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## A Study of Certain Green Manure Crops in Making Rock Phosphate Available in Soils

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## A STUDY OF CERTAIN GREEN MANURE CROPS IN MAKING ROCK PHOSPHATE AVAILABLE IN SOILS.

ROSS L. BANCROFT AND B. J. FIRKINS.

At the present time the world is in the midst of the greatest conflict ever staged. The byword on the lips of every thoughtful American is, "Food will win the war." In order that food may be conserved it must first be produced. Therefore, increased crop production must be stimulated. We must produce larger crops upon a given area, that is, intensive farming should be practiced.

Primary among the controlling factors in securing increased crop production is an abundant supply of active organic matter and sufficient soluble phosphorus for the entire needs of the growing crop.

Available or soluble phosphorus is obtained commercially by mixing raw phosphate with sulfuric acid. At the present time sulfuric acid is difficult to obtain. Accordingly the idea was conceived of growing a green manure crop on soil to which raw rock phosphate had been applied. By selecting a green manure crop which is able to utilize so-called inert phosphate obtained from raw rock and by plowing the same under, the succeeding crop should derive at least two beneficial effects. In the first place an essential and desirable amount of active organic matter would be supplied to the soil, also a quantity of soluble phosphorus might be made available for the following crops.

Accordingly in order to study this problem a miami silt loam soil was selected. This soil contained a small amount of organic matter and an analysis showed the total phosphorus content to be .033 per cent. Ten pounds of this miami soil was placed in pots of one gallon capacity. The equivalent of 1200 pounds per acre of Tennessee brown rock phosphate was added to the miami silt loam soil. Soluble salts containing plenty of the other essential plant foods were added and thus phosphorus was made the controlling element in the crop production.

The following green manure crops were sown on this soil: buckwheat, Japanese millet, German millet, both bearded and beardless barley, rape, Iowa 103 oats, durum wheat, soy beans, cane, alfalfa, alsike and red clover, cow peas and timothy. Ma-

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turned under. It has been found that Japanese millet is not able to utilize so-called inert phosphorus from raw rock. Accordingly Japanese millet was immediately seeded on these green manured soils. The millet was allowed to mature and then was harvested. The yield was calculated and the amount of phosphorus contained in the crop was compared with the yield of millet. Analyses were made also to determine the amount of phosphorus in the soil at different stages of growth, soluble in fifth normal nitric acid. In connection with this problem approximately 550 determinations of so-called available and total phosphorus were made.

It was found that the greatest yield of millet was produced from the soils on which alfalfa, bearded barley, durum wheat, and cow-peas had been turned under as green manures. These higher yields accompanied a lower percentage of residual phosphorus in the soil and a consequent lower availability of this residual supply. Where any one of the four above mentioned crops was used as a green manure and thus available phosphorus was formed a profitable increase in total yield of millet was obtained over the check.

There are numerous common cereal crops besides millet which make a much better growth if the phosphorus in the soil is in an available form.

From the results of this experiment it seems possible that the practice of manufacturing soluble or available phosphorus in the soil by aid of certain green manure crops may prove a valuable asset to an increased crop production in the United States.

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