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PEAT DEPOSITS IN TEXAS

by F. B. Plummer

Peat, because of its humus content, its water-absorbing qualities, its acid properties and cleanliness, has been used extensively in Texas by florists, gardeners, and horticulturists to condition alkaline soils, to lighten and enrich heavy colloidal clay loams, to propagate seedlings, and for potted plants. Up to the beginning of the present European war, most of the peat moss used in the Southwest came from Holland, Denmark, and north Germany. The amount of importation during the last few years is as follows:

Year	Tons of Peat	Value
1935	54,547	$ 677,513
1936	75,066	955,807
1937	86,871	1,219,127
1938	69,509	1,092,942
1939	78,611	1,204,882

In 1932 Denmark alone produced 200 million pieces of machine peat and 520 million pieces of cut peat (520 million pieces equals about 260,000 tons), 10,000 tons of peat briquets, and 25,000 bales of peat moss. In 1933 the production in Denmark increased to 290 million pieces of machine peat, 580 million pieces of cut peat, and 30,000 bales of peat moss. In 1938 Holland produced 800,000 metric tons and Russia 26,460,700 metric tons. Compared with these figures, the production of peat in the United States where there are thousands of excellent bogs is small, as shown in the following figures:

Year	Tons of Peat	Value
1935	37,060	$199,377
1936	46,126	266,883
1937	51,223	305,156
1938	45,933	286,127
1939	54,483	362,066
1940	?	

The average wholesale price for peat moss during 1939 was $15.33 per ton. Peat moss during 1938 and 1939 sold in the Houston market for $3.50 per bale of about 65 lbs. Since the freight rates by rail from Minnesota, Wisconsin, or northern New York State are prohibitively high, a strong demand has arisen to develop peat bogs in Texas and to supply the local demand from a home market. Two peat bogs have been located and are now being developed north of Giddings in Lee County, and search for other commercial bogs is being carried on throughout east and south Texas at the present time.

Description of Peat

Peat is a brown or black, spongy, organic substance formed by the accumulation of organic matter of plant origin in poorly-drained marshes and bogs. It consists generally of a tangle of more or less disintegrated moss, ferns, rootlets, leaves, sedges, algae, grasses, and partially decayed wood all pressed together to form a soft, spongy layer underneath the moss, fern, and sedge coverings of a marsh.

Origin

The formation of peat is brought about by conditions which favor abundant growth of marsh plants, particularly mosses, abundant and continuous supply of shallow water which tends to promote growth, preserve the woody substance from complete or destructive decay, and particularly conditions which preclude the deposition of much silt, sand, or calcareous material which will contaminate or displace the plant detritus. In the North where the country has been covered by glacial ice, peat accumulates in the small, undrained depressions left by the retreat of the ice-sheet. In Canada, northern Wisconsin, and Minnesota, many bogs, much rainfall, and poor drainage conditions are most favorable for peat. Peat bogs form especially where a thick forest growth protects the soil from erosion and prevents the bogs from silting up. In the South where there are no depressions of glacial origin and fewer foresets, bogs and marshes are much less common. The peat bogs form in the South, however, where drainage has been restricted by some natural cause and where plant and forest growth is prevalent. Favorable spots are to be found in east and southeast Texas under the following conditions:

(1) Marshes may occur in small, branch stream valleys choked or partially dammed up by loose sand deposited by floods in a main stream. These situations occur mostly in the areas of outcrop of the unconsolidated sand formations; that is, the Simsboro member of the Wilcox, the Queen City formation, and the Sparta sand formation. The loose sand layer must be underlain by an impervious layer of clay or marl so that the water of the bog will not seep out and dry up. The branch containing the bog must be small and forested so that during flood periods, sand will not be washed over the bog. In most places the ground-water table is high, and the small branch is fed by springs and water seeping out of the sand. The presence of a series of springs in a small forest-covered valley is the best place to look for a peat bog.

(2) Undrained stagnant water marshes occur adjoining or in an ancient natural levee. That is, an area near the coast where ancient floods and winds have built up sand deposits along old stream courses above the level of the coastal plain or valley flat, and where subsequent stream changes have diverted the stream to another course so that the area is no longer flooded. The undrained area must be continually wet by springs or by a very high water table.

