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Product Evaluation for Soil Erosion Control and Plant Growth Enhancement

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Report of Tests

PRODUCT EVALUATION FOR SOIL EROSION CONTROL AND PLANT GROWTH ENHANCEMENT

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INTRODUCTION

Manufacturers in the developed countries of the world continue to formulate new and better products for controlling soil erosion. Only by careful comparative testing of such products is it possible to determine their relative merits. In the test facility at the Utah Water Research Laboratory (UWRL), the variables of wind, sunlight, soil, hillslope, and rainfall rate and duration can all be independently controlled, thus providing an ideal location for determining the actual effectiveness of various kinds of erosion control products. Many companies are availing themselves of the opportunity to accurately compare their products at the UWRL with other similar ones on the market.

Central Fiber Corporation contracted with the UWRL to evaluate two of its products along with products from two of its competitors. This report contains the test results.

MATERIALS AND METHODS

Description of Testing Facility

Rainfall simulator. The rainfall simulator is a drip–type device in which raindrops are formed by water emitting from the ends of small diameter brass tubes. The rate of flow is controlled by admitting water into a manifold chamber through fixed orifice plates under constant hydraulic pressure. Five separate inlet orifices are used in each chamber or simulator module. The ratios of the areas of the orifices are 1:2:4:8:16. By controlling the flow to each orifice with an electrically operated solenoid valve, it is possible to vary flow in on–off increments with 31 steps. Outlet from the chambers or modules is through equally spaced brass tubes. Each module is a 24–inch square enclosed box about 1–inch deep and oriented so that the ends of the tubes or needles form a horizontal plane to let the water drip vertically toward a tilting flume. Each module has 672 needles spaced on a 1–inch triangular grid pattern.

The rainfall simulator consists of 100 modules spaced and supported to make a continuous simulator 20 feet square. Each module has separate controls so that a spatially moving storm with time–changing intensities can be simulated. The 500 switches are manually operated or can be controlled by a programmed computer if desired.

Raindrop sizes and velocities of impact are representative of typical high intensity storms. The spatial distribution of rain is essentially uniform, and the control of application rates is within the accuracy requirement of most experiments.

Testing flume. The square test flume measures 20 feet on each side and can be tilted at any angle up to approximately 43°. The rainfall simulator is supported over the flume so that rain falls directly onto the test plots. Approximately 1 foot depth of soil is supported in the testing flume by a metal grating which is covered with a filter cloth through which water can drain.

For the Central Fiber Corporation tests, the flume was divided into six test plots, each measuring 2 feet by 19.5 feet. There were three sets of two plots each, and the sets were separated from each other and from the side walls by 2–foot wide walkways. The rainfall simulator was arranged so that rain fell upon the plots and not upon the walkways. Runoff from each test plot was collected in a plastic container and weighed. The water was decanted off, and the soil was dried and weighed to determine the amounts of soil and water leaving each plot per unit of time.

Sunlight simulator. A balance of radiant energy needed for good growth of plants is provided to the test plots by a sunlight simulator which utilizes incandescent as well as florescent lamps. It has the same dimensions as the tilting flume, is square, and measures 20 feet on a side. It is rolled on and off the test plots on wheels riding on horizontal rails mounted on top of the sidewalls of the tilting flume. When in position, it is about 3 feet above the test plot surfaces and provides illumination at a photon flux density (400–700 nm) of 216 $\mu E \bullet m^2 \bullet sec^{-1}$ (measured with a La–Cor 190 S quantum sensor on a Model LI–185 quantum radiometer/photometer).

Products Included in Tests

The following products provided by Central Fiber Corporation were included in the tests:

1. CENTRAL FIBER'S Second Nature™ Wood Fiber with Tack.
2. CENTRAL FIBER'S Second Nature™ Straw Tack Mulch.
3. CONWED'S Regular Fiber Mulch (without tack).
4. WEYERHAEUSER'S Silva–Fiber Plus.

