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**SEMI-ANNUAL PROGRESS REPORT**

**CHARACTERIZATION OF  
SPHAGNUM TOP MOSS:  
ECOLOGY AND MARKET**

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## Characterization of Sphagnum Top Moss: Ecology and Market

### Semi-Annual Progress and Financial Report for Minnesota Technology, Inc.

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**Reporting Period:** July 1, 1993 - June 30, 1994

**Objective:** The overall goal of this project is to evaluate the feasibility of commercializing *Sphagnum* top moss production in Minnesota.

**Background:** A long-term goal of the Peat and Environmental Technologies Program at the Natural Resources Research Institute (NRRI) is to establish a competitive top moss industry in Minnesota, in an environmentally sound manner. A related goal is the utilization of suitable top moss species for the restoration of peatlands. In Wisconsin, *Sphagnum* top moss is harvested for use in hanging baskets, wreaths, as a medium for seed germination, and for use as a packing material. Top moss is also reported to be used as a bedding material and as a component in several hygiene products including diapers, feminine napkins, and band-aids. Research conducted at NRRI during the past several years indicates that *Sphagnum* top moss also has potential to be used as an effective oil sorbent in the oil spill clean-up market. This project will specifically characterize the habitat of top moss including plant community associations, water table conditions, water chemistry, and peat substrate properties of two *Sphagnum* top moss peatlands. A characterization of ecological conditions is necessary to determine the technical feasibility for identifying potential top moss production sites in Minnesota. A marketing study is also included in this project to determine the strength of the top moss market and financial feasibility for developing a top moss industry in Minnesota.

The project is a cooperative endeavor involving the Natural Resources Research Institute BioProducts Division, and NorthWoods Organics. Funding is provided by Minnesota Technology, Inc. (MTI) and by in-kind contributions from the above cooperator.

**Summary of Progress:** In August 1993, two active *Sphagnum* top moss harvesting sites were visited and characterized near City Point, Wisconsin. The top moss industry in Wisconsin has a long history dating back to the late 1800s. These sites were designated as the Jaromin site, located two kilometers south of City Point, and the Spaulding site, located five kilometers west of City Point. Both sites are poor fens used for the production of top moss, with the Jaromin site two years into the regeneration cycle, and the Spaulding site seven years into the regeneration cycle. The Spaulding site was being harvested at the time of our visit.

The characterization of each site included physical and chemical properties of the underlying peat, peat depth, water chemistry, and vegetation surveys. Peat analyses were completed at NRRI. Water chemistry and vegetation surveys were conducted by Dr. Jan Janssens of the University of Minnesota, Department of Ecology and Behavioral Biology.

Preliminary probing and examination of peat cores at each site indicated there were peat differences from surface to the underlying mineral soil, which is typical. There was very little difference between peat cores at the same depth. A sampling plan was devised in which samples were collected at exactly the same depth intervals so that the results of the analyses could be compared and contrasted at each site. At each site, three peat cores were taken at a distance of ten meters apart. A total of 60 samples were collected from the Jaromin and Spaulding sites.

The samples were analyzed at NRRI. Tables 1 and 2 present the results of the physical and chemical characterization analyses. In general, the peat properties and depth at the two sites are quite similar. Moisture contents at both sites are nearly the same and are very similar to highly decomposed *Sphagnum* moss peats or moderately decomposed reed-sedge peats. Surface ash contents are relatively high on both sites, perhaps a result of the cultural practice of burning, or oxidation of peat following a period of drainage. Ash contents with depth are very similar to acidic reed-sedge peats found in Northeastern Minnesota. The pH of the peat at both sites is very acidic. They compare with the most acidic pH found in reed-sedge peats in Minnesota, and they are in the middle range of *Sphagnum* moss peats. The fiber contents are again very similar between sites. Fiber contents are comparable to the most fibrous reed-sedge peats and to moderately decomposed *Sphagnum* moss peats in Minnesota. The high ash content, and low moisture and fiber contents for the samples collected at greater depth indicate the peat/mineral soil interface. Based on the peat analyses, these sites appear to be transitional between fen and bog. That is, at the stage where *Sphagnum* species proliferate and rapidly replace fen vegetation.

Table 1.--Average characteristics of underlying peat - Spaulding site, City Point, Wisconsin.<sup>1</sup>

Depth (cm)	Moisture Content (%)	Ash (%)	pH (in water)	Unrubbed Fiber (%)
0-17	83.7 ± 0.3	18.4 ± 2.8	3.9 ± 0.2	36.0 ± 4.0
17-35	85.2 ± 0.5	9.5 ± 0.5	3.8 ± 0.1	36.7 ± 5.0
35-50	85.6 ± 0.4	9.1 ± 1.1	3.7 ± 0.4	41.3 ± 6.1
50-75	88.0 ± 0.7	7.6 ± 0.3	4.1 ± 0.3	37.3 ± 2.3
75-100	88.8 ± 0.3	5.8 ± 0.5	4.0 ± 0.2	45.3 ± 6.1
100-115.5	87.7 ± 2.3	20.3 ± 19.0	4.1 ± 0.2	38.0 ± 2.0
115.5-134	86.2 ± 2.3	12.6 ± 3.6	4.2 ± 0.1	32.0 ± 4.0
134-142.5	79.3 ± 6.6	28.6 ± 4.7	4.2 ± 0.2	12.7 ± 3.1
142.5-150	60.2 ± 2.2	73.5 ± 2.9	4.2 ± 0.2	6.7 ± 3.1
150-155	34.7 ± 20.0	93.4 ± 7.7	4.4 ± 0.3	9.0 ± 4.2

<sup>1</sup>Table contains arithmetic mean values ± standard deviation. Sample size n=3, one sample per peat core.