(3) Bogs may form in undrained pools in old meander scars in ancient valleys which are no longer subject to intense floods.

(4) Bogs may form in sink holes where solution of an underlying bed has caused the earth to settle and form an undrained marsh. Some sinks occur in limestone areas and on the shallow type salt domes. As far as known, no peat deposits have been found in limestone sinks in Texas.

The organic matter buried in the bogs forms a brown mass made up of moss, roots, twigs, leaves, and woody substances. The surface mass is quite porous and spongy, and, where made up largely of sphagnum moss, it is called peat moss. Buried deep, the mass slowly disintegrates, turns black, and through the action of bacteria and in absence of oxygen, becomes a finely divided black mass called peat.

The chemical composition of peat at different depths in a bog is illustrated in the following table:

	% Total C	%Cellulose content	%Protein, lignin, etc.	% Humus	Depth below surface
Sphagnum moss	49.57	54.72	23.7	1.0	0"
Young sphagnum peat	54.21	14.98	54.6	45.9	12"
Sphagnum peat		11.37	56.0	68.2	24"
Old sphagnum peat	58.57	8.50	66.6	88.3	48"

Thus, during the process of peat formation from moss, the cellulose content decreases and the protein, lignin, and humus content increases. The analysis of a typical young peat from a New Jersey bog collected at a depth of 160 cm. is as follows:

pH Value	% Ether soluble fraction	% Water soluble fraction	% Hemi-cellulose	% Protein	% Lignin	% Ash
6.7	0.78	1.14	17.51	19.81	42.10	15.0

The pH value is a measure of the acidity of the peat. Since one chief use of peat moss is to make alkaline soils neutral, or slightly acid, this value is important. A pH value of 7.5 is neutral, neither acid nor alkaline. pH values less than 7.5 are acid, so that peat having a pH of 3.8, 4, or 5 is acid and suitable for acid-loving plants like azaleas. Peat having a pH of 7.5 or 8 is neutral or slightly alkaline, and neutral soils are best for non-acid-loving plants. The brown-colored surface peat is generally more acid than the older, deeper black peat deposits.

Classification of Peat

Peat is described and classified by geologists into four types as follows:

(1) *Low moor peat*, formed in marshes draining into low regions, glacial depressions, etc. Chemically it is high in ash and nitrogen and low in cellulose and in acidity. The predominant vegetation is sedges, reeds, and shrubs. Sphagnum is rare.

(2) *High moor peat*, formed in regions of cold or moderate temperatures and high rainfall. Chemically it is low in ash and nitrogen and high in cellulose and high in acidity. The predominant vegetation is sphagnum, Calluna (heather), Ledum (Labrader tea), Andromeda, and Eriophorum (cotton grass).

(3) *Forest peat*, formed in forested regions. It is chemically halfway between high moor and low moor peat. The vegetation in the peat swamps consists of various water-loving trees: birch, alder, and spruce, and low plants such as Calluna, blueberry, dwarf willow, Andromeda, and sedge.

(4) *Sedimentary or lake peat*, formed under water largely by algae and aquatic plants, animals and insect shells, spores, pollens, particles of clay, and silt. It occurs in many places in the lowest layers of a low moor peat bog. It is variable in chemical composition. It is more or less gelatinous and is called "sapropel" by some geologists.

Each one of these types may be further subdivided and named on a basis of the kind of plant or vegetable matter which predominates in the peat. Thus, there is *sphagnum peat, sedge peat, woody peat, hypnum peat, reed peat, fibrous peat,* etc.

The high moor peat rich in sphagnum, or sphagnum peat, is most commonly the type sold to florists. The low moor peat, woody peat rich in humus and not too acid, is used by gardeners who desire rich, light, neutral soils.

Utilization

Peat in northern Europe is used mainly as a fuel, as a cheap substitute for coal. It is cut into rectangular blocks, dried, pressed, and sold in the form of bricks known in Holland and Belgium as "turf." It is burned in fire places and in sheet-iron stoves. In the United States, particularly in the South, it is used chiefly as a conditioner for soils.

