The Incorporation of Potassium Antimony Tartrate in Molybdenum Blue Method for the Automated Colorimetric Determination of Available Phosphorus in Soils

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ABSTRACT

The incorporation of potassium antimony tartrate (K\textsubscript{2}SbOC\textsubscript{4}H\textsubscript{4}O\textsubscript{4}) in molybdenum blue-ascorbic acid (Mo blue) method for phosphorus (P) determination of Bray & Kurtz No. 2 soil extract was studied. Results obtained by this method are in close agreement with those by Fogg and Wilkinson and Stannous Chloride manual methods.

INTRODUCTION

Several automated methods based on Mo blue-ascorbic acid procedure for the analysis of P in Bray & Kurtz No. 2 extract have been published. Lacy (1965) used a method based on the ascorbic acid reduction technique of Fogg and Wilkinson (1958). Ng (1970) also used a modified ascorbic acid method for the analysis. Grigg (1975) adopted a colorimetric method described by Murphy and Riley (1962). All these methods however, involved heating of a solution to a high temperature to speed color development. This manner of color development is undesirable and should be avoided as Salt (1968) has shown that hydrolysis of organic phosphate occurs under such a condition.

The method described in this paper successfully overcame the problem mentioned. The procedure employed is the modification of Ng method with the incorporation of potassium antimony tartrate to speed color development at room temperature.

MATERIALS AND METHODS

Apparatus
Technicon Autoanalyser II and Pye Unicam Ultra-violet/Visible Spectrophotometer were used.

Reagents
All solutions were prepared from analytical reagent grade materials. The following reagents were prepared:
1. Extracting solution — 0.03N NH\textsubscript{4}F/O. HCl 100ml of 1N HCl solution and 30ml 1N NH\textsubscript{4}F were mixed and made to liter. The solution was adjusted to pH = 1.8.
2. Boric acid — 0.8M (to suppress fluoride interference).
diluted to a liter and 5 drops of Levor IV added as wetting agent.

7. Working standards.
   Standards of 0 to 10mgP/l were prepared in the extracting solution.

Procedure
20ml of the extracting solution was added to 2g soil (60 mesh) in a test-tube (1 X 8") and shaken by wrist inversion at 2 second/inversion for 1 minute, i.e. 30 inversions per minute. On completing the process, the extract was left to stand for one minute before filtering through Whatman No. 2 filter paper.

Determination
The manifold for the analysis is shown in Figure 1. The 0 to 10mgP/l was achieved by using 0.32ml/min sample line.

The sampling rate was set to 50 samples/hour and filters of 660nm were used. The temperature of heating bath was that of room temperature.

RESULTS AND DISCUSSION
Results of twelve selected soil samples to cover the common range of values are given in Table 1. All determinations were carried out in duplicate. The results showed that for soil with low P values, i.e. about 5 p.p.m., the Fogg and Wilkinson method gave higher results compared with either ammonium molybdate/KSbO\(_4\)H\(_4\)O\(_6\) or Stannous Chloride method which agreed well.

According to Salt, the heating of solution to develop the color hydrolysed organic phosphorus from low P soil will give significantly more inorganic phosphorus.

The concentration of potassium antimony tartrate in the ammonium molybdate/KSbO\(_4\)H\(_4\)O\(_6\) method described is sufficient to give a linear calibration graph of up to 10mgP/l. The standard calibration was adjusted to 5.00 and 1.00 unit(s) for standards ranging 0 to 4mgP/l and 0 to 10mgP/l, respectively.

Grigg recommended that the modules should be connected by glass tubing where possible, and a washout of the manifold with 10% sodium hydroxide solution should be adopted to prevent slight baseline drift.
THE INCORPORATION OF POTASSIUM ANTIMONY TARTRATE IN MOLYBDENUM BLUE METHOD

TABLE 1
Comparison of results using different procedures for Bray — Kurtz No. 2 soil extract

<table>
<thead>
<tr>
<th>Sample number</th>
<th>Mo/Sb Autoanalyser Mean (p.p.m.)</th>
<th>S.D.</th>
<th>Fogg &amp; Wilkinson manual Mean (p.p.m.)</th>
<th>S.D.</th>
<th>Stannous Chloride manual Mean (p.p.m.)</th>
<th>S.D.</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>1.5</td>
<td>0.25</td>
<td>2.1</td>
<td>0.92</td>
<td>1.7</td>
<td>0.50</td>
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<td>2</td>
<td>2.0</td>
<td>0.72</td>
<td>2.5</td>
<td>1.95</td>
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<td>3</td>
<td>2.4</td>
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<td>0.68</td>
<td>2.4</td>
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<tr>
<td>4</td>
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<td>4.6</td>
<td>0.74</td>
<td>4.0</td>
<td>0.30</td>
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<tr>
<td>5</td>
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<td>1.00</td>
<td>4.6</td>
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<tr>
<td>6</td>
<td>4.6</td>
<td>1.50</td>
<td>5.0</td>
<td>0.81</td>
<td>4.8</td>
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<td>7</td>
<td>7.9</td>
<td>1.15</td>
<td>7.5</td>
<td>1.05</td>
<td>7.5</td>
<td>1.20</td>
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<tr>
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<td>50.1</td>
<td>2.05</td>
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</table>

CONCLUSION
The improved method which involves incorporation of potassium antimony tartrate is suitable for providing rapid and accurate phosphorus determination of Bray and Kurtz No. 2 soil extract. No heating is required for color development and therefore the question of hydrolysis of organic phosphorus does not arise.

ACKNOWLEDGEMENT
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