TESTING PROCEDURE

Plot Preparation

Each of the six test plots was filled with a sandy loam soil having the following approximate composition: total sand = 63 percent, total silt = 24 percent, total clay = 13 percent, and total organic matter = 1.41 percent. Each plot was cultivated with a garden tiller to a depth of approximately 6 inches. To prepare for applying the test product, the soil was then raked smooth and uniformly compacted with a lawn roller filled with water.

Product Application

Each of four different products was applied to three separate plots, totalling 12 plots in all. This required two separate runs with the products randomly distributed on the 12 plots as shown in Figure 1. There were no tests on bare soil. A laboratory-size hydromulcher was used to apply the materials at rates of 2,000 lbs/acre for the mulches and 200 lbs/acre for the barley.

Sufficient mulch, seed, and water were mixed in a batch to cover a single plot so that the desired rates could be accurately controlled.

Rainfall Application

When the plots were tilted to the desired slope, they were covered with a plastic sheet. The rainfall simulator was turned on at full capacity to purge the air from the system. During this purging, the rain fell onto the plastic and ran into a drain without wetting the plots. When the purging was complete, the rainfall was adjusted to the desired rate and allowed to stabilize. The plastic sheet was then quickly removed so the rain fell directly onto the plots, and the time clock was started.

Rain was applied during these tests at a rate of 4 inches per hour on a slope of 2 1/2:1. Total time was recorded from the instant the rain began falling onto the plots until significant rilling was noted. Then the rain was turned off and the sunlight simulator was installed.

Sunlight Application

Sunlight was applied alternately, 12 hours on and 12 hours off, for a 7-day period at which time the barley crop was measured, cut, dried, and weighed.

Runoff Measurement

The sediment and water leaving each plot during the period of the test were collected and weighed together. After the sediment had settled, the clean water was decanted from the containers and the soil was dried and weighed.

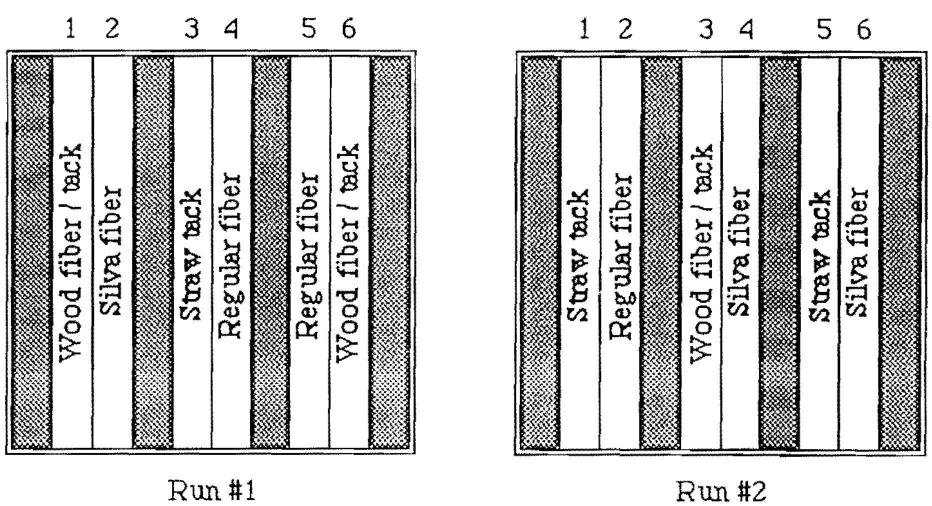

Figure 1. Plot layout.

RESULTS AND DISCUSSION

Photographic Results

A narrated, unedited VHS video tape was made of the test runs. It is being submitted as part of this final report.

Numerical and Graphic Results

Table 1 presents data of runoff from individual plots, as well as the averages of each set of three replications. Table 2 contains data pertaining to the barley after it had been exposed to 12 hours of artificial sunlight per day for a 7-day period. Figures 2 through 6 are graphical representations of data presented in the tables.

