FINAL PROGRESS REPORT

PEAT-BASED COMPOSTS FOR COMMERCIAL FOREST SEEDLING PRODUCTION

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Peat-Based Composts for Commercial Forest Seedling Production

Final Progress and Financial Report for Minnesota Technology, Inc.

Coordinator: Kurt Johnson

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Objective: The goal of this continued research is to further integrate and expand the use of peat-based composts into tree seedling production in order to propagate superior planting stock for forestry applications.

Background: This research is the final segment of the Minnesota Technology, Inc. (MTI) funded project "Peat-Based Composts for Commercial Forest Seedling Production" conducted in fiscal years 1992-1994. Results of previous research show that peat-based compost exhibits beneficial properties when used as a component of container growing media and nursery bed soils in the production of coniferous and hybrid aspen tree seedlings. The peat-based compost amendment (PBCA) used in these studies consists of a mixture of horticultural grade Sphagnum moss peat, turkey litter manure, and liquid hog manure, which has undergone biological decomposition (composting) of the organic constituents (primarily the manures) under controlled aerobic conditions. This amendment will be referred to as PBCA throughout this report.

The forest seedling industry currently uses Sphagnum moss peat-vermiculite mixes as growing media for tree seedling production. The beneficial properties of this mix include a high water holding capacity, high cation exchange capacity, uniform consistency, optimum pH range, and sufficient air space for gas exchange. PBCA also possess these properties, in part because they contain Sphagnum moss peat. Further, PBCA is beneficial because it is biologically active and contains slow release organically bound nutrients. Some composts have also been shown to be effective for suppressing certain plant diseases.

The research conducted during the past two years indicates that PBCA enhanced container substrates had similar physical characteristics and greater nutrient concentrations compared to a traditional forest seedling substrate. The seedlings grown in PBCA enhanced substrates had the same or better germination percentages and root-to-shoot ratios as compared to the traditional substrate with and without supplemental mineral fertilizer.

Addition of PBCA to standard container growing media at rates of 20 to 40 percent by volume resulted in an increase in seedling height of 6 percent for red pine, 10 percent for white pine, and 14 percent for white spruce, when compared to a control. Containerized hybrid aspen seedlings grown in the PBCA enhanced substrate also exhibited increased height and diameter measurements, when compared to a control.

PBCA applications to nursery beds resulted in considerable increases in hybrid aspen seedling diameter compared to the control. PBCA application rates of 5 and 10 dry tons per acre resulted in diameter increases, compared to the control, of 43 percent and 52 percent respectively.

The project is a cooperative endeavor involving the Natural Resources Research Institute (NRRI), Peat and Environmental Technologies Program; Itasca Greenhouse, Inc.; Blandin Paper Company; Fafard/Minnesota Sphagnum Inc.; and Heartland Compost Products, Inc. Funding was provided by Minnesota Technology, Inc. (MTI) and by in-kind contributions from the above cooperators.

Summary of Results: Hybrid aspen seedlings grown at Blandin Nursery in styroblock containers and nursery beds amended with PBCA during the 1993 growing season were outplanted to a prepared forest site in May 1994. Container seedlings grown in substrate amended with Osmocote™ mineral fertilizer, 0, 10, 20, and 40 percent PBCA by volume, and nursery seedlings grown in soils amended with 0, 5, and 10 dry tons PBCA per acre, were planted in a randomized block design. An additional treatment was the addition of 300 ml of PBCA (approximately 50 grams dry weight) to the planting hole at the time of planting for selected seedlings. Seedling diameter was measured at the time of planting in May and again in October. The diameter measurements were converted to basal area in order to adjust for initial seedling size. The increase in seedling basal area for each treatment during the growing season was analyzed using the SAS General Linear Models procedure. Seedling survival was also recorded and analyzed.

Data for the outplanted hybrid aspen container seedlings is presented graphically in Figure 1. Statistical analysis of the data reveals a significant main effect of PBCA as a component of the container media, although it is only beneficial at the 40 percent by volume application. These seedlings grown in 40 percent PBCA were statistically the same as those container seedlings grown in Osmocote™.

It is evident from Figure 1 that PBCA added to the planting hole at the time of outplanting had a very beneficial effect on the growth of outplanted container seedlings. Statistical analysis reveals a significant beneficial main effect of PBCA added to the planting hole at the time of outplanting for all container seedlings. Seedlings with PBCA added at the time of outplanting had an increase in basal area of 66 percent for seedlings grown in container media without PBCA, 289 percent for seedlings grown in 10 percent PBCA, 213 percent for seedlings grown in 20 percent PBCA, 247 percent for seedlings grown in 40 percent PBCA, and 167 percent for seedlings grown using Osmocote™, compared to those seedlings without PBCA added at the time of outplanting. The PBCA used had an average nutrient analysis of 2.39 percent elemental nitrogen (N), 3.04 percent available phosphate (P_2O_5), and 1.29 percent soluble potash (K_2O). This application supplied an average of 1.20 grams N, 1.52 grams P_2O_5, and 0.65 grams K_2O per seedling. This rate is reasonably consistent with commercially available forest seedling starter tablets.

