

MODIFICATION OF THE AB-DTPA SOIL TEST TO CORRECT BLUE-P ANALYSIS

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Abstract

The phospho-molybdenum blue color intensity and stability in relation to phosphorus concentration in solution and color, are greatly influenced by the presence of large amounts of ammonium. Our objective was to study the stability with time of the Soltanpour and Schwab blue-P calibration graph. Standard solutions containing 0.00, 2.50, 5.00, 10.00, 20.00 and 40.00 mg P L⁻¹ were made in AB-DTPA extracting solution. A calibration graph with an acidity of 0.18 M H₂SO₄ was prepared by placing a 0.25 ml aliquot of standard in a 2.5 cm matching spectrometric tube. Then 0.25 ml of 5M NaOH was added and allowing the reaction to occur for 15 min. Then, 10.0 ml of pure water and 2.0 ml of color developing reagent (CDR) were added. Absorbance readings were obtained at 882 nm at 10, 20, 30, 40, 60, 90 and 120 min. after the addition of the CDR. Results indicated that 5M NaOH, greatly enhanced the stability of phospho-molybdenum blue color with time for P concentrations up to 0.80 mg L⁻¹ in the AB-DTPA extracting solution.

Introduction

The 1.0M NH₄HCO₃-0.005M DTPA or AB-DTPA soil test, developed by Soltanpour and Schwab (1977) estimates the availability of NO₃-N, PO₄-P, K, Fe, Mn, Zn and Cu simultaneously in neutral and alkaline soils containing free calcite and dolomite. Soils with high levels of extractable P resulted in P precipitation when CDR was added. Blue-P color in AB-DTPA was not stable with time for high phosphorus standards, due to presence of high levels of ammonium Folsom et al. (1977).

Objective

Identify and correct the interference of phosphorus that is causing the precipitation.

Materials and Methods

Modified AB-DTPA Soil P Test Reagents:

DTPA Solution 0.005 M: In a polyethylene container, dissolve 9.85 g. of DTPA in about 4.8 L of pure water. Stir overnight for total dissolution, dilute to 5.0 L with pure water. This solution is stable with regard to pH.

NH₄HCO₃ 1M-DTPA 0.005 M Extracting Solution @ pH = 7.60: Carefully dissolve 79.06 g. of ammonium bicarbonate in about 900 ml of 0.005 M DTPA. Adjust the pH to 7.60 with slow agitation while diluting to 1 L with more DTPA solution. Prepare this solution fresh daily as needed.

Calibration Standards: Standards containing 0.00, 2.50, 5.00, 10.00, 20.00 and 40.00 mg P L⁻¹ were made in AB-DTPA extracting solution.

5M Sodium Hidroxide: Caution: this solution can get very hot during its preparation. In a plastic container with about 800 ml of pure water, carefully dissolve 200 g. of NaOH and dilute to 1 L with pure water.

Extracting Procedure: Place 10.0 g. of soil in a 125 ml plastic Erlenmeyer, add 20.0 ml of AB-DTPA solution and extract for 15 min. on a reciprocating shaker at 180 cycles per min. filter through medium filter paper. Analyze P in the filtrate with the blue method (Murphy and Riley, 1962).

Blue-P Chemical Analysis: A calibration graph was prepared with an acidity of 0.18 M H₂SO₄ (Rodriguez et al. 1994) by placing 0.25 ml aliquots of std solutions in a 2.5 cm spectrometric tubes. Then 0.25 ml of 5M NaOH was added to each standard, vortex and allowed to react for 15 min. then 10 ml of pure water and 2.0 ml of CDR (Watanabe and Olsen, 1965) were added. Absorbance readings were obtained at 882 nm at 10, 20, 30, 40, 60, 90 and 120 min. after adding the CDR. Soil samples extracts were analyzed from the calibration graph using the same preparation procedure done for the standards

Results and Discussion

In the original calibration standard graph of Soltanpour and Schwab (1977) soil test, the phospho-molybdenum blue color was not stable with time, for the high phosphorus standards (Fig. 1). After adding the CDR, the calibration graph was linear up to 30 min., and then changed to a quadratic model (Rodriguez et al., 1994). This was probably due to the presence of large amounts of ammonium in the AB-DTPA, interfering with phosphorus at a concentration greater than 0.40 mg L⁻¹ which creates a precipitate making the solution cloudy (Folsom et al., 1977). It was suggested that samples with a phosphorus content greater than 0.4 mg L⁻¹ should be diluted in AB-DTPA before analysis. This suggestion is a problem for routine analysis.

