Cotton Phosphate Fertilization

new soil test provides reliable and easily applied diagnostic guide to quantity of available phosphate

D. S. Mikkelsen

A new soil test that tells how much phosphorus in the soil is available to crops—recently developed at the U.S.D.A. Western Regional Phosphate Laboratory—uses a sodium bicarbonate—baking soda—solution to extract the soil phosphate.

The new test has given better correlation with yield response from phosphate fertilization in both greenhouse and field tests than other methods now in use.

The application of the sodium bicarbonate-phosphate test for determination of the phosphate needs of cotton grown in the San Joaquin Valley has been one aspect of a comprehensive cotton fertilization test program conducted during the past four years.

About 100 field tests on the major cotton-producing soils in the San Joaquin Valley were made to measure the correlative response of cotton to nitrogen, nitrogen-phosphate and nitrogen-phosphate-potash fertilization. Soil samples were taken to a depth of 8″ to 10″ during April and May when the cotton fertilization tests were established.

Soils from 30 test locations, representing 12 major soil types, were prepared for soil-test analyses and were tested by various soil-test methods — including phosphate extraction by the sodium bicarbonate method—to determine which one gave the best correlation with yield. Where the phosphate content of the sodium bicarbonate extract was less than 1.0 ppm—parts per million—phosphate, yield increase from the use of phosphate with adequate nitrogen occurred in 95% of the tests. Phosphate values ranging between 1.0 ppm and 1.5 ppm gave an accuracy in yield response of 83%. Soil extracts testing more than 1.5 ppm indicate sufficient available phosphorus, and phosphate fertilization was not beneficial.

The relation of the sodium bicarbonate-extracted phosphate to the probable need of phosphate fertilization on cotton soils in the San Joaquin Valley is shown below. The yield increase of seed cotton from treatments receiving uniform nitrogen-phosphate applications was compared with treatments receiving only the nitrogen application in establishing the soil-test correlation.

The relationship of sodium bicarbonate-extracted phosphate to actual yield-increase of seed cotton resulting from phosphate fertilization is shown in the accompanying graph. Other soil-test methods for determining available phosphorus gave poorer correlations than the sodium bicarbonate method.

The important cotton-producing soils in the San Joaquin Valley are largely alluvial in origin and alkaline in reaction. They are typically deep and uniform in characteristics throughout the area explored by cotton roots. Surface samples analyzed in these tests correlated well with phosphate responses. Some cotton soils, however, are shallow, with markedly different subsoil characteristics. In these areas, it becomes necessary to examine both the surface and subsoil in order to evaluate the availability of phosphorus to cotton.

Maintaining the fertility of soils is a continuing problem, and fertilizer application is an easy method of restoring plant foods, but often it is difficult to determine intelligently what kind and how much to use for best economic returns.

Field trials, where the response to fertilizer under field conditions is actually

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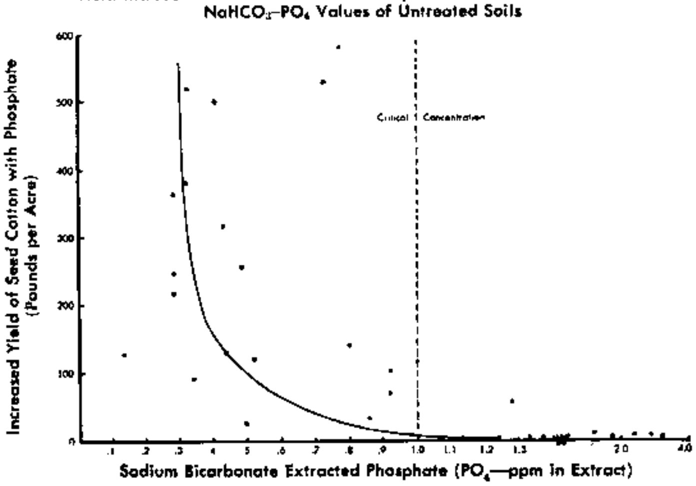
Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate.*

A 0.5 molar $NaHCO_3$—sodium bicarbonate—solution—Arm and Hammer Baking Soda, commercial grade, is satisfactory—is adjusted to pH—relative acidity-alkalinity—8.5 with NaOH—sodium hydroxide. Five grams of soil—sieved to pass a two-millimeter screen—with 100 milliliters of the $NaHCO_3$ solution and one teaspoon of decolorizing carbon—phosphate free—are shaken uniformly for 30 minutes, then filtered through a suitable filter paper, and the colorless extract is collected. If the extract is colored, more decolorizing carbon is used. A suitable aliquot of the extract—usually 5 milliliters—is placed in a 25-milliliter Volumetric flask for the colorimetric determination of phosphorus.

If an aliquot smaller than five milliliters is used, sodium bicarbonate solution is added to make a total of five milliliters so that the solution pH will be uniform for developing the color. The standard phosphate curve is prepared with the sodium bicarbonate solution included. The extracted phosphate is expressed in parts per million of phosphate—PO_4—in the soil extract in the results reported in this article.

* Source: U. S. D. A. Circular 939, S. R. Olsen et al., March 1954.

