Sand Point – Brownfield Reclamation Project

2002 Rose Lake PMC Greenhouse Study

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Introduction

An extensive area of shoreline on Lake Superior's Keweenaw Bay, known as Sand Point, and wholly within the L'Anse Indian Reservation, is contaminated by 'stamp sand,' deposited waste from a former industrial site. This area has great potential for recreational value, yet its' resources suffer due to vast tonnage's of industrial copper mining sands from an early 20th century factory. A copper stamping mill along the shoreline operated from 1902 to 1919. During its history of operation, the stamp mill crushed copper mine rock from nearby mines and deposited the waste into Keweenaw Bay. The total estimated volume of mine rock brought to the stamp mill was six billion pounds of mine waste and this went into Keweenaw Bay.

Lake currents over the last several decades have deposited these industrial sands into 2.5 miles of the Reservation's Lake Superior waterfront. The deposited waste, crushed mine rock or stamp sand, likely contains elevated levels of copper, lead, and cadmium and other heavy metals. It is presumed that these contaminants remain in the beach area along the Reservation shoreline property.

The Keweenaw Bay Indian Community is a federally recognized Indian Tribe and administers the Reservation lands. The community plans to transform this industrial wasteland area into a recreational park. The long-range goal is to incorporate attractive greenspaces and efficient landscape architectural designs into this area. As the community's recreational base grows; the intent is to remain responsible stewards of the environment by protecting these valuable resources. The focus of the proposed project is the research, assessment and testing of the site, as well as the development of a reclamation plan for the Sand Point area.

The Rose Lake Plant Materials Center has been asked to compare capped and uncapped stamp sand soil from the Keweenaw Bay area with typical potting sand to determine potential inherent problems with the industrial sand. This has been identified under Objective 3 of the Sand Point – Brownfield Reclamation Project goals. The following is a discussion of that study.

Methods and Materials

Three treatments with soil and soil cap components were used. Stamp sand from Baraga county and greenhouse sand were the major components with the capping materials being common fill from an area near the stamp sand site. Plots were established in a six-inch high wooden grid atop a greenhouse bench. Fine mesh synthetic material over a perforated plastic sheet was used to line the bottom allowing for drainage while retaining the sand. A randomized complete block (RCB) design with six replications was utilized for this study. Each 6"x7" plot was filled with the appropriate soil and cap material then planted with fifty uniformly spaced rye seeds approximately ½" deep (the

rye seed was purchased locally). The fifty seeds were planted in each plot. Plots were irrigated and fertilized daily through a overhead mist system.

Pictures were taken a number of times per week to compare and document growth. At nine days a count was taken on the number of plants per plot, a second count was taken on day thirty-two and a final count on day fifty-seven.

On day fifty-seven each plant was cut 2 inches from the surface. The harvested material for each treatment was weighed using a triple beam balance, packaged in paper sacks and sent for tissue analysis. The tissue analysis will test for phosphorus, calcium, potassium, magnesium, copper, iron, zinc, and manganese.

Plots were maintained, and irrigation and fertilizer applications continued until day 89. The plants were removed from the plots with the roots intact. Roots were washed free of soil then visually compared and digitally photographed.

Results and Discussion

Germination began on all treatments within two days and grew to six inches in the first week. The analysis of variance for final plant counts (Table 1) showed that differences between treatments is highly probable. A separation of means by an LSD test (Table 2, Figure 1) indicated there was not a significant difference between the greenhouse sand and the stamp sand. The average plant count for the stamp sand with soil cap, however, was significantly different and produced approximately half the number of plants than either of the other treatments.