Its value is threefold: (1) its porosity or ability to absorb and hold moisture; (2) its humus content, which is an excellent plant food; (3) its acid characteristics, which serve to condition alkaline soils and to promote growth of acid-loving plants.

Dried sphagnum is used extensively in packing flowers and plant roots for shipment and for preserving flowering plants and shrubs in plant shows. Finely ground sphagnum peat is mixed with about equal parts of sand and used in greenhouses for propagating plants from cuttings. In the greenhouses and gardens its function is fourfold: (1) creates looseness of soil and a more favorable medium for plant growth; (2) absorbs, retains, and retards the removal by evaporation and seepage of water containing valuable plant nutrients which soak into the soil; (3) supplies the plant itself with a continuous stream of the necessary nutrients during its decomposition processes brought about by bacterial agencies; (4) increases the acidity of soil and neutralizes the high lime content so that acid-loving plants like azaleas, hydrangeas, and chrysanthemums can be raised successfully.

In addition to these agricultural uses, the Norwegians have experimented successfully in the utilization of peat as a substitute for wood fibre in the manufacture of linoleum and for use as a basis in plastic masses for electric insulation, as an absorbent in the manufacture of explosives, and in the glass industry.

Development of Peat Deposits in Texas

The utilization of peat from bogs in Texas was not attempted until 1940, when development work was started on two bogs located in the valley of Yegua Creek about halfway between Giddings and Lexington in Lee County. The southern bog is owned by Mr. Ender and the northern bog by Mr. Patschki. The Ender bog is leased to Mr. Joiner and others, and to Mr. Sanquinet, the Patschki bog to Mr. Sanquinet.

Geology of the Peat Deposits

The bogs near Giddings are situated in the Queen City sand formation along the valley flat developed by Yegua Creek. Spring water seeps through the sand and furnishes the water that produces the bogs. Each bog covers an area of about 10 acres, and the marsh is about 10 feet deep. A cross section of the peat as exposed by excavation shows about 12 inches of brown young peat containing many rootlets and very rich in leaf humus at the top. Then there are 2 feet of black spongy peat and a layer 6 to 8 inches thick of brown, spongy peat, then more black, silty and clayey peat. The lower muck is soft and springy, and a rod can easily be run into it a distance of 10 feet. No chemical analysis of this peat is available, but the upper 12 inches is light and fluffy, of good color, and appears to be rich in humus. It is said to have a pH value of about 4.5; hence, it is rather strongly acid and suitable for acid-loving plants.

Methods of Harvesting the Peat

The peat is taken from the bogs wholly by hand labor. The water in the bog is first drained by cross ditches. Then the trees and brush are removed and the roots pulled out by hand. Then the upper brown humus-bearing layers are cut and peeled off by spade and shovel, more roots are removed, and the rich brown peat is dried.

The drying is accomplished by spreading the peat in layers about 3 inches thick on woven wire screens which are tacked on frames and suspended on posts 2 feet above the ground, thus forming wire platforms. After all the excess water has dried out, a process which requires about three days of good weather, and before the cakes of peat have become too hard and lumpy, the cakes are pulverized by grinding. The pulverizing is carried out in a small-type ice chipping machine driven by a ¼-horse power electric motor. The grinding machine has a capacity of about two tons a day. After grinding, the peat is screened through ¼-inch screens, sacked, and shipped by truck to the markets in Houston, San Antonio, and Dallas.

Conditioning and Testing the Peat

The proper preparation of peat for market is important. The Holland and German peat is carefully dried, cleaned, graded, and baled and comes to the consumer as a dry, spongy mass of clean shreds easy to handle and to mix with soil or to use in pots. In the cities much of the flower gradening is done by women who have become accustomed to this dry, clean product. They do not take to a black, powdery, dirty, or hard, lumpy product even if it has excellent plant nutritive qualities. A product to be marketed should be cleaned of roots, sticks, pebbles, etc. It should not be dried to hardness and should be carefully pulverized to a light, spongy, but not powdery, consistency tested and graded according to its uses.

