COTTON-BASED HYDROMULCHES FOR SEEDED BERMUDAGRASS ESABLISHMENT

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Abstract

Hydromulches and other mulch covers are commonly used for vegetation establishment on roadsides and other construction sites. The objective of this research project was to evaluate different wood and paper based hydromulches, and compare them to newer cotton-plant based hydromulches for their ability to produce a bermudagrass groundcover. Conducted as three separate greenhouse experiments that included hydromulches, mulch blankets, and a loose straw cover, all compared to bare soil. Hydromulch and blanket treatments included those made from cotton-plant based materials that were compared to paper, wood, and other cellulose hydromulches and blankets. Hydromulches made with cotton-plant material typically had faster bermudagrass establishment and greater dry matter production over the 10 week evaluation period. Newspaper and wood-based mulches performed poorly, with poor germination and growth from the seeded bermudagrasses. Differences are most likely related to the widely differing C:N (carbon:nitrogen) ratios of the products.

Introduction

Hydromulches and mulch covers have long been shown to help prevent soil erosion and assist in vegetation establishment. Mulch materials are widely used for roadside or construction-site vegetation establishment (Dickens and Johnston, 1978; Osborne and Gilbert, 1978). Typically, the hydromulches (those materials that are mixed with water and sprayed onto the soil surface) are made from mixes of paper, wood or other cellulose material. The hydromulches may also contain proprietary ingredients such as synthetic fibers, polyacrylamide gels, fertilizer nutrients or growth stimulants.

The evaluation of mulch materials has increased in the past few years, as new mulches derived from waste products have reached the marketplace. One type of mulch utilizes composts from yard waste, biosolids and bio-industrial byproducts, with those products laid down as mulch blankets (Persyn et al., 2004). Another type of waste-based mulch is a hydromulch created from blends of cotton plant by-products (gin trash) and straw (Holt et al., 2005a; 2005b).

Although there has been some research which examined the effectiveness of these new mulch materials to affect soil erosion (Holt et al., 2005a; 2005b; Persyn et al., 2004), there is scant research which examines vegetation establishment with these products. One study found that compost mulches were as effective as topsoil in crop establishment and weed suppression, regardless of the depth of the mulch layer (5 or 10 cm) (Persyn et al., 2007). Because there is no published refereed research about crop establishment with cotton -plant based hydromulches, the objectives of our research were to: 1) compare the effectiveness of various hydromulch materials and mulch blankets to produce a cover of seeded common bermudagrass, and, 2) compare the 'standard' industry mulch materials to those containing cotton-plant materials. A series of three greenhouse trials were completed to test these objectives.

Materials and Methods

A series of three 10 week long greenhouse studies were conducted at the Auburn University greenhouse (Auburn, AL) in ambient light. Studies were initiated in September, 2006, March, 2008, and June, 2008, with the following procedures used in each case. Standard plastic greenhouse production flats (30 x 60 cm, with drain holes) were filled with a 5 cm deep layer of Marvyn loamy sand that had been sieved to pass a 5 mm mesh. A preliminary soil test indicated that the soil (for all 3 experiments) had sufficient P (76 kg/ha) and K (146 kg/ha), and that the soil pH (6.1) was satisfactory for bermudagrass production.

Soil-filled flats were transported to Centre, AL, where the hydromulch treatments were applied. Hydromulch treatments were applied using a commercial hydromulch applicator, with the nozzle rigged to a chain-driven aerial applicator placed 2 m above the soil surface of the flats. This system allowed for calibrated application of hydromulch to the small flats, while still using a commercial applicator system. The following hydromulches were applied at rates of 2,245 and 4,490 kg/ha (2,000 and 4,000 lb/A): 1) CocoFlex ET – FGM, 2) Flexterra FGM, 3) Geoskin, 4) Hydra CM, 5) Hydra CX2, 6) Paper, 7) TeraMatrix SM, and, 8) 70/30 Wood Blend. Additional treatments included the industry standard of a 75% cover with loose straw, a Coco mat mulch blanket, and a bare soil control. Although treatments are listed by their commercial trademarked names, specific company or product names used in this paper are for reporting and information purposes, and should not be considered an endorsement or recommendation by the United States Department of Agriculture, Auburn University, or the Alabama Agricultural Experiment Station to the exclusion of other products of equal value and performance.

