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115. IRREVERSIBLY DESICCATED PEAT, CLAYEY PEAT AND PEATY CLAY SOILS; THE DETERMINATION OF THE DEGREE OF REVERSIBILITY

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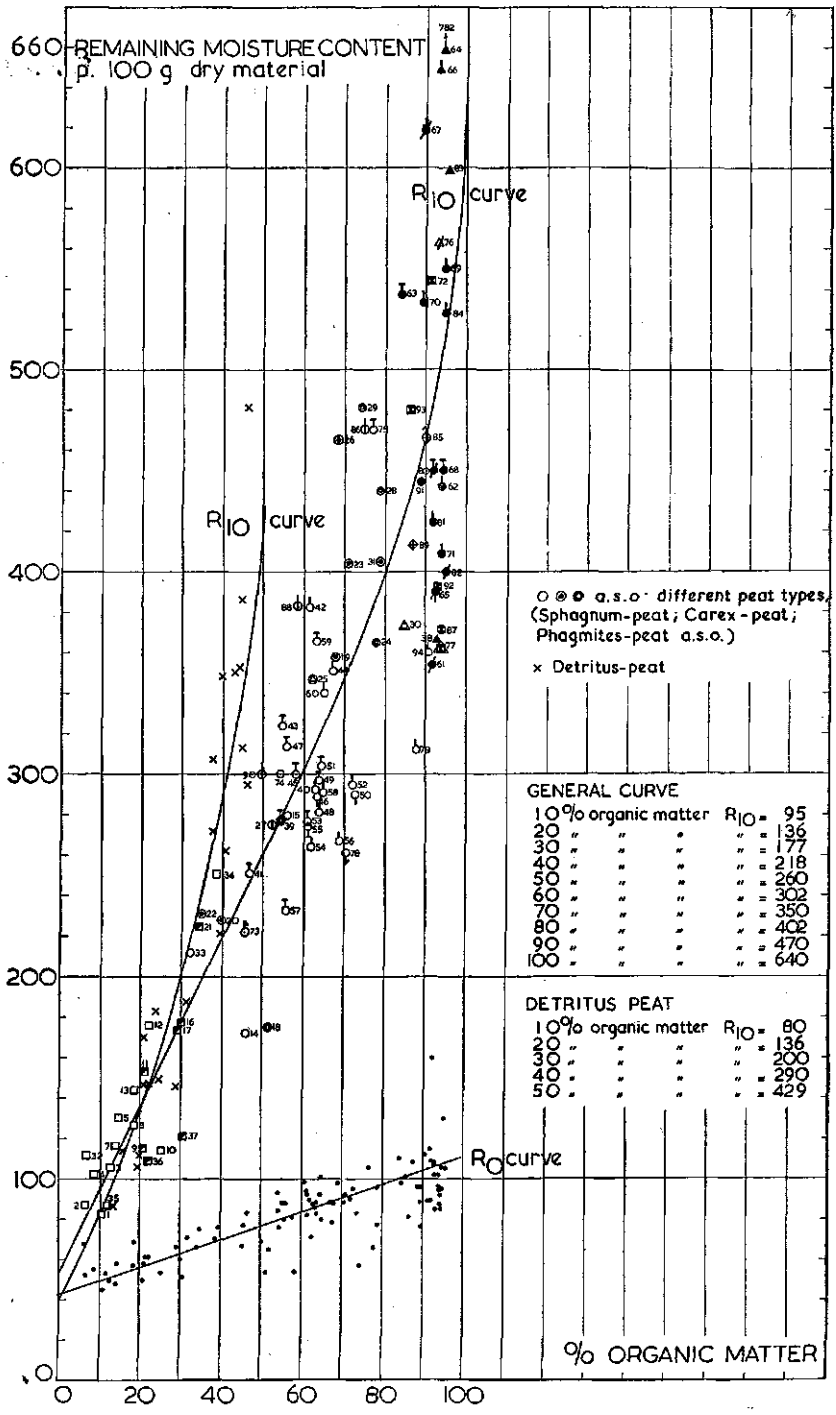
In the peat districts of the provinces of Utrecht and Zuid Holland, where peat soils are used as grassland, desiccation of the soil is evident over a more or less extended surface. In the worst cases even no grass is present. The surface of the soil is often bumpy, while the root-development in the sod is abnormal (see DUYVERMAN (1), HUDIG and co-operators (2), ZUUR and co-operators (3)).

The direct cause of this phenomenon is a too low water-table in the ditches. In consequence of this the water-table in the soils falls too much in dry periods, through which the upper layer desiccates irreversibly. This means that the soil once dry, does not take up moisture up to its original percentage of moisture, even when the soil sample remains under water for some days.

To study this phenomenon it appeared necessary to have a test method by which the influence of different factors on the reversibility could be followed and the so-called degree of reversibility of the grassland could be measured.