For example, the upper young sphagnum moss is light in weight, low in humus, a good water absorbent, and is best used for shipping rooted plants, bulbs, etc., and for stock bedding and poultry litter. It is also employed as a mixer and absorbent for liquid manure. Older peat is richer in humus and lignin, has less cellulose and more acidity. Its best use may be for acid-loving plants: azaleas, hydrangeas, rhododendrons, etc. The deeper, blacker, less acid peat may serve best in gardens where neutral soils are desired. If the peat does not reach specifications desired, it can be conditioned by addition of certain chemicals. But this must be done only after careful testing and under supervision of one thoroughly acquainted with chemical methods and chemical tests. If the peat has a pH of more than 4.5, addition of a little lime may help. If more alkaline that pH 7, addition of a little sulphur or aluminum sulphate is recommended. Some gardeners recommend the addition of a little copper sulphate to many types of peat. The copper sulphate increases acidity slightly and is said to favor plant growth and to reduce certain harmful fungi.

Acid peats are also used with phosphates in forest nurseries since the acid properties of the peat increase the solubility of the phosphates.

The very finely divide and dark-colored peat, which is nearly neutral, is used for mixing with potting soil for potted plants. Most amateur gardeners do not know how to test soils; therefore, commercial peat should be carefully conditioned for them, graded and labeled properly to indicate its properties and uses.

Tests for Peat

The commonest and most essential test for peat is its acidity. This test is best carried out in the laboratory using a conductivity cell and Wheatstone bridge-testing apparatus. The acidity should run from pH 7, slightly acid, to pH 4.5, strongly acid. Commercial New Jersey peat has an acidity of about pH 6.7. Other tests are fixed carbon content, total ash content, percentage of humus, percentage of hemi-cellulose, percentage of protein, percentage of lignin and lignin-like substances, sulphur and iron content, water-absorbing capacity, and moisture content. All these tests have to be carried out in a chemical laboratory under supervision of an experienced chemist and are expensive and time-consuming. Nevertheless, in order to properly grade and evaluate peat, chemical tests are necessary. At least the acidity, humus content, water absorption, water content, and total ash content of each type of peat to be marketed should be known. The total ash analysis indicates the amount of silt, sand, and mineral matter in the product. If the percentage of ash is high the black deposit may be little better than ordinary garden soil which is made up of clay, silt, and sand.

Factors Bearing on Success of Peat Industry

Peat in Texas will have to compete with peat from other states and later from Europe. Since, however, a big saving freight rates and shipping costs favor the Texas product, the success of the new enterprise will depend upon the quality of the product and upon proper marketing facilities. The quality of almost any product depends upon honest, intelligent management and scientifically controlled tests leading to proper grading, conditioning, and labeling. Both the quality of the product and marketing depend to some degree upon adequate financing. Therefore, one should not attempt to develop a new peat deposit unless he has made exhaustive tests to be sure that the product is of good quality and that it is the right type of peat adapted to Texas garden soils. Finally, he should not attempt operations unless he has sufficient finances to properly handle, test, and condition his peat to keep the quality high. The specifications for good peat as required by the Federal government are as follows:

Reed or sedge muck (peat humus) for gardens. The product must be dark brown to black, granulated, uniform in composition and size, slightly acid to slightly alkaline in reaction (pH 5 to 7.5), free of lumps, low in ash content (8 to 15%), and low in content of woody material and mineral matter such as sulphur and iron. The water-absorbing capacity should be high, ranging from 100 to 350%. The water and moisture content should not exceed 60% by weight.

Reed or sedge peat for azaleas, hydrangeas, and other acid-loving plants. The product should be brown, low in iron and sulphur, and low in content of woody material. The water-absorbing capacity should be high, ranging from 350 to 800%. The water and moisture content should not exceed 50%. The acid reaction should be within close limits, varying from pH 4.5 to pH 5.5.

The United States government recognizes three types of peat as follows: peat humus, reed or sedge peat, and peat moss. In Texas deposits the young, fibrous, grassy beds would be classed as sedge peat, the rich, brown, pure peat as peat humus.

Publications Dealing with Peat and the Peat Industry

A very large number of articles and books have been written on peat. Since, however, peat deposits have been developed so much more extensively in Europe than in America, most of the articles are in Dutch, German, Danish, and Scandinavian. These foreign references are not available to most readers, and all except one or two are omitted in the following list confined to those published in the United States. The references are arranged alphabetically.

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