Discussion

There was a noticeable difference in the soil erosion rate between the two test runs, as evidenced in Table 1. This was probably due to a difference in initial soil moisture conditions, pointing to the importance of having each test replicated. The more replications there are, the more valid the results.

From the video one may be able to note that there was not a significant difference in the performances of the wood fiber with tack and the silva fiber; the runoff data support this fact. However, both the wood fiber with tack and the silva fiber are superior to straw tack and regular fiber. Similar comparisons are evidenced in the plant data, particularly in total organic matter produced. This may be due to a greater degree of protection to the seeds by the wood fiber and silva fiber mulches, allowing more seeds to germinate under the warmth of the sunlight simulator. Those less protected dried out and did not germinate or were eroded away with the runoff and left the plots.

Table 1. Test data for runoff.

Test	Plot	Product	Collect. time (hr)	soil weight, lb	water vol., ft^3	water runoff rate, ft^3/hr	soil erosion rate, lb/hr
1	1	Wood fiber/tack	0.750	1.90	0.795	1.060	2.533
1	2	Silva fiber	0.750	0.50	0.385	0.513	0.667
1	3	Straw tack	0.750	29.00	0.359	0.479	38.667
1	4	Regular fiber	0.750	25.00	4.223	5.631	33.333
1	5	Regular fiber	0.750	12.00	3.269	4.359	16.000
1	6	Wood fiber/tack	0.750	4.00	0.745	0.993	5.333
2	1	Straw tack	0.500	65.50	3.918	7.837	131.000
2	2	Regular fiber	0.500	80.30	4.968	9.936	160.600
2	3	Wood fiber/tack	0.500	14.00	3.069	6.138	28.000
2	4	Silva fiber	0.500	5.00	2.612	5.224	10.000
2	5	Straw tack	0.500	82.50	2.732	5.465	165.000
2	6	Silva fiber	0.500	6.50	3.301	6.603	13.000
Averages		Wood fiber/tack				2.730	11.956
		Silva fiber				4.113	7.889
		Straw tack				4.593	111.556
		Regular fiber				6.642	69.978

Table 2. Test data for plants.

Test - Plot	Material	Number of Plants Top	Middle	Bottom	Total	Plant height (cm) Top	Middle	Bottom	Average h(cm)
1-1	Wood fiber tack	17	23	34	74	15.5	16.4	16.3	16.15
1-2	Silva fiber	12	17	32	61	15.0	15.1	16.4	15.76
1-3	Straw tack	5	12	19	36	13.7	14.6	15.0	14.69
1-4	Regular fiber	21	16	13	50	15.1	13.2	14.9	14.44
1-5	Regular fiber	25	18	12	55	16.8	15.2	13.2	15.49
1-6	Wood fiber tack	23	14	19	56	15.6	14.2	16.4	15.52
2-1	Straw tack	19	21	22	62	15.0	14.3	13.2	14.12
2-2	Regular fiber	13	15	18	46	16.1	13.2	13.2	14.02
2-3	Wood fiber tack	30	30	31	91	15.8	14.8	13.4	14.65
2-4	Silva fiber	24	28	26	78	16.4	13.4	13.3	14.29
2-5	Straw tack	10	21	11	42	15.5	14.2	13.1	14.22
2-6	Silva fiber	29	21	38	88	16.9	13.6	13.6	14.69
	Wood fiber tack	70	67	84	221	15.66	15.22	15.25	15.37
	Silva fiber	65	66	96	227	16.36	13.90	14.45	14.84
	Straw tack	34	54	52	140	14.96	14.33	13.84	14.30
	Regular fiber	59	49	43	151	16.04	13.93	13.71	14.69

