APPENDIX 2

# PAPER MILL SLUDGE AS A MULCH DURING TURFGRASS ESTABLISHMENT

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## IMPACT STATEMENT

The use of paper sludge, a waste product of paper milling, as a mulch during turfgrass establishment would be a positive alternative to landfilling. The objective for our research was to determine if paper sludge is effective as a mulch in establishing turfgrass without negatively impacting the physical properties of the underlying soil. Throughout this study, paper sludge was not significantly different from the commercial product hydromulch with regard to the height of germinating turf plants or percent turf cover of the plots. In addition, paper sludge did not significantly reduce water infiltration compared to the other mulches.

## BACKGROUND

Sludge is a paper mill waste by-product that is produced in great quantities daily. Most of the sludge is land filled, creating financial and environmental burdens. A typical paper mill produces approximately 900 tons of sludge per day. The daily cost of landfilling this waste is $2,250 ($2.50/ton). The current legislative trend in many states is to restrict the amount and type of materials permitted into landfills. This may limit the paper sludge disposal options of mills in the near future. Finding an alternative use for paper sludge would benefit paper mills financially while also having positive environmental effects such as prolonging the life of landfills.

Paper sludge is composed of cellulose fibers, clay fillers, and coating agents (Norrie and Gosselin, 1995). Past research has demonstrated that paper sludge has potential as a turfgrass soil amendment. Paper sludge additions decreased the bulk density of the soil when mixed with a heavy soil to grow Kentucky bluegrass (Poa pratensis), (Laganiere et al., 1995). Conversely, other studies have shown that the positive effects of using paper sludge as a soil amendment are limited (Fierro et al., 1995).

Another possible way to utilize paper sludge is as a mulch during turfgrass establishment. Mulches are used during establishment to reduce evaporative water loss from the soil, buffer temperatures near the seedbed, and prevent the washing of seeds during precipitation and irrigation. Since paper mill sludge has similar physical properties to other commercially available turfgrass mulches, it may be able to enhance turfgrass germination and establishment. However, since sludge is composed partly of clay, when used as a mulch, it could have a negative impact on water infiltration into the underlying soil.

The objectives of the following research were: 1) to determine if paper mill sludge could be used effectively as a mulch during turfgrass establishment compared to straw and hydromulch; and 2) determine the effects of the mulch treatments on water infiltration into the underlying soil.

## RESEARCH DESCRIPTION

Turf plots were established in the greenhouse in plastic tubs (15 x 20 x 5 in.) with holes drilled in the bottom for drainage. The tubs were packed with a sandy loam soil to a bulk density representing typical field conditions (~1.6 g/cm3). Tall fescue (*Festuca arundunacea* cv. Millenium) was seeded in the tubs at a rate of 20 g/m2. Immediately following seeding, tubs were mulched with either paper mill sludge, straw, hydromulch, or nothing (control). Mulch rates are given in Table 1. Through the remainder of the study, the turf was maintained according to Table 2. The mulches were evaluated throughout the study in accordance with Table 3.

Each mulch treatment was replicated four times in a randomized complete block design. One-way analyses of variance (ANOVA) were performed on the data from each evaluation parameter to determine if mulch effects were significant. When mulch effects were significant ($P < 0.05$), treatment means were separated according to Fisher's least significant difference test.

## FINDINGS

Plant height. All of the mulches were equally effective with regard to initial germination date. Over time, however, the straw mulch proved to have quicker establishment in terms of seedling height (Table 4). By 12 days after seeding, all mulch treatments had significantly greater plant height than the control.

Percent cover. The straw mulch initially had significantly greater turf cover than the other treatments (Table 4). However, by 37 days after seeding, the paper sludge and hydromulch treatments were not significantly different from the straw. At 23 days after seeding, the control treatment had significantly lower percent cover than all other mulch treatments. Over time, the seed in the control plots eroded into low areas within the plots, negatively impacting percent cover. All three mulch treatments were effective in preventing the erosion of seed.

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Infiltration. The infiltration rates for the four different mulch treatments were not significantly different ($P < 0.73$) (Table 4). The infiltration values ranged from 22.9 to 26.6 cm/hr. Although the paper sludge is composed partly of clay material, it did not significantly impede water movement into the soil in this study.

