Soil Mulches for Grassing

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The degree of success in establishing turf on highway slopes depends on making all factors that influence germination and subsequent seedling growth as favorable as possible. If any one growth factor is adverse, seeding failure will occur even though all other factors are favorable for growth. The following factors that effect growth must be considered concurrently:

1. Tilth and compaction of soils as interrelated to ceration and water infiltration.
2. Chemical composition of soil and adequate liming and fertilization.
3. Available soil water.
4. Adapted plant species in compounding seed mixtures.
5. Suitable dates of seeding to capitalize on favorable soil moisture and temperature periods.
6. Uniform placement of seeds, lime, and fertilizer.
7. Uniform light application of mulch that improves moisture and temperature for germination and rapid seedling development.
8. Control of weeds that compete with desirable seeded species.
9. Biological pests, such as diseases and insects, may cause seeding failures.

These complex interrelated factors in seed and seedling environment along slopes on highways cannot all be simultaneously controlled; thus, complete success in sod establishment is not usually attained. Stands from new seedings on a slope may range from complete plant cover to bare ground; hence, reseeding of new seedings is frequently necessary.

REASONS FOR MULCH USE

Failures in establishing new turf areas are more often attributed to low moisture than any other factor. Surface mulches improve moisture availability and, consequently, germination and subsequent seedling growth. Suitable mulches encourage rapid moisture infiltration into soils and reduce evaporation. Mulches, because of better water infiltration, reduce water runoff and concurrent soil erosion. Soil temperatures are moderated by good mulching materials; the insulation from mulch reduces temperatures built up during the day and retards heat loss during the night. The lower temperatures of mulched soils reduce rates of evaporation. Some mulching materials also bind soil particles together to resist erosion.

Mulches tend to assure successful turf establishment. The experiments show that mulches invariably improve rate of germination and seedling growth and shorten the period for developing a suitable turf; water and soil loss is also reduced on sloping cuts or fills. The more difficult the environment or moisture stress, the greater the benefits from surface mulching. Tests with tobacco stems and straw have shown that tobacco stems were not suitable because of poor stabilization and perhaps a toxic excretion. Results with straw mulches have been unsatisfactory with heavy applications. Straw or hay mulches are often distributed unevenly causing seedling extermination where applications are heavy. Unthreshed small grains or weedy species in hay mulches are objectionable. The rapid germination and seedling growth of small grains has exterminated the stands of desirable seeded species in experimental and other seedings. Straw mulch should be applied at the rate of 1 to 2 tons per acre, but a better criterion is to leave 25 to 50 percent of the soil exposed. The best way to stabilize straw or hay mulches against air drafts from fast-traveling vehicles and on slopes is to use asphalt.

COMPARISON OF STRAW AND TURFIBER

Because of improved turf establishment with mulches recent cooperative trials were set up with the Virginia Landscape Engineers and the International Paper Company to compare turf establishment with straw and Turfiber. The experimental site is located just east of Bristol on Interstate 81. The 2:1 sloping cuts and fills were topsoiled with 2 to 4 in. of topsoil. Dolomitic finely ground agricultural limestone was applied at the rate of 3,000 lb per acre and incorporated into the soil 6 to 8 in. deep with a bulldozer chisel and then smoothed with a ball and chain drag. The lime was worked into the soil on some slopes to a depth of 4 to 6 in. with the ball and chain drag. The area was then immediately seeded on this loose soil; all seedings were finished on May 6, 1961.

Of the 7 acres seeded, about one-half of the area was on slopes and fills with cool northern exposures and the other acreage on slopes with warm southern exposures. The site is shown in Figures 1 to 3.

Straw mulch check seedings (0.1 acre each) were established on long sloping cuts with northern and southern exposures. Turfiber seedings were made adjacent to and on each side of the straw mulched plots. Straw mulch was applied by hand at the rate of 2 tons per acre to attain a 75 percent ground cover; the seed and fertilizer were mixed together and applied over the straw mulch (Fig. 2). Fertilizer, 1,750 lb per acre of a 5-10-5 and 60 lb per acre of an identical seed mixture, was applied for both mulches. The seed mixture composition in pounds per acre was Kentucky bluegrass, 60; domestic ryegrass, 8; white clover, 8; and redtop, 4.

