COMPARING MULCHES:

the long and short of it

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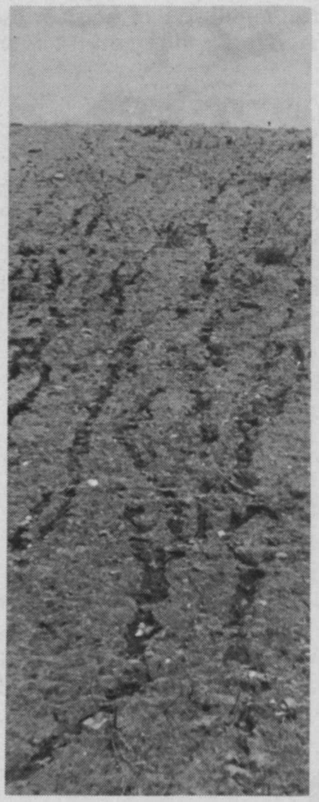

Note erosion differences between above photos showing results of mulch applications: top, a plot protected by straw plus asphalt mulch 28 days after application; bottom, a plot in the same replication but protected by a wood pulp mulch. (Photos 1 and 2).

IN highway seeding work a critical erosion prevention period, usually 2 to 3 months in length, exists between seeding and the time a sufficient vegetative cover becomes established. Soil and seed may be lost during this time and the roadway, drainageways, slopes, and adjacent areas damaged. Mulches lessen erosion damage and improve turf establishment. Straw mulch tacked with asphalt is a widely used type. It often is effective in preventing erosion during turf establishment. However, straw mulch has some disadvantages. It is difficult to hold in place on critical areas, may contain noxious weed seeds, may be a fire hazard when dry, and will smother out plant growth if too heavy a layer is used. Other difficulties such as acquiring a sufficient, economical supply and proper storage are common. A material is needed which will supplement or replace straw mulch.

Mulches tend to assure successful turf establishment by improving moisture availability and, consequently, germination and subsequent seedling growth. Mulches encourage rapid moisture infiltration into the soil and because of better water infiltration, reduce water runoff and concurrent soil erosion. The more difficult the environment the greater the benefit from mulching.

Wood pulp (as short-fibered mulch) has been found by some researchers to be equal to the conventional straw and asphalt combination (a long-fibered mulch) for erosion prevention and turf establishment. Other researchers have found that straw provides greater erosion protection than other mulches including wood pulp. A rate of 1400 lb/A of wood pulp was thought better than the sometimes recommended rate of 1000 lb/A.

Materials and Methods:

Two relatively long-fibered and three short-fibered mulches were tested. The standard long-fibered mulch used on Minnesota roadsides, straw plus an as-

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phalt emulsion tack, was used as a "check" material (Treatment 1). A green wood excelsior fiber[1] (Treatment 4) was the other long-fibered mulch. This material comes in bales shaped like straw bales and is placed with a mulch blower. Three short-fibered wood pulp mulches, each made by a different manufacturer, were tested. One pulp[2] (Treatment 2) is about the same as paper pulp, i.e., it received the southern Kraft process treatment. The second wood pulp[3] (Treatment 3) is produced from hardwoods using a mechanical grinding process which utilizes the whole pulp bolt. The third wood pulp[4] (Treatment 5) used Douglas fir and was also produced by the mechanical grinding process. The manufacturers' recommended application rates are 1000 lb/A with up to 1500 lb/A being recommended for more difficult sites.

Research plots were located on highway fill slopes in the St. Paul, Minnesota area. Mulches were applied to 2 replications June 13, 1965 and to 3 replications July 20, 1965.

The short-fibered mulches were applied with a hydroseeder. The slurry contained seed, fertilizer and mulch. Pulps were applied at the rate of 1200 lb/A (Photo 3). After the plots had been seeded and fertilized with a hydroseeder, the 2 long-fibered mulches were applied with a mulch blower at the rate of 2 tons/A, and in the case of straw, also 200 gal. of asphalt emulsion.

The plots were seeded with Class 13 seed of the Minnesota Standard Specifications, 1964. This mixture provided the following minimum weights in pounds of pure live seed per acre: smooth bromegrass *(Bromus inermis)*, 9; white clover *(Trifolium repens)*, 3.5; Kentucky bluegrass *(Poa pratensis)*, 10.5; timothy *(Phleum pratense)*, 3.5; and perennial ryegrass *(Lolium perenne)*, 3.

Two replications were on a clay loam which had been covered with 3 inches of loamy topsoil. One replication was composed of muck peat, and alluvial swamp material. The other 2 replications had a loam to silty clay loam soil covered with a loamy topsoil. All plots were tilled with a spring-toothed harrow and all rills were obliterated prior to seeding. The slope angle varied from 24 to 43% and the differences were not associated with treatments. The average slope was 33%.

