Reprinted from:
Transactions of the International Congress of Soil Science;
Amsterdam 1950, Volume I.

PLANT ANALYSIS AS A MEANS OF EVALUATION OF CHEMICAL SOIL TESTS

F. VAN DER PAAUW
Agricultural Experiment Station and Institute of Soil Research T.N.O.
GRONINGEN, Netherlands

Chemical soil testing and plant analysis have frequently been applied as competing methods for the determination of soil fertility (1). The first method has been preferred for practical advisory purpose in the Netherlands. This does not mean that the latter method is not of great interest for agricultural research, especially in horticulture. In view of practical application, however, objections arise (various crops are grown, annual variations, influence of age), which do not apply to the same extent for soil analysis.

The conventional methods of soil research are tested on experimental fields (2). Series of several rather small field experiments are laid out. In the years 1947 and 1948 330 phosphate experiments were made on grassland, divided into 12 series on different soils. The yields of the plots, which did not receive a dressing of phosphate, expressed in percents of the yields obtained on the fully dressed plots, are graphically correlated with the results of soil tests (method also used by BRAY, (3)). The results of a series of phosphate experiments on peaty soils are given in fig. 1. Frequently the relation appears to be dependent on other factors. The influence of these factors can be stated by relating the deviations of the dots to the approximate average curve to these factors. Disturbing influences are noticed and may be eliminated.

Consequently the relation of the yield with the original factor often appears to be considerably better than before the correction was made.

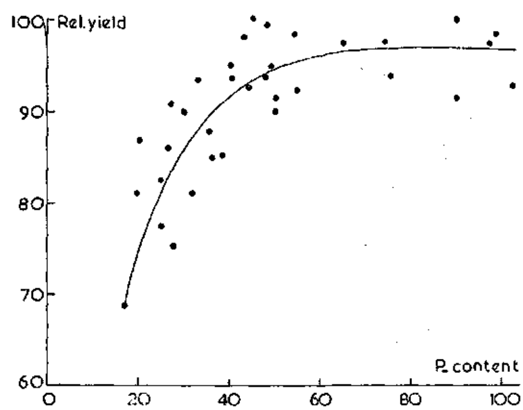

Fig. 1. Relation between P content of the soil (citric acid) and relative yield of grassland on clay soils.

Yield is obviously the touchstone of agricultural research. This, however, does not mean that the yield is the most satisfactory measure for the determination of the reaction of the crop upon a soil fertility factor from a physiological point of view.

To distinguish adequately the value of a manuring factor it is necessary to have a sensitive index. The content of a substance in the plant is more directly dependent on the intake than is the case with the yield. As a matter of fact the correlation of this factor with the soil fertility factor generally appears to be higher. This is promoted by the usually small error of plant analysis.

The use of plant analysis for evaluation does not at all exclude the possibility that other properties of the crop may also be useful. It may be mentioned that differences in yields are often preceded by much more pronounced differences in early stages of development of the crop. Secondary properties, such as the 1,000 corn weight and the hectoliter weight of cereals, the specific weight of potatoes which is a measure of the dry matter content, may correlate as well to some soil factors. Of course the application of these factors demands a closer knowledge of the relation between these factors and the yield.

The correlation between the P level of the soil and the P_2O_5 content of the crop is usually moderate (fig. 2*a*). This is chiefly caused by the

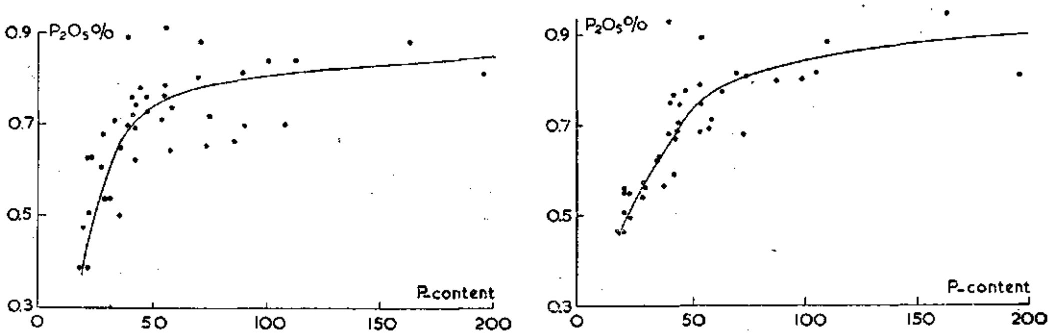

Fig. 2. Relation between P content of the soil and P content of grass on peaty soil (*a* before, *b* after correction on same N level).

different physiological stage of the material. The P_2O_5 content declines as the grass is growing older. The N content is a reliable measure for the stage of development of the grass. If the deviations of the dots in analogous cases as representated in fig. 2*a* are put into relation to the N-content, generally a clear linear relationship appears to exist. With the help of this relationship a correction of the P_2O_5 contents may be introduced.

The correlation between these corrected P_2O_5 contents and the P level appears to be very good in many cases (fig. 2*b*). It must be borne in mind that results obtained on fields, differing in soil conditions and in botanical respects, are compared. However, differences in botanical composition may also be largely eliminated by this correction. It appeared that the P_2O_5 contents of grass species growing at the same P level do not appreciably differ if a correction is made for the different N contents.