Turfiber was applied by the method developed by the International Paper Company in cooperation with the Finn Equipment Company, manufacturer of the Super Hydroseeder. Turfiber is a wood-pulp cellulose fiber, distributed in 80-lb bundles and applied at the rate of 1,000 lb per acre. The 1,000-gal tank of this hydroseeder was filled with water and then seed fertilizer and Turfiber for one-third of an acre. This slurry was then sprayed on sloping cuts and fills as shown in Figure 2. The strong winds during some of the seeding operations did not interfere with making uniform applications of the slurry.

The seeding mixture used for the straw mulch and Turfiber comparisons was also modified to include Kentucky 31 tall fescue and/or sericea lespedeza on some seedings with the Turfiber method. Kentucky 31 fescue also replaced the domestic ryegrass in some seedings.

Heavy rainfall occurred during the week after seeding, but the weather before making the first inspection on May 27 was warm and dry. The surface $\frac{3}{4}$ in. of soil was very dry on the slope with a northern exposure, on the southern exposure the surface $1\frac{1}{2}$ in. was very dry. The straw and Turfiber mulches retarded water loss; nevertheless, the surface soil was dry because the loose surface soil was not in a firm contact with the subsurface soil to encourage roots to grow to and utilize the capillary moisture.

The initial stand and growth of turf plants was somewhat better with straw mulch than for Turfiber. The plant population on plots with either of the mulches was fully ten times as high in the compacted tracks where individuals walked as compared with the uncompacted soil. The heavy tramping while applying seed, fertilizer, and straw on the straw-mulched plots did unintentionally give a firmer seedbed; thus a better moisture status for germination and growth. The quick initial growth of unthreshed cereal seed in the straw mulch also gave the straw mulched plots a somewhat greener appearance during the May inspection. The growth and stands of grass on the cool slope for straw and Turfiber seedings were similar; stands and growth were slightly better on the straw than Turfiber-mulched plots on the warm slope. However, the differences were small, and the stands and growth of seedlings mulched with Turfiber were satisfactory (Table 1). The germination and growth of seedlings of all species was considered satisfactory on both slopes seeded with the Turfiber method. Growth was better on the northern than on the southern slope because of more favorable temperatures and moisture. The stand of plants was more than adequate to produce a good sod for stabilization.

Figure 1. (a) Straw mulch applied by hand at 2 tons per acre. (b) Seed-fertilizer mixture then applied. Seeding of test area (slope depth about 80 ft). Method simulates hydroseeding-straw mulch technique.