This experiment showed that the straw mulch provided faster turf establishment than the other three treatments during the first 23 days after seeding. In addition, the paper sludge treatment performed equally to, and in some cases out-performed, the hydromulch treatment. This experiment showed the importance of using some type of mulch during turfgrass establishment as the control treatment performed significantly worse than all of the mulches throughout the study. These data showed that paper mulch can be used effectively during turfgrass establishment and may provide an alternative to landfilling for paper mills.

**LITERATURE CITED**

Fierro, A., J. Norrie, C.J. Beauchamp, and A. Gosselin. 1995. Response of several grass and legume species to paper deinking sludge. HortScience 30:859.

Laganiere, M.P., P. Lecomte, and Y. Desjardins. 1995. Effect of composted paper sludges and municipal waste compost amendments on the growth of Kentucky bluegrass. HortScience 30:896.

Norrie J., and A. Gosselin. 1995. Paper sludge amendments for turfgrass. HortScience 31:957-960.

**Table 1. Information on mulches used in the turfgrass mulch study.**

| Mulch type | Source | Application rate |
|---|---|---|
| Paper mill sludge | Fort James, Muskogee, Okla. | 170 g $m^{-2}$ |
| Wheat straw | Univ. of Ark. Res. and Ext. Center, Fayetteville, Ark. | 290 g $m^{-2}$ |
| Hydromulch | Conwed Fibers, Statesville, N.C. | 170 g $m^{-2}$ |
| Control | | |

**Table 2. Turf management practices utilized in the turfgrass mulch study.**

| Management practice | Description |
|---|---|
| Mowing height | 2.5 in. |
| Mowing frequency | Once per week after seedlings reach 4 in. height. |
| Irrigation | During germination, 0.1 in. water once per day. Once established, 0.5 in. water three times per week. |
| Fertility | Starter fertilizer (1:2:1) applied at seeding at a rate of 10 g $P_20_5m^{-2}$. Upon germination, soluble N applied biweekly at 2.5 g/$m^{-2}$N. |
| Pest control | None. |

**Table 3. Treatment evaluations used in the turfgrass mulch study.**

| Evaluation | Description |
|---|---|
| Emergence date | Following seeding and mulching, the plots were checked daily for seedling emergence. The date of first seedling emergence was recorded for each tub. |
| Plant height | After plants emerged, average plant height was recorded three times per week and plant density was evaluated once weekly. Average plant height was determined by measuring plant tissue height from the soil surface at four randomly selected areas with each tub. Plant height was recorded in each tub until plants had reached 4 in. height. |
| Plant cover | Plant cover was evaluated weekly by taking overhead digital images of each tub and downloading them to a PC for cover analysis in SigmaScan software. |
| Infiltration | Infiltration rates for each tub were determined approximately 4 months following germination using a double-ring infiltrometer. |

**Table 4. Effects of mulch treatment on plant height, infiltration, and percent plant cover.**

| Mulch | Plant height mm | | | Infiltration cm/hr | Plant cover % | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 das[z] | 10 das | 12 das | 90 das | 10 das | 15 das | 23 das | 30 das | 37 das | 43 das | 57 das |
| Check | 10.4 b[y] | 26.7 c | 43.3 c | 26.0 a | .17 b | 1.9 b | 12.6 c | 33.0 c | 44.3 b | 53.8 c | 57.6 b |
| Straw | 22.7 a | 56.0 a | 75.1 a | 26.6 a | 15.4 a | 27.0 a | 63.1 a | 79.7 a | 88.5 a | 92.8 a | 78.6 a |
| Hydromulch | 13.9 b | 38.1 b | 57.6 b | 29.1 a | .77 b | 4.3 b | 30.6 b | 67.2 b | 78.7 a | 85.0 b | 81.1 a |
| Sludge | 15.1 b | 34.5 bc | 67.1 ab | 22.9 a | 1.2 b | 5.0 b | 33.4 b | 68.3 ab | 80.3 a | 87.9 ab | 82.4 a |
| P value | 0.0015 | 0.0008 | 0.0027 | 0.7344 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | 0.0014 |

[z] das=Days after seeding.

[y] Within a column, means sharing a letter are not significantly different (P<0.05).