BASE SATURATION AND pH IN RELATION TO LIMING AND NUTRIENT CONSERVATION OF SOIL

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LIMING needs of soil are estimated most commonly and conveniently by measuring the pH. Morgan (16) has recently pointed out that this method is satisfactory, provided there is a known relationship between pH and percentage base saturation and provided the approximate base exchange capacity is known. The pH and percentage base saturation relationship may be expected to be fairly constant within a soil type, but it may vary widely between soil types. These variations are particularly great in the subsoil (14, 15) and since, in many cases, the reaction of both the surface and subsoils serve as a guide to the amount of lime needed, it is important to know the relationship of percentage base saturation and pH for the different soil types. A knowledge of pH and base saturation of the subsoil in its relation to nutrient conservation is also of appreciable practical importance in regions with high rainfall and in soils with low nutrient adsorptive capacities. Results of some studies are, therefore, reported in this paper dealing with the relationship of percentage base saturation and pH as factors governing the accuracy of making lime recommendations and with the nutrient losses from sandy soils as influenced by pH, and base saturation of both surface and subsoils.

BASE SATURATION AND pH IN RELATION TO LIMING

The reliability of a factor to be used for calculating the amount of lime needed to raise the reaction of soil from a measured pH to the desired pH value is dependent in part on the direct relationship of percentage base saturation to pH. This direct relationship is frequently lacking and, if the percentage base saturation is plotted against pH, the usual picture is a wide scattering of points. Results of this nature are shown in Fig. 1. Part of the data, as indicated, were plotted from tables given in a paper by Reed and Sturgis (18). A small amount of the data available for North Carolina soils has been plotted also. These results, along with others cited previously (14) show that the relationship of percentage base saturation and pH is too imperfect to permit the use of a single factor in calculating the liming needs of soil.

The value of these data can be increased when they are related to the nature of soil colloids as indicated by the curves shown in Fig. 1. The curves represent the base saturation-pH relationship of pure materials of bentonite, beidellite (13), kaolinite, and peat. By visualizing the existence of these base exchange colloids in soil, the data representing the very different soils acquire positiveness. It is seen, therefore, that in place of one average factor several individual factors are essential, because it does not seem logical to assume that the extreme deviations from the mean values of the data in Fig. 1 or the data of Peech and Morgan (16) are essentially errors. Errors do exist in measurements of this kind, but they are small in comparison to the natural factors of the soil which influence the relationship of percentage base saturation to pH (14, 15). The use of a theoretical titration curve to include all the data in Fig. 1 would not do much to an appreciation of soil differences in this relationship and plant growth. Applying the single value concept to some soils of Florida, Peech (17) found the base saturation to increase from 25 to 75% by increasing the pH value of a soil from 5 to 6 and he assumes the total exchangeable bases...