

GENERAL INFORMATION

PEAT BOGS

Formation and Origin

The formation of peat is dependent upon a special combination of climatic and topographical conditions. The principal factors are:

- (1) an adequate supply of rainfall and surface water,
- (2) growth of aquatic and moisture-loving plants,
- (3) a soil or subsoil that will retain water at the surface,
- (4) a sufficiently humid atmosphere to prevent too rapid evaporation,
- (5) a temperature high enough to allow a profuse growth of vegetation, yet low enough to check a too rapid decay of vegetable matter.

These conditions are all found in the area of Guysborough County where the survey was carried out. There are numerous lakes that are shallow because of growing vegetation. For the most part, the bogs, as is all this area, are underlain by rock which prevents the escape of surface water. The humidity is high for most of the summer, and fog, which keeps the temperature cool, is very prevalent.

Composition

Peat in its natural state consists of approximately 90% water and 10% partly decomposed and disintegrated vegetable matter. Although many varieties of plants are found in peat bogs, the bulk of the material has been supplied by comparatively few varieties. Chief among the peat-forming plants are the sphagnum and hypnum mosses, marsh and heath plants, grasses, sedges, water plants and algae. Sometimes the roots, trunks, and leaves of trees are also found.

The plant varieties forming the successive layers of a peat bog reflect the climatic conditions and topographic features of a bog. Changing conditions during the life of the bog cause changes in the growth and composition of the plant communities, and as a result, successive layers in a peat bog may be composed of the remains of different plant communities and, therefore, possess different characteristics.

A vertical section of a peat bog might show, from top to bottom, the following strata:

- (1) a bed six to 12 inches thick of living sphagnum mosses, overlying six to 10 feet of unhumified dead moss, which is known as peat moss,
- (2) a bed of well humified woody peat, containing partly decomposed stumps and roots,
- (3) beds of reed and sedge peat, formed by the humification of reed or sedge plants, and
- (4) finally, a layer of dark, jelly-like ooze, sometimes called sedimentary peat, resting on a clay or silty bottom.

There is, of course, considerable variety in the composition of different peat bogs, depending on the climatic or other condition under which they were formed, and not all bogs contain all the varieties of peat described above.

The bogs studied in this survey could generally be classed as sphagnum peat bogs with some reeds and sedges, roots and wood distributed evenly throughout.

Classification of Peats Surveyed

Peat occurs in nature in two different forms, humified peat and unhumified or fibrous peat. The humified peat is fairly homogeneous, colloidal, plastic and somewhat elastic. Unhumified peat is simply fibrous peat or peat moss.

In the areas covered during this survey, both types of moss were encountered. In the Goose Harbour Lake Area the only bog examined was found to be very highly humified at the surface. In all of the other bogs sampled, areas of humified peat were found. This will be covered in more detail later with the bog descriptions.

Generally, it can be said that the large majority of the moss found and sampled in the project area was of the unhumified type.

Properties

Sphagnum peat moss (sometimes called "white moss" or "genuine peat moss") seldom occurs in deposits in a pure state. Generally, it is intermixed with a variety of marsh plants, such as Cotton Grass, Bog Rosemary, Labrador Tea, Cranberry, Blueberry and an occasional Pitcher Plant.

The most important property of commercial sphagnum peat moss is its high water-absorbing capacity. This is due to the porosity and

capillarity of the plants from which it was formed and the peculiar anatomical structure of the sphagnum plant, designed by nature for the storage of water.

Some twenty varieties of the sphagnum plant have been recognized. Their moisture-absorbing capacities vary from about 18 to 27 times the weight of the plant, as follows:

Sphagnum molluscum	- 26.8 times its own weight
Sphagnum papillosum	- 25.3 times its own weight
Sphagnum cymbifolium	- 23.1 times its own weight
Sphagnum cuspedatum	- 20.3 times its own weight
Sphagnum acutifolium	- 18.6 times its own weight.

In some cases the analytical results of the samples taken during the summer of 1964 showed the moisture-absorbing capacity to be higher than those shown in the above table. This is an indication of the high quality of peat moss present in the bogs that were sampled.