To apply the hydromulch treatments bermudagrass seed was spread across the top of each flat (cv. 'Jackpot' sown at 98 kg Pure Live Seed/ha (2 lb PLS/1,000 sq. ft.)), and the hydromulch treatments were sprayed as previously described. Loose straw was spread across designated flats, and the coco mat was cut to size and affixed with sod staples. The 11 treatments were all replicated 4 times, transported back to Auburn, AL, and arranged in a completely randomized design in the greenhouse. Flats were maintained with uniform daily watering, with no supplemental fertilization applied during the length of the test.

Each week for approximately 6 to 8 weeks bermudagrass cover, in percent, was measured by placing two marked (each with 25 marks) sticks diagonally across each flat, and counting the number of times plant tissue touched a mark. At 10 weeks the dry weight of bermudagrass was determined by harvesting all aboveground plant material in each flat, drying it in an oven and weighing it.

Results and Discussion

In each of the three experiments bermudagrass established more rapidly and produced greater dry matter when a cotton-plant based hydromulch was included as a treatment (Figure 1). Figure 1 illustrates results from the second greenhouse experiment, which was initiated in March, 2008, but results from all 3 experiments were similar.

Application of a cotton-plant based hydromulch also increased total dry matter production of bermudagrass, as compared to the bare soil treatment (Figure 2). This increase in dry matter was most likely linked to the lower C:N ratio (38:1) of the cotton-plant based materials, as compared to the C:N ratios of around 300:1 in paper or wood-based products. Materials with lower C:N ratios will stimulate organic matter (mulch) decomposition and release of mineral N (C:N < 20:1) (Brady and Weil, 2002), allowing it to serve as a fertilizer source for the growing bermudagrass.

In 2 of the 3 experiments (observed in experiments 1 (Sept, 2006) and 2 (March, 2008)) some of the hydromulch materials had bermudagrass dry matter production that was significantly lower than that measured in the bare soil control (Figure 3). This was observed in the paper, Flexterra FGM and 70/30 wood blend (exp. 2 only) hydromulch treatments. In the case of the paper hydromulch the majority of the grass seed simply failed to germinate, whereas the Flexterra and 70/30 wood blend products had grass seed germination but the seedlings failed to emerge through the surface crust produced by those mulches. It is unknown if the crusts produced would develop in the field, or if they were a result of daily watering in a greenhouse environment. Certainly, field testing is warranted to further evaluate those hydromulches.

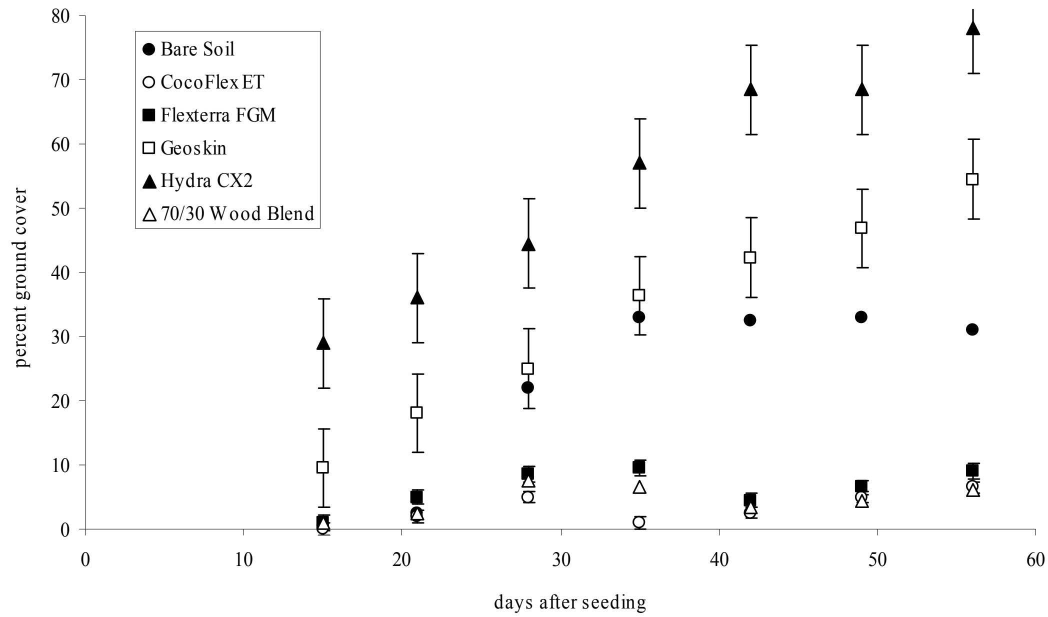

Figure 1. Establishment of seeded bermudagrass as affected by mulch cover, greenhouse study 2 (March, 2008). All hydromulches applied at 4,490 kg/ha.

