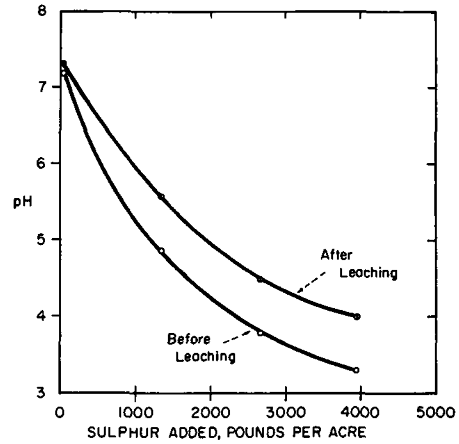
Sulfur requirement of soils for control of

Scab Disease of Potatoes

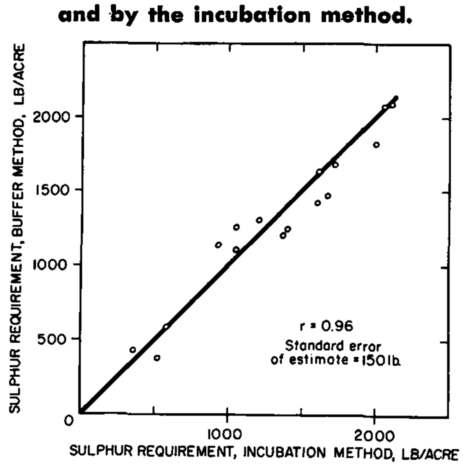
estimated rapidly by new method

P. F. Pratt



Relationship between pH and the rate of application of sulfur to an alkaline noncalcareous soil before and after *salts* were removed by leaching with water. All pH determinations were measured following a three-month incubation period.

Relationship between sulfur requirement measured by the buffer method and by the incubation method.



Coarse-textured noncalcareous soils of southern California often require the addition of sulfur to acidify the soil for the control of scab disease of potatoes.

Below a comparatively narrow range of pH—relative acidity—values, toxic concentrations of soluble manganese or aluminum, or both, seriously reduce the growth of the potato plant and above this range the scab disease is not adequately controlled. The upper and lower limits of the control range depend on the sensitivity of the potato variety to the disease and the manganese and aluminum properties of the soil, but the usual desired range is between 4.8 and 5.4.

A method of estimating the correct amount of sulfur to add to the soil is necessary to avoid adding too little or too much.

For the purpose of having a specific target for developing a rapid evaluating method, the sulfur requirement was arbitrarily selected as the sulfur needed to bring the soil pH to 5.2 measured on the saturated paste of the salt-free soil. Since salts depress the pH, and most growers use acidifying fertilizers, the pH of the soil in the field will be below 5.2 if the sulfur requirement is accurately measured and the irrigation water used is free of bicarbonate.

Sixteen soils were incubated with measured amounts of sulfur until pH values no longer changed with further incubation, which required about three months for most soils. Each soil was treated with four levels of sulfur, the amounts of sulfur depending somewhat on the original pH and the cation-exchange capacity of the soil. After the incubation period the soils were leached with a volume of water equal to five times the volume of the soil sample and the pH was measured again. The pH of the leached soil was plotted against the amount of sulfur added and the sulfur required to acidify to pH 5.2 was estimated from the resultant graph. The sulfur requirement obtained by this method was used as a standard with which to test the more rapid buffer method.

A number of acid buffers were prepared and tested by adding a given volume of buffer to a given weight of soil and measuring the change in pH of the buffer at various intervals of time. The change in pH of the buffer was plotted against the sulfur requirement by the incubation method to learn how well the two were correlated.

The buffer solution which gave the best correlation was prepared by dissolving 2.0 grams of calcium acetate monohydrate, 1.8 grams of p-nitrophenol, 3.0 grams of potassium chromate, 4.7 grams of potassium acid phthalate and 1.0 milliliter of 88% formic acid in about 800 ml—milliliters—of water. The p-nitrophenol dissolved best when added separately to about 200 ml. of hot water. The pH of the solution was adjusted to 2.0, using 6 *N* hydrochloric acid, and then diluted to 1.0 liter. When 5.0 ml. of the solution are diluted with 35 ml. of water the pH should be 2.50.

Forty grams of air-dry soil were put into a beaker and 35 ml. of water added followed by 5.0 ml. of buffer. Then the wet soil and the mixture were stirred thoroughly. After 30 minutes the pH of the soil-buffer suspension was measured. The estimated sulfur requirement is equal to 100 pounds sulfur per 2,000,000 pounds of soil for each 0.10 pH unit above pH 3.70. For example, if the pH of the soil-buffer suspension were 4.70 the sulfur requirement would be 1,000 pounds per 2,000,000 pounds. At all times the pH meter was adjusted to pH 2.50 using a solution made by diluting 10 ml. of buffer with 70 ml. of water.

The difference in pH before and after leaching to remove salts was relatively large for the soil represented in the upper

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Covering the bottom of the truck bed with a ¾″ rubber pad could reduce the injury for the 2′, 3′, and 4′ drops by 5%, 10%, and 18%. Increasing the drop to the truck bed from the conveyor chain of the loader increased the amount of injury. Dropping tubers from a 4′ height caused 20% more injury than dropping them from 3′.