USES OF PEAT

Peat moss owes its usefulness to its high absorptive capacity for liquids and gases, resistance to decomposition, low conductivity of heat, elasticity and to its deodorizing quality. It is used primarily in agriculture and industry.

Agriculture

In agriculture, peat moss is used for stable bedding, poultry litter, horticulture and market gardens. Peat moss has the requirements of a good stable litter and surpasses in quality all other materials used for that purpose since it provides for the animals a warm, clean, dry and elastic bedding, absorbs and retains excrement, and increases the fertilization value of the manure by retaining the more valuable parts thereof.

Peat moss poultry litter has been acclaimed as being of prime importance to the health and comfort of the flock. When used as bedding in the pens, the intervals between cleanings may be appreciably increased, and it absorbs the droppings of the birds to form a valuable manure, rich in nitrogen. Peat moss litter makes a warm flooring and nesting and when scattered in the chicken run provides an ideal scratching material.

Peat moss is not a fertilizer, but it is important as a soil conditioner, as a filter in commercial fertilizers, which, if used alone, would "burn" the plant growth, and as a base for composting manure. In gardens, peat moss is used extensively as a soil conditioner

and, being free from weed seeds, serves as an excellent soil dressing. As a mulch, it virtually prevents growth of weeds, and effects greater retention of soil moisture. This mulch will protect young plants from winter-killing. The use of peat moss tends to produce healthier and more advanced plants. It is also used for packing vegetables and plants for shipping or storage.

Industry

In industry peat moss is used mainly as a fertilizer base when combined with waste from fisheries and packing houses. It is also used as an insulating material in buildings and as a packing material for perishable products.

AGRICULTURAL USE OF PEAT BOGS¹

The value of an organic soil for agricultural purposes depends more upon its nearness to a market and the climate of the area than upon the quality of the deposit. Intensive agricultural use of an acid dome bog is determined chiefly by its location, how easily it can be cleared and drained and whether the area lends itself well to mechanized truck farming.

Drainage

There are two systems of drainage available: (1) open, and (2) underground (tile drainage).

The main purposes of drainage are: (1) to lower the water table so that machinery can operate on the land, (2) to make sufficient oxygen available for plant growth, and (3) to aerate the soil so that the microflora will decompose the raw organic deposit. It is a serious error to overdrain a bog because peat material, if dried, is extremely difficult to wet again artificially, furthermore, overdrainage may cause an undesirable increase in the rate of settling due to increased oxidation.

Open Ditches

Open ditches are most economical on newly claimed acid dome peat bogs. Due to the amount of shrinkage and compaction over the first few years, tile drainage would be very uneconomical. Open ditches 36 to 48 inches deep, spaced 150 to 200 feet apart, have been found satisfactory

1 The author wishes to note that the theory and figures in the following information were taken from correspondence and literature obtained from Newfoundland, Ontario, Quebec and Nova Scotia.

on deep bogs formed by deposits of Carex and Sphagnum. These open ditches should be cleaned out every few years. This is due to the fact that colloidal muck which is present in many deposits is forced into the ditches by weight of the soil and water. This is one of the main reasons why it is better to have the ditches wider at the top than the bottom.

Many types of machines and hand labour have been used for digging open ditches with varying degrees of success. It is common practice and economical to use drag lines to dig the main ditches, and back diggers for ditches. Plows and mechanical wheel diggers have also been used with some success (Jasmin, 1960).

Tile Drains

Tile drainage of organic soils is generally not considered practical even when the loss of land due to open ditches is considered. During the first few years, tile laid at a depth of three and one-half feet in organic soils may settle as much as nine inches. If this condition occurs, it may become necessary to relay the tile system. This procedure is much more costly than maintaining properly constructed open ditches.

Clearing and Plowing

The preliminary clearing of a bog depends on the amount of large trees and bush present on the bog. These must be removed before a speed roto cutter can be brought in to pulverize the material on the bog surface. Sometimes controlled burning is used as a preliminary measure to remove surface material; however, this method is very hazardous.

