Use of Available Phosphate Test as a Help In Determining Need of Phosphate

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The need for chemical methods of estimating fertilizer requirements has been recognized for many years. At present there is a special need for a method of evaluating the available supplies of phosphate in soils of the western sugar beet growing areas. This is so because such great extremes in phosphate level exist in these soils.

About twenty-five years ago quite general responses to phosphate were noted in the sugar beet fields. Without soil tests as an index to phosphate levels in the soil, phosphate fertilizers have been used regularly on many of the beet fields since this time. As a result, many soils have accumulated large reserves of available phosphorus. In many cases additional phosphate is not needed and probably will not be needed for several years. On the other extreme are many soils producing poor yields of sugar beets because of insufficient supplies of readily available phosphorus. Some of these fields have also received some phosphate fertilizer but not adequate amounts.

While a number of states in the East and Midwest have, over a period of years, established useful correlations between soil test values and crop responses to fertilizers, investigators in the West, generally, have not accumulated much data in support of soil test values. Attempts to apply chemical procedures and nutrient levels developed in the East to Western conditions have been largely unsuccessful. (2) [2]

New analytical methods and new correlations had to be worked out to fit Western conditions. McGeorge (1) proposed the use of carbonic acid as opposed to organic or buffered inorganic acid solutions for extracting available plant nutrients from calcareous soils. Tests made in Idaho support this carbonic acid method of extraction.

Experimental Procedure

During 1947, 1948 and 1949, data were obtained from a number of representative sugar beet growing areas throughout Utah and Idaho. The carbon-dioxide soluble phosphate was measured on samples of soil from check plots and compared with yield response to phosphate alone and to phosphate in combination with nitrogen. The original purpose of these plot tests was to establish suitable fertilizer amounts and ratios for the different areas. The experiment was not designed specifically for determining the correlation between available phosphorus and crop response. Had this correlation been the major objective some variables could have been eliminated and a much closer relationship most likely would have been found.

[1] Soil Testing Laboratory, Utah State Agricultural College; Utah-Idaho Sugar Co.

[2] Numbers in parentheses refer to literature cited.

Results

It was immediately evident that beets grown on soils with very low available phosphate contents (0-5 ppm as PO_4) responded to phosphate fertilizer with but very few exceptions. On the other hand beets on soils containing high amounts of phosphate (>50 ppm) very seldom gave any increase in yield due to applied phosphate even when in combination with nitrogen. Available phosphorus contents in between these two extremes were somewhat less closely related to yield responses.

The data are summarized as follows (Table 1), assuming that 20 ppm of available PO_4 is a critical level.

Table 1.

	Available PO_4 less than 20 parts per million Percent	Available PO_4 greater than 20 parts per million Percent
Percentage of tests responding to phosphate applications	72	32
Percentage of tests showing no response to phosphate applications	18	68
Percentage of tests showing response to nitrogen applied alone	80	91
Percentage of tests showing greater response to mixture of N + P than to nitrogen alone	84	36
Percentage of tests where it would have been most profitable to apply nitrogen alone	16	64

Thus the chances for predicting the phosphate need from the analysis of any given sample depend somewhat upon what the available amount is. If the amount is very low or very high, a fairly accurate prediction can be made. Chances are 3 to 1 that yield increases of sugar beets will be obtained if the soil contains less than 20 ppm of CO_2 soluble PO_4.

Recommendations for the use of phosphate fertilizer must, of course, be made in view of other factors which influence yield; but the soil test value is a fairly reliable index to the phosphate-supplying power of a soil.

Literature Cited

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3. SMITH, V. T. An evaluation of the carbon dioxide method of determining available phosphoric acid in high-lime soils, Jour. Amer. Soc. Agron. 40:1045-1046, 1948.