimental mix No. 1, where a small slump occurred, the only plots to show consistently large

[2] See footnote 1.

Table 1.--*Species composition and plant cover on plots representing five treatments during the first year following seeding*

Treatment	Pounds per acre of seed	Species composition	Block	April	June	Sept.
			- - *Total percent plant cover* - -			
Control			1	0	0	5
			2	0	0	15
Mulch and fertilizer			1	5	70	75
			2	5	65	80
Blue River District mixture (no mulch)	6.25	Colonial bentgrass *(Agrostis tenuis* Sibth.)	1	20	95	95
	5.00	Creeping red fescue *(Festuca rubra* L.)	2	10	95	95
	3.75	Perennial ryegrass *(Lolium perenne* L.)				
	8.75	Tall fescue *(Festuca arundinaceae* [Schreb.] Wimm.)				
	1.25	White Dutch clover *(Trifolium repens* L.)				
Oregon Highway mixture	18.0	Creeping red fescue	1	25	75	85
	12.0	Chewings fescue *(Festuca rubra* var. *commutata* Gaud.)	2	40	95	95
	4.0	Perennial ryegrass				
	6.0	White Dutch clover				
Experimental mixture No. 1	8.0	Italian ryegrass *(Lolium multiflorum* Lam.)	1	10	95	95
	20.0	Tall fescue	2	35	90	90
	8.0	Creeping red fescue				
	3.0	Colonial bentgrass				
	2.0	New Zealand white clover *(Trifolium repens* L.)				
	2.0	Birdsfoot trefoil *(Lotus corniculatus* L.)				
Experimental mixture No. 2	8.0	Italian ryegrass	1	25	90	90
	20.0	Tall fescue	2	35	95	95
	8.0	Creeping red fescue				
	3.0	Colonial bentgrass				
	3.0	Red clover *(Trifolium pratense* L.)				
	3.0	Alsike clover *(Trifolium hybridum* L.)				
	7.0	'Lana' woollypod vetch *(Vicia dasycarpa* Ten.)				

Table 2.--*Average cumulative soil loss or gain on 12 backslope plots during the first year after construction, compared with soil movement in 1 year on a comparable backslope 5 years after construction*

Treatment and block	1968			1-year results from 5-year-old backslope[1/]
	April	June	Sept.	
	Inches			
Control:				
1	-0.48	-0.55	-0.83	-0.23
2	-.45	-.59	-.84	-.44
Mulch only:				
1	-.06	-.08	+.05	+.13
2	--	-.07	-.07	-.14
Blue River District mixture:				
1	-.72	-.72	-.77	+.05
2	-.42	-.55	-.31	+.14
Oregon Highway mixture:				
1	-.12	-.13	-.20	-.13
2	-.11	-.19	-.23	-.04
Experimental mixture No. 1:				
1	[2/]-.54	-.66	-.65	+.11
2	+.10	+.14	+.17	+.10
Experimental mixture No. 2:				
1	+.01	-.07	-.07	+.14
2	+.02	+.08	+.11	-.01

[1/] Data taken from C. T. Dyrness. Grass-legume mixtures for roadside soil stabilization. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-71, 19 pp., illus. 1967.

[2/] Most of this movement was caused by a small slump near the base of the plot.

amounts of soil loss were the control and Blue River District mixture plots. It is significant that these two treatments are the only ones which lacked a straw mulch covering. In order to fully appreciate the magnitude of soil loss, one needs only to realize that 1 inch of soil is roughly equivalent to 100 tons per acre. Thus, a 0.45-inch loss represents a soil loss of approximately 45 tons on an acre basis. Although much of this eroded material comes to rest in the roadside ditch, road drainage water during rainy periods generally carries some of the sediment into stream channels. The soil gain figures shown in the table probably represent deposition of soil which raveled down from the top of the backslope on the measured slope section.

By June and September, a nearly complete covering of grasses and legumes on all plots, including plots treated with the Blue River District mixture (table 1), had substantially reduced soil movement. As a result, the control plots were the only ones to show continued high rates of soil loss during this period (table 2). It is interesting to note that for the control plots dry season loss by raveling was almost as great as rain-caused soil loss.

The hypothesized greater instability of freshly constructed backslopes is apparently borne out by the data in table 2. One-year soil losses from unprotected new slopes are roughly two to four times greater than losses in a 1-year period from a 5-year-old backslope. However, since soil and slope characteristics of the two sites differ, sweeping general conclusions should be avoided.

CONCLUSIONS

Considerable evidence has indicated the desirability of treating newly constructed roadside slopes in the early fall before heavy rains. Probably most important is that the loose, unprotected soil is most vulnerable to erosion during this period and, therefore, needs protection. For example, Fredriksen[3] reported that stream sediment content increased 250 times during the first rainstorms after road construction in a small drainage in the western Cascades. The open, porous soils on freshly constructed slopes offer a very favorable seedbed. On the other hand, slopes which have been exposed to the beating action of rainfall tend to have smooth, sealed surfaces and are less favorable for germination and seedling establishment.

Results of this study suggest that mulching backslopes may be essential for reducing soil loss to a minimum during the first few critical months following construction. The only mulched plot which showed a large amount of soil movement did so as a result of a rather deep-seated slump--indicating, of course, that these treatments are effective only in curtailing surface erosion. These results also indicate that, contrary to appearances, a luxuriant growth of grass and legumes during the first growing season following fall treatment is not conclusive evidence that soil loss was negligible during the preceding winter months.

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[3] R. L. Fredricksen [Fredriksen]. Sedimentation after logging road construction in a small western Oregon watershed. U.S. Dep. Agr. Misc. Pub. 970, 56-59, illus. 1965.