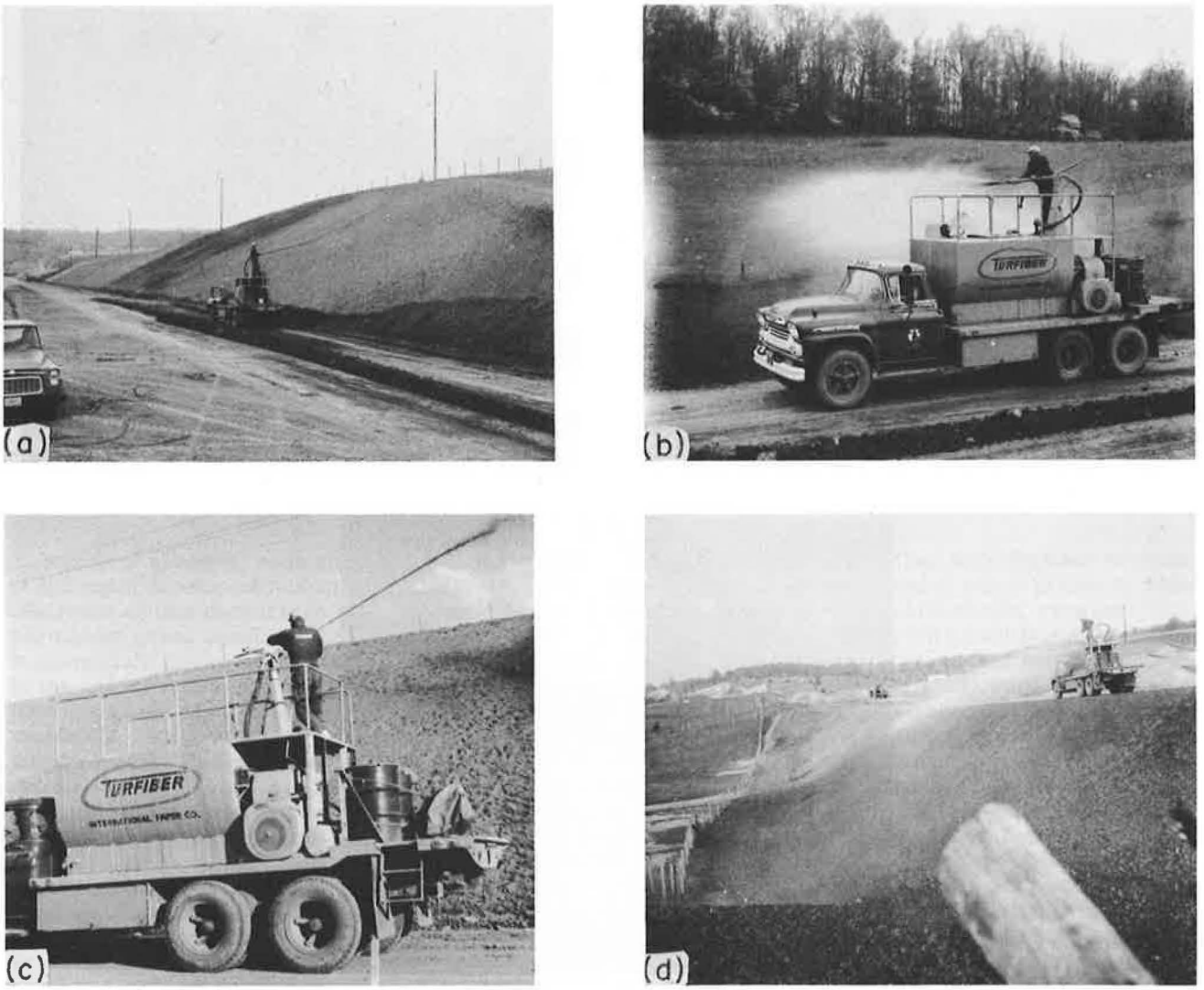

Figure 2. Spraying seed-fertilizer-Turfiber mulch slurry simultaneously on sloping cuts and fills in Interstate 81 near Bristol, Va. Different nozzles depending on slope and wind were used to attain uniform cover.

TABLE 1

SEEDLING HEIGHT, GROWTH MORPHOLOGY AND STAND FOR NORTHERN AND SOUTHERN SLOPES, BRISTOL PROJECT, MAY 27, 1961

Slope Exposure	Species	Height (in.)	Morphology (stage)	Stand
Northern	Ryegrass	3.0	3- to 4-leaf	Excellent
	Fescue	1.8	1- to 3-leaf	Excellent
	Redtop	0.5	1-leaf	Excellent
	Bluegrass	0.3	1-leaf	Good
	White clover	0.5	Unifoliate to first trifoliate leaf	Excellent
	Lespedeza sericea	0.2	Cotyledon	Good
Southern	Ryegrass	2.5	2-leaf	Excellent
	Fescue	1.5	1- to 2-leaf	Excellent
	Redtop	0.4	1-leaf	Good
	Bluegrass	0.2	1-leaf	Good
	White clover	0.4	Cotyledon to unifoliate	Excellent
	Lespedeza sericea	0.3	Cotyledon to first compound leaf	Excellent

