Isolation of potassium solubilizing bacteria in Andisol soil affected by the eruption of Sinabung

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Abstract. The Sinabung eruption emits smoke and volcanic ash which will decompose into the main soil material and turn into effect the structure of Andisol that will be formed. This study aims to find isolates of potassium solubilizing bacteria in several thicknesses of volcanic ash. The research was conducted at the Laboratory of Soil Biology, Agriculture Faculty, Universitas Sumatera Utara. Potassium solubilizing bacteria was isolated using medium Aleksandrov. The results showed that 7 isolates were found in different thickness, in the soil sample there was 1 isolate (K1), at a thickness of 1 - <2 cm 2 isolates (K2, K3) were found, at a thickness of 2-5 cm there were 2 isolates (K4, K5), and at >5cm there were 2 isolates (K6, K7).

1. Introduction
The explosion of Sinabung in 2013 emitting smoke and volcanic ash which will break down into the main soil which affect the structure of Andisol that formed. Soil chemical properties, soil physical properties, and soil biology will be affected by the eruption [1]. The volcanic ash will decompose into the main soil material and turn in, will affect the structure affect the physical properties of the soil formed. The activity of microorganisms influenced by the soil structure, volcanic ash will affect soil structure, because the thicker the soil density caused by the eruption will affect the soil circulation [2].

Based on research conducted by [3], it was found that soil potassium from volcanic ash ranged from 0.39 - 0.58 me / 100g in certain soil samples. This is also supported by research by [4] which states that the nutrient is classified as moderate (0.42 me /100g) but it needs to be increased because the leaching rate of potassium by erosion is quite high.

Based on the research of [5] that soil pH ranged from 4.4 to 6.5, while pH from Sinabung volcanic ash in this research ranged from 3.3 to 3.5. If the soil pH is low and volcanic ash. The activity of microorganisms was influenced by the soil structure due to the binding of heavy metals and toxic. Based on the research was conducted by [6-8] in Andisols erupted by Sinabung, it was obtained data that the pH of the Andisol that volcanic ash is significant decrease in the range of 4.1-5.59 so that the soil became acidic. This is also supported by the research of [9] that the thickness of several thicknesses of ash has decreased the pH to acidity, based on the analysis, it was obtained that a pH of 4.50 on the soil had no impact on ash, 4.89 on a thin thickness, 4.17 at the medium thickness and 3.7 at thick thickness. This is also supported by the research of [10-13] that the pH value due to the eruption was very acidic with a value of 4.29. It can affected the bacteria in the soil to survive, so that soil organisms grow at neutral pH. So that it has become one of the limiting factors for the growth of soil organisms.
The functions of K is in the formation of starch and as transportation of products from photosynthesis carbon-hydrated, so if the plant is deficient in K, the leaves will have brown spots like burning, this brown color starts from the side of the leaf to the leaf bones, that is the general signs of the plant. Potassium deficiency is the leaves turn yellow along the leaf margins and can cause the leaves to fall off, the root system is underdeveloped and stunted root growth and weak stems [14]. The purpose of this research is to finding the isolates of Potassium Solubilizing Bacteria in several thicknesses of volcanic ash.

2. Materials and methods
The research was carried out at the Soil Biology Laboratory, Agriculture Faculty, Universitas Sumatera Utara, Medan, which was conducted from August to September 2020. The soil used in this study is soil that is differentiated based on some thicknesses of ash. Aleksandrov is the medium that used for the composition per liter of aquadest: Aleksandrov media (Calcium Phosphate 2 g, Dipottasium Phosphate 3 g, Magnesium Sulfate 0.5 g, Iron Chloride 0.1 g, Calcium Carbonate 2 g, Glucose 5 g, gelatine 20 g, and 1L aquadest), and the ingredients for the gram staining. The observed variable is pH (electrometry), and the population of microorganisms.

Isolation of soil bacteria was carried out by multilevel dilution and using the pour method plate. 3 g of soil was put into 27 mL of 0.85% NaCl physiological solution, then shaker in a rocking incubator for 1 hour at a speed of 120 rpm and a serial dilution of 10⁻¹ to 10⁻⁴ was made. The results dilutions of 10⁻², 10⁻³, and 10⁻⁴ of 0.1 mL poured out and spread in the media Aleksandrov and incubated at 28°C for 7 days. The growth of potassium solubilizing bacteria is characterized by a clear zone around the colony. The growing bacterial colonies were purified by the quadrant streak method. The pure bacterial isolates were stored as stock on Aleksandrov.

The sampling was carried out in Namanteran Subdistrict, Karo Regency, North Sumatra. The sampling was carried out in this area because the area most exposed by the eruption from Sinabung. Accordance on a survey which has been conducted by researchers in the field. Cultivation of land was obtained in the village area of the people of Kuta which is dominated by annual plants such as coffee and grass. The thickness of 0 - <2 cm was obtained at the same location, namely Kuta Rakyat village which is also dominated by annual plants. Whereas at medium thickness of 2 - <5 cm that it was found in Sigarang Garang village which was dominated by grass vegetation, and the thickness >5 also found in same location that was dominated by grass vegetation too.

3. Results and discussion
The table below shows the result of the research on mositure, pH, and soil temperature.

| Location | Temperature (°C) | Moisture (%) | pH  |
|----------|-----------------|--------------|-----|
| I        | 23              | 82           | 5.42|
| II       | 21              | 77           | 4.31|
| III      | 24              | 78           | 3.57|
| IV       | 24              | 68           | 3.07|

Description: Location I : Ash Thickness (0 cm)
Location II : Thickness of Ash (<2 cm)
Location III : Thickness of Ash (2-5 cm)
Location IV : Thickness of Ash (> 5 cm)
The data obtained from soil analysis showed that soil temperature, soil moisture and pH were different for each thickness. Soil humidity, pH and temperature affect the activity of organisms. From the data was obtained that the thicker the ash on the soil, the lower the pH in the soil, this is due to the volcanic ash content which can decrease the pH, this is supported based on research conducted by [3,15-17] the higher of the ash content in the soil, makes the lowest pH. This is also supported by [18] which states that the content produced by Sinabung volcanic ash, one of which is sulfur. Sulfur is known to be oxidized to turn into sulfuric acid and lower the pH in the soil.

Soil structure and texture affect soil temperature and moisture, moisture content and soil temperature at 0 cm ash thickness or if the soil is higher than the thickness of other ash, this is because the aerated soil and soil pore structure are better, meanwhile at the ash thickness> 5 cm is classified as low because it has been covered and mixed with volcanic ash which already contains soil mineral minerals so that the thickness of the ash makes the soil will disturb the aeration of the soil.

After sampling, the table shows the result from the samples were isolated using media Aleksandrov.

| Location | Number of Isolates | Code Isolate  | Population (10^3) |
|----------|--------------------|--------------|-------------------|
| I        | 1                  | K1           | 55                |
| II       | 2                  | K2, K3       | 38                |
| III      | 2                  | K4, K5       | 23                |
| IV       | 2                  | K6, K7       | 17                |

Information: Location I: Thickness Ash (0 cm)  
Location II: Thickness of Ash (<2 cm)  
Location III: Thickness of Ash (2-5 cm)  
Location IV: Thickness of Ash (> 5 cm)

Seven types of bacteria were found in some thicknesses of ash, the bacteria that have been found are coded K1, K2, K3, K4, K5, K6, and K7. It where at the sample of thickness 0 cm there was 1 isolate (K1), at thickness of 1 - <2 cm that were 2 isolates (K2 and K3) were found, at thickness of 2 - 5 cm there were 2 isolates (K4 and K5), and at >5cm there were 2 isolates (K6 and K7).

The total population obtained at 0 cm of ash thickness obtained a population of 55 x 10^3, at thickness of 0-<2 cm was found 38 x 10^3, while a thickness of 2 - 5 cm was found as much as 23 x 10^3, and at a thickness of ash> 5 cm. So the total bacteria was 17 x 10^3. It was obtained that the potassium solubilizing bacteria which were not exposed to ash was higher than the thickness of the ash <2cm, 2-5 cm and > 5 cm, It was caused by the respiration of microorganisms in the soil which was influenced by volcanic ash [6,8]. The result showed that the thickest of the volcanic ash cover surface of the soil, at least the microbial population in the soil.

Based on the data, it was found the thickest of the ash was observed, the less the population of potassium solubilize bacteria that found. This is also influenced by vegetation, chemical and physical properties, this is by following the literature of [19] which states that on the soil the number and activity of soil microbes are influenced by soil type, plant growth, treatment that will be given to the soil, planting, macro and microclimate from every location.
| No. | Isolation Code | Micro | Form  | Gram  |
|-----|----------------|-------|-------|-------|
| 1   | K1             | Coccus| Negative |
| 2   | K2             | Bacil | Negative |
| 3   | K3             | Coccus| Negative |
Seven results in isolates, it is known that the bacteria obtained are dominated by round morphological shapes, the form of bacteria was found in the soil according to research conducted by [20] states that common potassium solubilizes bacteria have an oval round shape, colony edges, and colony sizes tend to be small.

Based on the Research of [20], bacteria that found mostly *Pseudomonas, Burkholderia, Acidithiobacillus, Ferrooxidans, Bacillus, Mucilaginosus, Bacillus edaphicus*, *B. circulans*, and *Paenibacillus* sp. Those are in the form of bacil have been reported to dissolve potassium in the soil, this is by following the results obtained by bacteria from isolates.

4. Conclusions
The results of this study were found that 7 isolates were found of different thicknesses, 1 isolate (K1) was found in the tillage sample, 2 isolates (K2 and K3) were found, 2 isolates were found at 2-5cm thickness (K4 and K5), > 5cm there were 2 isolates (K6 and K7) which were dominated by rods and spheres.

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