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SELECTION AND CULTIVATION OF FINAL VEGETATIVE COVER FOR CLOSED WASTE SITES AT THE SAVANNAH RIVER SITE, SC

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DISCLAIMER

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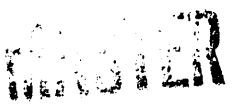

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Abstract

Low-level, hazardous, and mixed waste disposal sites normally require some form of plant material to prevent erosion of the final closure cap. Waste disposal sites are closed and capped in a complex scientific manner to minimize water infiltration and percolation into and through the waste material. Turf type grasses are currently being used as a vegetative cover for most sites. Consequently, the sites require periodic mowing and other expensive annual maintenance practices. The purpose of this five year study was to evaluate alternative plant material for use on wastes sites that is quickly and easily established and economically maintained, retards water infiltration, provides maximum year-round evapotranspiration, is ecologically acceptable and does not harm the closure cap. The results of the study suggest that two species of bamboo (Phyllostachys bissetii and P. rubromarginata) can be utilized to provide long lived, low maintenance, climax vegetation for the waste sites. These large species of bamboo will also reduce the probability of intrusion by humans, animals and deeply rooted plant species.

Introduction

In 1985 a study was initiated by the U. S. Department of Agriculture, Soil Conservation Service (USDA-SCS) and the Savannah River Technology Center (SRTC) to evaluate alternative plant species for permanent cover on low-level waste disposal sites at the Savannah River Site. Due to the desired plant characteristics set forth by the SRTC, bamboo was chosen as the most likely plant to solve the problem. It's easily established, long lived, shallow rooted, ecologically sound, low maintenance, insect and disease

free. Seven species were selected based on known degrees of temperature hardiness and rate of growth.

Three species of Phyllostachys were planted in replicated plots in March 1985 and four species were planted in the same manner in 1986.

Discussion

Two field studies, each having four replications, were installed at the Savannah River Site to determine the best species of bamboo based primarily on quickness of ground cover development.

The location for the first planting was near the Old Burial Ground. Soil conditions at the site were extremely poor and did not represent typical soil conditions planned for future disposal sites.

Soils at the site had been intensively compacted by heavy vehicles so tractor and manual rototillers were utilized to loosen the soil. One hundred pounds of dolomitic limestone and 30 pounds of 10-10-10 fertilizer were added to the .05 acre site.

Sixteen clumps of Phyllostachys bissetii, nigra and dulcis were transplanted from the University of Georgia Coastal Research Center near Savannah, Georgia, to the Savannah River Site on March 6, 1985. Four clumps of each species were planted four feet apart in replicated plots at Site I as depicted below. Individual species were separated with corrugated aluminum sheets to prevent merger. Honeysuckle, Lonicera japonica, was added as a potential cover plant by the SRTC staff.

Site I
Test Plot Diagram

Rep 1		Rep 2		Rep 3		Rep 4	
Lj	Pb	Pn	Lj	Pn	Pd	Pb	Pd
Pn	Pd	Pd	Pb	Pb	Lj	Lj	Pn

Lj (Lonicera japonica), Pb (P. bissetii), Pn (P. nigra), Pd (P. dulcis)

Sixteen clumps of four additional species of Phyllostachys were transplanted from a bamboo nursery in Birmingham, Alabama and planted at the SRS near the H-Area seepage basins in March 1986. Site II preparation and planting were done in the same manner as for Site I. The following

species were planted as depicted below:

Site II
Test Plot Diagram

Rep 1		Rep 2		Rep 3		Rep 4	
Pr	Ps	Pa	Pr	Pf	Pa	Ps	Pf
Pf	Pa	Ps	Pf	Pr	Ps	Pa	Pr

Ps (P. aureosulcata), Pr (P. rubromarginata),
Pf (P. flexuosa), Pa (P. aurea)

All plots at both sites, including the control, were mulched with pine straw and irrigated during the first growing season to maintain soil moisture and enhance establishment of the bamboo. Weed control amounted to limited culling of large annual weeds by hand and use of post emergent herbicides to eradicate invading perennial woody plant species e.g. poison ivy, dewberry, trumpet-creeper, pine seedlings, etc. Every March, fertilizer (10-10-10) was broadcast over all plots at 1.5 lbs N/1000 sq ft the first three growing seasons and at 3.0 lbs N/1000 sq ft the last two growing seasons. Both sites were regularly monitored for disease, insect and other pest problems. There was no evidence of deer browse to the bamboo although the honeysuckle was heavily browsed each year.