Test - Plot	Material	Dry weight (gm/sample) Top	Middle	Bottom	Total	% of seed lost	germi.	non-g.	check
1-1	Wood fiber/tack	0.29	0.42	0.61	1.32	17.31	71.15	11.54	100
1-2	Silva fiber	0.21	0.34	0.58	1.13	20.19	58.65	21.15	100
1-3	Straw tack	0.09	0.27	0.33	0.69	53.85	34.62	11.54	100
1-4	Reg. fiber mulch	0.39	0.41	0.31	1.11	21.15	48.08	30.77	100
1-5	Reg. fiber mulch	0.50	0.38	0.22	1.10	32.69	52.88	14.42	100
1-6	Wood fiber/tack	0.54	0.33	0.44	1.31	29.81	53.85	16.35	100
2-1	Straw tack	0.30	0.21	0.28	0.79	28.85	59.62	11.54	100
2-2	Reg. fiber mulch	0.22	0.31	0.26	0.79	38.46	44.23	17.31	100
2-3	Wood fiber/tack	0.52	0.61	0.45	1.58	0.96	87.50	11.54	100
2-4	Silva fiber	0.43	0.42	0.36	1.21	17.31	75.00	7.69	100
2-5	Straw tack	0.23	0.32	0.15	0.70	46.15	40.38	13.46	100
2-6	Silva fiber	0.47	0.31	0.46	1.24	2.88	84.62	12.50	100
	Wood fiber/tack	0.45	0.45	0.50	1.40	16.03	70.83	13.14	100
	Silva fiber	0.37	0.36	0.47	1.19	13.46	72.76	13.78	100
	Straw tack	0.21	0.27	0.25	0.73	42.95	44.87	12.18	100
	Regular fiber	0.37	0.37	0.26	1.00	30.77	48.40	20.83	100

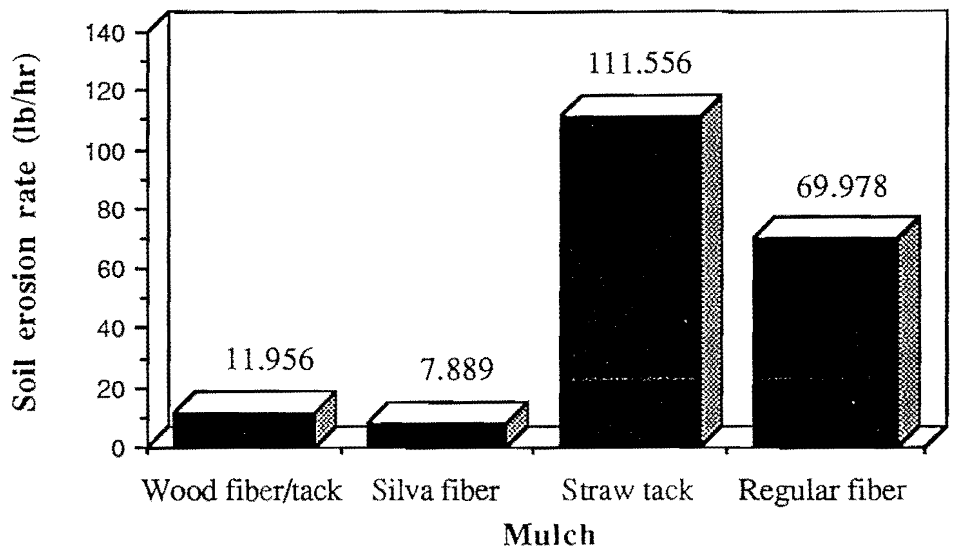

Figure 2. Comparison of soil erosion rates.

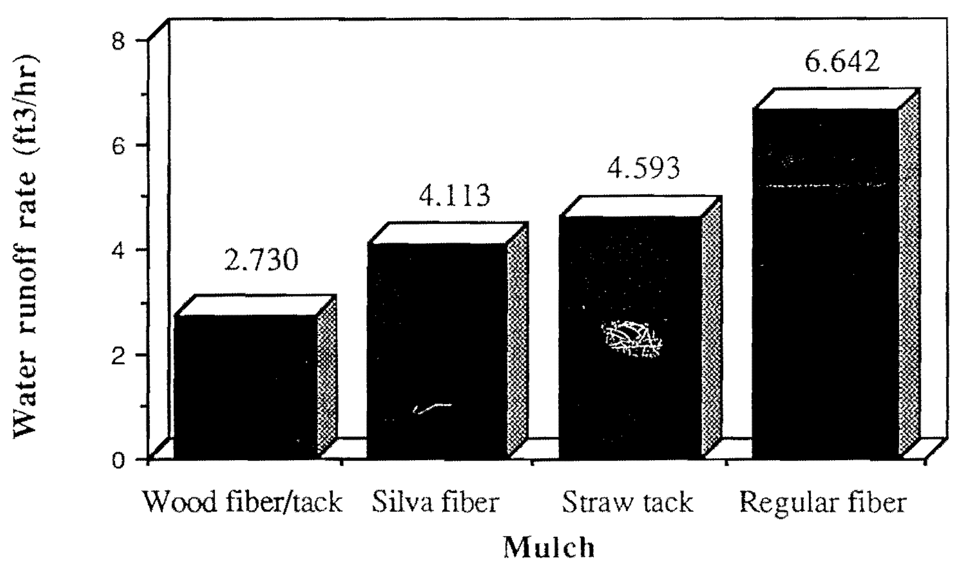

Figure 3. Comparison of water runoff rates.

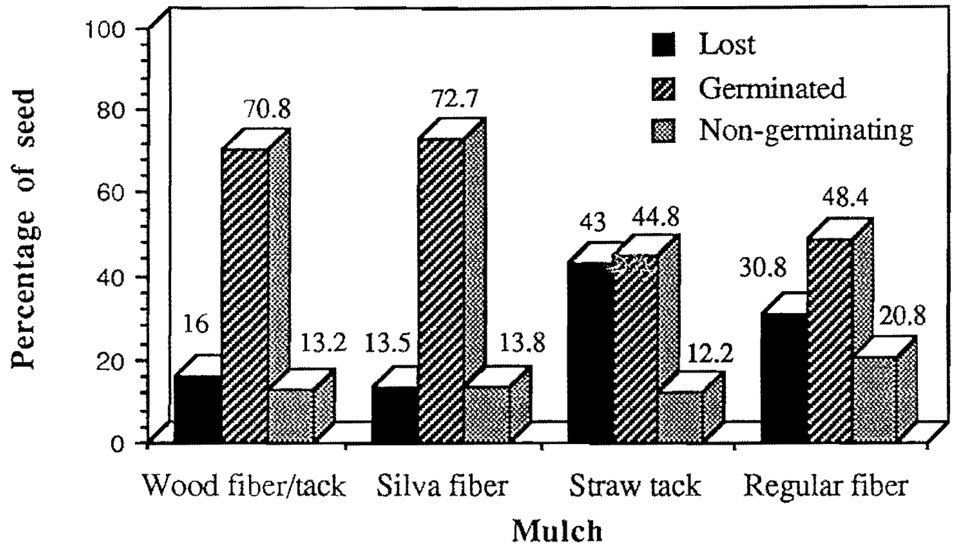

Figure 4. Comparison of seed data.

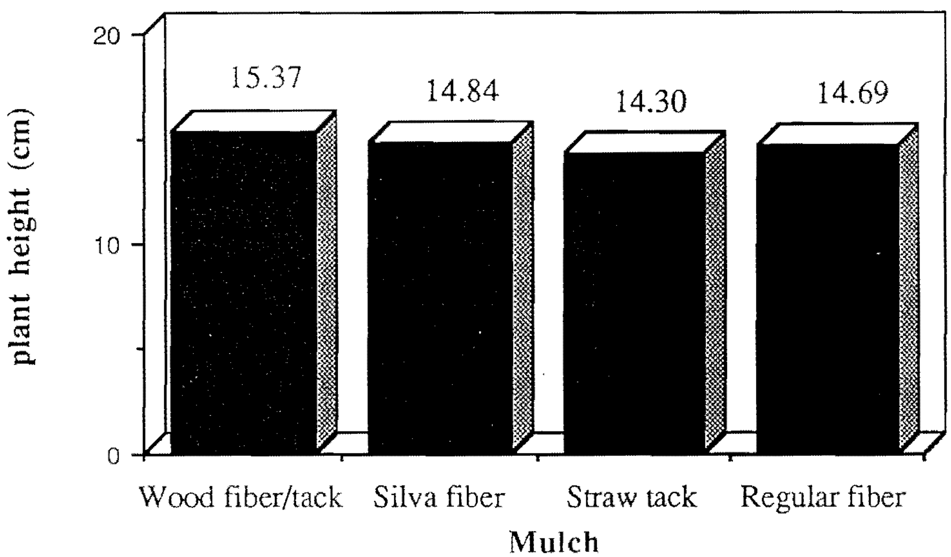

Figure 5. Plant height comparisons.

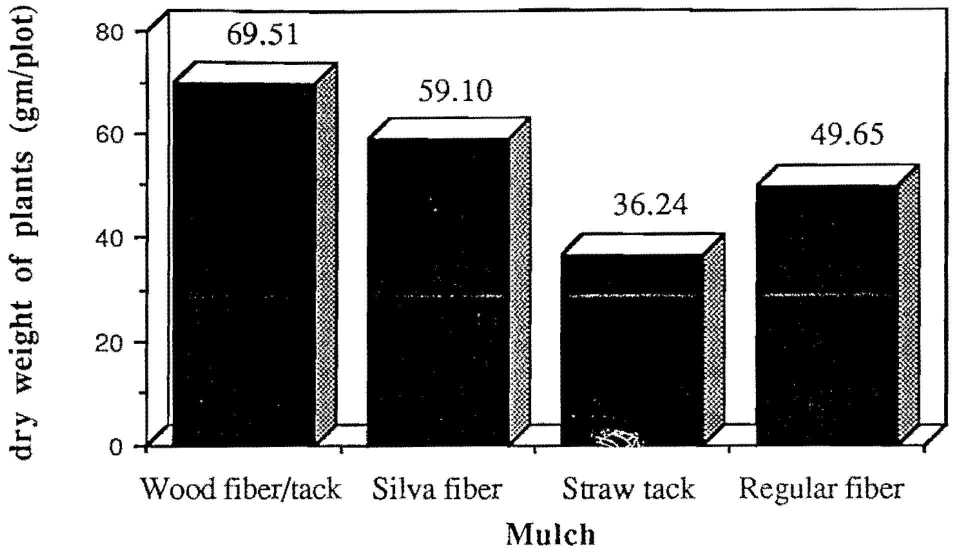

Figure 6. Comparison of plant dry weights.

SUMMARY AND CONCLUSIONS

The following summary statements, suggestions, and conclusions are based upon the foregoing data, as well as on observations made and impressions received as a result of performing the tests:

1. The performance of erosion control products herein described was for a particular set of soil, slope, and rainfall conditions and may be expected to be different if any or all of these conditions were to be changed.
2. Due to the limited number of replications that were run, we believe the results presented herein are indicative only and not conclusive.
3. Generally, it appears that long-fibered products perform better than short-fibered ones, and that products with a tackifier perform better than those without.

Policy Notice

The University has requested that the following be included in all test reports:

It is understood that the production of this report and contents thereof does not constitute an endorsement by the University of any of the products tested. The client shall not use the University's name for advertising purposes, and shall not publish statements pertaining to University research or test findings about such products except statements specifically approved in writing by the University.