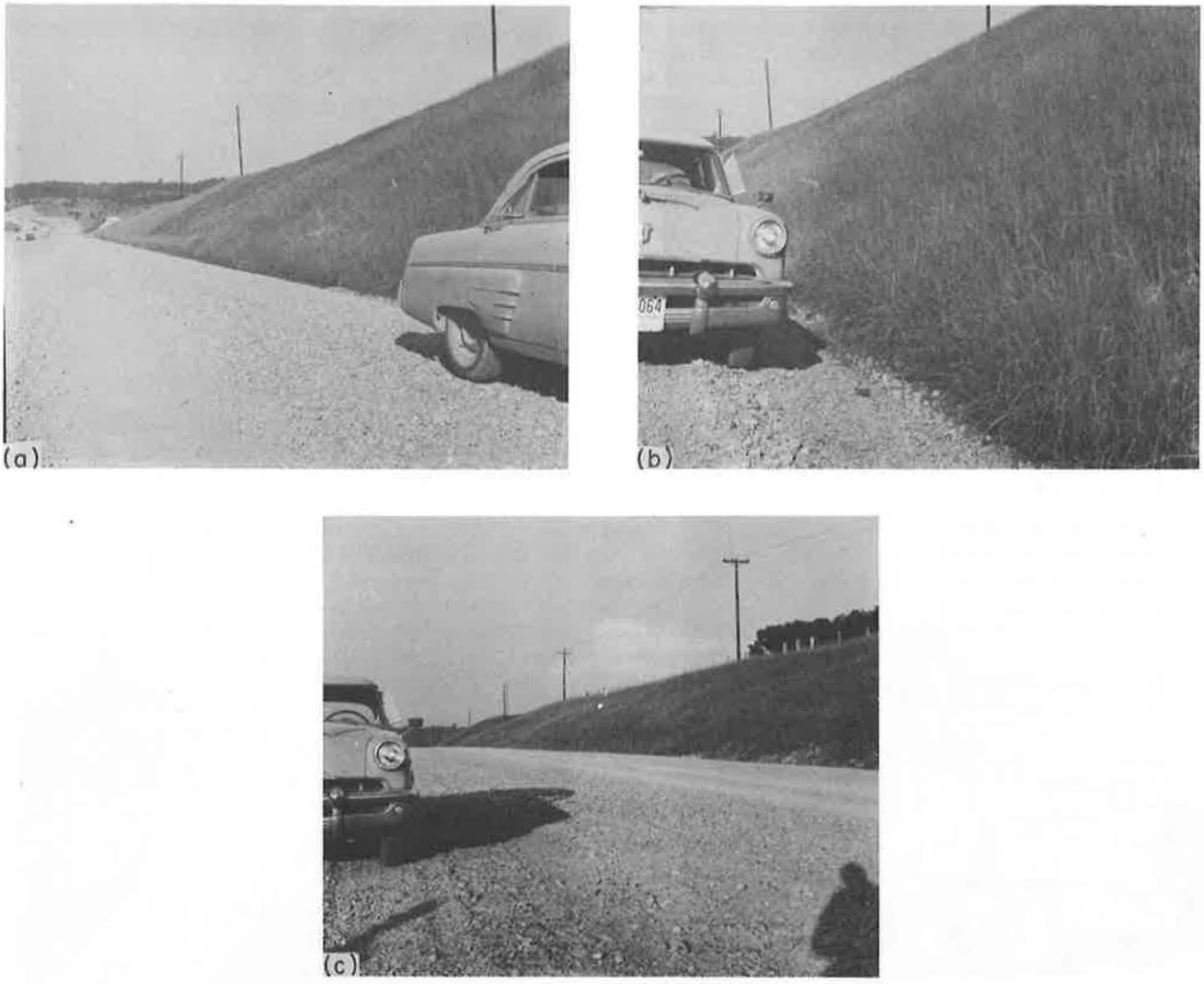

Figure 3. Seedings made to compare Turfiber and straw mulches. Strip of 1/10 acre in distant background on each slope mulched with straw. Seeding made in May 1961 showed excellent sod and stabilization in September 1961. Turfiber and straw mulches were both very satisfactory, as no reseeding required on 7-acre area. (a) and (b) Slope with northern exposure. (c) Warm slope with southern exposure.

The rate of germination and subsequent seedling growth varied for the turf species in the mixture. Ryegrass seedlings developed about 10 times faster than bluegrass, and Kentucky 31 fescue developed 5 to 6 times faster than bluegrass. Redtop seedlings developed about 2 times as fast as bluegrass. The legumes, white clover and especially sericea lespedeza, were slow starters.

Data on ground cover, with grass and weeds and soil erosion during June and September for straw and Turfiber mulches, are given in Table 2. Rainfall during June was favorable. During June there was a better grass cover with straw mulch than for Turfiber, but much of the straw mulch sod was made up of small grain seedlings. There were more weeds in the plots with straw mulch than for Turfiber. Seedling stands for both mulches were better on the cool northern slope as compared with the warmer southern slope. The cover and seedling development with both mulches was considered satisfactory and the turf stabilized the soil as erosion was very low.

