NORTH CENTRAL FOREST EXPERIMENT STATION
Research Note NC-333
1992 FOLWELL AVE. ST. PAUL, MN 55108 FOREST SERVICE-U.S.D.A.
1985

MANAGING VEGETATION ON PEAT-SAND FILTER BEDS FOR WASTEWATER DISPOSAL

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ABSTRACT.—Five species of grass, one sedge, and cattail were grown on a peat-sand filter bed irrigated with sewage effluent. Yields, uptake of nitrogen and phosphorus, and lodging problems were determined for all species when grown to various heights ranging from 5 to 75 cm.

KEY WORDS: Cattail, sewage, effluent, nutrients, grass, sedge.

Several peat-sand filter beds have been constructed to treat sewage effluent from campground and recreation areas on national forests. The filter beds have proven to be effective in removing fecal coliform bacteria and wastewater nutrients (Nichols and Boelter 1982). Nichols and Boelter found that the vegetation growing on the filter beds is important in overall nitrogen (N) and phosphorus (P) removal. Rough-stalked bluegrass (*Poa trivialis* L.) is typically grown on filter beds, and it takes up nutrients well, but requires frequent mowing. If allowed to grow taller than 12 cm, it falls over, becomes matted down, and begins to die out. Parrott and Boelter (1979) found that yields and N uptake were greater when bluegrass on the filter beds was maintained between 5 and 10 cm in height than when allowed to grow taller. However, the frequent mowing (at least once a week) required to maintain the grass at 5 to 10 cm is time consuming and costly.

The purpose of this study was to find an alternative to bluegrass that would remain healthy when grown taller than 15 cm and provide high uptake and removal of nutrients from filter beds.

STUDY AREA

The study was conducted on a peat-sand filter bed near the Cutfoot Visitor Information Center on the Chippewa National Forest in north central Minnesota. The filter bed is used for tertiary treatment and final disposal of effluent from a small secondary treatment plant. The treatment plant receives wastes from several Forest Service residences, campground vault toilets, and self-contained camping units (RVs). The filter bed is circular with a diameter of 15 m. It has about 20 to 25 cm of peat over a 10 cm layer of mixed peat and sand, which is over the native sand material. The bed is sheltered from the wind and receives full sunlight for about 75 percent of the day. Sewage is applied with a sprinkler mounted about 20 cm high at the center of the bed. Rates of effluent application are <0.5 cm per day from May through October. These rates are low compared to applications on other filter beds. The average precipitation from May through October is 48 cm, about the same as the evapotranspiration for the same period. Because the bed was drained, had low effluent application rates, and received little excess rainfall, the surface remained dry compared to some other filter beds.

METHODS

We divided the bed into six pie-shaped sections and planted a different species in each section; these included five grasses (Gramineae):
Agropyron repens (L.) Beauv. (quackgrass)
Alopecurus geniculatus L. (marsh foxtail)
Festuca elatier L. (meadow fescue)
Phalaris arundinacea L. (reed canary grass)
Poa trivialis L. (rough-stalked bluegrass)
and one sedge (Cyperaceae):
Scirpus cyperinus L. (wool-grass).

We then monitored the growth, condition, and chemical composition of each species for 3 years. The grass was harvested when it reached various heights ranging from 9 cm to 75 cm. In all cases the grass was cut back to 5 cm at harvesting. All harvested material was collected and removed from the bed. Before harvesting, we collected a randomly located m^2 sample from each section to estimate production and chemical content. Each sample was dried at 65°C in a forced-draft oven and weighed. A subsample was ground in a Wiley mill and transferred to the Research Analytical Laboratory in the Department of Soil Science, University of Minnesota. Each sample was analyzed for Kjeldahl nitrogen, nitrate nitrogen, and total phosphorus.

After 3 years, we tilled the entire surface of the bed and planted 1,100 *Typha latifolia* L. (cattail) rhizomes from a nearby marsh on the bed at a spacing of 38 × 38 cm. The cattails were harvested once a year at the end of the growing season. Before harvesting, we collected 20 samples to estimate production and chemical content. The cattails were analyzed with the same methods as the grass samples.

RESULTS AND DISCUSSION

The filter bed was designed to handle up to 7.5 cm of water per day but the sewage application plus rainfall averaged <1 cm per day, so the filter bed was rarely saturated. Because of the bed's dryness, the cattails did not persist past the second growing season and grass invaded the bed. Wool-grass was difficult to establish apparently because it also is better suited to a wetter environment. Cattails and wool-grass are therefore not recommended for peat-sand filter beds with low application rates, but probably would grow much better on a filter bed that is saturated much of the time. High yields have been reported for cattails grown on wetland soils (Garver *et al*. 1983).

The grasses (reed canary, meadow fescue, marsh foxtail, quackgrass, and bluegrass) yielded from 3.9 t/ha to 7.0 t/ha. These values were comparable to the yields of bluegrass reported for another peat-sand filter bed in northern Minnesota that received wastewater applications of about 1 cm/day (Nichols and Boelter 1982), but the values are lower than those reported by Palazzo and McKim (1978) for grasses receiving wastewater applications (1-2 cm/day) on sandy loam and silt loam soils in New Hampshire. Marten *et al*. (1979) also reported higher yields on a silt loam site with wastewater application (1-2 cm/day) near the Twin Cities Metropolitan Area in Minnesota. All five species were vigorous and grew well when maintained at a height <15 cm. All species showed some signs of matting, die off, and reduced yields when allowed to grow taller than 15 cm, but reed canary, meadow fescue, and marsh foxtail withstood the taller heights better than the quackgrass and bluegrass. Meadow fescue was the most consistent producer over the whole range of harvesting heights (table 1).

The annual N removal for the five grass species ranged from 220 Kg/ha to 327 Kg/ha. Annual P removal ranged from 30 Kg/ha to 54 Kg/ha. None of the five species showed a definite advantage in N and P removal (table 1). The concentrations of N and P were higher than in similar vegetation on unfertilized soils in the area, and the amount of N and P removal by the vegetation was adequate for typical filter bed loading.

Points to consider when maintaining grass at a height of <15 cm:

1. Any of the five species will produce good yields and remove large amounts of nutrients.
2. Filter bed looks neat and clean.
3. A normal rotary lawn mower with a grass catcher is all that is needed for cutting the grass.
4. Frequent mowing is required (about once a week).

Points to consider when allowing grass to grow taller than 15 cm:

1. Mowing is less frequent (3 to 4 times a year).
2. Meadow fescue, marsh foxtail, or reed canary will be less likely to lodge and die than bluegrass or quackgrass.
3. The sprinkler head must be raised so the spray is not blocked by the tall grass.
4. A sickle mower or some device other than a rotary lawn mower is needed to cut the grass.
5. The bed will need to be raked following each mowing to remove the cut grass.
6. Most people feel that the tall grass is less aesthetic than the shorter, lawn-like grass.

It appears that maintenance costs could be reduced by allowing the grass to grow taller on the filter beds. Even though mowing and removing the cut grass would take longer each time for the taller

Table 1.—*Average annual yield and nutrient removal of the filter bed vegetation*

(In Kg/ha (dry weight))

	Reed canary	Meadow fescue	Marsh foxtail	Quackgrass	Bluegrass
Yield	4,724	5,838	5,661	4,828	4,969
N removed	244	282	282	240	267
P removed	37	36	40	42	38

grass, the total time for the whole season should be less than half that required for maintaining a grass height of
5 to 15 cm.

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