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The Application of Waste Mussel Shell and Nitrogen - Phosphorus - Potassium (NPK) Fertilizer on The Growth Components of Jasmine (Jasminum)

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Abstract: Chemical fertilizers have helped farmers in increasing crop production for ages but it also causes negative effects. The excessive nutrients caused by chemical runoff from the excess fertilizer reduces the amount of oxygen in the water as well as can contribute to the release of greenhouse gases such as carbon dioxide into the atmosphere. Besides that, chemical fertilizer can lead to soil acidification because of the decrease amount of organic matter in the soil. This study investigates the efficiency of the growth performance of the Jasmine (Jasminum) plant by using organic fertilizer from waste mussel shell powder and Nitrogen- Phosphorus-Potassium (NPK) on the Jasmine plant. The experiments were conducted to evaluate the effectiveness of waste mussel shells powder and NPK in aiding the growth of the jasmine plant. The fertilizer applied on jasmine plants with various concentrations which are 5g, 10g, 15g, 20g for waste mussel shell powder, and NPK. A major operating condition such as the height of the plant, the diameter of the stem, and soil pH are commonly physical measurements to measure plant growth. The data obtained from the growth performance of Jasmine plants after a few weeks, the concentration of 20g is the best fertilizer in growth performance. The effects of pH on soil were determined for waste mussel shell plant-soil to maintain in neutral pH, however; NPK fertilizer soil slightly reduces to acidic scale. The application of experimentally verified the application of natural fertilizer will provide good benefits to humans and the conservation of the environment.

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Keywords: Waste mussel shell, NPK, organic fertilizer, growth performance

1. Introduction

Chemical fertilizers are high in nutrient content such as nitrogen. Over-application of chemical fertilizer to plants may cause the leaves to turn yellow or brown, damaging the plant and reducing crop yield [5]. This condition is known as chemical leaf scorch. Leaf scorch can cause the leaves of the plant to wither and may cause the plant to die [13]. The over-use of chemical fertilizers can lead to soil acidification because of a decrease in organic matter in the soil [9]. Nitrogen applied to fields in large amounts over time damages topsoil, resulting in reduced crop yields. Sandy soils are much more prone to soil acidification than are clay soils. Clay soils have an ability to buffer the effects of excess chemical fertilization. There is an increasing concern that continuous use of chemical fertilizers on soil depletes the soil of essential nutrients [14]. As a result, the food produced in these soils have less vitamin and mineral content [2].

There are Chemical or Nitrogen- Phosphorus- Potassium (NPK) fertilizers with different compositions as not all plants have the same nutritional needs [16]. Therefore, the specific material that is specifically essential for the plant is present at a higher percentage or a higher concentration in the fertilizer [8] [11] . A series of numbers on the substance, which is NPK value, differentiate the different formulations from each other. For example, green plants benefit from a 7-3-6 (7 percent nitrogen, 3 percent phosphorus and 6 percent potassium) or 14-8-20 fertilizer, while a 7-8-6 or 6-8-7 fertilizer is recommended for flowering plants which require an increased amount of phosphorus [6].

The knowledge that obtain from a lot of research and studies, this information helping to create a product that is called fertilizer which is being used by many farmers to enhance the nutrients in the soil to produce a healthier plant [10]. Nowadays, technology helps us make two type of fertilizer which are chemical and organic fertilizer. Organic fertilizer are made from organic sources such as vegetable, fruits, seafood, or anything that can be consider as “organic” [12]. The benefits of using organic fertilizer are can reduce the amount of waste in our planet [3] [15]. This is also ideas to save the environment by reducing the use of chemical substance in our soil [7].

For this research, the waste mussel shells were collected at a native village in Pasir Gudang, Johor. Piles of waste mussel shells on the seashore have caused an unpleasant odor that may have caused discomfort to the locals [4]. This research will be helpful for the locals to reduce the problem. This research are aimed to prepare an organic fertilizer from waste mussel shells, study the efficiency of waste mussel shell and NPK fertilizer to the Jasmine plant and analyse the application of these to fertilizer to Jasmine plant.

2. Materials and Methods

2.1 Materials

Waste of mussel shells were collected in Pasir Gudang, Johor Bahru and Nitrogen- Phosphorus-Potassium (NPK) fertilizer was purchased through an online shopping platform and Jasmine plant (Jasmine) as tester plant.

