Soil Test for Phosphate

new method of chemical analysis of soil for available phosphate is rapid and accurate

Frank T. Bingham

A new test for available phosphate in soils requires only standard laboratory equipment. It is rapid, economical and gives a better correlation with pot and field experiments than other extraction methods commonly used.

Before any confidence can be placed in chemical soil tests, they must be correlated with plant growth. In the present study, the results from over 500 greenhouse pot tests and 108 field trials were available for verifying the value of the new method of phosphate determination.

In the greenhouse pot test, the soil to be examined is placed in flower pots and given a treatment of nitrogen, potash, and phosphorus. An indicator plant—such as lettuce or barley—is grown for a period of several weeks. The yield obtained is designated as the *full treatment yield.*

In a parallel experiment another sample of the same soil is given a partial treatment by adding nitrogen and potash only. The yield obtained is the *partial treatment yield.*

The relative phosphate-yield—P_o—is calculated by dividing the partial treatment yield by the full treatment yield, multiplying the ratio by 100. The relative phosphate-yield is a biological measure of the available phosphate in the soil.

A valid chemical soil phosphate test should give a good correlation with relative phosphate yields as well as with the field tests.

The available phosphate was determined on over 350 different California soils which had been subjected to pot tests. Eliminating the soils in which the full treatment yields were very low—toxicity effects—a positive correlation was obtained by plotting the relative phosphate-yield against the amount of phosphate extracted.

A plot curve was obtained on phosphate-yields of Romaine lettuce. Good growth was attained by the lettuce plants for concentrations of phosphate greater than 1.0 ppm—parts per million.

The new method of chemical extraction of available phosphate correlates with lettuce pot tests.

METHOD OF PHOSPHATE DETERMINATION

Ten grams of air dry soil which had passed through a 2 mm. sieve are weighed into an Erlenmeyer flask containing 100 mls. of distilled water. The mixture is shaken for a period of five minutes and then filtered through a No. 12, 24 cm. folded filter paper. The filtrate is centrifuged 15 to 20 minutes. A 50 ml. aliquot of the centrifuged filtrate is used to determine phosphate colorimetrically. The phosphate extracted is expressed in parts per million of the filtrate.

Field Trial Correlations

In coöperation with the Agricultural Extension Service and the Soil Conservation Service more than 100 phosphate field trials were conducted on 68 different soil series throughout the State.

The field and truck crops tested were: alfalfa, barley, Bur clover, celery, corn, cotton, flax, Ladino clover, oat-vetch pastures, onions, sweet potatoes, and sugar beets. Small grains were the predominating crop.

The rate and mode of phosphate fertilization was not the same for all plots. The usual rate of application varied from 40 to 80 pounds of phosphate per acre. The mode of application was either broadcasting or placing. Only a qualitative response is recorded for each site.

The 108 soils—whose response to phosphate fertilizer in field trials are recorded—were analyzed by the new method. They were classified into groups according to the soil analysis. In each group the per cent of soils responding to phosphate fertilization is given.

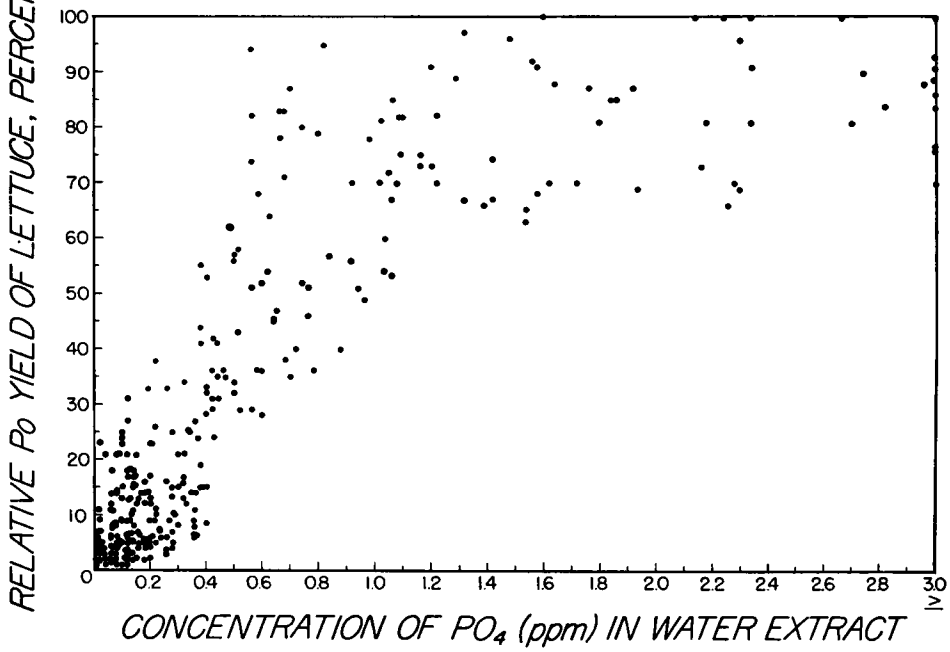
Relation of responses to phosphorus fertilization in the field to the chemical extraction.

PO_4 extracted ppm	Number of field trials	Per cent of soils responding to phosphate fertilization
0–0.20	54	85
0.21–0.30	11	82
0.31–0.40	7	100
0.41–0.50	6	16
0.51–1.00	9	13
Over 1.00	21	5

This data indicates deficiency for concentrations less than 0.40 ppm. For

Continued on page 14

Correlation of greenhouse pot test yields with the chemically extracted phosphate.



