

By WILLIAM A. ALBRECHT, Ph.D.

# ORGANIC MATTER balances SOIL FERTILITY

Doctor Albrecht points to the  
real key to soil fertility.

**SOIL TESTS**, attempting to measure plant nutrition, have demonstrated that the high quality of the crop depends on what may be called a "balanced diet" offered to the plants by the soil. In its first aspect, that diet consists of the required insoluble, but available, inorganic elements. The amounts of several of those have now been specified within fairly reliable ratios for balance. Those specifications hold more particularly for the ash-rich and protein-rich crops, like the legumes.

## Clay and Humus Responsible

The clay and the humus are the parts of the soil responsible for the concept of "insoluble, but available" nutrients. Of those, the calcium, magnesium and potassium have been fairly accurately determined as desirable amounts required in a soil to prevent deficiencies of them. Sodium, as the alkaline element, and hydrogen, as the acidic one, have been listed as *tolerable* amounts or ratios, above which they would be injurious.

These are the positively charged elements. They are held as insoluble, but available, ones by the colloidal (glue-like) humus and colloidal clay. By means of their adsorbing capacity, those two parts of the soil filter those soluble elements out of solution. They hold them as "insolubles", much like the water-softening compound takes soluble "hardness" out and holds it.

## Soil-Root Exchange

But those first four essential, adsorbed elements are given up to the plant root when it comes along and exchanges hydrogen, or acidity, for them. The hydrogen does not serve as a nutrient from that source. These elements are "insoluble" in rain water going down through the soil, yet they become available ones, so far as the plant nutrition is concerned.

The soil's capacity for holding positively charged elements, or cations, is measured by soil tests. That property is called the "cation exchange capacity". It is abbreviated, "CEC". It is specified in terms of "equivalents of the hydrogen". The amounts of each of the five elements (calcium, magnesium, potassium, hydrogen and sodium) held by the exchange capacity, are also measured. They are specified as their percentages of that total capacity.

## Balanced "Plant Diet"

The desirably balanced "plant diet", according to experience to date in soil testing related to plant nutrition, would have the available calcium represent 60-75% of the soil's exchange capacity; magnesium, 10-20% and potassium, 2-5%—all so balanced to prevent deficiencies. Then it would have sodium take up 0.5-3% and hydrogen less than 10% to avoid excesses of these two. Trace elements are signifi-

cant for plants in such small amounts that our measures yet designed are too unreliable to warrant specifications of them for either soil or crop.

In its second aspect, the plant diet includes organic compounds. The organic matter is Nature's main means of giving the "balanced" property in the soil for growing plants as contrasted to growing them in the highly diluted solutions of salts of the nutrient elements used in the practice of "hydroponics". Soil tests of farms in Lancaster County, Pennsylvania, the home of the Garden Spot of America Organic Club, give the evidence for the truth of that statement. For years, that county has practiced using both barnyard and green manures for building up the soils in organic matter. Much use has been made of limestone, rock phosphate, glauconite (green sand marl), granite dust and other natural mineral applications to the soil. Those practices are showing, according to the soil test data, that organic matter is the safety factor against excesses of elements in soil treatments, or upsets and imbalances in the plant diets resulting in low quality of the crops as feed and food.

### Excellent Example

The soil test data from the more than eighty-acre farm of Mr. and Mrs. Willis K. Killhefer of Manheim, Pennsylvania, may well be one of several that could be taken as examples. They grow wheat, corn, tobacco, red clover, soybeans, grasses and an excellent garden with vegetables and flowers in wide variety, but high quality. They market their crops via cattle and chickens to give human food products mainly as milk and eggs.

Such a plan of management calls for purchase and import of concentrates to supplement the generous yields of forages, ensilage, hay and bedding. But all those result in the larger amounts of manure managed carefully to maintain fertile fields, but particularly a more fertile garden considered "so essential for the health of the family". It is the garden, managed by machinery insofar as possible like



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the fields, that speaks for organic matter to balance plant diets for crop quality.