Table 2.--Average characteristics of underlying peat - Jaromin site, City Point, Wisconsin.<sup>1</sup>

Depth (cm)	Moisture Content (%)	Ash (%)	pH (in water)	Unrubbed Fiber (%)
0-16	88.9 ± 0.6	14.1 ± 0.9	4.2 ± 0.2	32.0 ± 4.0
16-31	87.3 ± 0.9	12.0 ± 1.8	4.3 ± 0.2	41.3 ± 16.2
31-50	74.8 ± 17.9	10.1 ± 0.7	4.1 ± 0.6	30.0 ± 2.0
50-66.5	87.1 ± 0.6	9.2 ± 1.3	4.3 ± 0.4	35.3 ± 3.1
66.5-82	87.5 ± 0.2	8.8 ± 0.6	4.1 ± 0.2	36.0 ± 8.0
82-96	88.1 ± 0.2	11.8 ± 2.1	4.0 ± 0.2	44.7 ± 15.0
96-116	78.2 ± 1.1	33.3 ± 3.2	4.3 ± 0.1	12.7 ± 5.0
116-124.5	65.1 ± 8.7	58.7 ± 10.7	4.4 ± 0.1	13.3 ± 4.6
124.5-130	n/a <sup>2</sup>	n/a	n/a	n/a
130-135	18.5 ± 5.7	98.7 ± 0.8	n/a	n/a

<sup>1</sup>Table contains arithmetic mean values ± standard deviation. Sample size n=3, one sample per peat core.

<sup>2</sup>Not available.

Table 3 presents the average values for pH and color of the surface water. There is no significant difference between the Jaromin and Spaulding sites for pH and color. Surface water pH is lower than the pH of the peat, largely due to the influence of recent growth of *Sphagnum*. Both sites are very oligotrophic (nutrient poor) and the moderately high absorbance values suggest quite a long residence time for the water. The peats appear to be moderately decomposed and there is no evidence of significant upwelling (e.g. no pools with more minerotrophic (nutrient rich) vegetation or any patterning).

Table 3.--Average water chemistry - Spaulding and Jaromin sites, City Point, Wisconsin.<sup>1</sup>

Site	pH (in water)	Color (absorbance)
Spaulding	3.6 ± 0.1	0.580 ± 0.113
Jaromin	3.8 ± 0.1	0.433 ± 0.074

<sup>1</sup>Table contains arithmetic mean values ± standard deviation. Sample size n=7.

The following three paragraphs summarize the vegetation surveys at the two sites.

The Jaromin site has a higher bryophyte (moss) species diversity than the Spaulding site, notwithstanding the far shorter time period within the regeneration cycle. *Sphagnum papillosum* is the dominant bryophyte in all plots. Possible explanations for the difference in species diversity:

1. the Jaromin site has been in production for a shorter length of time than the Spaulding site and is less "clean",
2. different cultural practices exist (e.g. burning, harvesting time) between the sites, or
3. competition of *Sphagnum papillosum* eventually eliminates other bryophytes, farther along in the regeneration cycle.

The vascular plant diversity is similar between the two sites. Leatherleaf (*Chamaedaphne calyculata*) is unique and common at the Jaromin site, while bog birch (*Betula glandulifera*) is a unique and abundant part of the Spaulding site.

The main condition for successful growth of top moss appears to be highly diluted, oligotrophic stagnant waters, a high and constant water table, and the elimination of shrubby vegetation and graminoid (grass) litter by the harvest techniques (burning and raking), and the establishment and persistence of a strong sedge rhizome mat and sparse sedge cover. The longest *Sphagnum papillosum* plants preserved at the Spaulding site showed four annual growth increments, so it might be possible to reduce the regeneration time to 4-5 years, rather than the customary 7 year rotation.

Several Minnesota peatlands, having characteristics similar to the Wisconsin *Sphagnum* top moss harvesting sites, were visited as part of this project. Two Minnesota sites were selected for future research, one located near Willow River, and another near Toivola. Both sites are poor fens and contain the predominant Wisconsin top moss species, *Sphagnum papillosum*. Preliminary characterization of these has been done. Further characterization of the sites will be done in the summer of 1994, in the same manner as the Wisconsin sites; including physical and chemical properties of the underlying peat, peat depth, water chemistry, and vegetation surveys. Also, research will be conducted on harvesting, seeding, and revegetation of the Minnesota sites to determine the technical feasibility of developing a top moss industry. Other potential research areas identified as a result of this project include:

1. Determination of overall moss accretion rates in the upper portions of the top moss harvesting sites using stratigraphic studies and pollen event dating. This would make it possible to answer concerns about the long-term sustainability of the sites for the production of top moss.
2. Above and below ground proportioning of the sedge (*Carex oligosperma*) biomass, a species which makes the top moss management practices possible and will stay critically important, even after full mechanization of the harvesting technique. The species is also important as support for the growth of regenerating *Sphagnum* clones.
3. Hydrological measurements, using piezometers (wells) to check upwelling and document chemistry gradients and residence time.

A marketing study was also included in this project to determine the strength of the top moss market and financial feasibility for developing a top moss industry in Minnesota. This portion of the project met with limited success. The top moss industry is characterized by tightly held family businesses. Gathering information, beyond that of the cooperator, has proven to be very difficult. Even with the lack of sound economic data, the viability of the top moss industry is still considered strong and should be pursued in Minnesota.

This project is being continued through the 1994-95 fiscal year.