The analysis also showed a slight interaction between the effects of percent PBCA in the container media and PBCA application at the time of outplanting. Trees grown in container media at higher PBCA applications appear to respond better to PBCA applied at the time of outplanting than seedlings grown in container media with no PBCA. There was no significant effect of any treatment on container seedling survival.

Data for the outplanted nursery seedlings is graphically presented in Figure 2. Nursery seedlings did not increase in basal area as much as the container seedlings. This reduced stem growth could be a consequence of increased root growth in this first year of outplanting. Although there appears to be some effect of PBCA application (Figure 2), statistical analysis indicates no significant effect of any treatment on seedling basal area increase. There was no significant effect of any treatment on nursery seedling survival. Nursery and container seedlings may require several years of observation to determine the effects of PBCA application.

In conclusion, increases in basal area for outplanted hybrid aspen container seedlings were significantly greater due to the effects of PBCA in the container media and PBCA added at the time of planting. There was no significant effect of PBCA application on the growth of outplanted hybrid aspen nursery seedlings for any treatment. There was no significant effect of PBCA application on outplanted hybrid aspen container or nursery seedling survival. Several years of observation may be required to determine the full effects of PBCA application on the growth of hybrid aspen seedlings. The potential benefits of PBCA application for hybrid aspen seedling growth demonstrated in this project warrant future monitoring of these outplantings.

The cooperators recognize the potential for a PBCA product. Unfortunately, production of such a product has only been done at the pilot scale, although Heartland Compost Products, Inc. may produce a PBCA product in the foreseeable future.

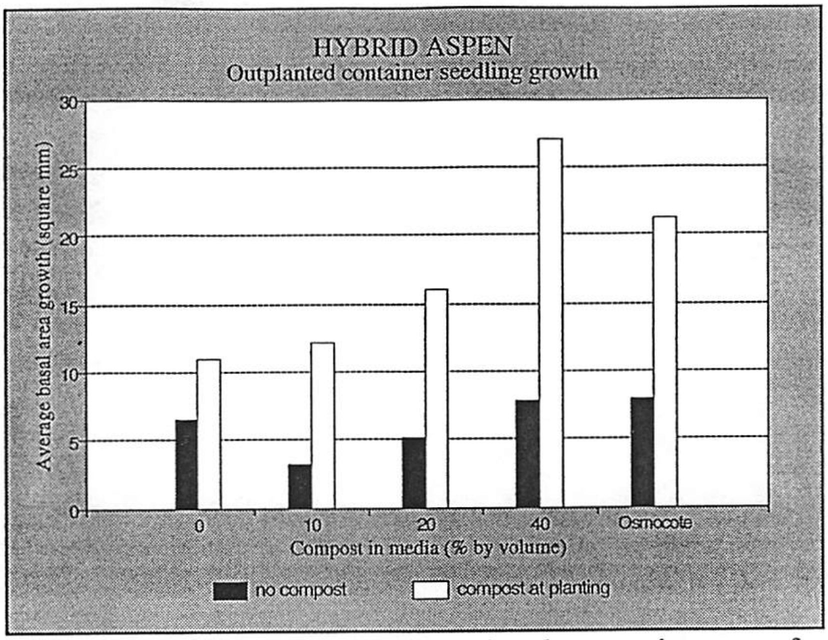

Figure 1.--Average hybrid aspen basal area increase for outplanted container seedlings grown in PBCA enhanced media, with and without PBCA applied at the time of outplanting (1994 growing season).

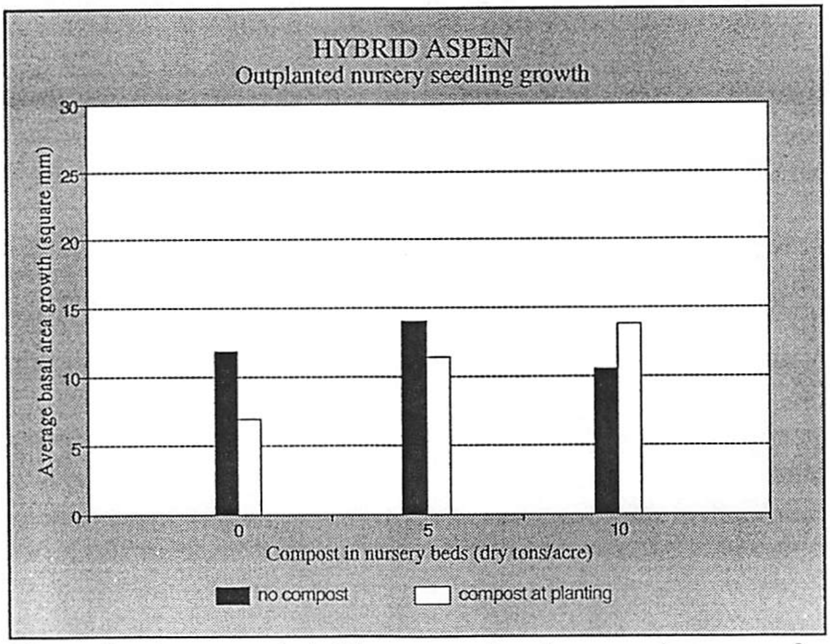

Figure 2.--Average hybrid aspen basal area increase for outplanted nursery seedlings grown in PBCA enhanced soils, with and without PBCA applied at the time of outplanting (1994 growing season).