2.2 Equipment

Brushes were used to clean up the mussel shells as it was covered with dirt. Furnace was used in purpose to dry up the whole moisture that contain in the mussel shells to ease the drying process. Blender was used to grind the mussel shell and NPK fertilizer. Sieve equipment were being used to

sieve to get the size of 0.075mm-0.15mm. Digital weighing scale was used to measure fertilizer based on its concentration.

2.3 Collecting process

The waste of mussel shells were collected in a native village in Pasir Gudang, Johor Bahru (see Figure 1). The waste mussel shells were discarded on the beach coast. The mussels shells were then collected and once it was enough it was put into the plastic bag. Meanwhile, for the NPK fertilizer, it was gained by an online shopping platform as it has been commercialized (see Figure 2). The Jasmine plant that used were purchased at a nursery in Muar (see Figure 3).

Figure 1: Waste mussel shells collecting process

Figure 2: NPK fertilizer purchased through online shopping

Figure 3: Jasmine plant purchased from nursery

2.4 Cleaning process

At first, the mussel shell were all covered with dirt. The mussel shells then were cleaned using brushes and tap water. After done washing the shells until it was well-cleaned, it has been dried up under the sun for a few hours as shown in Figure 4 before proceed to the next process.

Figure 4: Cleaning process of waste mussel shells after collect it

2.5 Drying process.

This process was done at the Environmental Laboratory. The furnace (see Figure 5) was used to dry the whole moisture that available in the mussel shell at 200°c for 30 minutes. This process was being done to make the shells easier to grind.

Figure 5: Furnace used in drying process

2.6. Grinding process

The waste mussel shells were grinded using blender until the size is 0.075mm-0.15mm. To get the size, sieve equipment from Concrete Work Laboratory were used as shown on Figure 6. While, the NPK fertilizer has been crushed using blender machine to make it into powder size and put into a container. This process took about a few minutes for this fertilizer to change from small pieces to a powder sample.

Figure 6: Blender and sieve equipment

2.7. Packaging process

The waste mussel shells and NPK fertilizer that have been grinded well were then been weight using the digital weighing scale. It has been weighed depending on its concentration which is 5g, 10g, 15g and 20g. After the weighing process been done, the fertilizer were then packed into a small plastic and being arranged regarding their concentration as shown in Figure 7.

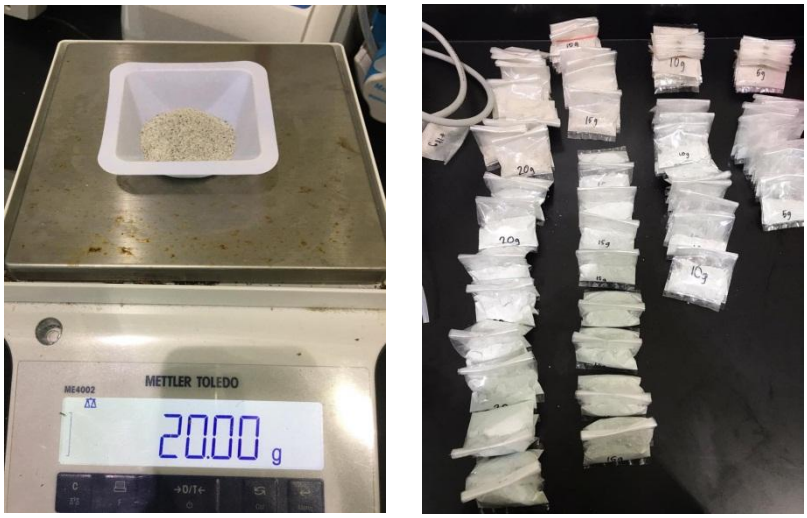

Figure 7: Packaging process of grinded waste mussel shells and NPK fertilizer

2.8. Fertilizing process.

These fertilizers were being tested on 39 pots of Jasmine plant (Jasminum). These fertilizers were being put on the plants once in a week as on Figure 8. The plants also were watered every morning and evening everyday. The results on the plants growth were being observed.

Figure 8: The 39 pots of Jasmine plant and fertilizing process

As a summary of this research, Figure 9 below shows the flow chart of the whole process for this research.