After the top vegetation is roto cut, limestone should be applied at a rate of about two to four tons per acre. The amount to apply will depend on the acidity of the bogs, the base exchange capacities of the soils, and the amounts of calcium present. A standard breaking plow, capable of making a furrow 14 to 16 inches deep by 20 to 24 inches wide, is generally used to break these soils. Flat plowing, which turns under both the top vegetation and the surface application of lime, is preferable.

After plowing, the land should be worked thoroughly in both directions with a double disk and levelled in the same operation with planks or other levelling devices pulled behind the disks. The fibrous organic material of an acid dome bog needs thorough disking before a seed bed can be prepared. After this disking a second application of lime should be added, the amount depending on the pH of the soil and the crop to be grown. This application should be worked thoroughly into the top 10 inches of the soil with a roto tiller or heavy disk harrow (Jasmin, 1960).

Lime Applications

Experimental work conducted at the Organic Soils Substation at Ste-Clothilde, Quebec, indicated that lack of lime is a primary limiting factor for plant growth on dome bogs.

The figures given for rate of application of lime on Quebec, Nova Scotia and Newfoundland differ greatly. All agree, however, that the final application should be applied to the surface and worked in well so that it penetrates at least 10 to 12 inches. The amount of lime used, again, will be determined by the pH of the bog and the crop to be grown.

Agricultural limestone is the material most commonly used to correct soil acidity; however, hydrated lime can be applied if so desired. Approximately two-thirds as much hydrated lime is required in relation to ground limestone; however, the heavy applications needed for these very acid soils and the considerably higher cost of hydrated lime ordinarily make its use impractical.

Effects on Crop Nutrients

Lime applied to acid dome bogs affects the acidity of the soils and influences both uptake and availability to crops of major and minor nutrients. Complex effects occur in the soil after a heavy application of lime has been made in an effort to correct soil acidity.

Applications of limestone decrease the availability of potassium in the soil and the uptake of potassium by plants. Magnesium is not lessened to any extent, probably because of the magnesium contained in the limestone. The calcium content of crop plants is increased considerably with increased lime applications.

Liming decreases the availability to crop plants of most minor nutrient elements because of the higher soil pH values. Initial studies on acid dome bogs indicate that copper and borax are the two most important limiting minor elements. However, there is some indication that, after crops have been produced for a few years, zinc, sulphur, manganese and possibly other elements may also become limiting factors in production. Consideration of such effects of liming must be given in a recommended fertilizer program for any particular crop on an acid dome bog.

Fertilization

Agricultural use of acid dome peat bogs is relatively new. Since these deposits are generally higher than surrounding mineral land, large amounts of minerals are unlikely to move from the surrounding soil to the bog. For this reason, the amounts of calcium, potassium, magnesium and minor elements in these bogs are lower than in marsh deposits, thus they become more acid, for leached minerals move into marshes with the influx of salt water.

Early in the development of a bog, each grower can become familiar with his own problems by careful observation. With each additional year of production and for each new area brought into production, growers will have a better understanding of the general fertilizer problems and soil requirements. For this reason the soils of the different fields should be analyzed frequently and records kept of the plant growth resulting from each fertilizer program. This will help a grower to maintain proper levels of soil fertility and to interpret the requirements of similar soils.

MARKETS

Canadian Market

The domestic market rose from a modest market of 9,000 tons in 1950 to 36,000 tons in 1961, but declined somewhat in 1962 to 27,000 tons. Consumption by each province is not known, but Ontario is believed to be the largest single market for peat moss in Canada. To a certain degree, this market is supplied by producers in Quebec and the Maritimes. While the domestic market is expanding, it should be borne in mind that a number of large producers have been supplying the market with high quality products for years. Thus any substantial potential producer is well advised to examine the opportunities in the export market.

Export Market

The principal strength behind the growth in Canadian peat moss production stems from export demand. In 1962, for example, nearly 90% of Canadian production was exported. While from time to time, Canada ships very small quantities to Bermuda, the Bahamas, Alaska, Hawaii, etc., the continental United States is our principal export market.