In other cases, however, a rather wide scattering of the dots may be left. Then it is investigated whether other soil factors are possibly responsible for this. The scope of this communication does not allow us to go into detail. It may only be mentioned that on clay and peat soils the relation between the K_2O contents of crop and soil is largely depen-

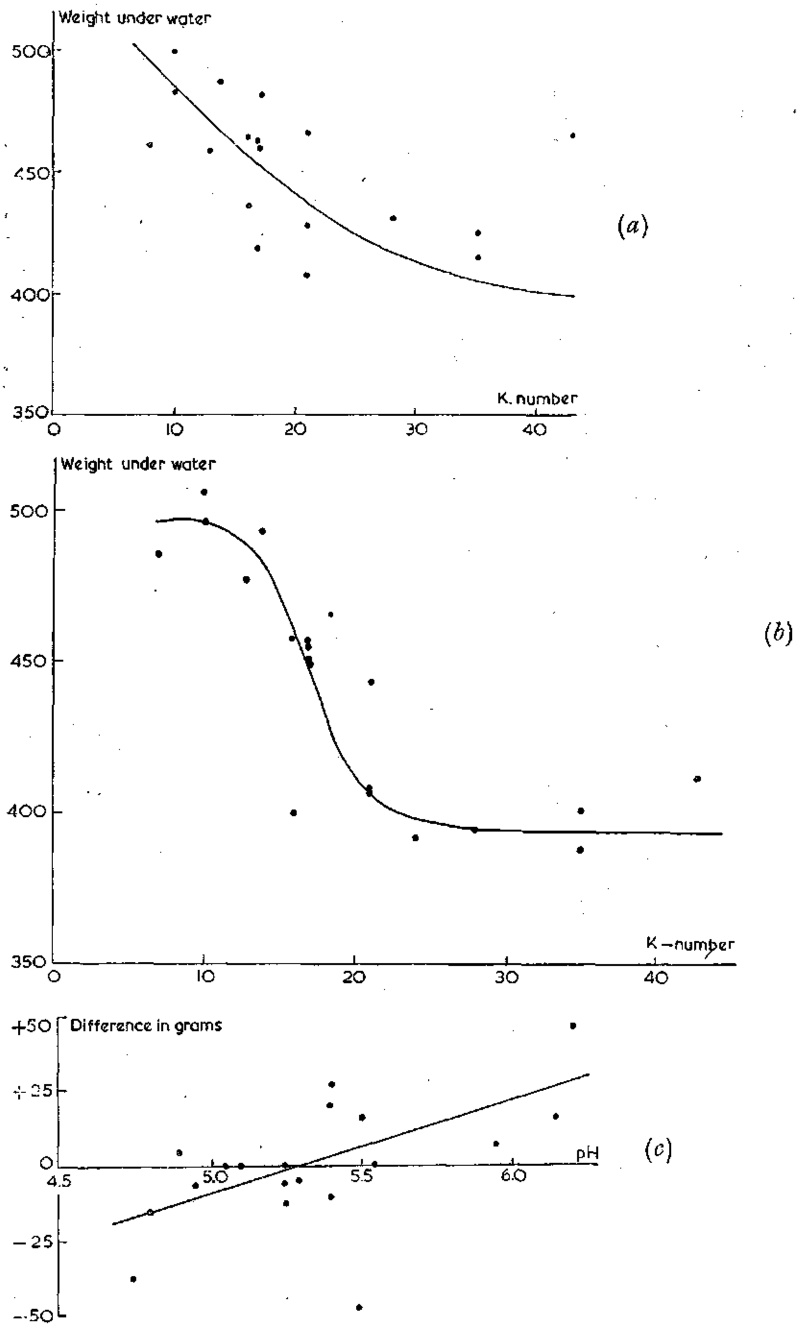

Fig. 3. Relation between K-number and „weight under water" of potato tubers on sandy soil (*a* before, *b* after introduction of various corrections, *c* influence of pH on this relation).

dent on the humus content. The pH of the soil and the content of clay particles may also be of importance in similar cases (P and K).

A second example concerns the test of the K-number (the amount of K related to humus) of sandy soils by means of the specific weight of potatoes, determined as "weight under water". The correlation of this weight with the K-number is rather bad (fig. 3*a*). Fig 3*b* gives the same after introduction of various corrections.

It could be shown that 4 factors at least are responsible for the unsatisfactory correlation. Two of them, the N-nutrition and the absolute yields of tubers, are of little importance. The influences of pH (fig. 3*c*) and humus content dominate.

In the case of fig. 3*c* corrections have been made for the influences of the other factors. These influences were, however, only determined in a rather rough way. Vertical deviations of the dots to the average curve were measured and plotted against the other factors. A larger experimental material, however, would allow a further subdivision of the material and the establishment of interactions.

By this approximation it is indicated that with the same K-number a high humus content coincides with a low specific weight. A high humus content corresponds at a same level of exchangeable K with a higher availability. In fact the larger sorption complex (humus) contains a greater amount of available K.

At a higher pH the specific weight is optimal (fig. 3*c*). This corresponds to a smaller availability of K, which might point to the existence of a Ca/K antagonism.

The relation shown in fig. 3*b* is identical with the relation established on individual fields, when increasing amounts of K are applied. However, in the first case the result has been derived from various parcels differing considerably in soil conditions. Consequently an insight into the combined effect of factors has been obtained. An evaluation of the K-number for practical use can be based upon it.

The auspicious aspect of similar tests is that the investigation is not necessarily dependent on the high costs of large numbers of experimental fields. Simple determinations in crop samples or mere estimates may often be sufficient for the purpose.

LITERATURE

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