PLANT GROWTH ON AGGREGATED OIL SANDS PROCESSING RESIDUES

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ABSTRACT

A greenhouse experiment was conducted to evaluate plant performance on the aggregated oil-sand processing residues. Seedlings of three species, "AEC Highlander" slender wheatgrass (*Elymus trachycaulus subsp. trachycaulus*), alpine milkvetch (Astragalus alpinus L.), and saskatoon (*Amelanchier alnifolia, smokey*), were transplanted into aggregates made from: (1) MFT(mature fine tails):CT(composite tails)(1:1 ratio) amended with 5, 10, and 15% peat moss, and (2) MFT:TS(tailings sand)(1:1 ratio) amended with 5, 10, and 15% peat moss. Standard land reclamation coversoil material was used as a control. For each species, the growth rate, total shoot and root dry mass were compared among the aggregate treatments. The growth of slender wheatgrass showed no significant differences among treatments. The growth of Saskatoon seedlings increased with increasing peat moss in the aggregated materials. Alpine milkvetch performed poorly on all the treatments. This was attributed to sensitivity of milkvetch to the high salt contents in the aggregated residual materials. This study indicated that it is possible to create a plant growth medium using oil sands processing residues.

INTRODUCTION

The establishment of self-sustaining ecosystems is a major challenge in the reclamation and restoration of oil sands processing residues. The primary residues consist of coarse tailings sand (TS), mature fine tails (MFT), and composite tails (CT). It is extremely difficult to establish a plant community on these materials without first improving their physical structure (Monenco Consultants Limited, 1983). We had demonstrated that a suitable soil structure could be created by blending these materials through an artificial aggregation process (Li and Fung, 1996). The objective of this study was to evaluate plant growth on these aggregated oil sands processing residues in a controlled environment.

MATERIALS AND METHODS

Two plant treatments, "AEC Highlander" slender wheatgrass *(Elymus trachycaulus subsp. trachycaulus)* plus alpine milkvetch *(Astragalus alpinus L.)* and saskatoon *(Amelanchier alnifolia, smokey*, were used to evaluate plant establishment and growth in six aggregated materials. The materials were MFT(mature fine tails):CT(composite tails)(1:1 ratio) amended with 5, 10, and 15% peat moss and MFT:TS(tailings sand) (1:1 ratio) amended with 5, 10, and 15% peat moss. A standard land reclamation coversoil material was used as a control. Plant seedlings were grown in plastic containers (29 cm diameter × 45 cm height) in a greenhouse. The bottom 20 cm of all containers were filled with CT materials at approximately 1.1 g cm^{-3} bulk density to simulate a subsoil. Twenty (20) cm of aggregated materials or control material, with a bulk density of 1.1 g cm^{-3}, were placed on top of the CT materials. All treatments were replicated three times. One set of containers (21) had two seedlings of "AEC Highlander" slender wheatgrass and one seedling of alpine milkvetch grown together in each container. A second set of containers (21) had two seedlings of saskatoon grown in each container. Initially, 200 ppm N and 80 ppm P were applied to all the treatments. After transplanting, all treatments were watered to "field water holding

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capacity', approximately 28% by volume. During the growth period, water content was maintained at 18 to 20%. The height, leaf and tiller number of plants were measured during the growth period. Plants were harvested at day 130. Biomass, including shoot and root mass, was measured. Roots in the top layer of the aggregated materials and the bottom layer of CT were measured separately.

RESULTS AND DISCUSSION

For "AEC Highlander" slender wheatgrass, the total root dry mass showed no significant differences among treatments. More than 40% of total root dry mass was grown in CT materials for all the treatments. This would enhance the development of CT materials and contribute to the development of a sustainable plant community. The height of slender wheatgrass also showed no difference among treatments. The total shoot dry mass of slender wheatgrass grown in the MFT:TS with 5% peat moss was significantly lower than that in the control and MFT:CT materials. The lower shoot dry mass was due to the lower tiller number. The higher peat moss (15%) in the MFT:TS treatment did not improve shoot dry mass. This could have been due to higher microbial activity which competed for nutrients in this treatment. Alpine milkvetch also performed poorly in all the treatments as compared to the control. This can be attributed to the sensitivity of milkvetch to high salt contents in the aggregated residual materials. There was significant growth reduction in saskatoon seedlings in the aggregated materials as compared to the control. An increase in peat moss improved both shoot and root growth of saskatoons. Although saskatoons did not perform as well as slender whatgrass, they showed significant improvement as they grew older.

In conclusion, this study indicated that it is possible to create a plant growth medium using oil sands processing residues. However, research should focus on the selection of salt-tolerant plant species as well as the ways of reducing salt levels in the soil profile.

REFERENCE

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