Results of Test Plots

Site I

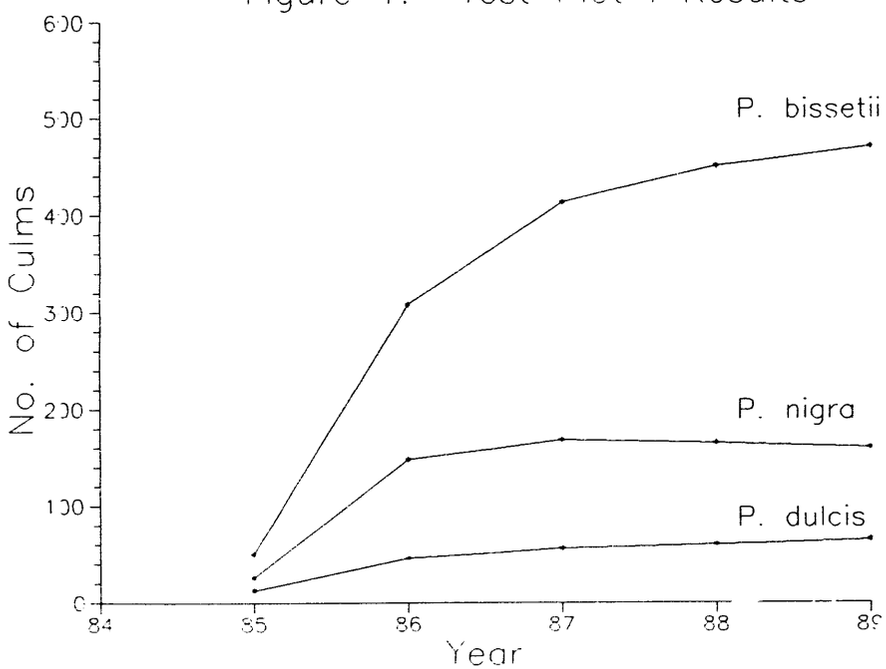
First year transplant survivability at Site I was excellent for P. bissetii with 100% and P. nigra with 91%, while P. dulcis was poor with 50%. Initial survival rate obviously impacted the rate of stand density development.

After four growing seasons, accurate culm counts of P. bissetii could not be made and after the fifth growing season the plots were completely covered, passable only by rodents, rabbits and other small animals. At the end of the evaluation period (Fall 1989) , the P. nigra or P. dulcis plots were still sparsely populated with culm counts low when compared to the P. bissetii, as shown in Figure 1.

Place Figure 1 here or close to here.

The P. nigra and P. dulcis plots were also heavily infested by herbaceous weeds while the P. bissetii plots had only a few scattered weeds in each plot. Although herbicides were

Figure 1. Test Plot I Results



used in all plots to eradicate invading perennial woody plant species, most of the weeds in the P. bissetii plots were naturally eliminated by the shade and mulch created by the dense stand of bamboo.

Site II

First year survivability of the four Phyllostachys species planted in March 1986 at Site II was 97%. Sixty-two of the sixty-four clumps were actively growing at the start of the second growing season.

The high survival rate can be attributed in part to the quality of plants received from the nursery and in the experience gained by the workers in planting the bamboo at Site I. During the first two growing seasons, Phyllostachys flexuosa, aurea, and rubromarginata demonstrated good vigor by each producing over 200 culms. P. aureosulcata was the least vigorous of the collection. It produced slightly more than 100 culms having an average height of only two feet during the same period.

Site II was cultivated in the same manner as Site I. After four growing seasons, P. flexuosa and P. rubromarginta had demonstrated superior vigor by producing stands too thick to make accurate counts. As with P. bissetii at Site I, the stands were penetrable only by small animals. Neither P. aureosulcata nor P. aurea produced dense stands of new shoots during the evaluation period (See Figure 2).

