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IV. 2. — Soil Organic Matter and Plant Growth

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Short-term effects of organic manuring.

Supplying the soil with organic material from outside such as animal or human excreta, composts, etc. causes immediate reactions, called by us short-term effects. They result in the main from the nutrient elements contained in the organics. Since fertilizers have come into general use these effects have lost in importance; for plant nutrition is more efficiently met by fertilizers (an exception to be made for various minor elements and such growth-factors as vitamins, hormones, auxins).

Short-term effects may not however be neglected; for the nutrient elements have money value as the fertilizer-dressings can be diminished proportionally. If this is overlooked there is a danger of overdosing (especially with N and K). So we must know the contents of the nutrient elements (by analysis) and their activity (most effectively determined with pot-experiments). In stable manure f.e. most elements are fully as effective as in fertilizers: N, however, is less active. In 1953 I found ⁽¹⁾ that the uptake by potatoes from 100 kg of mineral N reached its maximum, 65 kg, six weeks after the emerging of the sprouts and remained unchanged afterwards. From 100 kg of N in stable manure however the uptake regularly increased with 1.3 kg every week till harvesting in the last week of September; then the total uptake was 20 kg and the « degree of activity » ⁽²⁾ had risen to $20 : (0.01 \times 65) = 30 \%$.

(1) As yet unpublished data.

(2) This term is here taken from analogy as it is generally used in relation to yield.

This number is variable, averaging 40 on sandy soils and about 20 on heavy soils. In town-waste compost it is in both cases low for N and P (10-15 %).

Long-term effects of organic manuring.

By the supply with organics (included those in the form of roots and stubble, green manuring, ley farming) the result will be a rise in humus content of the soil or its maintenance on a certain level when otherwise it should decrease. This causes effects of a more lasting character. Among these, besides its forming a medium with base exchange capacity, we recognize two important agencies performed by humus :

1. Humus is the store of nitrogen, containing 5-7 % of N. Supply from this store is however insufficient for getting top-yields : in the above mentioned experiment the sandy soil contained in the top-soil about 100 tons of humus with approximately 5 à 7.000 kg of N; in the plots without any supply of N the total uptake was 90 kg and a further supply with 120 kg of mineral N was required to reach the top-yield.

Though this humus function is of less importance than in pre-fertilizer-days, 80 kg of N still represent a value of 80 guilders (= 8 £).

2. Humus is a store for water, it being able to hold an amount of water equal to 2 à 2 ½ times its own weight. The afore mentioned soil can contain in the humus of the upper 15 cm layer about 250 tons of water, equivalent to 2.5 cm of precipitation. This is very important in summer.

How to regulate humus content.

Ascertaining a difference in humus content with sufficient reliability requires an extremely accurate sampling and analyzing technique. With the small differences generally involved it is hardly to be attained. A better method is to make determinations during a series of years and to adjust the points obtained.

In this way I have found ⁽¹⁾ that the total amount of humus in the top-soil in the moderate climatic regions is about 20 times the average yearly supply of dry organic matter.

This is the natural equilibrium under the given circumstances ultimately to be got at after carrying on a special system of farming or organic husbandry for a sufficient period. The level of the

(1) As yet unpublished; the idea also occurs in (1).

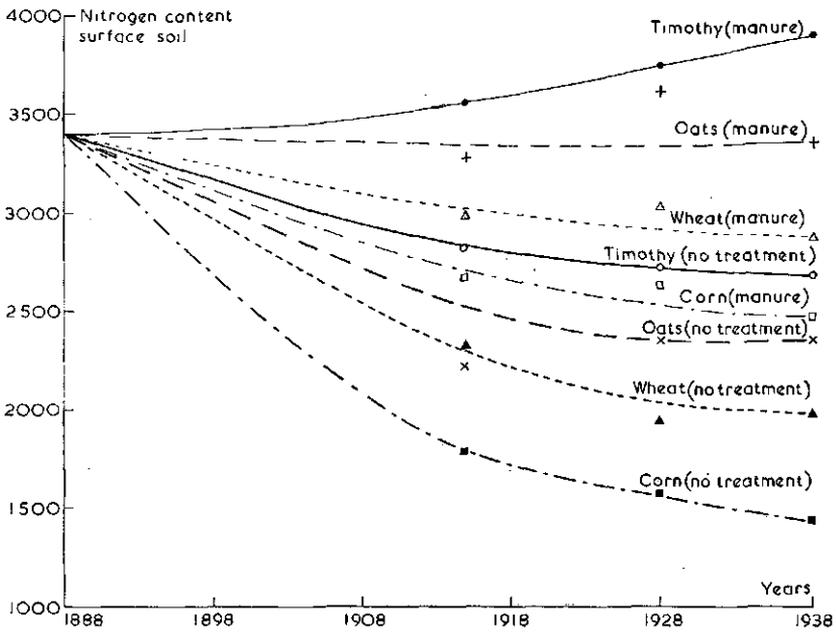


Fig. 1 Development of nitrogen content as a measure for humuscontent under various circumstances as to organic matter supply. From G. E. Smith, Sanborn Field 1942

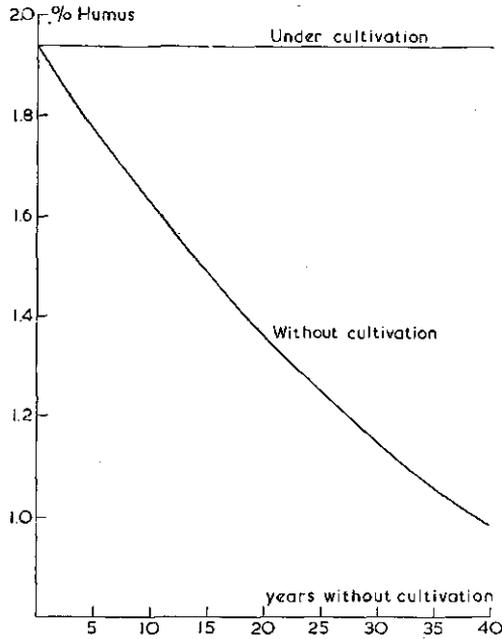


Fig. 2 Decrease of humuscontent without any supply of organic matter and without cultivation according to Jac. Kortleven; not yet published.