Each time the potatoes were handled some injury occurred, but the digger and the loader caused the largest single increases in injury. In field IV the injury after digging was less than 4%. Slower operation of the diggers and loaders, thorough padding, and careful handling could eliminate much of the mechanical injury to potato tubers during harvesting.

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Efficient distribution of water in

Irrigating Annual Crops

with limited supplies in drouth years

John R. Davis and Melvin A. Hagood

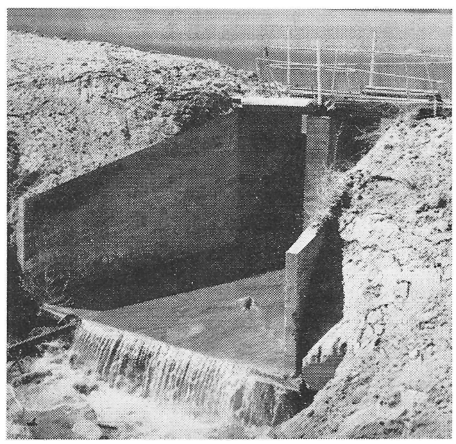
In every water-deficient year, growers are confronted with a series of decisions concerning the utilization of a limited supply of water for crop production.

Perennial crops such as tree fruits, vines and alfalfa require some minimum application of water to protect the crop and the investment for following years, thus influencing to some extent the final decisions. With annual crops, however, the flexibility and also the difficulty of decision making increases considerably, because so many factors have an influence on the end results.

In addition to the questions of how much water to apply and when to apply it, growers must decide the uniformity with which water is applied, the most economic application of water, which crops to irrigate, or even whether to irrigate at all. As individuals, growers must make decisions that are based on extremely variable and complex functions and in the face of a sometimes critical economy.

To provide information to illustrate some of the decisions that can be enacted in a farm situation, a replicated plot study of irrigation of sweet corn was initiated at Davis in 1960. Sweet corn is a fairly representative annual crop, and the findings may be applied to other crops.

In one test plot, to be used as a check, the soil was irrigated with a depth of water and a frequency according to good local practice, so that throughout the growing season the moisture content of the soil always exceeded 30% of the total



Limited water supplies require efficient irrigation.

available moisture. The remaining plots were irrigated at the same time on the same day, but received at each irrigation 25, 50, 75, 150, and 200% of the depth of water applied to the check plot. The objective of the six treatments was to provide conditions in the plots that might represent certain distributions of water within a field, or that might simulate results of underirrigation or overirrigation with a given frequency of irrigation.

Golden Cross Bantam sweet corn was planted in the plots on May 2 in Yolo silty clay loam soil, a deep permeable soil with good internal drainage. Nitrogen was side-dressed on June 2, at the rate of 90 pounds per acre. All plots had been pre-irrigated to a depth of about 6′. The two inside rows of corn in each plot were harvested on July 28 and on August 2, and the weight and number of marketable ears were measured for each harvest. The yield information definitely reflected the effects of pre-irrigation, therefore the results of the study may be interpreted for those conditions where pre-irrigation is inevitable, due to winter rains, leaching operations, or the availability of cheap water. Where pre-irrigation is not possible, the information is valid but the numerical values would change.

The yield results for the six irrigation treatments are shown in the smaller graph. Although the maximum yield of about 5.2 tons per acre was attained with a depth of application of 32″ of water, the most efficient irrigation, from the

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graph. At a pH of about 5.0 in the salt-free soil the average pH for all soils was 0.5 unit lower in the unleached than in the leached soil. The range of differences was 0.17 to 0.77 pH unit.

The lower graph on page 5 presents the relationship between sulfur requirement by the buffer method and by the incubation method. If the sulfur estimated by the buffer method had been added to these soils the pH—as indicated from the data obtained by the incubation method —would have been within the 4.8 to 5.4 range for all soils. Nine of the soils would have had a pH in the 5.0 to 5.2 range. Two would have had a pH between 4.8 and 5.0 and five would have had a pH between 5.2 and 5.4. Thus, the buffer method does have some reliability in predicting the sulfur requirement.

The estimated sulfur requirement as expressed in pounds per 2,000,000 pounds can be converted to pounds per acre-six-inches if the soil has a bulk density of about 1.3 to 1.4. The amount of sulfur must be adjusted proportionately for lower or higher bulk densities.

All of the soils used in this study were relatively coarse-textured with low amounts of organic matter. The buffer method seriously underestimated the sulfur requirement on an organic soil and on a clay soil but because most potato production in southern California is on coarse-textured soils, the underestimation for these two soils does not represent a serious problem.

The buffer method for the estimation of the amount of sulfur needed to acidify coarse-textured soils to pH 5.2 is rapid and requires no special equipment. The correlation between the sulfur requirement by the buffer method and by an incubation method was 0.96 with a standard error of estimate of 150 pounds of sulfur per 2,000,000 pounds of soil.

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