PHOSPHATE

Continued from page 11

concentrations greater than 0.50 ppm deficiency is unlikely to occur—only two out of 30 soils gave a response.

In the light of field and greenhouse results, the following ranges of phosphate in water extract are suggested for tentatively defining the status of available phosphorus in a given soil.

Class *1*. Response likely, less than 0.30 parts per million of phosphate.

Class *2*. Response uncertain, from 0.30 to 0.50 parts per million of phosphate.

Class *3*. Response unlikely, greater than 0.50 parts per million of phosphate. It must be emphasized that these ranges of phosphate are expressed on the solution basis.

An anticipated response to phosphate fertilization implies that only phosphorus is the limiting element and that there exists no toxic condition in the soil. In California often nitrogen must be added to secure a phosphate response.

In the case of a phosphorus-deficient soil, response can be expected only when sufficient amounts of phosphate have been added. In the case of a soil containing minerals of the kaolinite type, fixation would be great. This would require considerably more phosphate for a response or a banding of the fertilizer in the immediate vicinity of the roots.

The ranges of phosphate suggested for interpretation of the chemical extraction apply only to the crops listed, mainly pastures, field crops and truck crops.

Field experiments suggest that these responses are especially pronounced for winter crops.

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The above progress report is based on Research Project No. 1157.

CLINGS

Continued from page 9

is becoming moist is to compare the thermometer readings.

Because of the large trimming losses—pits and peel—the over-all drying ratio is less favorable than for other fruit. A good quality fruit dries about 9:1 and a higher ratio is found for orchard run lots.

To complete the reduction of moisture content to about 20%, the fruit is removed from the dehydrater and allowed to stand for several hours.

In foggy climates this plan can not be followed, for standing fruit might actually absorb additional moisture from the air. In such places, the temperature at the finishing end of the tunnel is reduced to about 150° F and the drying finally completed while the fruit is still in the tunnel.

The cooled fruit is removed from the trays to clean, wooden boxes for temporary storage before shipping.

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CITRUS

Continued from page 10

aration of 500 gallons of 2,4-D spray are given in the accompanying table.

Experimentally the spray has been applied as a complete coverage spray of from 15 to 20 gallons per tree to as little as about six gallons per tree. Applications of four gallons per tree or less do not appear to be satisfactory at the concentrations listed. It seems reasonable to expect that spray-dusters, boom sprayers, or other equipment applying at least six gallons per tree of the 2,4-D sprays listed, would be satisfactory.

Much more information is needed on application methods before more than these tentative conclusions may be drawn.

Inasmuch as 2,4-D used to reduce mature fruit drop has been found to be compatible with the usual spray chemicals, it seems likely that when used at somewhat higher concentrations for fruit size increase it will likewise be compatible.

When applying 2,4-D, it seems desirable to reduce the curling of the new young leaves by delaying application until after the spring leaf growth has occurred. In some trials, although leaf curling has been severe, it has not reduced production of fruit quality. Succeeding leaf growth flushes usually have appeared normal.

Spraying Valencia oranges and grapefruit with 2,4-D to increase fruit size of next season's crop has not been found to increase fruit size of the current, mature crop. It will, however, effectively reduce mature fruit-drop of the current crop.

Trials are now in progress to compare 2,4-D with 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and other chlorinated phenoxy acids for effectiveness in increasing fruit size. Preliminary data indicate that 2,4,5-T is at least as effective as 2,4-D.

The over-all effect of 2,4-D sprays to increase citrus fruit size seems to be an accentuation of the juvenile characteristics of the fruit. This includes large fruit size, delayed maturity, dark green young fruit; somewhat rough, pebbly rind to maturity; and thick fruit-stems.

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SPINACH

Continued from preceding page

trace of fungus penetration or development. The freedom from disease, then, can be considered to be true immunity, rather than high-level resistance.

The consistent reaction of the immune stocks during the winters of 1947–48 and 1948–49, have not suggested the presence of any physiologic strains of the fungus in the Davis areas, although there was ample opportunity for infection from natural sources throughout the course of the experiments.

Because of the predominantly dioecious habit of spinach, self-pollination is not normally possible. Inheritance data, therefore, have been secured on the first generation resulting from the cross between immune and susceptible plants and on the first backcross of immune first generation plants to the susceptible types.

The results of these experiments have shown that immunity is simply inherited as a single dominant genetic character. Because of this, it will be possible to transfer to commercial spinach varieties the complete freedom from downy mildew which has been found in the Iranian variety.

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TIMBER

Continued from page 7

Whitaker's Forest is situated in one of the most productive timber types in California. Sugar pine, ponderosa pine and white fir are all important timber trees, and the sequoias here have demonstrated their ability to grow in height and volume at a rate exceeding that of most softwood tree species.

The east portion of the forest above the camp clearing is cooler and somewhat more moist than the west portion and contains a mixed stand of sugar pine, white fir and sequoia with occasional incense cedars and black oaks.

Ponderosa pines appear in greater number towards the west with increase in warmth and dryness and the sequoias drop out of the stand before the west boundary is reached.

From there west on the National Forest there are virtually no sequoias at this elevation. A heavy stand of mature ponderosa pine on the ridge west of the property produced a large volume of timber when cut under National Forest timber sale in 1944 and 1945.

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