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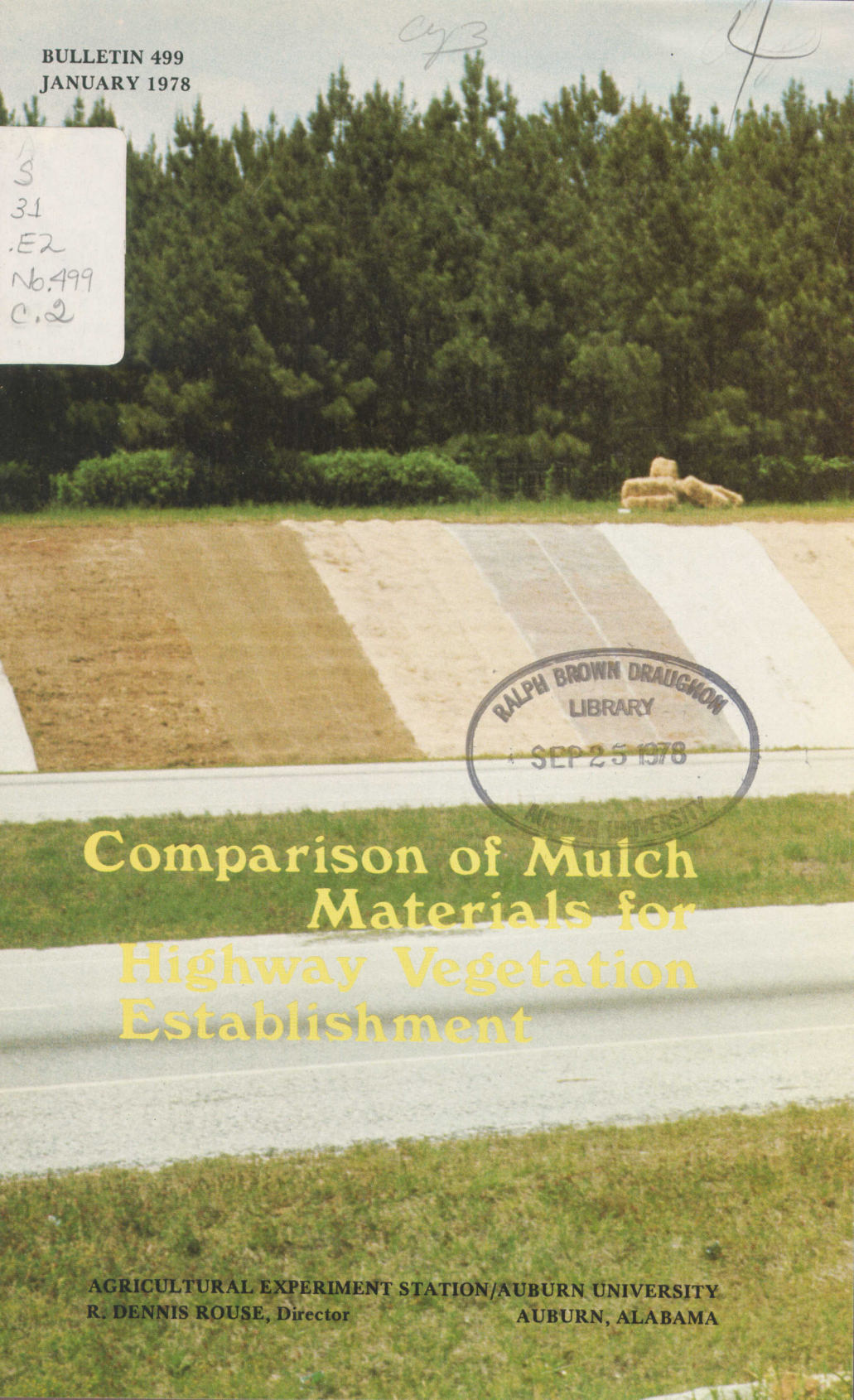

Comparison of Mulch Materials for Highway Vegetation Establishment

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INTRODUCTION

EROSION of unprotected highway slopes is a serious problem, particularly in the Southeast with its high rainfall. Vegetative cover is the most satisfactory method of protecting these areas and at the same time providing an attractive surface (5). In most instances, establishment of vegetation in the adverse environment present on highway slopes requires the use of some type of mulch (6).