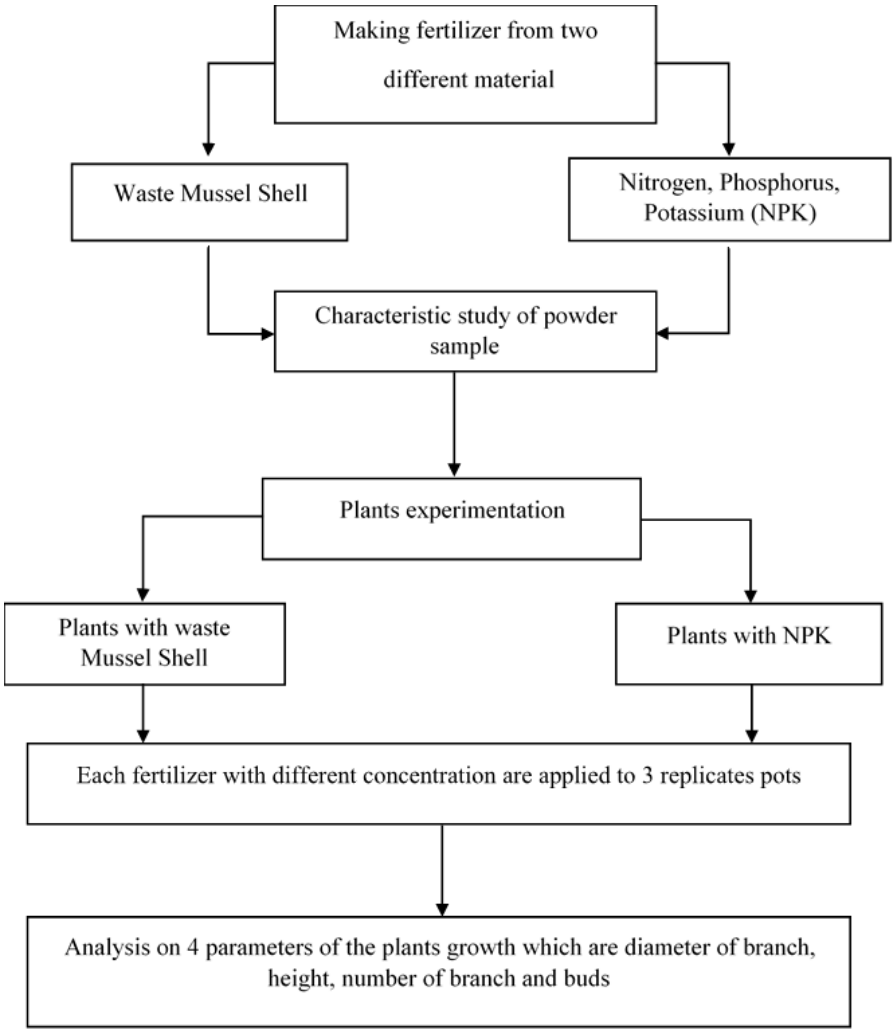

Figure 9: Flow Chart of Overall Methodology

3. Results and Discussion

The soil pH was measured before start the fertilization process and after eight week which is the end of our research period. The soil weight 100g was taken and mix with 100ml of distilled water then stired for 5 minutes. Next, the reading of the sample were taken using pH meter provided [1]. The soil initial and final pH recorded shown on Table 1 below.

Table 1: Initial and final soil pH

Type of fertilizer	Concentration (g)	Soil initial pH	Soil final pH
WMS	5	6.5	6.6
	10	6.5	6.7
	15	6.5	6.9
	20	6.5	7.1
NPK	5	6.5	6.3
	10	6.5	6.1
	15	6.5	5.9
	20	6.5	5.6

After 4 weeks of research period in collecting the data, the table and figure shows the potential development of plants. The table of data that been made is result of average height (cm) and the average diameter (cm) of the plant using both of the fertilizer and a graph from each result. As the result, Figure 10 shows height of plant using WMS fertilizer while Figure 11 shows height of plant using NPK fertilizer.