Horticultural peat moss (fertilizer grade) enters the United States free of duty. Poultry grade peat moss bears a duty of twenty-five cents per long ton (2,240 lbs.). In 1962, the United States accounted for all our exports of peat moss apart from \$600.00 worth shipped to Hong Kong. In response to the United States demand, Canadian exports rose by 210% between 1950 and 1962, from 66,000 tons to 205,000 tons. During the same period, value of our peat moss shipments to the United States rose from \$3.0 million to \$11 million, a gain of over 250%.

However, it should be noted that the exports to the United States of sphagnum type peat moss are of relatively high value in quality. Domestic production of this latter superior material falls far behind demand. Canadian peat moss competition in the United States has, in the past, come primarily from European rather than United States producers. It should also be noted that considerable latitude is

allowed the United States in labelling their products. A great deal of the American production in the senior category, peat moss, falls far below most imported peat moss in quality.

For the year 1961, the following Customs Districts (with tonnage noted) were the largest importers of Canadian peat moss:

Buffalo	26,646 tons
Dakota	17,842 tons
Maine and New Hampshire	3,320 tons
Michigan	23,950 tons
St. Lawrence	16,769 tons
Vermont	34,212 tons
Washington	65,584 tons.

In 1962, of the total United States imports of 268,000 tons, Canada supplied some 80%; West Germany, formerly the principal foreign supplier, contributed 13%, with the remainder coming from a number of countries primarily in Europe.

Canadian Production, Exports and Consumption of Peat Moss

1950 - 1962

(Short Tons in Thousands)

<u>Year</u>	<u>Production</u>	<u>Exports</u>	<u>Apparent Domestic Consumption</u>
1950	75	66	9
1951	77	72	3
1952	75	68	7
1953	82	73	9
1954	99	87	12
1955	118	103	15
1956	128	113	15
1957	138	118	20
1958	149	129	20
1959	184	161	23
1960	185	157	28
1961	224	188	36
1962	232	205	27

Production by Provinces - 1961

<u>Province</u>	<u>Plants</u>	<u>Employees</u>	<u>Production</u>	<u>*F.O.B. Plant Selling Price</u>
N. S. and N. B.	4	311	37,642	\$1,856,352.00
Quebec	24	466	75,741	2,614,175.00
Ontario & Manitoba	2	132	33,483	1,349,767.00
British Columbia	12	423	77,165	3,731,537.00
Canada	42	1,332	224,031	9,551,831.00

* Includes container value.

Peat Moss Imports to the U. S. - 1964 Calendar Year*

(Weight in Long Tons)

<u>Country</u>	<u>Weight</u>	<u>Value</u>
Canada	3,361	\$208,080
Mexico	22	4,345
Netherlands	40	775
Belgium	1	135
West Germany	867	38,706
Japan	5	2,575
Total	4,316	\$254,616

* U. S. Department of Commerce

The above tables show the growth of the peat moss industry in Canada over the twelve year period from 1950 to 1962 and the breakdown of the present production across Canada. Also shown is the tonnage and value of peat moss imported into the United States for 1964.

METHODS OF ANALYSIS

The type of analysis carried out on the samples taken during this survey was strictly a physical analysis. There was no chemical analysis. Of the six tests carried out on the samples, four were actual tests and two were calculated. The analyses involved moisture as received, water-holding capacity of 0% and 25% moisture, loss on ignition, ash and pH (acidity).

The moisture as received test involved the placing of a known weight of moss, as it came from the sample bag, in an oven at 105° C, and leaving it there for a period of twelve hours or more. The difference in weight expressed as percent (%) resulted in the figure for moisture as received.

To determine the water-holding capacity at 0% moisture, a known portion of sample was allowed to saturate in warm water for 30 minutes. The increase in weight expressed as percent when divided by the dry matter in the sample, gives the water-holding capacity at 0%. The water-holding capacity at 25% is calculated. The pH was determined by using a pH meter on a portion of each sample.

The loss on ignition test involved the weighing of a 1 gm. sample on an analytical balance, placing it in a furnace at 1200° F for one and one-half hours and weighing the ash. The difference in weight is the loss on ignition expressed in percent. The ash is calculated. In order to begin this test the sample must be oven dry. For this test the oven dry sample obtained in the moisture as received analysis is used.