Mulches improve conditions for seedling establishment by moderating soil temperatures, conserving soil moisture, preventing soil crusting, and reducing erosion of the soil surface (1, 3). Numerous natural materials such as pine straw, cereal straw, hay, sawdust, pine bark, and peat moss have been tested (2, 4, 7). Processed materials tested for mulches include wood cellulose fiber, corn meal, starch, latex, fiberglass, plastic sheeting, jute webbing, burlap, and kraft paper netting.

Researchers agree that for general use on highway slopes of 3:1 or less, cereal straw or pine straw at 1–2 tons per acre is the treatment of choice. However, on slopes steeper than 3:1 or in diversion ditches and other waterways, materials such as excelsior or jute mats held in place by staples may be more effective. One disadvantage of these products is their high cost, both for materials and labor during installation. A large part of the materials cost is for freight and handling of the bulky, low-density substances. For example, jute netting, a commonly specified material, must be imported from Pakistan. An effective mulch material

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available locally and requiring less labor for installation would aid in reducing vegetation establishment costs on critical slopes along highways.

OBJECTIVES

The objectives were to compare currently available mulching materials as to their effects on vegetation establishment and erosion control on critical highway slopes; and to determine the availability to germinating seedlings of plant nutrients contained in certain mulch adhesives.

MATERIALS AND METHODS

Comparison of Mulch Materials

Opelika, Alabama

The areas selected were two backslopes on Interstate Highway 85 (I-85) having slopes of approximately 3:1 with little topsoil present. Initial seeding made during construction had failed to produce adequate vegetative cover. Laboratory tests of the soil showed a pH level of 5.3 to 5.6, very low P levels, and low to medium levels of K.

On April 22, 1971, dolomitic limestone at 1 ton per acre and 8-8-8 fertilizer at 1,000 pounds per acre were applied uniformly by hand and disked into the soil. Seeds of 'Interstate' sericea lespedeza at 30 pounds per acre and 'Pensacola' bahiagrass at 20 pounds per acre were sown over the area with a centrifugal seeder and covered by a tractor drawn corrugated roller. Mulch materials were applied to plots 12 feet wide and extending the length of the slopes; approximately 30 to 45 feet (see cover photo). Materials tested were as follows:

1. Swift-Hold – All cotton ¼- to ½- inch square mesh open-weave netting weighing 1.5 ounces per square yard. Swift Textiles Inc., Phenix City, Alabama.
2. Swift-Gro – Netting as described for Swift-Hold plus a layer of laminated cellulose tissue. Minimum weight of 2.75 ounces per square yard. Swift Textiles, Inc., Phenix City, Alabama.
3. Jute Net – Heavy jute netting with 1-inch mesh weighing 15 ounces per square yard. Bemis Bag Co., St. Louis, Missouri.
4. Amxco-Mat – Machine produced mat of curled wood excelsior (80% of fibers $\geq$ 6 inches) covered on one side with wide mesh lightweight kraft paper netting. Minimum weight of 13 ounces per square yard. Amxco, Inc., Arlington, Texas.
5. Turf Blanket – Wood cellulose blanket covered on one side

FIG. 1. General view of the west one half of the Athens test area immediately after application of mulches.

with extruded 9-mil strands of polyethylene netting of ¼-inch mesh. Conwed Corp., St. Paul, Minnesota.

Stand counts were made on emerged sericea lespedeza and bahiagrass seedlings on May 26, 1971, and July 13, 1971. Plants in 10 randomly selected 1 square foot areas were counted on each plot. The experimental design was a randomized complete block design with 6 replications.

Athens, Alabama

The areas chosen were backslopes on each side of U.S. Highway 31. The soil was a deep clay containing very little rock. The pH was approximately 5.0. Soil test values indicated very low P and K levels. Steep slopes in this area prohibited the use of machinery in soil preparation.

Slopes were lightly hand scarified June 8, 1971, with asphalt rakes, and received dolomitic limestone at 2 tons per acre and 8-8-8 fertilizer at 1,000 pounds per acre. The lime and fertilizer were unincorporated.

