

# A COMPARISON OF THREE SOIL TEST P EXTRACTANTS ON AN ALKALINE LOUISIANA SOIL

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## Abstract

A comparison was conducted between Strong Bray, Mehlich 3 and Olsen's P extractants on a Norwood silt loam (Fine silty, mixed, calcareous, thermic Typic Udifluent) to determine which extractant was most correct in recommending fertilizer P. Soil test P levels varied greatly across the years tested. Strong Bray correctly recommended P fertilizer two of three years tested. Olsen's correctly recommended P fertilizer one of three years. Mehlich 3 incorrectly recommended P fertilizer all three years. However, the Mehlich 3 incorrect recommendations may be the result of recommending P fertilizers as a small maintenance amount. In all cases of incorrect recommendations, the methods recommended fertilizer where no yield response occurred. In no case did any method under-recommend P fertilizer.

## Introduction

In alkaline soils, there is a question as to the correct P soil test extractants to use. The LSU Soil Testing Laboratory uses Strong Bray (0.1 Normal hydrochloric acid plus 0.03 Normal ammonium fluoride). This extractant is strong and active. It is feared that Strong Bray may extract insoluble calcium phosphates in alkaline soils, overestimating the amount of plant-available P in the soil.

When farmers ask a laboratory to use both Strong Bray and Olsen's (Sodium Bicarbonate) to extract P in alkaline soils, they often receive a report stating the Strong Bray P as high and the Olsen P as low. The difference in recommendations may cost as much as \$20 per acre.

## Materials and Methods

A test was initiated to compare Strong Bray, Olsen's, and Mehlich 3 on a Norwood silt loam. The initial soil pH was 7.2. Soil test P values for each of the extractants in each year are shown in Table 2. These are averages from the 0 P<sub>2</sub>O<sub>5</sub> plots. Four rates of P<sub>2</sub>O<sub>5</sub> were used: 0, 30, 60 and 90 pounds per acre. The test was replicated three times in a Randomized Complete Block design.

Plot integrity was maintained through the three year study. Plots were four rows wide and 400 feet long. All plots

received 100 pounds of N per acre and 80 pounds of K<sub>2</sub>O per acre each year.

Soil samples were taken before fertilizer addition each year. Fertilizer P was broadcast and incorporated. All other cultural practices were identical on all plots and were based on recommendations of the LSU Agricultural Center and Pest Management Enterprises, a private consulting firm.

## Results and Discussion

Soil test P values varied greatly among years, even though the soil samples were collected at approximately the same time of year (Table 2). Strong Bray varied from a low of 86 ppm (M) P in 1994 to a high of 124 ppm (VH) P in 1995. Olsen extractant varied from a low of 6 ppm (L) P in 1994 to a high of 23 ppm (H) P in 1995. Mehlich 3 varied from 18 ppm (L) P in 1994 to 38 ppm (M) P in 1993.

Cotton lint yields were unaffected by P<sub>2</sub>O<sub>5</sub> addition in all three years. There were no statistically significant differences due to P<sub>2</sub>O<sub>5</sub> within years or averaged over the three year period (Table 1). Cotton yields were average in 1993, good in 1994 and very poor in 1995. We were able to test the extractants in a wide range of climatic conditions.

In 1994, soil test P was lower in all three extractants than in any other year. There was a trend towards higher yields with 60 pounds P<sub>2</sub>O<sub>5</sub> per acre in this year, though not statistically significant. In 1993 and 1995, when soil test P levels were higher, there was not even a numerical advantage to using P<sub>2</sub>O<sub>5</sub> fertilizers.

Table 2 shows the average soil test P levels by extract and year. The average soil test P level was calculated by averaging the values in the 0 P<sub>2</sub>O<sub>5</sub> plots. The table also shows whether or not fertilizer P was recommended, and if the recommendation, or lack thereof, was correct.

Strong Bray correctly recommended no P<sub>2</sub>O<sub>5</sub> fertilizer in 1993 and 1995. It incorrectly recommended 40 pounds P<sub>2</sub>O<sub>5</sub> per acre in 1994 when soil test P was considered medium. At a medium level, the LSU Agricultural Center recommends fertilizer with the knowledge that there is about a 50-50 chance of yield response. The recommendation is made for the possibility of the yield response and for a maintenance level. No fertilizer is recommended when soil test P levels are high or very high.

Olsen (Sodium Bicarbonate) correctly recommended no P<sub>2</sub>O<sub>5</sub> fertilizer in 1995. It incorrectly recommended fertilizer in 1994 when soil test P was low, and in 1993 when soil test P was medium.

Mehlich 3 incorrectly recommended P<sub>2</sub>O<sub>5</sub> fertilizer in 1994 when soil test P was low, and in 1993 and 1995 when soil test P was medium.

In this test, Strong Bray was superior in ability to predict a yield response to P<sub>2</sub>O<sub>5</sub> fertilizer. More research is needed on other soils to support this finding.

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**Table 1. Effect of Phosphate Fertilizer Cotton Yield (1993-95)**

Year	-----Yield lint cotton/A-----			
	0	30	60	90
1993	817	787	737	777
1994	969	984	1087	871
1995	643	662	594	599
Avg.	810	811	806	749

Yields were not significantly different in any year at the 5% or 10% level of probability.

**Table 2. Accuracy of 3 Phosphorus Extractants**

Strong Bray		Fertilizer Recommended?	Recommendation Correct?
Year	PPM P		
1993	104 (H)	No	Yes
1994	86 (M)	Yes	No
1995	124 (VH)	No	Yes
Olsen			
1993	11 (M)	Yes	No
1994	6 (L)	Yes	No
1995	23 (H)	No	Yes
Mehlich 3			
1993	38 (M)	Yes	No
1994	18 (L)	Yes	No
1995	31 (M)	Yes	No