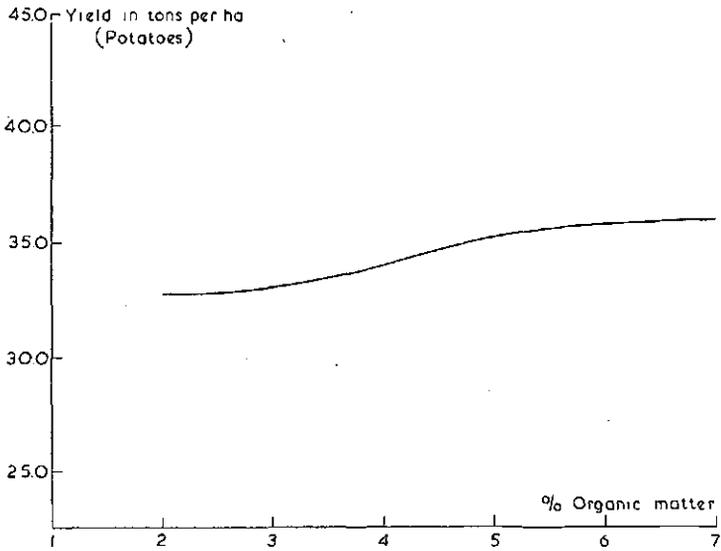


Fig. 3. Relation between humuscontent and yield according to Ferrari (agronomic research with potatoes 1952)

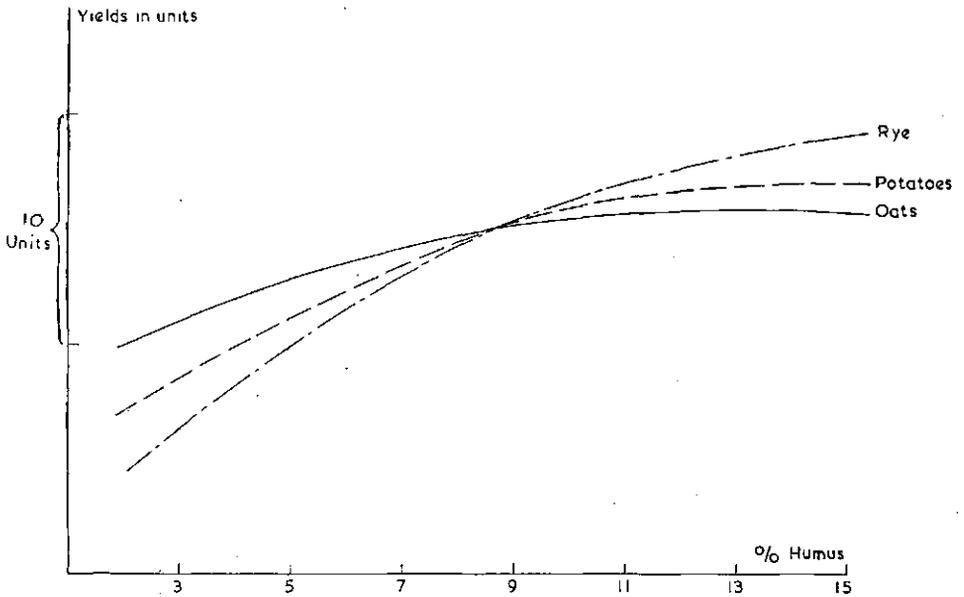


Fig. 4. Relation between humuscontent and yield according to W.C. Visser (not published)

equilibrium and the period required are to be calculated beforehand as organic matter supply and humus content are functionally related (represented by a logarithmic curve). In various systems there is however some difficulty in estimating the organic matter supply.

Figures 1 and 2 give examples with and without supply of organic matter.

Humus content and yield.

This relation is possibly not to be obtained otherwise than with the polyfactor analysis. In this way FERRARI (2) found a difference of 2 tons of potatoes coinciding with a difference in humus content of 3-5 % on river clay soils (figure 3). W. C. VISSER (1) found similar results for sandy soils (figure 4). It is necessary to assemble more information regarding this relation.

Summary and conclusions.

Organic manuring causes short- en long-term results. The first, being in the main nutritive, form a nuisance in organic matter investigations concerned with the last in which aim and purpose of organic manuring are embodied. To separate them we must know content and degree of activity of the elements present.

Principal long-term effects are storing and supplying of nitrogen and water.

The ultimate humus content in the state of equilibrium is directly proportional to the average yearly supply of organic matter.

Yield depends on humus content.

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2. FERRARI. — An agronomic research with potatoes, etc. *Versl. Landbouwk. Onderz.*, Den Haag, LVIII, 1 (1952).

RÉSUMÉ. — *Les fumures organiques (composts, excréments, etc.) donnent des réactions immédiates et à long terme. Les premières, liées principalement à la teneur en éléments nutritifs, contrarient*

(1) Unpublished data.

l'étude de l'action de longue durée des matières organiques qui sont employées dans ce but.

Il est donc nécessaire de connaître la teneur et le degré d'activité des éléments présents.

L'activité de longue durée se traduit principalement par l'apport et l'emmagasinage d'azote et d'eau.

La teneur finale en humus dans l'état d'équilibre est proportionnelle à l'apport annuel des matières organiques. Les rendements varient selon la teneur en humus.
