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Analysis of Phosphorus on Prill and Liquid Fertilizer

Dita Rahmawati*, Khoirriah Widyasari
Department of Chemistry Education, Universitas Negeri Yogyakarta

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Corresponding Author:

Dita Rahmawati,
Department of Chemistry Education
Universitas Negeri Yogyakarta

Email:
ditarahmawati.2018@student.uny.ac.id

ABSTRACT

The research was conducted on the determination of the levels of phosphorus on prill and liquid fertilizers using the UV-Visible method compared with Indonesian National Standard (SNI 02-2801-2010). Phosphorus is the most important nutrient for crop to gain the high productivity. The sample of the research were prill and liquid fertilizer that had SNI. Phosphorus levels in NPK fertilizer were analyzed using the UV-Vis spectrophotometer method. The result was an analysis of phosphorus levels in prill fertilizers of 14,67% and phosphorus levels in liquid fertilizers of 18,55%. These results are in accordance with the Indonesian National Standard (SNI) 2803:2010, which is a minimum phosphorus content of 8%.

Keywords: *nitrogen, liquid fertilizer*

1. INTRODUCTION

Currently, the use of inorganic fertilizers among farmers is still quite high. The need for fertilizer for agriculture is increasing, but it is not balanced with fertilizer production and the high price of fertilizer. Excessive use of inorganic fertilizers in the long term will actually be detrimental because it can damage the environment such as the soil structure becomes hard and soil microorganisms are decreasing which results in decreased soil productivity (Handayani et al, 2015).

According to their origin, chemical fertilizers (inorganic) are divided into natural chemical fertilizers and artificial chemical fertilizers. Natural chemical fertilizers are taken directly from nature and after undergoing processing and packaging are then sold to consumers. Artificial chemical fertilizers are made from basic chemicals in factories. The nature and character of this fertilizer can be seen from the results of the analysis listed on each package (Worsfold et al., 2016).

Nitrogen fertilizers that have been shown to increase the efficiency of N use include leasing, controlled release N fertilizers and "stable" N fertilizers. Slow-release N fertilizers, such as urea formaldehyde (UF), consist of: low water soluble compounds, which become available on enzymatic hydrolysis (Chalk et al., 2015). The dominant nutrient elements in soil fertility include nitrogen (N), phosphorus (P) and potassium (K) (Firmansyah et al, 2017). Nitrogen (N) is the most important nutrient and has high productivity (Shui-qin et al, 2019). Urea fertilizer is an inorganic fertilizer made by factories containing potassium, phosphate, and nitrogen. In these three elements nitrogen has the most important function in the growth of a plant, especially the growth of leaves (Dewi et al, 2013). Urea is a fertilizer that contains about 45-46% Nitrogen. Its soluble nature makes urea quickly available to plants (Ramdhani et al, 2016). Urea is produced in the form of prills or granules, depending on the finishing process used.

The efficient use of N fertilizer is an attempt to provide fertilizer according to plant needs, so that rice plants easily absorb nutrients optimally and reduce the level of N loss due to accumulation of N in the soil layer in the form of NH_4 and NO_3 or into NO_x gas (Triyono et al., 2013) The availability of nitrogen in this compost is due to the decomposition process of organic matter

carried out by microorganisms. Therefore, there is a need for research related to nitrogen levels in prill fertilizers and liquid fertilizers. So that the composition in the soil can easily cultivate plants with maximum fertility.

Phosphorus is often referred to as the key to life because it is directly involved in almost all life processes. It is a component of every living cell and tends to be found in seeds and growing points. The important problem that must be known from this phosphorus is that some of the phosphorus in the soil is generally not available to plants, although the total amount is greater than nitrogen. In this case, the availability of phosphorus in the soil is very dependent on the nature and characteristics of the soil itself, and how the soil is managed by humans. The addition of phosphorus into the soil is very dependent on the nature and characteristics of the soil itself, and how the soil is managed by humans. The addition of phosphorus into the soil only comes from the deposit or weathering of rocks and minerals that contain phosphate. unlike nitrogen whose addition can be through biochemical binding. Therefore, the phosphorus content in the soil is only sourced and determined by the amount of phosphorus mineral reserves and the level of weathering (Damanik et al., 2010).

The use of compound fertilizers must be adjusted to the needs of the types of plants to be fertilized because each type of plant requires a certain ratio of N, P, and K. In Indonesia, several types of compound fertilizers are circulated with various N, P, and K compositions. The purpose of this study was to determine the levels of phosphorus on prill and liquid fertilizer.

2. RESEARCH METHOD

The samples used is factory prill and liquid fertilizer which had SNI No.02-2801-2010. Sample preparation and analysis was carried out at the Laboratory of Analytical Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta. .

2.1. Tools and materials

The tools used were measuring flask, analytical balance, beaker glass, volumetric pipette, dropper pipette, hot plate, stirrer, funnel, erlenmeyer, pestle and mortar Whatman filter paper, and UV-Vis spectrophotometer.