### Key to Balanced Fertility

Its soil tests tell us that one builds balanced soil fertility successfully by using generously of organic manures and natural mineral fertilizers, and enough so to be satisfying even where the crop quality goes under critical taste inspection regularly by the entire family.

The garden lies alongside the road as "front" to the house and farmstead. There are fields on either side of the garden with suggestions, in advance of soil inspection, that all three are of the same soil type. Consequently, differences in the values found by soil tests for the garden and fields must be due to the generous manuring and treatment with minerals. The test results exhibit the two fields as very much alike. But they show that the garden is decidedly higher in all the values measured by test, yet those are well balanced as plant nutrition. This is true even after the soil's total

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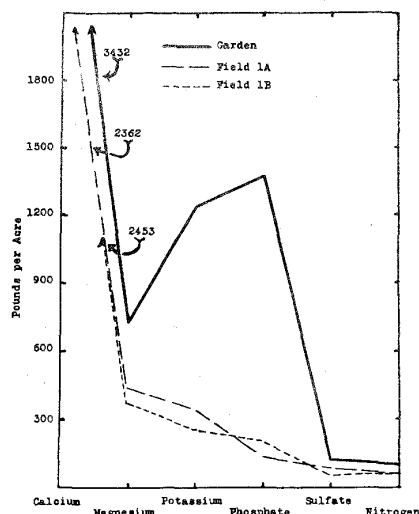


Figure I. Available nutrients (Pounds per acre) in the highly organic soil (solid line) compared with the soils of lower organic matter in the fields alongside (broken lines). Data by Brookside Farms Laboratories.

exchange capacity (CEC) in the garden has been increased during the years of organic manuring by 40% over that of the adjoining fields. That has increased the available fertility in the garden accordingly.

#### Test Results

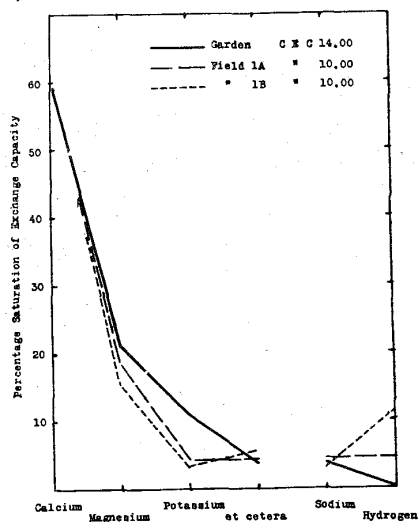
The test results, or measured amounts of the available fertility as pounds per acre, i.e. per two million pounds of soil, are shown in Figure I. The different elements are listed along the base line. Their pounds per acre are shown along the left margin (going upward). It is significant to note that the values for the garden soil (solid line) are far higher than those for the two adjoining fields. They are particularly higher for the phosphate and the potassium.

At first sight, the curve for the garden as pounds per acre appears a bit erratic, especially the potassium. But when one considers (a) that the organic matter of the garden soil was increased by nearly 70% above that of the fields, and (b) the mineral treatments were separate applications,

should one not anticipate possible imbalances? Yet, quite contrary to such anticipations, the test values in Figure II, reporting the percentages of saturation by the elements of the exchange capacities of the three soils, show that they are each in like balance according to desired standards as we now have them. Even if the values of the total exchange capacity for the garden went up 40% over that of the fields, because of its increased organic matter, each of the elements increased accordingly and none went out of balance. Nature's balance by organic matter transcends man's by soluble means.

According to the report, there was little that the professional soil tester could specify as deficiencies or necessary treatments. About all he could recommend was to keep on with the past *natural* practices as this farmer in the Garden Spot of America had been using them for many years. He had followed Nature's methods of providing balanced diets for growing nutritious crops and had not fallen into any errors as far as man's knowledge to date could determine. ●

Figure II. Available nutrients as percentages saturation of the total exchange capacity of the garden soil as compared with those of the adjoining fields. Data by Brookside Farms Laboratories.



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