Available Phosphorus Status of Nebraska Soils in Relation to Series Classification, Time of Sampling and Method of Measurement

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SOIL testing can be a most useful tool for prescribing to farmers the fertilizer nutrient needs of crops to be grown. Recently in Nebraska, as throughout much of the United States, a considerable demand for quick and reliable testing procedures has been placed on the Extension Service and Experiment Station for supplying these prescriptions. It goes without saying that the efficacy of any soil testing program depends upon an accurate calibration of the procedures employed and knowledge of the contingent limitations of each test.

In recent work measuring correlations between quick tests for phosphorus and 'A values', the Bray and Kurtz No. 1 and NaHCO₃—soluble phosphorus methods were outstanding among those investigated (9, 21). It thus seemed expedient to obtain further evaluation of these and other soluble phosphorus testing methods at this time and to calibrate them to Nebraska conditions. Other objectives were to classify further the major Nebraska soil series as to their phosphorus status, and to study the availability of soil phosphorus throughout the growing season.

LITERATURE REVIEW

Many tests for soluble phosphorus are currently in use throughout the United States. Most of these methods employ acid (2, 10, 11, 13, 16, 19, 22, 29, 30) or water (4) extractants while a few employ alkaline solutions (8, 21, 23). Judging by the large number of proposed methods of phosphorus extraction, they apparently have a common characteristic of limited adaptation over a wide range of soil conditions, with consequent poor state- or region-wide crop growth correlation (6, 17).

There have been some favorable expressions on the value of soil series classification as an indicator of available phosphorus of soil (1, 20, 22, 24, 26). On the other hand strong contentions have been made by many agronomists, for the most part not in print, to the effect that soil series designation gives no soil fertility connotation whatsoever.

Recent work with greenhouse-determined A values has brought out the extreme usefulness of the A value in specifying the reliability of soluble phosphorus tests. The A value is a numerical figure of the amount of the soil equally available to that added to the soil in fertilizer, usually expressed in pounds P₂O₅ per acre.

Several investigators have reported that deficiencies in lower phosphorus content of forage and grains are the case in wetter years (7, 12, 19). It has also been found that increasing the dilution of water to soil results in more total phosphate in the solution (4). But no consistent expression is to be found in the literature with regard to short term variation in the "total" available phosphorus in the soil. Burd and Martin (3), for example, in one case suggest a tendency for phosphate concentration in the soil solution at the end of the season, and later (5) with studies of soil in undrained tanks describe a decreased phosphate concentration through the season, the latter being attributed to increased alkalinity. Other expressions are generally negative (23), i.e., time of incubation shows little effect on soluble phosphorus in the case of untreated soils.

MATERIALS AND METHODS

A rather comprehensive state-wide testing program in Nebraska whereby accurate evaluation of the fertilizer status of soils throughout the state is possible. This permits of experiments with fertilizers on many soils of the state. In 1952 and 1953, 62 field experiments with winter wheat and oats grown on soils of 14 different series were carried out through final yield evaluation. Representative soil