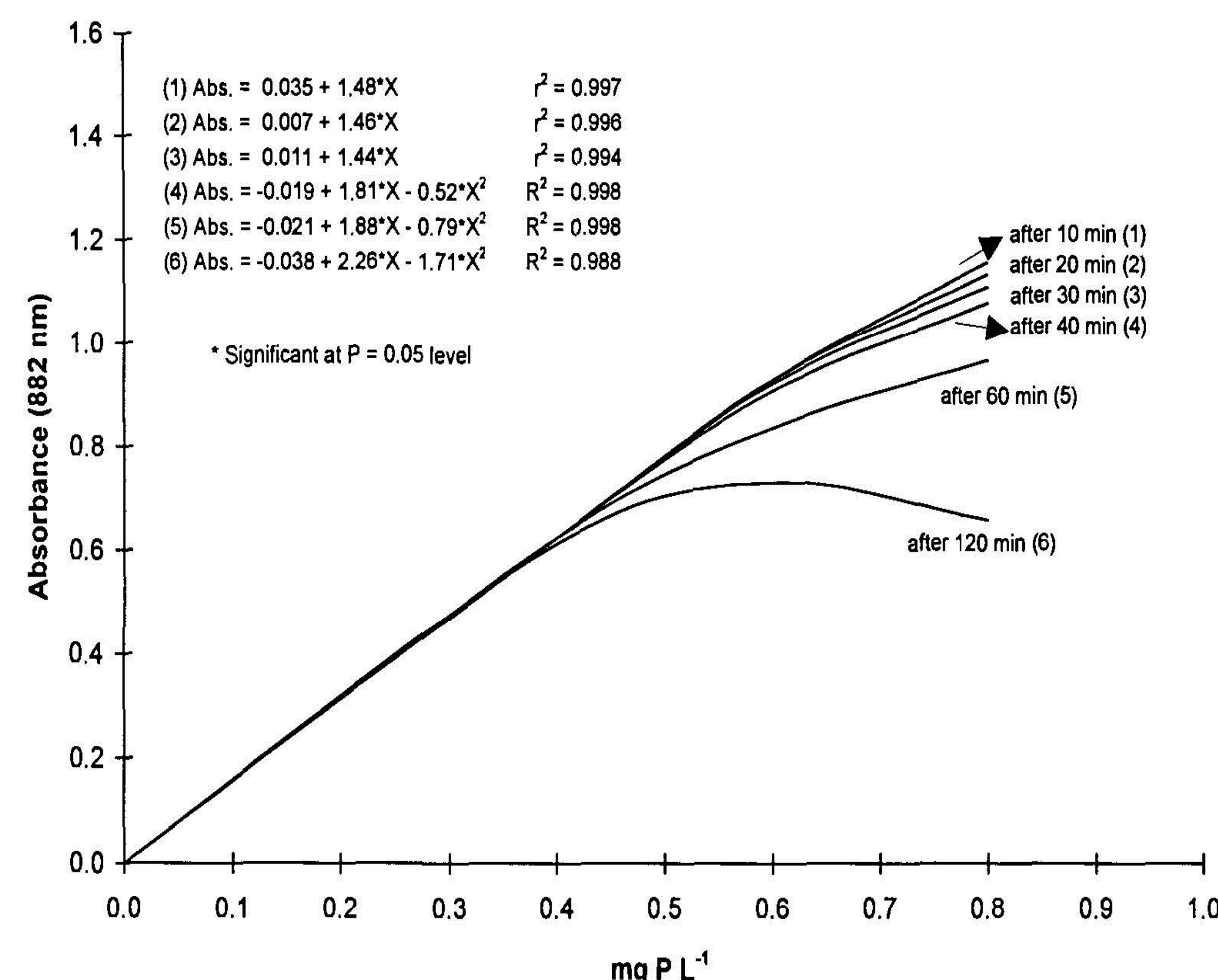


Fig. 1. Soltanpour-Schwab P calibration graphs read at different times.

Instead, the ammonium interference was eliminated from the standards or samples as ammonia with the addition of concentrated sodium hydroxide. Results are presented in Fig. 2. After elimination of ammonium as ammonia, the phospho-molybdenum blue color was stable for at least 60 mins. Which gave sufficient time for the chemical analysis to proceed using a single linear model.