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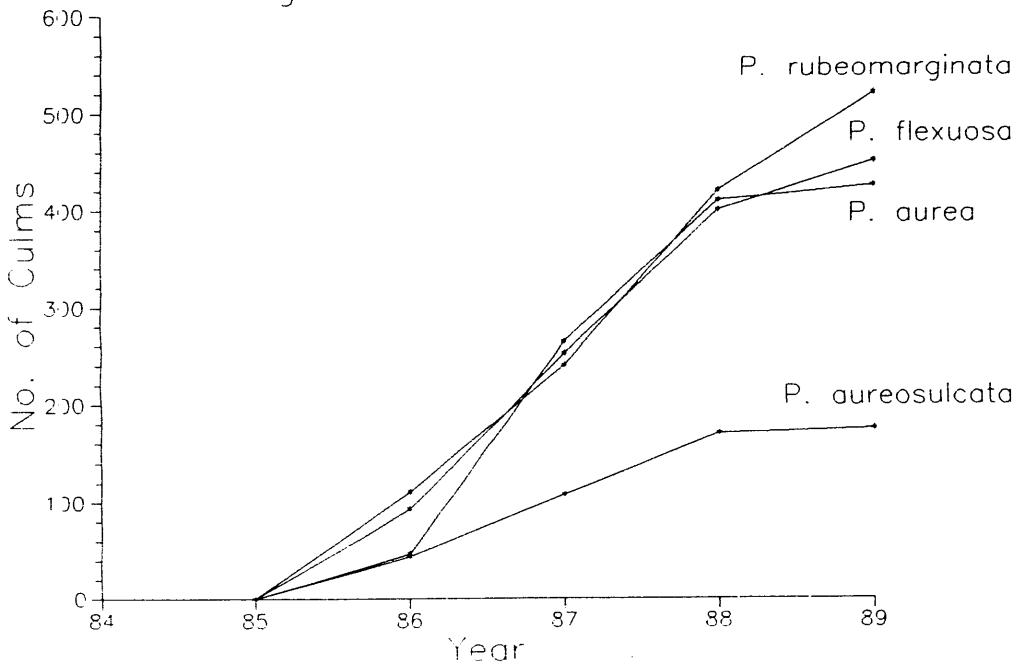
Establishment of Bamboo Nursery Plot

Late in 1990, SRTC decided to develop a large quantity of bamboo with material from the two test plots. With the help of a Soil Conservation Service Soil Scientist, a three acre site was selected having characteristics suitable for bamboo growth. The site, containing the Orangeburg loamy-sand(1), was part of a twenty-acre tract that had recently been clear-cut during a timber harvest. Initial site preparation was done with a bulldozer using a root rake to remove stumps and clear debris. Once this was completed the site was disked and raked. Early in March 1991, site preparation was completed by using a single blade mold board plow to cut one-foot deep furrows ten feet apart.

The most successful bamboo species from each test plot P. bissetii and P. rubromarginata, were selected for transplanting. The plants were trimmed to about four feet in height with a bush hog mounted on a hydraulic arm. On March 20, 564 clumps of bamboo were transplanted to the nursery area, 317 P. bissetti and 247 P. rubromarginata.

Figure 2. Test Plot II Results



The clumps were removed from the test plots with a backhoe and separated using axes and bush knives. They were transported to the nursery area by truck and placed into the furrows about ten feet apart. They were immediately covered with soil. The following morning the plants were individually watered.

On April 15, the newly planted bamboo clumps were examined. Both species showed positive signs of growth in 95% of the clumps. In early summer, three types of herbaceous ground cover were seeded at the nursery area. Kobe lespedeza, Lespedeza striata, was seeded in the alleyways between the bamboo plants to prevent erosion during the establishment period. Bahia grass, Paspalum notatum, and Centipede grass, Axonupus affinis, regionally adapted turf grasses, were seeded on the periphery to be evaluated as possible short term vegetative covers for waste site closures. One year after planting all three varieties had become well established.

During the summer of 1992, a rain gauge and series of soil moisture gauges were installed at the nursery area. The moisture gauges were placed beneath each bamboo species and each ground cover type. These will be used to measure the effectiveness of the plants in reducing deep infiltration of water.

Significant Findings

Transplanting bamboo must be done in late winter to early spring before the bamboo breaks dormancy. Planting stock (clump) should be 2 year old rhizomes, no less than 12" long, with at least 2 culms attached cut at 2-3 feet.(2) The root ball should be wrapped and handled carefully prior to planting to prevent damage and desiccation of the new juvenile shoots. At planting, each clump should be fertilized with 4 oz of 10-10-10 and the root ball thoroughly saturated by filling the plant hole with water. After the water has drained, the hole can be backfilled and the soil tamped to remove air pockets. Good growth rate is achieved by annual application of 90-100 lbs N/acre using a 1-1-1 analysis fertilizer applied half in late winter and half in early summer.(3) After a dense stand develops, fertilization is required only as needed to maintain good vigor.

Recommendations

When planted on 4 foot centers (3025 per acre), Phyllostachys bissetii, rubromarginata, and flexuosa are each capable of producing dense impenetrable vegetative cover in four growing seasons at the Savannah River Site.

This is consistent with findings of other researchers.(4) When compared with turf-type ground cover these bamboo species require significantly less maintenance, remove much more water by evapotranspiration, and greatly reduce the probability of intrusion by humans, animals, and deeply rooted plant species.

Closure caps are required to be monitored for a period of time after closure is complete so that any changes due to settlement may be corrected. When this period is over, the two species of bamboo currently being cultivated could be transplanted directly onto the closure caps. During the bamboo establishment phase, some initial maintenance will be required (fertilization and weed control), but after that little or no additional care will be needed, reducing the long-term costs significantly.

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