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Influence of Surfactants on TENSILE STRENGTH & ROOTING of Bermudagrass Sod

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Influence of Surfactants on TENSILE STRENGTH & ROOTING of Bermudagrass Sod

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THE USE OF SURFACTANTS, or wetting agents, has been recommended for alleviating several turfgrass management problems associated with water infiltration and nutrient availability. Research to date has been limited and results are inconclusive in many instances. Therefore, many recommendations for the use of surfactants in turfgrass culture are based on observations, testimonials, and/or results obtained in other crop and soil situations.

Research to date indicates that surfactants may increase wetting *(3,4)* and drying *(5)* of certain hydrophobic soils and aid in water infiltration. The initial wetting of organic layers, such as thatch, may also be enhanced by the presence of surfactants, resulting in elimination of "dry spots" in turf *(1,2)*. In contrast, surfactants have also been shown to decrease foliage growth of turfgrass *(7)* and injure root tips *(6)*.

The potential for beneficial effects from application of a surfactant appears to be greatest under adverse soil conditions where infiltration of water is retarded. Sandy soils used for sod production in the Southeast have low infiltration rates due to severe compaction at or near the soil surface.

The objective of this study was to determine the effects of applying two nonionic surfactants, Wex and X-77[2], on tensile strength and rooting strength of bermudagrass sod grown on a compacted sandy soil.

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[2]Wex is the trade name for a blend of nonionic surfactants and an emulsified silicone type anti-foam material marketed by Conklin, Co., Inc., Shakopee, Minnesota; X-77 is a blend of nonionic surfactants marketed by Colloidal Products Corp., Sausalito, California.

MATERIALS AND METHODS

Tensile Strength Test

The experiments were conducted at the Agricultural Experiment Station Turfgrass Research Area at Auburn University on Marvin loamy sand. The test area was prepared by rotary tilling the soil to a depth of 6 inches and incorporating 6 pounds of 16-0-8 fertilizer per 1,000 square feet. The area was irrigated and rolled to smooth and compact the soil.

Tifway bermudagrass plugs, 2 square inches in area, were planted on a 6-inch spacing in rows 12 inches apart. Plots, 5 feet by 5 feet, were located in a randomized complete block design with five replications.

The surfactants were applied to the plots using a compressed CO_2-powered sprayer mounted on wheels and equipped with Tee Jet 8002 tips spaced 20 inches apart. A spraying pressure of 40 p.s.i. was used to produce an application rate of 21 gallons of spray per acre.

After surfactant application on June 13, 1977, the area was maintained as for irrigated sod production. The grass was mowed to 1-inch height as needed and fertilized with 1 pound of nitrogen per 1,000 square feet per month from ammonium nitrate.

On September 22, 1977, duplicate samples of sod, 12 inches by 24 inches in size, were harvested with a mechanical sod cutter adjusted to cut at 0.5 inch below the soil surface. Each sod sample was placed soil side up on exposed spikes embedded in a platform having both a movable and a stationary section. Force was applied to the movable section by depositing sand in a container suspended by a rope and pulley system from that section. The force necessary to tear the sod strips apart, determined by weighing the sand in the container when breakage occurred, is considered directly related to the tensile strength of the sod. The tensile strength was measured on September 22 and again on October 14, 1977.

Rooting Strength Test

Soil preparation and field plot design were the same as utilized in the tensile strength tests. After the area was rolled and the plots located, two pieces of plastic coated, welded wire fabric (2-inch by 4-inch mesh), 2 feet by 3 feet in size, were placed on the soil surface. A single 12-inch by 24-inch strip of freshly harvested Tifway bermudagrass sod was placed in the center of each piece of wire mesh. After placement of the sod the area was irrigated and rolled to bring the sod in contact with the soil. At this time the appropriate rate of surfactant was applied to each plot in the same manner as for the tensile strength test. Additional sod and wire mesh pieces were placed along the boundary of the test area and used to determine when substantial rooting had occurred.

The area was irrigated as needed to prevent desiccation of the sod pieces. When examination of the test blocks indicated adequate rooting had occurred, the sod blocks were trimmed to 1 square foot in size. A frame was attached to the wire mesh in a manner which allowed uniform upward tension to be applied to the square of sod. A spring tension scale was attached to the frame and then by a nylon rope to a small winch located directly above. Tension applied to the sod was increased at a constant rate until the sod broke free from the soil. The maximum scale reading produced was recorded and used to compare the relative amounts of rooting strength developed under the various treatments. The experiment was conducted twice during 1977.

TABLE 1. EFFECTS OF SURFACTANTS ON TENSILE STRENGTH OF TIFWAY BERMUDAGRASS SOD PRODUCED ON COMPACTED MARVIN LOAMY SAND

Surfactant	Rate/acre	Sod strength: Harvest 1	Sod strength: Harvest 2
	Fl. oz.	*Lb./sq. ft.*	*Lb./sq. ft.*
Wex	8	29.3 ab[1]	31.0 b
	16	30.2 ab	42.7 a
	32	24.1 b	38.0 ab
	128	33.3 a	37.5 ab
X-77	8	27.0 ab	36.7 ab
	16	27.9 ab	33.0 b
	32	26.2 ab	34.5 ab
Control	—	28.1 ab	30.5 b