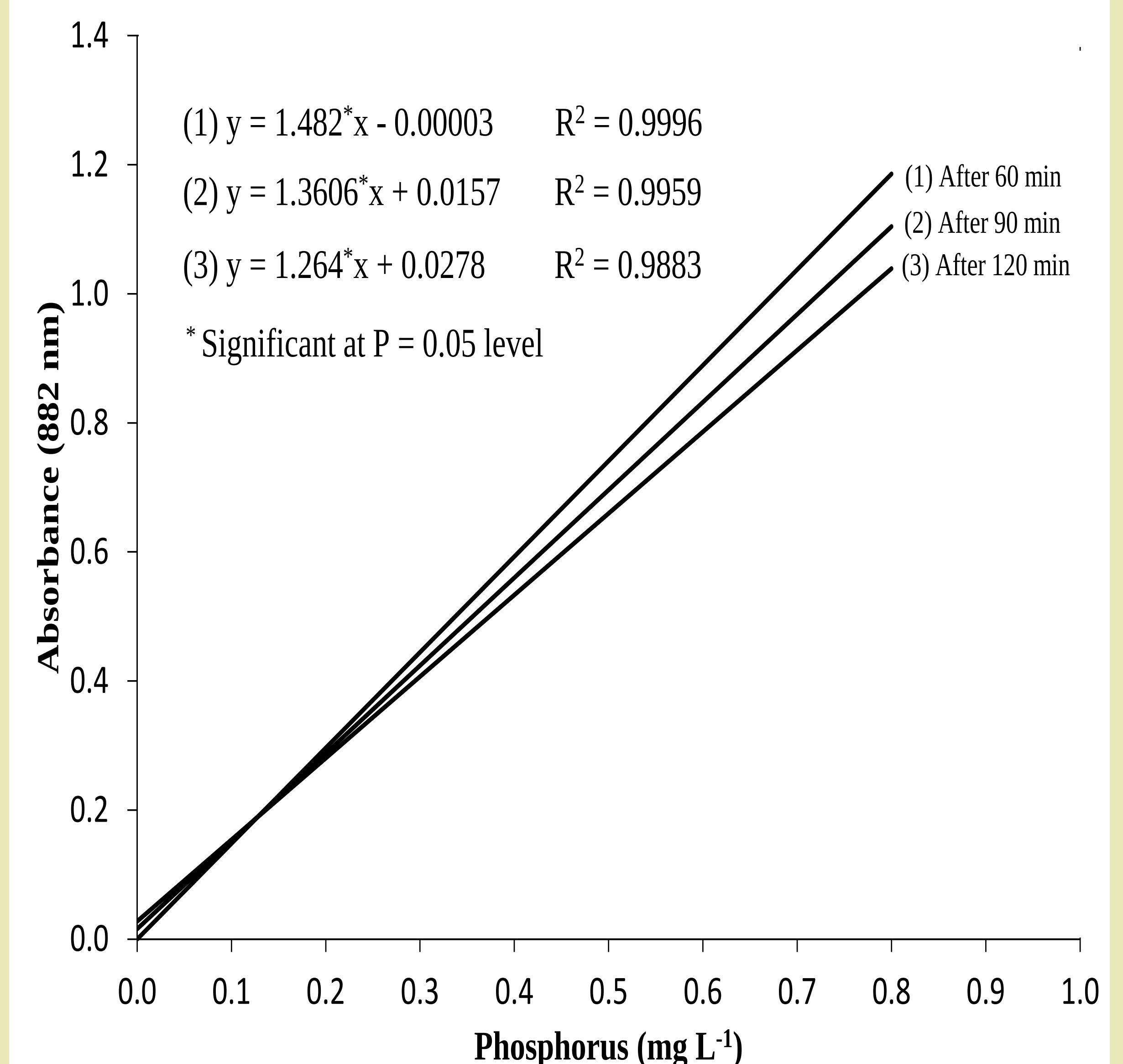


Fig. 2. Corrected Soltanpour and Schwab P calibration graphs read at different times.

Conclusions

Addition of concentrated sodium hydroxide to the AB-DTPA standards and soil extracts, minimize the interference of ammonium, enhancing the stability of the phospho-molybdenum blue color and allowing the quantification of phosphorus with the same linear model for up to 60 mins.

References

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