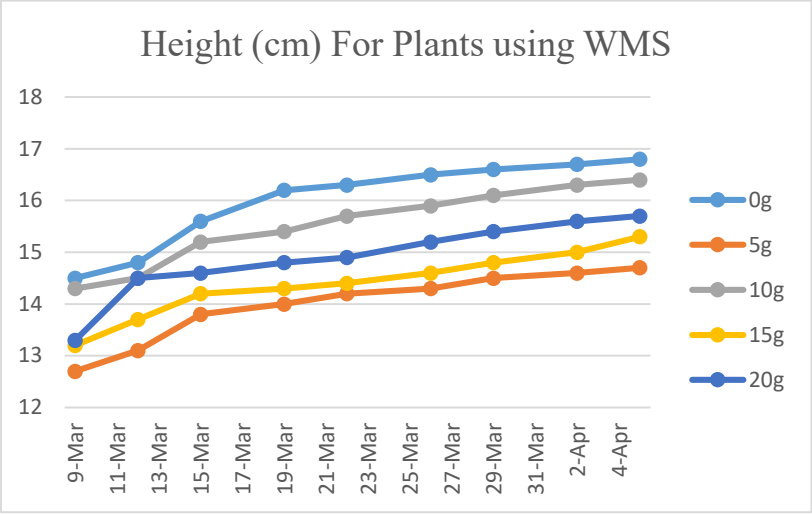

Figure 10: Height (cm) for plant using waste mussel shell fertilizer

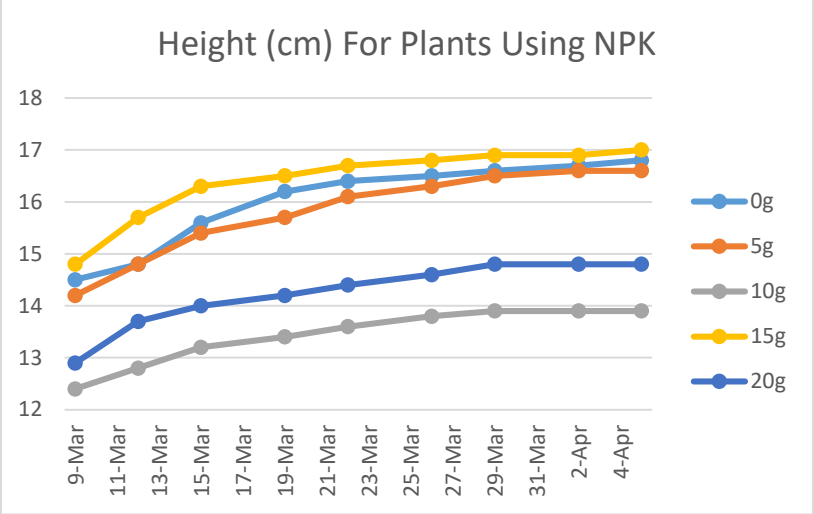

Figure 11: Height (cm) for plant using Nitrogen-Phosphorus-Potassium fertilizer

Based on the table and graph, the best concentration of fertilizer were chosen by subtract the last average height and the first average height of the plant since all of the plant did not have the same height at the beginning. The amount of the subtraction shows the growth rate and the highest amount shows the best concentration of the fertilizer. Table 2 shown the best concentration for the waste mussel shell fertilizer are 20g with 2.4 cm of different height while for NPK fertilizer are 5g with 2.4 cm different as shown on Table 3 below.

Table 2: Difference in height (cm) for WMS fertilizer

	WMS Concentration (g)				
DATE	**0**	**5**	**10**	**15**	**20**
Height of plant for 9 March, First-day (cm)	14.5	12.7	14.3	13.2	13.3
Height of plant for 5 April, Last-day (cm)	16.8	14.7	16.4	15.3	15.7
Difference in Height (cm)	2.3	2.0	2.1	2.1	2.4

Table 3: Difference in height (cm) for NPK fertilizer

	NPK Concentration (g)				
DATE	**0**	**5**	**10**	**15**	**20**
Height of plant for 9 March, First-day (cm)	14.5	14.2	12.4	14.8	12.9
Height of plant for 5 April, Last-day (cm)	16.8	16.6	13.9	17	14.8
Difference in Height (cm)	2.3	2.4	1.5	2.2	1.9

The second data that was recorded is diameter of the plant as shown on Figure 12 which is for WMS fertilizer and Figure 13 for WMS fertilizer. To choose the best concentration of the fertilizer, the method were used is also the same which is by subtract the last average diameter and the first average diameter of the plant. It is also because the plant did not have the same diameter at the beginning.