Yield Increase of Seed Cotton from Phosphate Fertilization in Relation to $NaHCO_3$–PO_4 Values of Untreated Soils



Relation of sodium bicarbonate-phosphate values to probable phosphate fertilizer needs

Parts per million phosphate in 1:20 Soil:$NaHCO_3$ Extract	ppm PO_4	Probable phosphate condition of cotton soil
	0	
Less than 1 ppm PO_4	.2	Low phosphate (Response likely)
	.4	
	.6	
	.8	
1 ppm PO_4	1.0	Critical level
	1.2	
	1.4	
	1.6	
Greater than 1 ppm PO_4	1.8	Phosphate adequate (Response unlikely)
	2.0	
Greater than 2 ppm PO_4	+ 2.0	(Response very unlikely)

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may remain unused in the form of residues left in the woods, and slabs, edgings, and sawdust resulting from manufacture.

In 1953 about 175 million cubic feet of such wood residues were produced in Humboldt County. About two fifths of the total was left in the woods—the bulk of it in the form of pieces too small or of too low a quality for use in sawmills or veneer plants. Much of this type of unused raw material is suitable for pulping. But unless an active local market for pulpwood is established, such logging residues cannot be considered part of the effective wood supply.

Substantial progress has recently been made in using coarse sawmill and plywood plant residues for pulp chips. Twelve plants in the county are now equipped with chippers, producing raw material for pulp mills located elsewhere in the State. Large volumes of unused mill residues remain, however.

These limitations on the volume, accessibility, and utilization of timber mean that Humboldt County is approaching the most difficult part of its transition from old-growth timber liquidation to permanent timber management. The county still has time to do many things that will help in mitigating future raw material shortages which would inevitably result if present trends continue. Permanent stability of timber industries can only be obtained if the forest land in the county is under effective management. Moreover, such management is needed now if the county is to avoid in the future the sort of crisis which has wrecked the economies of many other timber-dependent areas.

At present, net timber growth in the county is estimated at about 440 million board feet per year, or a little over 250 board feet per acre annually. Almost four times as much—960 board feet per acre—would be needed to balance the 1951 level of cutting.

Commercial timber growth in the redwood stands can be increased by cutting mature stands selectively. This means removing now only the bigger, overmature trees and leaving a fairly heavy reserve stand of thrifty younger trees. Such cutting increases annual growth substantially on redwood areas. Although selective cutting is now an established practice in Humboldt County, there is still much need to increase the area so treated and to leave heavier reserve stands.

Management of Douglasfir stands for increased timber growth would require cutting only those patches of timber in the stand which are now overmature, and leaving untouched those areas now occupied by thriftily growing trees. The current practice of clearcutting Douglasfir stands over a large area of 100 or more acres has resulted in destroying much small timber which would have grown rapidly if left on the ground and has not led to satisfactory restocking of the land.

The cutting practices needed to build up timber growth will only be widely adopted if certain existing economic obstacles to forest management are removed. Among the most important of these obstacles are taxation policies which discourage timber growing, the difficulty of providing adequate technical forestry advice for the large number of landowners with small forest holdings, unfamiliarity of many owners with timber markets, and the need for better fire protection. Problems such as these cannot be solved by the timber owners and operators alone.

To use the timber resources fully and to realize their potential economic benefits will require efforts by all citizens: efforts to understand the forest situation; to recognize the potential benefits from improving it and the costs of failing to do so; and to put into effect practical measures of general county policy which seem likely to be essential for continued timber prosperity.

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POPULATION

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butter, and eggs are prominent examples—have shifted to the import category. As these deficits occurred, they were filled by inshipments from other states. Meanwhile, the production of export commodities—many of which California is the nation's principal or sole supplier—has continued without regard to the size of the state's market. Thus, the dominant influences governing the agricultural output of California have been those of demand outside of the state rather than within it.

Influence of Markets

Of the few commodities for which the state is on a self-sufficing basis, market milk is the most important and most likely to adjust to the needs of an expanding state population.

There would appear to be no compelling reasons for expecting a state market based on 20 or 25 million people to have much more influence on what California agriculture produces—other than such commodities as market milk—than a market based on 12 million. Hence, there appear to be no reasons for an expanding population, in and of itself, to induce a trend toward a more self-sufficing agriculture.

Flexibility and adaptability have always been outstanding characteristics of California's agriculture. Future changes —even if the state continues its rapid growth—are likely to be influenced much more by national and world markets than by the size of the state's markets or by the need of an expanding occupational base to absorb its mounting population.

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measured, have always been the source of most reliable information. With the complexity of modern farming, diversity of soil conditions, variety of crops and management practices, field testing becomes a difficult and time-consuming task.

In experiments conducted to date, the most reliable and easily applied diagnostic guide in cotton fertilization is the sodium bicarbonate test for available phosphorus.

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The above progress report is based on Research Project No. 1437.

NEMATODES

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have continued to make satisfactory progress during the second year of growth.

Most growers prefer to replace old vineyards immediately following their removal, but it is likely that a rotation program—followed by soil fumigation—will be essential to obtain productive vineyards for the length of time necessary to make them profitable. The minimum time for such rotations has not been determined, but in this case, three years seem to be sufficient.

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L. A. Lider, Assistant Professor of Viticulture, University of California, Davis, has cooperated in rating the vines and evaluating their growth.