The areas were seeded to sericea lespedeza and bahiagrass at the same rates used in the Opelika test. Adequate seed remained on all parts of the slope. However, no attempt to cover the seed was made because of the danger of moving all the seed and plant nutrients down the steep slopes.

The mulches were applied on June 9 and 10, 1971, using ladders to traverse the steep slopes. Plot size and experimental design were the same as in the Opelika test, figure 1.

Stand counts and an estimate of erosion control were made July 21, 1971. Estimates of percent cover were made October 15, 1971.

Effects of Tissue Layers and Plant Nutrients Adhesives

Greenhouse evaluations showed that the rate of nutrient release from Swift-Gro was adequate to enhance growth rates of seedling grasses. Also earlier field tests indicated that additional tissue bulk might improve the mulching properties of Swift-Gro. Additional field tests were conducted: (1) To determine the effects of doubling the amount of tissue by laminating a layer to both sides of the netting. (2) To determine fertility response to plant nutrient adhesives.

Baldwin County, Alabama

This test was conducted on Interstate Highway 10 (I-10) 1 mile east of the junction of Alabama Highway 181 in Baldwin County, Alabama. The test area was a front slope extending from the pavement edge to the drainage ditch on an outside lane of I-10 that was under construction. The fill-soil was a mixed sandy loam material containing pockets of sandy clay. The soil contained approximately 2.5 p.p.m. available P and 22.5 p.p.m. available K. The soil pH was 5.7.

On October 27, 1971, lime was applied at the rate of 1 ton per acre. One-half of the main plots received 8-8-8 fertilizer at the rate of 420 pounds per acre and ammonium nitrate at 150 pounds per acre (this equalled the amount of N, P, and K supplied by a coating weight of 1.65 ounces of adhesive, Paranol-F 8026, per square yard of Swift-Gro). The lime and fertilizer were incorporated into the soil and the area was seeded with 30 pounds per acre of 'Kentucky 31' tall fescue and 5 pounds per acre of inoculated 'Regal' ladino white clover. The seed were settled with a corrugated roller.

The mulch variables were: (1) single tissue Swift-Gro with plant nutrient; (2) single-tissue Swift-Gro without plant nutrients; (3)

double-tissue Swift-Gro with plant nutrient; (4) double-tissue Swift-Gro without plant nutrient; (5) Turf Blanket; (6) no mulch. The mulches were applied October 27 and 28, 1971. The area was syringed with water to settle mulches to the soil surface.

The experimental design was a split-plot design with 4 replications, the main plots being fertilizers and sub-plots being mulch materials.

Plant counts, height measurements, and cover ratings were made on December 21, 1971.

Eufaula, Alabama

The test site was on an earthen dam at Lakepoint Resort State Park. The soil contained 1 p.p.m. available P and 20 p.p.m. available K. The pH was 6.3.

The general preparation, seeding, fertilizing, and mulch application were the same as for the Baldwin County test. The area was seeded November 10, 1971, and mulches were applied 1 day later.

Plant height measurements were made January 18, 1972.

RESULTS AND DISCUSSION

Comparison of Mulch Materials

Opelika, Alabama

The moisture conditions at the I-85 site were ideal for germination and establishment of vegetation with very little soil erosion. The largest daily rainfall during the 4 weeks after seeding occurred on the day the mulches were being applied when the area received 1.26 inches. At no other time did daily rainfall exceed 1 inch.

Plant stands per square foot 35 days after planting averaged 25 for sericea lespedeza and 33 for bahiagrass, table 1.

TABLE 1. EFFECTS OF MULCHES ON STANDS OF SERICEA AND BAHIAGRASS OF HIGHWAY BACKSLOPES NEAR OPELIKA, ALABAMA

	Number of plants per square foot			
	35 days[1]		82 days[1]	
Mulch material	Sericea	Bahia	Sericea	Bahia
Swift-Gro	27 ab[2]	30 a	22 a	21 a
Swift-Hold	22 a	29 a	15 a	20 a
Jute Net	19 a	30 a	15 a	20 a
Amxco Mat	33 bc	38 a	20 a	17 a
Turf Blanket	39 c	41 a	27 a	23 a
No mulch	27 ab	33 a	17 a	14 a

[1]Days after planting on April 22, 1971.

[2]Means within a column followed by the same letter are not different ($P < .05$) by Duncan's Multiple Range Test.

Turf Blanket was the only mulch treatment which produced stands of sericea superior to those obtained where no mulch was used. Jute Net and the Swift-Hold showed a trend toward fewer sericea plants. There was no effect from any mulch treatment on the establishment of bahiagrass seedlings.

Erosion was not significant on this area because no hard rains occurred before vegetation became established. However, observations made during the first 2 weeks after planting indicated that erosion control from Swift-Gro was not as good as that of the other products. The main problem appeared to be a lack of volume in the tissue and a shrinkage of the netting which caused the material to lose contact with the irregular soil surface.

After one or two hard rains all the tissue was stripped from the Swift-Gro net and the Turf Blanket and deposited on the soil surface. However, the volume of material from the Turf Blanket was sufficient to provide a uniform cover over the entire soil surface. On the other hand, the tissue from the Swift-Gro did not provide an adequate amount of material to prevent erosion. The netting alone could have aided in erosion control if it had remained in contact with the soil surface.

Stand counts of sericea and bahiagrass made 82 days after planting showed that there was no difference due to mulches.

Athens, Alabama

The soil moisture situation at the Athens site was the opposite of that encountered on the Opelika site. The soil at time of planting was very dry, partially due to the extreme slope of the banks. Two hard showers occurred the week following planting but no significant rainfall occurred during the rest of the month.

Notes taken on July 1, 1971, indicated that no appreciable germination had occurred on any of the plots. Considerable erosion of the unmulched plots had occurred at this time.

Three weeks later stands were still very sparse on the upper portions of the slopes. Therefore, counts were only made on the lower 8 feet of the plots.

Amxco Mat and Turf Blanket were the only materials that increased emergence of bahiagrass when compared to the unmulched control, table 2. None of the plots had stands equal to those obtained at the Opelika location. The various mulches had considerable influence on germination of sericea. Swift-Gro, Amxco Mat, and Turf Blanket improved emergence and early survival of the sericea seedlings when compared to the unmulched plots or those

TABLE 2. EFFECTS OF MULCH MATERIALS ON INITIAL PLANT STANDS, EROSION AND COVER ON HIGHWAY BACKSLOPE NEAR ATHENS, ALABAMA

Mulch material	Initial stands[1], number of plants per square foot		Erosion[2]	Cover[3]
	Sericea	Bahia	control, pct.	vegetation, pct.
Swift-Gro	17 b[4]	8 b	52 b	39
Swift-Hold	6 c	1 b	7 c	28
Jute Net	6 c	4 b	82 a	38
Amxco Mat	17 b	18 a	86 a	48
Turf Blanket	27 a	23 a	88 a	64
No mulch	1 c	0 b	0 d	8

[1]Counts made July 21, 1971, 43 days after planting.
[2]Rating made July 21, 1971, 43 days after planting.
[3]Rating made October 15, 1971.
[4]Means within a column followed by the same letter are not different ($P < .05$) by Duncan's Multiple Range Test.

receiving Jute Net or Swift-Hold. Turf Blanket produced stands superior to either Amxco Mat or Swift-Gro.

All the mulch materials gave some degree of erosion control. Jute Net showed excellent erosion control; however, the establishment of vegetation was poor. Swift-Gro, on the other hand,

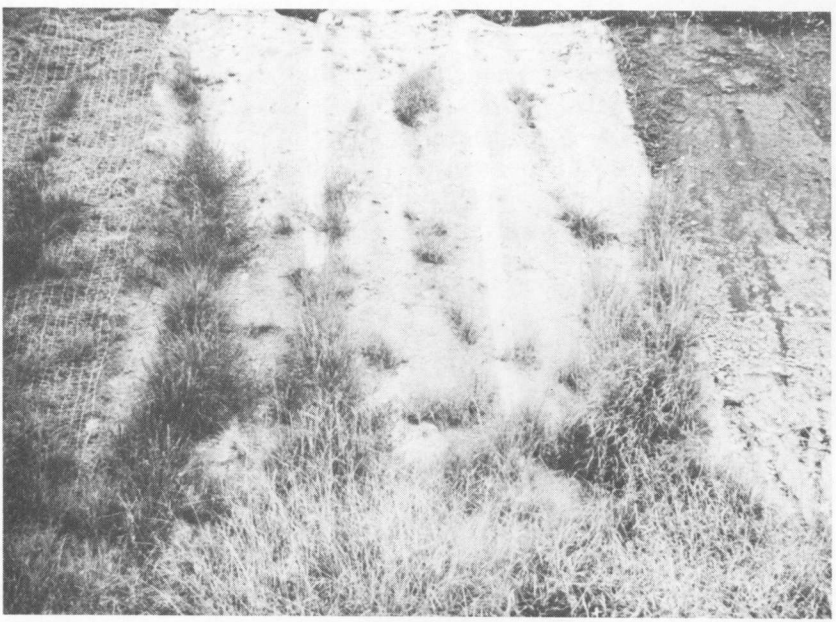

FIG. 2. Comparison of stand of bahiagrass on area mulched with Turf Blanket and Jute Net at left and no mulch at right.

caused sericea stands equal to Amxco Mat, but erosion control was inferior to that obtained from other mulches except for Swift Hold. The Swift-Gro used in these tests was made up of single tissue laminated to the cotton netting and apparently did not have sufficient bulk to act as a deterent to erosion on the soil surface. Also, the tissue was completely stripped from the netting with the first rain and could no longer intercept and lessen the impact of raindrops falling at a later time.

The two treatments showing the most vegetative cover on October 15, 1971, were those mulched with either Turf Blanket, figure 2, or Amxco Mat. Swift-Gro and Jute Net were intermediate in stands.

Effects of Tissue Layers and Plant Nutrients Adhesives

Baldwin County, Alabama

Approximately 1 month after planting emergence of tall fescue had occurred on all plots. However, stand counts could not be made at this time. Seedlings had not penetrated the Swift-Gro on areas where the netting was not in contact with the soil surface. Obvious differences in rate of seedling growth among mulches were noted on the areas receiving no soil applied fertilizers at planting.

When no fertilizer was added to the soil there was no difference between the average of the four Swift-Gro treatments and the others in stands of tall fescue or ladino clover, table 3. The number of tall fescue plants per square foot was greater on plots receiving Paranol treated Swift-Gro than those receiving untreated Swift-Gro. Paranol adhesive had no effect on the density of ladino clover plants on Swift-Gro plots.

TABLE 3. MULCH AND FERTILIZATION EFFECTS ON STANDS OF TALL FESCUE AND LADINO CLOVER 55 DAYS AFTER PLANTING IN BALDWIN COUNTY, ALABAMA

Mulch material	Paranol treated[1]	Number of plants per square foot			
		Fertilized		Not fertilized	
		Tall fescue	Ladino clover	Tall fescue	Ladino clover
Swift-Gro					
Single tissue.....	No	83	40	59	32
Single tissue.....	Yes	78	26	73	39
Double tissue ..	No	64	32	58	22
Double tissue ..	Yes	71	24	76	25
Turf blanket	No	65	18	58	32
No mulch.....	No	72	24	64	33

[1]Paranol, product of Para-Chem Southern Inc. Simpsonville, South Carolina.

Doubling tissue thickness reduced ladino clover stands but did not affect the tall fescue stands on unfertilized areas. The results on the fertilized areas were just the opposite; double tissue gave significantly lower stand values for tall fescue but did not affect ladino clover stands. Also, nutrient adhesive had no effect on tall fescue stands but was associated with decreased stands of ladino clover plants in fertilized plots. The stand of ladino clover on plots receiving Swift-Gro was superior to the average of other treatments on the fertilized areas, but not on the unfertilized areas.

Tall fescue plant heights were affected by fertilization and mulch material, table 4. The average height of tall fescue on the unfertilized areas was greater for Swift-Gro plots than on those receiving other mulches. There was no difference in height between plants mulched with Turf Blanket and those receiving no mulch. Average height was greater on plots receiving double tissue than those receiving single tissue. On the fertilized areas the plant height on Swift-Gro plots was greater than on other plots. The height of tall fescue plants with Turf Blanket was less than on the unmulched plots. There were no differences in plant height within Swift-Gro treatments due to tissue thickness or type of adhesive on the fertilized areas. However, Paranol increased plant height in unfertilized plots.

Cover ratings showed essentially the same results as those indicated by the tall fescue height data, table 4. This would be expected as the growth of tall fescue was a prime factor contributing to cover of the plots. On the unfertilized areas the Swift-Gro plots

TABLE 4. MULCH AND FERTILIZATION EFFECTS ON HEIGHTS AND COVER OF TALL FESCUE 55 DAYS AFTER PLANTING IN BALDWIN COUNTY, ALABAMA

Mulch material	Paranol treated[2]	Tall fescue height		Cover rating[1]	
		Fertilized	None	Fertilized	None
		In.	In.		
Swift-Gro					
Single tissue ..	No	5.5	2.0	7	1
Single tissue ..	Yes	5.5	4.3	7	4
Double tissue..	No	5.5	2.4	6	1
Double tissue..	Yes	5.9	4.7	8	6
Turf blanket....	—	4.3	1.6	5	1
No mulch	—	5.1	2.0	6	1

[1]Rating 0 = full coverage, 10 = full coverage.
[2]Paranol, product of Para-Chem Southern, Inc., Simpsonville, South Carolina

FIG. 3. Comparison of tall fescue seedling growth on plots mulched with Turf Blanket (left) and Swift-Gro containing plant nutrient adhesives (right) on a low fertility top soil in Baldwin County, Alabama.

had the most growth and best coverage, figure 3. There was no difference in cover of the Turf Blanket plots and the unmulched plots. The double tissue plots averaged better cover than the single tissue plots. The plots receiving nutrient adhesive were superior to those receiving the plain tissue. The thickness of plain tissue had no effect on cover while double tissue with nutrient adhesive gave cover superior to that obtained from single tissue.

On fertilized areas the Swift-Gro plots appeared better than the others. Also, the unmulched plots were superior to those receiving Turf Blanket. There was no measurable effect on plant cover from nutrient adhesives or tissue thickness on fertilized plots.

Eufaula Test

After 3 days of scattered showers, an estimated 6 inches of rainfall occurred at this location on November 29, 1971. The intensity and duration of the rainfall was such that severe erosion occurred, figures 4 and 5. No evaluation of stands or erosion control was possible. The only meaningful data obtained were height measurement on the tall fescue plants.

Where no fertilizer was applied to the soil average plant height on Swift-Gro plots was greater than that for other plots, table 5.

FIG. 4. Severe erosion which occurred on the Eufaula test site rendered most evaluations invalid.

Tall fescue height on the unmulched plots was intermediate while Turf Blanket produced the smallest plants. There was no effect on plant height from tissue thickness, but impregnation of the tissue with plant nutrients increased growth of the seedlings.

When fertilizer was added to the soil the average tall fescue height of the Swift-Gro treatment was greater than that obtained from averaging the unmulched and Turf Blanket plots. There was

TABLE 5. MULCH AND FERTILIZATION EFFECTS ON HEIGHT OF TALL FESCUE SEEDLINGS 68 DAYS AFTER PLANTING NEAR EUFAULA, ALABAMA

Mulch material	Paranol treated[1]	Tall fescue height	
		Fertilized	None
		In.	In.
Swift-Gro			
Single tissue.....	No	3.2	1.6
Single tissue.....	Yes	3.2	2.4
Double tissue	No	2.8	1.6
Double tissue	Yes	3.5	3.2
Turf blanket	—	2.8	1.2
No mulch.....	—	2.8	2.0