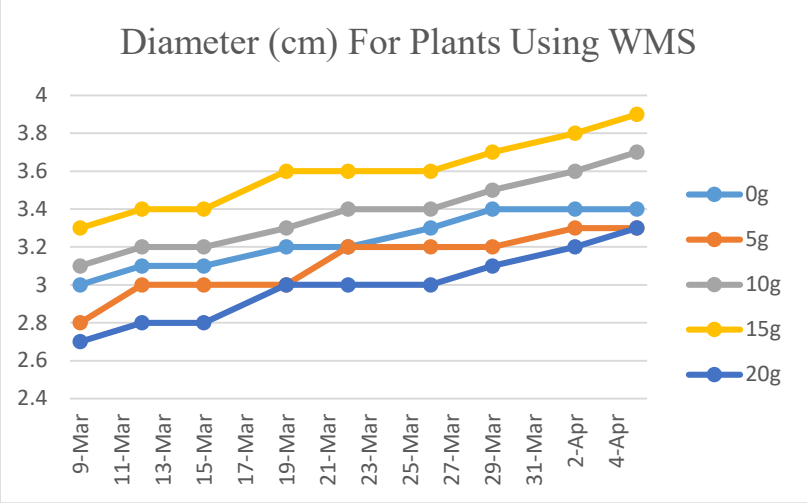

Figure 12: Diameter (cm) for plant with waste mussel shell fertilizer

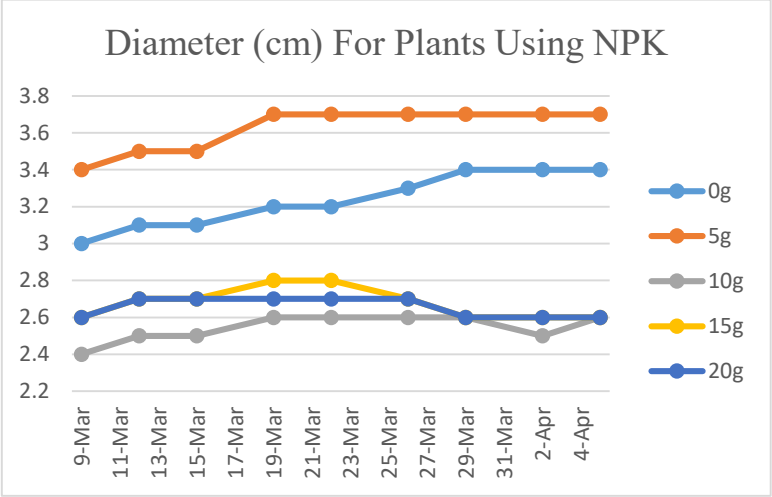

Figure 13: Diameter (cm) for plant using Nitrogen-Phosphorus-Potassium fertilizer

The result for difference in diameter of the plant using waste mussel shell from Table 4 shows there is three concentration which is 10g, 15g and 20g have the same value after the subtraction which is 0.6 cm. For the NPK fertilizer result on Table 5, 0g and 5g concentration shows the highest with 0.4 cm. This result shows the excessive of chemical fertilizers on plants can stunted growth of plants due to chemical burn to plants and mineral depletion of the soil. The effect of excessive chemical fertilizer to plants may cause the chemical leaf scorch which is the changes of leaves condition to turn yellow and damaging the the plants growth [17].

Table 4: Difference in diameter (cm) for WMS fertilizer

	WMS Concentration (g)				
DATE	**0**	**5**	**10**	**15**	**20**
Diameter of plant for 9 March, First-day (cm)	3.0	2.8	3.1	3.3	2.7
Diameter of plant for 5 April, Last-day (cm)	3.4	3.3	3.7	3.9	3.3
Difference in Diameter (cm)	0.4	0.5	0.6	0.6	0.6

Table 5: Difference in diameter (cm) for NPK fertilizer

	NPK Concentration (g)				
DATE	**0**	**5**	**10**	**15**	**20**
Diameter of plant for 9 March, First-day (cm)	3.0	3.4	2.4	2.6	2.6
Diameter of plant for 5 April, Last-day (cm)	3.4	3.7	2.6	2.6	2.6
Difference in Diameter (cm)	0.4	0.4	0.2	0	0

For the overall result, waste mussel shell fertilizer with concentration of 20g is the best because it can be look from the result that 20g concentration have the highest growth rate than the others. