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MINERALS AS BEARERS OF THE NATURAL SOIL FERTILITY

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Compared with the attention paid to chemical and physical methods of soil research, the mineralogical study of the soil has been neglected. Save for the qualitative data published in some studies on the mineralogy of soils directly connected with their fertility, there is a profound lack of interest in the deeper causes of soil-fertility in general.

It will be easily understood that only with the aid of mineralogical analysis can the quality and quantity of the soil-forming minerals be determined. This seems to be important as the properties of a soil undoubtedly depend in the first place on the properties of its components.

Especially the supply of plant food for direct use, as well as for a longer period of growth, depends on the minerals or mineral associations which build up the soil. Among them the potash-bearing minerals are the most important. That indeed these minerals are responsible for a natural deficiency or abundance of potash will be pointed out below.

First of all it will be demonstrated on the basis of some data out of the literature that the mineral-bound potash can be utilised to some extent directly by the plant.

Prianischnikov (1) compared the influence of powdered nepheline-rock, muscovite and orthoclase with that of KCl, on the growth of buckwheat, barley and mustard. The results showed that under the conditions of this experiment the influence of the ground nepheline-rock and of the muscovite-powder was more favourable than that of KCl, with buckwheat as well as barley. Of course this laboratory experiment does not allow of conclusions concerning the possibility of potash supply from the minerals under field conditions.

The results of the experiments of Popp and Contzen (2) showed, however, that in the field also the supply of potash depends on the minerals composing the soil.

In fertilizer experiments carried out by these investigators on grassland for 11 years, more potash was absorbed by the plants than was soluble in strong hydrochloric acid at the beginning of the experiment. The mineralogical analysis showed that potash felspar took a great part in the soil formation.

Analogous conclusions can be drawn from the investigations of Wiesmann and Lehmann (3) on ion-absorption by plants after the method of Neubauer. The first 100 seedlings took more potash from the soil than was originally present in exchangeable form. So did the second and the third crop.

The soil contained 2·48% K_2O or 52·65 milliequivalents, by total analysis. In exchangeable form 1·24 m.e. were obtained by the percolation method of Gedroiz. The first crop of seedlings contained 1·93 m.e. and 0·48 m.e. still remained in the soil as adsorbed potash. 1·17 m.e. were therefore dissolved out of the minerals by the root activity of the experimental rye seedlings.

A very distinct proof of the importance of the mineralogical composition of a soil is found in the recent work of Druif (4) from the Experimental Station at Medan (Sumatra), on the mineralogy of the Deli tobacco area. We learn from this work that a very close relation exists between the petrology of the soils and their value for the tobacco culture, even to the extent that on a distinct soil type tobacco of a definite market value was grown. Such a close relation between composition of the soil and plant growth cannot of course be expected in the regions of more temperate climate. However even there the natural fertility is immediately connected with the minerals which build up the soil, the finer particles in particular becoming important for the supply of the necessary plant food.

That this indeed is the fact is proved by my own investigations as to the supply of potash in three Dutch clays of different origin and accordingly different agricultural value. The clays were divided into fractions and each fraction up to the size of 1μ was studied by the microscope, and the two finer fractions, *viz.* $1\text{-}5{\cdot}5\mu$ and $<1\mu$, also with the aid of X-ray patterns. The result of these studies was striking, as the $1\text{-}5{\cdot}5\mu$ fraction of the clay richest in potash contained 6% felspar and 6% bleached biotite, the soil of mediocre potash content contained 4% felspar only and the soil very deficient in potash did not contain either of the minerals mentioned. According to the studies of Hansteen Cranner (5) great significance must be attached to the biotite which has a very high fertilizing value.

The finest fractions also showed in their X-ray patterns distinct differences, though no conclusions of direct practical value concerning the fertility of the clay could be drawn from them.

In connection with adsorption phenomena also further knowledge of the behaviour of the soil-forming minerals seems to be of interest.

As Van der Meulen (6) recently pointed out, the ion adsorption and exchange phenomena of different minerals are dependent on their crystal structure. Only those minerals are subject to ion exchange which have aluminium with the co-ordination value four.

Undoubtedly further experiments with minerals of the mica type will lead to a better understanding of the adsorption phenomena met with in the soil. The above-mentioned facts direct attention to the only method of soil research which can teach us something of the nature of the materials which build up our soils.

LITERATURE

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