The material used were potassium dihydrogen phosphate, ammonium molybdate, $SnCl_2$, hydrochloric acid solution and aquadest.

2.2. Preparation of concentrated phosphorus solution 227.941 mg/L

Potassium dihydrogen phosphate (KH_2PO_4) was weighed as much as 0.1 g and then dissolved in a glass beaker using distilled water. Next, it was marked into a 100 mL volumetric flask. This concentrated solution used as the mother liquor in the manufacture of standard phosphorus solutions with various concentrations.

2.3. Preparation of phosphorus standard solution

Preparation of a standard solution of phosphorus with a concentration variation of 2,279; 6,838; 13,676; 20.515; 34,191; 41.029 mg/L was carried out in a 25 mL volumetric flask using the dilution formula. The preparation of the standard phosphorus solution was carried out as quantitatively as possible in order to produce a linear calibration curve.

2.4. Calibration curve creation

Standard solutions of phosphorus with various concentrations of 2,279; 6,838; 13,676; 20.515; 34,191; 41.029 mg/L. Each pipette as much as 25 mL using a pipette volume of 25 mL and put into an Erlenmeyer. Then, 0.25 mL of ammonium molybdate solution and 1 drop of $SnCl_2$ were added. Next, the solution was stirred and allowed to react for 7 minutes. Then, the solution was put into a cuvette and the absorbance of the solution was read at a wavelength of 650 nm (Ngibad, 2019). Furthermore, the absorbance data of each standard solution was made a curve of the relationship between concentration and absorbance using ms. Excel so that the equation of the linear regression line $y = ax + b$ and the value of the correlation coefficient (R^2) shows the linearity of the standard curve.

2.5. Sample testing

A solid sample that has been mashed is taken as much as 1 gram and then dissolved in a concentrated HCl solution, then heated. Cool again then filtered. After that it was dissolved in 100 ml of distilled water, 1 ml was taken and then marked in a 100 ml volumetric flask. Then 25 mL pipetted and put into an Erlenmeyer. Then, 0.25 mL of ammonium molybdate solution and 1 drop of $SnCl_2$ were added. Next, the solution was stirred and allowed to react for 7 minutes. Then, the solution was put into a cuvette and the absorbance of the solution was read at a wavelength of 650 nm (Ngibad, 2019).

2.6. Data analysis

Based on the measurement data of the standard solution and the sample solution, a standard curve was made to obtain the relationship between absorbance (y) and concentration (x). The regression equation of the relationship between absorbance and concentration can be used with the equation:

$$y = ax + b$$

Description:

x = concentration

y = absorbance

a = slope

b = intercept (Dewi, 2013).

The concentration obtained from this curve is the concentration in mg/L units. To calculate the level of phosphorus in percent of the sample, you can use the formula:

$$\text{Rate (\%)} = \frac{\text{Concentration}\left(\frac{\text{mg}}{\text{L}}\right)\times\text{sample volume (L)}\times\text{dilution factor}}{\text{Sample mass (mg)}}\times 100$$

3. RESULTS AND ANALYSIS

Fertilizer is a material added to the soil with the intention of improving the physical, chemical and biological properties of the soil and as an addition to nutrients in plants growing on the soil surface or other growing media. Solid NPK fertilizer is an artificial fertilizer in the form of a solid containing the nutrients Nitrogen, Phosphorus and Potassium (SNI 2803-2010). Each of these components becomes a parameter component in determining the quality of NPK fertilizers, both in terms of N, P, and K content.

The research conducted was the analysis of phosphorus levels in prill and liquid fertilizers. Determination of phosphorus levels in solid and liquid inorganic fertilizers was carried out using a UV-Vis spectrophotometer. Where is the sample that has been mashed first. Then the sample was dissolved in concentrated HCl. The function of HCl is to dissolve the metals contained in the sample. After adding 10 mL of concentrated HCl, the solution turned yellow and then the solution was heated. Then the solution was cooled and filtered. Analysis of phosphorus added ammonium mobilibdate serves as a binder to phosphorus because phosphorus is easily oxidized. Sulfuric acid reacts with ammonium molybdate:

$$H_2SO_4(l) + (NH_4)_2MoO_4 \rightarrow H_2MoO_4 + (NH_4)_2SO_4$$

Then 0.25% $SnCl_2$ was added to form a blue complex, which was indicated by the following reaction equation:

$$H_2MoO_4 + 6H^{4+}(aq) + 4SnCl(aq) \rightarrow [Mo(NH_3)_6]^{2-} + 4Sn^{2+}(aq) + 8HCl\,(aq) + 2O_2(g)$$

This study uses a calibration curve analysis technique. In the calibration curve method, a standard solution series is first made. In this study, a series of standard solutions of phosphorus with a concentration of were used 2,279; 6,838; 13,676; 20.515; 34,191; 41.029 mg/L. Before measuring absorbance, it is necessary to determine the maximum wavelength in order to obtain maximum analytical sensitivity so as to obtain accurate results.