[1]Paranol, product of Para-Chem Southern, Inc. Simpsonville, South Carolina

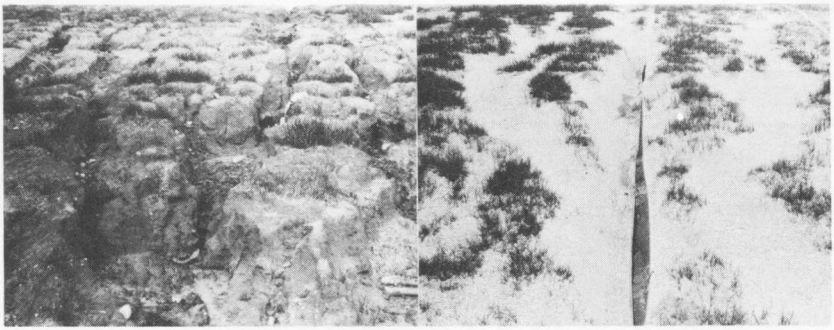

FIG. 5. Comparison of stands obtained on the Eufaula test site under no mulch (left) and Swift-Gro (right). Note that erosion occurred under the Swift-Gro netting.

no difference in plant height between plots receiving Turf Blanket and those receiving no mulch. Tissue thickness had no effect on plant height on the fertilized area; however, impregnation with plant nutrients increased plant height.

SUMMARY

Experiments were conducted at four roadside locations throughout Alabama to evaluate several mulch materials as to control of erosion and aid in seedling establishment. Results are summarized as follows:

1. Seedling establishment is increased by adding cellulose, excelsior, or other mulch materials to erosion control nettings.
2. Lightweight cotton netting gives erosion control inferior to other materials tested.
3. The incorporation of plant nutrients into the adhesive appears to be an acceptable method of applying fertilizers to mulched areas.

LITERATURE CITED

(1) BARKLEY, D. G., R. E. BLASER, AND R. E. SCHMIDT. 1965. Effect of Mulches on Microclimate and Turf Establishment. Agron. J. 57:189–192.

(2) BUTTON, E. F. AND K. POTHARST. 1962. Comparison of Mulch Material for Turf Establishment. J. Soil and Water Cons. 17:166–169.

(3) DUDECK, A. E., N. P. SWANSON, L. N. MIELKE, AND A. R. DEDRICK. 1970. Mulches for Grass Establishment on Fill Slopes. Agron. J. 62:810–812.

(4) LIPTAY, A. M., AND H. TIESSEN. 1970. Influences of Polyethylene-Coated Paper Mulch on Soil Environment. J. Amer. Soc. Hort. Sci. 95:395–398.

(5) RICHARDSON, E. C., AND E. G. DISEKER. 1961. Control of Roadbank Erosion in the Southern Piedmont. Agron, J. 53:292–294.

(6) _____. 1965. Establishing and Maintaining Roadside Cover in the Piedmont Plateau of Georgia. Agron. J. 57:561–564.

(7) SCHMIDT, B. L., G. S. TAYLOR, AND R. W. MILLER. 1969. Effect of Corn Steep Liquor for Erosion Control and Vegetative Establishment on Highway Backslopes. Agron. J. 61:214–217.

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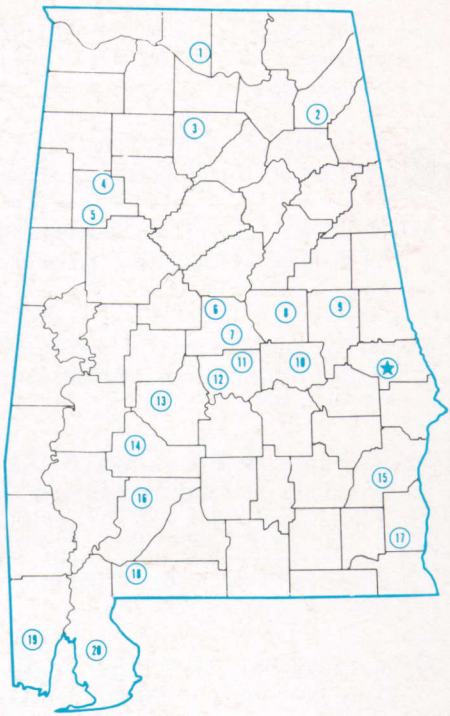

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
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9. Piedmont Substation, Camp Hill.
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13. Black Belt Substation, Marion Junction.
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17. Wiregrass Substation, Headland.
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