Table 1. Analysis of Variance for Plant Count

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1	Replication	5	8.278	1.656	0.1326	
2	Treatment	2	1675.111	837.556	67.0641	0.0000
-3	Error	10	124.889	12.489		
	Total	17	1808.278			

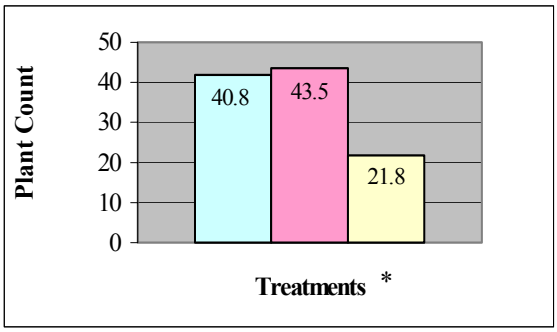
Coefficient of Variation: 9.99%

Table 2. Number of plants growing per plot at harvest (50 seeds planted/plot)

	Plant Count per Plot at Harvest						
	Replication						Treatment
Treatment	1	2	3	4	5	6	Average*
Greenhouse Sand	41	43	40	40	40	41	40.8 a
Stamp Sand	40	45	45	45	45	41	43.5 a
Stamp Sand w/Cap	26	15	20	20	23	27	21.8 b

* Means without common letters are significantly different using Least Significant Difference (LSD) Test at 1% level.

Figure 1. Average number of growing plants per plot at harvest (from 50 seeds/plot).



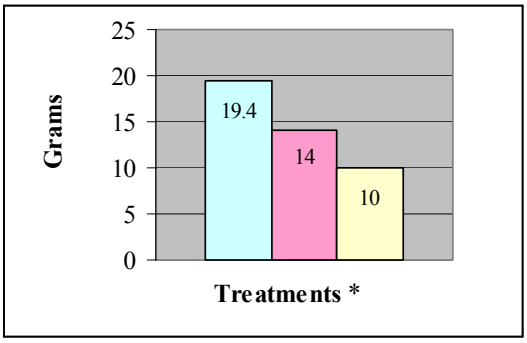
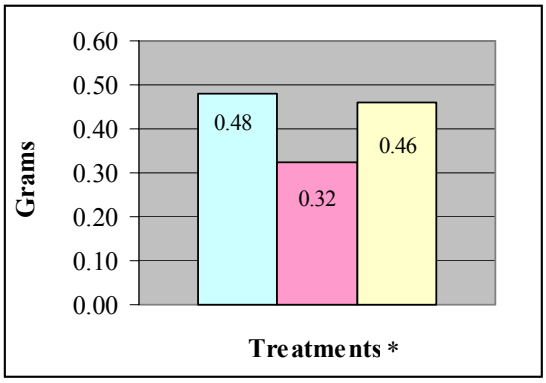


Figure 2. Average weight of harvested plant material per plot (cut 2 inches from soil surface).

Figure 3. Average weight of plant material per harvested plant.



* Treatment Legend:

Greenhouse Sand	Stamp Sand	Stamp Sand with Cap

Although the stamp sand produced the highest average number of plants per treatment it may be misleading when considering the overall health and average production per plant. Average plot weights of the harvested material (Figure 2) were considerably lower for the stamp sand and lower still for the capped material. However, taking into account the number of plants per plot we got a better idea as to the mean

above ground growth of individual plants in each treatment (Figure 3). Both greenhouse sand and capped treatments were markedly higher than the stamp sand treatment.

The color of the foliage and density of the growth comparisons were made between treatments. At two different times during the observation period the stamp sand foliage appeared to take on a hue different from that of the greenhouse sand and capped material. At first it took on a purple hue thought to be do to the copper minerals in the soil. Later the foliage began to turn a yellowish color. This could be an indication of plant stress caused by the heavy metals in the stamp sand soil.

Root mass was strikingly different between treatments (Figure 4). Plants grown in the greenhouse sand developed far more root mass than plant from either of the other treatments. Plants grown in the stamp sand produced the least amount of root material. Root material on the plants in the capped soil appeared to be more compressed near the soil surface than the roots found in either of the sands.

Figure 4. Root development in the 3 treatments after 89 days.