Data were collected via line transects. Stakes were placed on the plot boundaries ⅓ and ⅔ of the distance from the upper edge of the plot. These stakes were used to mark line transect locations. The first 5 feet in from the end of each plot was considered border. The line transects were delineated with a heavy, semi-rigid steel tape which served as a "flexible" straight edge. The width of each eroded area was recorded to the nearest hundredth of a foot. The depth, distance from steel tape to the soil surface, was recorded for each eroded area. If the eroded area was greater than .3 foot in width, 2 depth measurements were taken. The depth measurements for each eroded area were averaged and this average depth x the measured width were used to calculate square area eroded.

Erosion measurements were taken over the entire transect length August 10 to 12, 1965. Seedling counts of all seedlings touching the tape were made every other foot along transect, September 8 to 10, 1965. Counts were of species planted, grassy weeds and broadleafed weeds. Cover, bare soil, desirable cover, weeds, and clover estimates were made by 4 estimators June 16, 1966. Built-in comparisons were: (1) long-fibered mulches vs. short-fibered mulches; (2) long-fibered mulch, straw plus asphalt vs. long-fibered mulch, wood excelsior not asphalt tacked; (3) processed wood pulp vs. non-processed (mechanically ground) pulps; (4) hardwood pulp vs. softwood pulp. The use of an upper and lower transect made it possible to evaluate the difference in erosion due to location on slope and possible interactions resulting from location

Table 1. Daily rainfall recorded at University of Minnesota weather station, St. Paul Campus (station about 1 mile from test site).

Date		Rainfall in Inches
July	13	.4
	14	T*
	15	T
	16	.2
	30	1.4
	31	.2
August	3	.8
	6	.4
	7	.3
	8	T

* T equals Trace.

Table 2. The effects of different mulch materials on erosion factors. See text for treatment materials.

Treatment	Soil Loss Tons/Acre*	No. of Eroded Areas per Linear 100 ft.
1	19.3*	5*
2	59.3	84
3	62.5	99
4	15.3*	15*
5	40.4	71

* Mean of long-fibered mulches significantly different from mean of short-fibered mulches, 5% level of probability.

[1] Manufactured by American Excelsior Company.

[2] "Turfiber"—Trade name for a product manufactured by International Paper Co.

[3] "Conwed Hydro Mulch"—Trade name for a product manufactured by Conwed.

[4] "Silva Fiber"—Trade name for a product manufactured by Weyerhauser Co.

on the slope and mulching materials. Thus the experiment was analyzed as a split block design with the upper and lower line transects of each replication being the major A plots and the mulch materials being the major B plots. The various data fields were analyzed via orthogonal single degree of freedom procedures where the differences between the built-in comparisons were tested for significance, 5% level of probability.

Results and Discussjon:

Rainfall between the start of the study and the time of soil loss data collection is shown in Table 1. Total rainfall during the period was 3.7 inches.

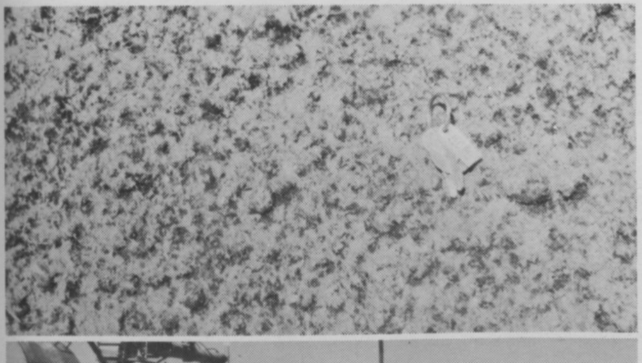
Soil lost per acre was more than twice as great on plots mulched with the wood pulps than on plots protected by long-fibered mulches (Table 2 and Photos 1 and 2). The total width of eroded areas per lineal 100 feet was much greater for the wood pulp mulches than for the long-fibered mulches. Almost ⅓ of the surface area of plots protected by Treatments 2 and 3 was disturbed by erosion. The major difference in erosion between the wood pulps and the long-fibered mulches was the total number of rills or eroded areas (Table 2). The average width or depth of an eroded area was not a factor being about the same for all mulches. There was no significant difference due to transect location on the slope, top or bottom, and none of the interactions (slope position x mulches) were significant.

The long-fibered wood excelsior mulch proved to be as good as straw-asphalt mulch in preventing soil loss. The excelsior mulch has the advantage of not requiring asphalt tack. The mulch remained on the plots about 10 days prior to any rainfall. About the only hot dry windy days of summer, 1965 occurred during this time. The wood excelsior did not move. Since this mulch does not require asphalt tack it has an advantage over straw-asphalt in urban and residential areas and in use on roadways which are already carrying traffic (Photo 4). The danger of spotting buildings, houses, and cars with blowing asphalt is eliminated.