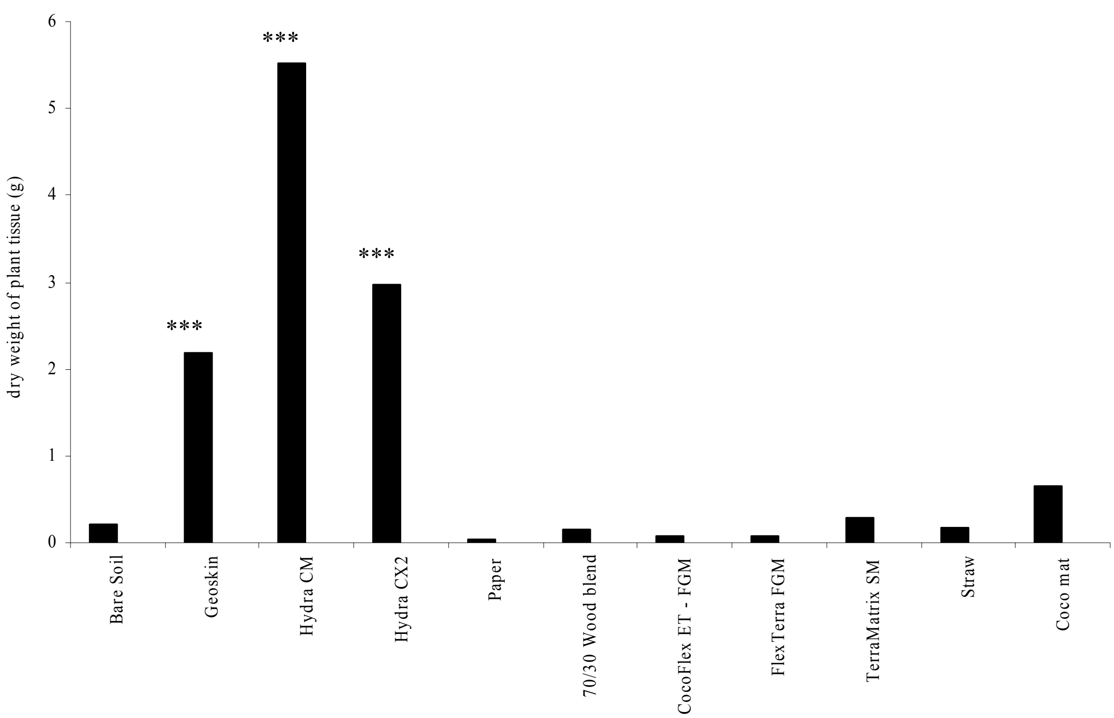

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Figure 2. Dry matter production (grams per flat) of bermudagrass as affected by mulch, greenhouse study 3 (June, 2008). *** - significantly different from the bare soil control at alpha = 0.0001. All hydromulches applied at 2,245 kg/ha.