By September, the grass ground cover for straw mulch and Turfiber seedings did not differ significantly. The cover was satisfactory for both mulching materials and it was considered that the slopes were now stabilized with sod. Photographs taken in September of cut slopes with northern and southern exposures show uniformly good sod with Turfiber. The sod cover for the straw-mulched treatments in the distant background is not visible in detail.

TABLE 2

GROUND COVER AND SOIL EROSION DURING JUNE AND SEPTEMBER FOR SEEDINGS MADE IN EARLY MAY TO COMPARE TURFIBER AND STRAW MULCHES

Date (1961)	Slope	Mulch	Ground Cover (%)		Soil Erosion[a]
			Grasses	Weeds	
June	Southern	Straw	50	15.0	1
		Turfiber	31	2.5	1
	Northern	Straw	55	15	1
		Turfiber	37	13	1
Sept.	Southern	Straw	71[b]	9	1
		Turfiber	60	6	1
	Northern	Straw	82	3	1
		Turfiber	70	6	1

[a]Rating of 5 was considered serious and 1, nil.
[b]Considerable portion of cover was small grain seedlings, but there was more small grain in June than in September.

RESULTS

Stands of grasses, soon after seeding, often appear better with straw mulch than with Turfiber because of the rapid development of small grain seedlings in straw mulch. A sparse stand of small grains is often desirable as this encourages quick stabilization and protection against erosion while slower growing permanent grass seedlings are getting established. In comparing straw and hay with Turfiber as mulches, it seems fair to use light seeding rates of small grains or other fast-growing grasses that may be present in the hay or straw mulches with the Turfiber seeding method. This technique of study would avoid confounding quickness of sod development with species in seeding mixtures with desirable effects of mulching materials. Various small grains have been used with Turfiber in other experiments, which sped up stand development. Too much small grain, or ryegrass or weedy species, in a mulching material or in a seeds mixture is very harmful to the slower growing, permanent sod species. Because of dense stands of small grains in some straw and hay mulches, desirable species are often exterminated. It appears wise to inspect straw and hay mulches, as is now done in some projects, before approving them for grassing mulches.

One of the best ways to obtain good grass stands is to use seeds of good permanent sod grasses in mixtures that have excellent seedling vigor. Kentucky 31 fescue at the rate of 30 and 60 lb per acre was used in place of ryegrass on some seedings with Turfiber in the Bristol project. The best stand and growth of desirable permanent grasses occurred when Kentucky 31 fescue was used in place of domestic ryegrass in a seeds mixture with the slow-growing bluegrass and redtop seedlings. The quickest sod development occurred when 25 lb per acre of ryegrass was used with a bluegrass-redtop-white clover mixture and seeded with the Turfiber mulching method; however, the sod for this treatment may not be satisfactory next year because the dense stand of quick-growing ryegrass seedlings reduced the stands of bluegrass.

The Turfiber method of seeding has been used successfully by landscape engineers and superintendents of the Virginia Highway Department for reseeding degenerated sods on highway slopes. The Turfiber method makes it possible to spot-spray the seed-fertilizer-mulch slurry with ease and speed to the bare soil areas where sod has degenerated. The slurry-fertilizer mixture also stimulates growth of impoverished grasses to encourage plant spread. It has been expensive and difficult to try to place straw mulch on the bare areas in degenerated sods. When straw mulch is used for reseeding partially successful new stands or degenerated sods, the misplacement of straw on established sod often retards their growth. Sod degeneration occurs because of inadequate fertilization, but other practices, such as mowing too often, are also objectionable.

SUMMARY

All factors that influence growth should be kept favorable when comparing mulching materials. Mulches reduce seeding failures because they improve water infiltration, reduce water loss, and moderate soil temperatures.

A 7-acre seeding on Interstate 81 near Bristol, Va., on long sloping cuts and fills was made in early May to study Turfiber and straw mulch. Initial sod development with straw mulch was somewhat faster than with Turfiber; but by September there was no appreciable difference between Turfiber and straw mulch; the sods with both methods were very satisfactory. The initial, more rapid sod development with straw mulch is usually attributed to small grains and weeds from unthreshed seeds. The use of Turfiber for reseeding degenerated sods or unsatisfactory new seedings was discussed.

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