BIOLOGICAL ASSAYS OF SOME SOIL TYPES UNDER TREATMENTS

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THE soil, which is biologically altered geological materials, provides the support and nutrients for the plants so that life itself may be sustained therefrom. Of the dry matter of the plant, 95% is combustible and 5% is ash. Four elements make up this 95% or combustible part. These are carbon, hydrogen, oxygen, and nitrogen. They are supplied by water and air — uniformly distributed through their fluidity. They are available in unlimited quantities, and when one is utilized, there is more of the same to move in to replenish the supply. At least 12 elements make up the 5% that is ash in the plant. These elements are limited in supply for any given plant. Since they are many and present in the soil in small quantities, a limiting supply of one or another for maximum growth is more commonly the rule than the exception.

Plants utilize the nutrients delivered to them by the soil, as elements or molecules to be combined with the elements making up the combustible plant portion — carbon, hydrogen, oxygen, and nitrogen — to form plant compounds. Different compounds may be manufactured by the growing plant depending upon the rate and balance of delivery of these nutrients to the plant by the soil.

Our chemical studies of the plants have made use of methods that determine the relative concentrations of the elements in the plant. They tell little about how these elements are combined into compounds. It is true that tests are common for certain standard compounds such as fats and carbohydrates, but for protein the nitrogen figure multiplied by a factor is the common concentration of elements in the dry matter rather than elements, the animal assay of plant differences caused by varied fertility delivery according to soil type and soil treatments seems most logical. It was in support of this hypothesis that the following study was carried out.

METHOD OF ASSAY

The domestic Chinchilla rabbit was used in lots of 8 to 10 animals for the bioassays of different soil types and soil treatments reported herewith. The rabbit is herbivorous and thus lends itself readily to assays of forages. It has been compared with steers by Crampton, et al., (1, 2), and they conclude that the rabbit as a "pilot" animal digests protein in certain rations more thoroughly but crude fiber and cellulose less completely than do steers. They state that the rabbit digests pasture herbage less completely, but that there are close correlations between the two species in the cases of protein and lignin. They report that the rabbit as a pilot animal has much promise and that further work with it is justified.

The rabbits used in this bioassay were genetically quite similar. They were all of approximately the same age, and they were distributed at random with respect to weight, sex, and litter. The feeding period started at weaning time and continued for six weeks. They were fed hays (a) from different soil types without soil treatment, and (b) from different soil types with soil treatment. The hay was fed ad libitum on wire-floored cages with facilities for collection of urine and feces. The voidings were measured and samples taken for analysis. The amount of hay fed and the amount wasted were measured so that actual consumption was determined. From these different values digestion and retention were determined.

One single species of plant, viz., Korean lespedeza, was grown on five different soil types within the limits of the state of Missouri. All hays were produced during a single season. The season varied only with locations of the soils. The hays varied widely in appearance chiefly because of soil differences, except in one case where the season had a distinct effect.

The soil types were Eldon sandy loam, Putnam silt loam, Clarksville gravelly loam, Grundy silt loam, and Lintonia fine sandy loam. They represent five distinctly different areas of the state, and were developed from distinctly different parent materials. They also vary considerably in age, topography, and vegetation.

The Eldon sandy loam is an unglaciated border Ozark soil developed from sandstone and cherty limestone under the influence of prairie vegetation on level to slightly rolling topography. The Putnam silt loam is a level, prairie soil, thought to have been formed from glaciated material covered by a thin layer of loess. It is underlain by a very distinct claypan. The Clarksville gravelly loam is a very old, residual soil formed on cherty limestone under the influence of forest vegetation and very rolling topography. It makes up the bulk of the Ozark area. The Grundy silt loam was developed on glaciated material with a deep layer of loess under the influence of prairie vegetation and level, to slightly rolling topography. The Lintonia fine sandy loam is a soil developed under forest cover upon sandy alluvial material laid down by the Mississippi river during the Coastal Plains period.

All soil treatments included lime and phosphorus. On the Eldon and Putnam soils potash deficiency appeared a few years after lime and phosphorus were first applied. As a result the treatments on these two soils included potassium as well as lime and phosphorus. Previous work has shown that where potassium was not deficient for crop growth, potassium as fertilizer did not increase the feeding value of forage.

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Reference by number is to "Literature Cited", p. 286.

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