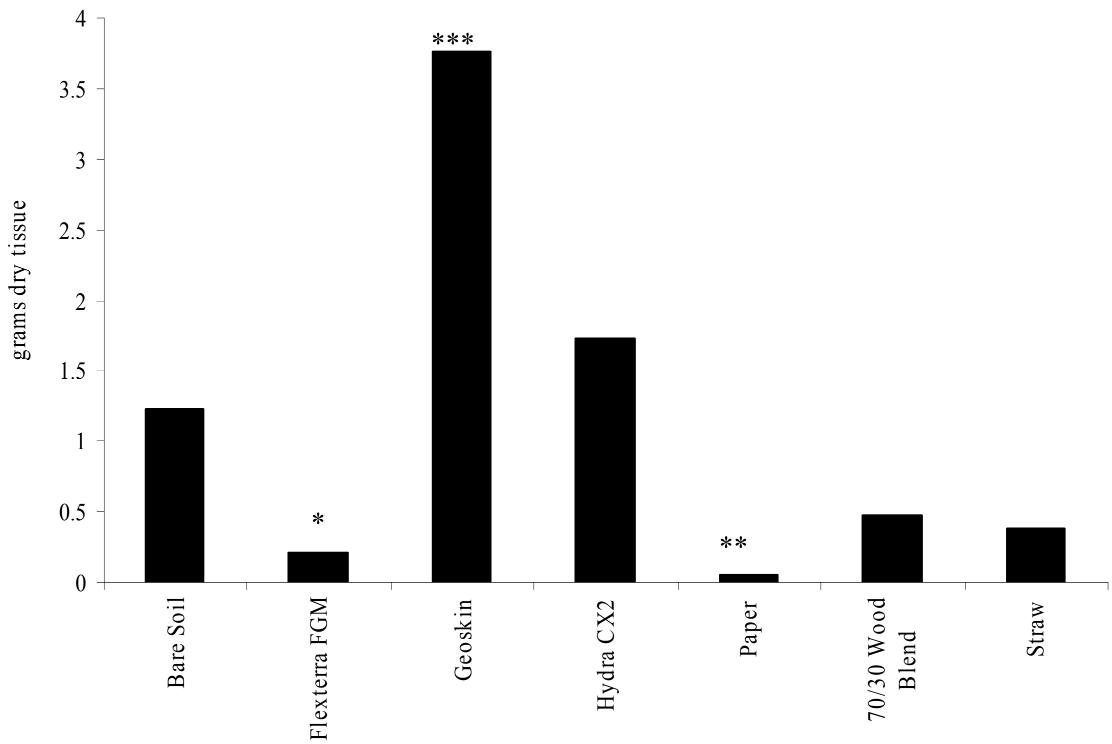

Figure 3. Dry matter production (grams per flat) of bermudagrass as affected by mulch, greenhouse study 1 (Sept, 2006). ***, **, * - significantly different from the bare soil control at alpha = 0.0001, 0.001 and 0.05 level of probability, respectively. All hydromulches applied at 2,245 kg/ha.

Conclusions

The hydromulches Geoskin, Hydra CM and Hydra CX2 produced best bermudagrass growth, while in some cases (in 2 of the 3 experiments) hydromulches that were cellulose or paper-based sometimes produced bermudagrass yield lower than that from bare soil. Hydromulch productivity is related to the nutrient supplying ability of the mulch, and additional work is need that examines the addition of fertilizers to cellulose-based hydromulches. The higher application rate (2,245 versus 4,490 kg/ha) produced greater bermudagrass clipping yield when the mulches Hydra CM, Hydra CX2 and Geoskin were applied, while increased application rate had no positive effect on bermudagrass yield from flats treated with paper, CocoFlex ET, Flexterra FGM, 70/30 Wood blend or TerraMatrix SM. Additional testing is needed to evaluate the mulch materials in outdoor field settings.

Disclaimer

References

Brady, N.C. and R.R. Weil. 2002. The Nature and Properties of Soils, 13th ed. Prentice Hall. Upper Saddle River, New Jersey. 07458.

Dickens, R. and W.J. Johnston. 1978. Comparison of mulch materials for highway vegetation establishment. Alabama Agric. Exp. Stn., Auburn Univ. Bull.

Holt, G., M. Buser, D. Harmel and K. Potter. 2005a. Comparison of cotton-based hydro-mulches and conventional wood and paper hydro-mulches - study 1. J. Cotton Sci. 9(3).

Holt, G., M. Buser, D. Harmel and K. Potter. 2005b. Comparison of cotton-based hydro-mulches and conventional wood and paper hydro-mulches - study 2. J. Cotton Sci. 9(3).

Osborne, D.J. and W.B. Gilbert. 1978. Use of hardwood bark mulch for highway slope stabilization. Agron. J. 70:15-17.

Persyn, R.A., T.D. Glanville, T.L. Richard, J.M. Laflen, and P.M. Dixon. 2004. Environmental effects of applying composted organics to new highway embankments. 1. Interrill runoff and erosion. Trans. ASAE. 47:463-469.

Persyn, R.A., T.L. Richard, T.D. Glanville, J.M. Laflen, and P.M. Dixon. 2007. Evaluation of revegetation from blanket applied composts on a highway construction site. Applied Eng. Agric. 23:631-635.