After making a series of standard solutions, the absorbance of each series is measured. In this study, the instrument used to analyze phosphorus was UV-Vis spectrophotometry. UV-Vis

spectrophotometry has advantages, among others, it has a fairly high sensitivity, is relatively easy to use, and can analyze samples in various species, both ions and compounds. Phosphorus absorbance was measured at a maximum wavelength of 650 nm. At that wavelength, there is a maximum absorption of the sample to be analyzed. The absorbance series of standard phosphorus solutions are shown in Figure 1.

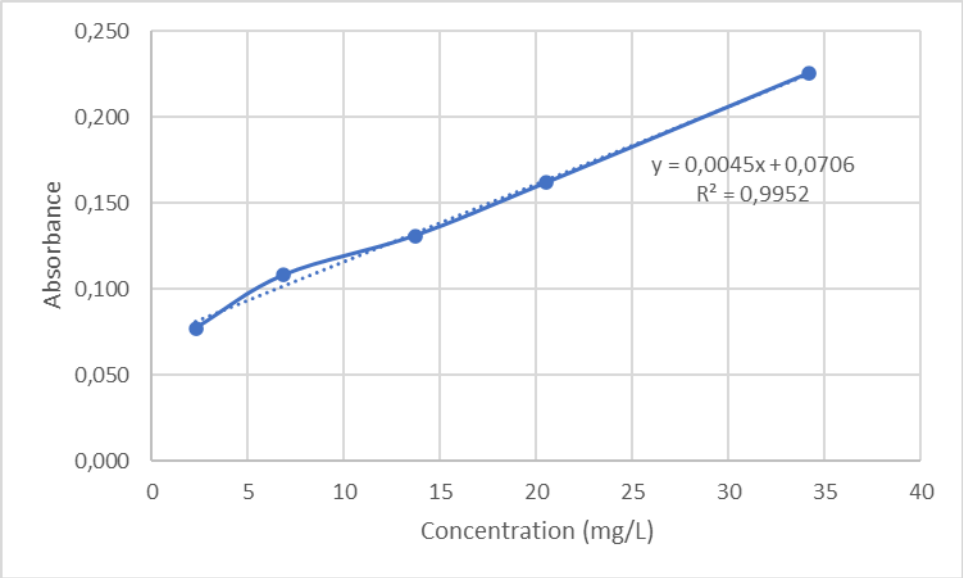

Figure 1. Absorbance of the standard solution curve

Based on the standard phosphorus curve, the regression equation y = 0.0019x + 0.0578 is obtained with a correlation coefficient (R^2) of 0.9842. This shows that absorbance is a function of concentration, the greater the concentration of the standard solution, the greater the absorbance. The regression equation obtained is y=ax+b, the value of y shows the absorbance, a shows the gradient or slope of the curve, and b shows the intercept. The intercept value obtained from the curve is negative. After the standard P curve was made, the absorbance of the sample solution was measured. The absorbance of the sample solution and the calculation of P levels are shown in the Table 1.

Table 1. Sample solution absorbance for measurement of phosphorus levels

No	Sample	Absorbance
1.	Solid fertilizer (sample 1)	0.097
2.	Liquid fertilizer (sample 2)	0.104

Calculation of determining the levels of fertilizer samples using the formula:

$$\text{Rate (\%)} = \frac{\text{Concenration}\left(\frac{\text{mg}}{\text{L}}\right) \times \text{Sample volume (L)} \times \text{dilution factor}}{\text{Sample mass (mg)}} \times 100\%$$

Then it can be determined that the phosphorus content of prill fertilizer 14,67% and liquid fertilizer is 18,55% in accordance with the Indonesian National Standard (SNI), which is a minimum phosphorus content of 8%.

The different results obtained on several inorganic fertilizers with phosphorus sources using the UV-Vis spectrophotometer method proved that the phosphorus content of each fertilizer was different but still met the established Indonesian National Standard (SNI).

Most forms of P fertilizer circulating in the market do not provide information on the availability of P they contain. Chemically the P contained in fertilizers can be easily determined how much % is soluble in water (which is immediately available) or the total amount of P contained. In terms of fertilizers, experts generally classify these fertilizers into 3 groups:

- P fertilizer that dissolves into strong acids (containing P_2O_5 is a P fertilizer that is slowly available for plant needs).
- P fertilizer that dissolves with neutral ammonium nitrate or citric acid (containing P_2O_5 is a fertilizer that is easily available for plant needs).
- Fertilizer that dissolves in water (contains P_2O_5, is also a P fertilizer that is easily available for plant needs).

4. CONCLUSION

Based on the analysis that has been carried out, it can be concluded that the results of the analysis of phosphorus levels in prill and liquid fertilizer are good enough to reach the minimum quality requirement for Indonesian National Standard (SNI) 2803:2010, which is 8%.

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