Analysis of variance

Source	df	SS Harvest 1	SS Harvest 2	F Harvest 1	F Harvest 2
Rep	4	262.6	1573.6	<1.0	4.14
Control vs. treated	1	.3	284.3	1.75	1.65
Wex vs. X-77	1	82.3	112.9	3.20	4.0
Wex linear	1	150.8	7.6	4.89[2]	2.24
Wex quadratic	1	230.2	153.8	1.20	7.77[2]
Wex cubic	1	57.2	522.3	<1.0	<1.0
X-77 linear	1	5.7	12.7	<1.0	<1.0
X-77 quadratic	1	8.8	56.6	—	—
Exp. error	28	1317.1	1918.7	—	—
Sampling error	40	1414.5	2251.5	—	—
C.V.	—	21.0%	21.1%	—	—

[1]Means within a column followed by the same letter are not significantly different ($P \leq 0.05$) by Duncan's Multiple Range Test.
[2]Significant at the 5 percent level of probability.

RESULTS AND DISCUSSION

Tensile Strength Test

Analysis of the data by Duncan's Multiple Range Test shows that at the first harvest date no surfactant treatment produced sod with greater tensile strength than that produced without surfactant application, table 1. At the second harvest date, only the 16-ounce per acre rate of Wex produced an increase in sod strength ($P \leq 0.05$). Orthogonal comparisons showed again no significant difference between surfactant treated sod and the untreated control. There was also no difference between responses from the two surfactants. The coefficients of variation for both evaluations (approximately 21 percent) lead one to conclude that if material differences in sod strength had existed among the treatments they would have been detected.

TABLE 2. EFFECTS OF SURFACTANTS ON ROOTING OF TIFWAY BERMUDAGRASS SOD ON MARVIN LOAMY SAND

Surfactant	Rate/ acre	Rooting strength	
		Test 1	Test 2
	Oz.	*Lb./sq. ft.*	*Lb./sq. ft.*
Wex	8	42.3 bcd[1]	45.9
	16	40.1 d	44.7
	32	44.6 ab	44.9
	128	43.5 abc	45.3
X-77	8	41.0 cd	44.4
	16	42.3 bcd	44.7
	32	45.8 a	43.6
Control	—	42.5 bcd	45.7

Analysis of variance

Source	df	SS		F	
		Test 1	Test 2	Test 1	Test 2
Rep	4	385.0	377.6	—	
Control vs. treated	1	1.0	7.3	<1.0	<1.0
Wex vs. X-77	1	.4	16.0	<1.0	<1.0
Wex linear	1	14.1	.0	2.2	<1.0
Wex quadratic	1	29.8	4.1	4.7[2]	<1.0
X-77 linear	1	126.4	4.4	19.6[2]	<1.0
X-77 quadratic	1	3.1	2.1	<1.0	<1.0
Exp. error	28	177.4	528.4	—	
Sampling error	40	283.0	791.0	—	
C.V.		6.3%	9.9%		

[1]Means within a column followed by the same letter are not significantly different ($P \leq 0.05$) by Duncan's Multiple Range Test.

[2]Significant at 5 percent level of probability.

Rooting Strength Test

In the first test only, one treatment (X-77 at 32 ounces per acre) produced rooting strength in excess of that achieved by the nontreated control, table 2. In the second test there were no differences among the treatments.

In neither test did orthogonal comparisons indicate differences due to the use of surfactants at the rates tested. The significant linear relationship between rooting strength and rates of X-77 indicates the possibility of a response at a higher rate, but higher rates of Wex gave a curvilinear response resulting in no increase even at rates of application as high as 1 gallon per acre.

CONCLUSIONS

Results of these experiments show that the application of nonionic surfactants cannot be expected to increase tensile strength of sod grown on sandy soils in Alabama. If any response occurs, it is of small magnitude and so transitory in nature as to be of no economic benefit in production of bermudagrass sod. Likewise, the application of surfactants to soil prior to laying bermudagrass sod cannot be expected to increase the rooting strength of the sod.

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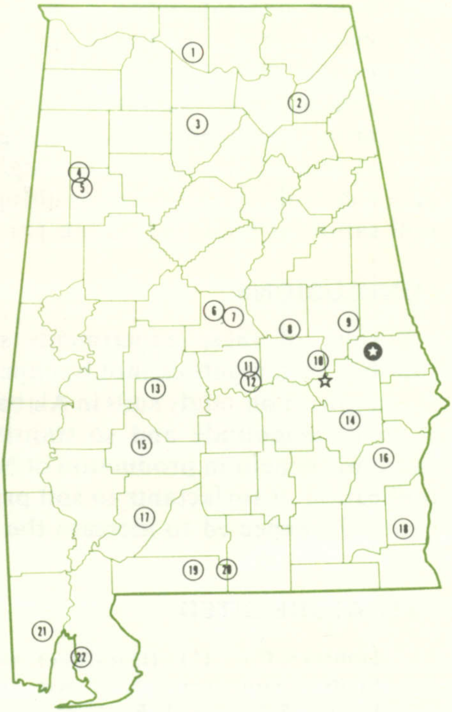

Research Unit Identification

⊛ Main Agricultural Experiment Station, Auburn.
☆ E. V. Smith Research Center, Shorter.

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. Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. The Turnipseed-Ikenberry Place, Union Springs.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Solon Dixon Forestry Education Center,
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21. Ornamental Horticulture Field Station, Spring Hill.
22. Gulf Coast Substation, Fairhope.