The number of grass seedlings occurring per linear foot was greater on plots protected by long-fibered mulches than on plots protected by wood pulps (Table 3). Also there were a greater number of clover seedlings on plots protected by long-fibered mulches. There were no statistically significant differences in the number of broadleafed weeds, grassy weeds and quackgrass plants occurring under the various mulches. When the growing cover under the various mulch types was considered on the basis of percentage contribution of the various plant types, the results appeared somewhat different (Table 3). The same differences regarding grass between the long-fibered mulches existed but Treatment 5 had a higher percentage than the other 2 wood pulps. The vegetative cover present under the short-fibered mulches (Treatments 2 and 3 but not 5) had a much higher percentage of broadleafed and grassy weeds than did the cover under the long-fibered mulches. There were no significant differences in plant counts due to transect location, top or bootom of slope.

No advantage in the use of excelsior mulch was detected with regard to the number of weed seedlings present. It had been thought that the use of mulch materials which did not naturally contain weed seed might reduce the weed population occurring on the roadside during turf establishment. Probably the soils encountered on roadsides already have such a high weed seed population that any effect from weed seed introduced by straw mulch would generally be completely overshadowed.

The significant plant stand effects due to the use of different mulches lasted only through the establishment year with one exception. The percent clover present in the long-fibered mulch areas was significantly higher than that present in the areas mulched with the wood pulps in 1966. The same trends regarding bare ground, cover, amount of



Wood pulp mulch was applied to this plot at the rate of 1200 lb./A. (Photo Three).

Pictured here is a plot mulched with green wood excelsior fiber at the rate of 2 tons/A. (Photo Four).

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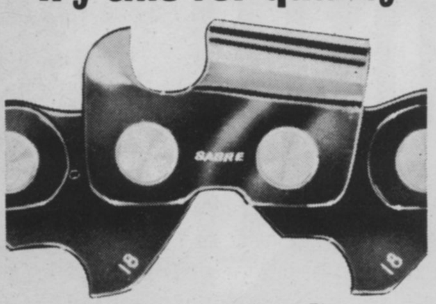

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Table 3. Seedling counts and percentage contribution to plant stand as affected by mulch materials and erosion. See text for treatment materials.

Plant Types	Treatments 1	2	3	4	5
Grass					
Number Per Foot	10.3*	3.0	3.5	9.7*	6.7
% of Population	72 *	45	49	73 *	72
Clover					
Number Per Foot	.9*	.3	.5	.9*	.3
% of Population	5	5	7	7	3
Broadleafed Weeds					
Number Per Foot	1.6	1.8	1.8	.9	1.2
% of Population	11 *	27	25	7 *	13
Grassy Weeds					
Number Per Foot	.6	.9	.8	.8	.5
% of Population	4 *	13	11	6 *	5
Quackgrass					
Number Per Foot	1.0	.7	.5	1.0	.7
% of Population	7	10	8	8	7
Total Cover— Number of Plants Per Foot	14.4*	6.7	7.1	13.3*	9.4

* Mean of long-fibered mulches significantly different from mean of short-fibered mulches, 5% level of probability (read across).

desirable cover and weeds were present the second year but the differences were not statistically significant. Overall, on the basis of both 1965 and 1966 data, wood excelsior mulch appeared the best followed by straw-asphalt and Treatment 5. However, it should be pointed out that the lowest cover in 1966 was 82 percent and this is an acceptable amount.

The mulch function which was primarily evaluated in this study was erosion prevention. A secondary factor also evaluated was the effect of erosion on the plant stands and their composition. A second mulch function, that of moderating the environment around the seedling, was only evaluated by plant counts. These were probably more greatly influenced by the amount of erosion than by any moderating effect which the mulches might have had on the moisture and temperature regimes.

The long-fibered mulches gave good protection to the soil. The short-fibered mulches provided less adequate protection. The erosion on plots mulched by wood pulps not only removed a much greater amount of soil but also greatly reduced the plant count of the seeded species. Apparently weed seeds were fairly evenly distributed in the upper few inches of soil and the resulting populations were not greatly reduced by erosion under the conditions of this study. However, due to the decrease in desirable plants on plots mulched with the wood pulps, weeds formed a greater percentage of the vegetative cover present on these plots. The vegetative cover on these plots was not only thinner but was composed of a higher percentage of undesirable plant types.

The wood pulps, however, do have a definite usefulness in highway erosion prevention work. The wood pulps can be readily used in spot and patch-up seeding operations. With the hydroseeder, the wood pulps can be easily placed on steep high slopes such as soil overburdens in rock cuts. Mulch blowing equipment for the long-fibered mulches cannot readily reach these areas. The wood pulp mulch acts as a "plaster" and helps hold seed and fertilizer in place until plant growth is started.