STANDARD CURVE OF REVERSIBLE PEATSAMPLES

The degree of reversibility (R_{gr}) may be defined as follows:

$$R_{gr} = \frac{10(R_t - R_0)}{R_{10} - R_0}. \qquad (1)$$

The method is based upon the determination of the remaining moisture content of the soil, which means the amount of moisture that is kept by a thoroughly moistened soil (during six days) against a centrifugal power. The degree of reversibility R_{gr} is computed by means of formula (1) from the remaining moisture contents R_t, R_0 and R_{10} referring to the soil sample from the grassland moistened immediately after sampling and after drying at 105° C and to a standard sample, respectively. This standard sample belongs to the same soil type and has the same humus and clay content, but has never become dry in natural conditions. For the determination of the R_{10} a standard curve is to be used which gives the remaining moisture content at differene percentages of clay (particles $< 16\,\mu$) and humus (loss by ignition). All these types give the same standard curve. Only the so-called detritus peat from the N.O.Polder has a deviating curve. The curves are shown in fig. 1.

The determination of the remaining moisture content happens in the following way:

The soil, which may not lose any moisture since the sampling (sending in well-closed tins or jars), must be mixed well in the laboratory. First the moisture content is determined in a good average sample of 3—4 g and after that the loss by ignition is determined (in dry peat samples separation is clearly evident), after which a part is made air-dry (determination of granular composition). Another part is pulverized by a sieve with meshes of 3 mm (wet samples) or a little pulverized in a mortar, until the soil has passed a sieve with meshes of 2 mm (dry samples). Small pieces of wood etc. must be removed.

In the china crucibles with porous bottom as much soil is weighed (fourfold) as agrees with 1.5 g dry matter. Two of these crucibles are dried to 105° C (determination of R_0), the content is pulverized a little if necessary and stirred with distilled water as much as possible, so there is still some water left above the soil. Water is immediately added to the two other crucibles (determination of R_t). Then these crucibles are placed into a desiccator with distilled water. They stand on a perforated plate of copper-netting. The liquid level in this desiccator has a height similar to the waterlevel in the crucibles, which should remain in the desiccator for six days when they are taken out and are centrifuged for 30 minutes. The water, which has collected at the bottom of the centrifuge-cups must be removed just like the water, which perhaps will be upon the soil in the crucibles (the latter does not happen very often) after which it has to be centrifuged again for 30 minutes (rotation-velocity 2500 rotations per minute), now and then to be examined with a good tachometer. Now the crucibles are taken out of the centrifuge and are dried on the outside [1]); they are weighed, while a dish is put under the crucibles (when the crucibles are outside the centrifuge, they are covered with a watch-glass). Next the crucibles are dried to 105 °C and are weighed again, from which we can now calculate the remaining moisture-content (R_t and R_0) at 100 g dry matter.

[1]) The bottom is wiped with filterpaper.

The remaining moisture content for the same soil is dependent on:

1. The number of days during which the soil samples remain under distilled water.
2. The rotation-velocity of the centrifuge.
3. The centrifugating time.
4. The quantity of soil, from which has to be started.
5. The preparations of the soil sample.
6. The situation of the crucibles.

Now it appears that the soil samples must be kept submerged in water for six days. The rotation-velocity must be fixed at 2500 rotations per minute and the time of centrifugating at 1 hour. This is concluded from a detailed investigation, allowing for the standard deviation. The quantity of soil is fixed at a quantity which agrees with 1.5 g dry matter (dried to 105° C).

The preparations and the cleaning of the crucibles are included in the description of the determination of the remaining moisture content. This description is like this:

To get reproduceable values the crucibles have to be cleaned after each determination in the following way. After removing the soil the bottoms of the crucibles are cleaned with hot water with a brush. Now the crucibles are placed in a beaker with 5 % NH_4OH-solution, for one day, on a boiling water-bath. After removing the rests of the ammonia the crucibles are again placed in a beaker with HCl 1 : 1, to which is added 10 % HNO_3 (d. 1.4), for some hours on a boiling water-bath. After washing away the rests of the acid the crucibles are washed again 3 times with hot distilled water. The crucibles can be used, when at a reduced pressure the water is sucked through rather quickly.

The values obtained after the above mentioned method have proved to be very useful. They show a correlation with the field experience and give an idea about the different processes in the course of our research. The principal cause of the irreversibility seems to be the formation of very hard and compact soil aggregates during the drying process. The principal remedy is found in a rise of the water table or in irrigation, i.e. in a constant sufficient wetting of the soil.

LITERATURE

(1) DUYVERMAN, J. J. The agricultural-chemical basis of regional planning, thesis, Wageningen 1948.

(2) HUDIG, J., J. J. DUYVERMAN en B. W. WITTEWAALL. Three reports (not puplished):
„Soil improvement in the Ronde Venen", 1944;
„Soil improvement in Western Utrecht", 1946;
„Soil improvement in Zegveld en Miland", 1941.

(3) ZUUR, A. J., met medewerking van G. BAKKER en B. VERHOEVEN: „Some results obtained with the HUDIG method to determine the reversibility of peat soils" (not published).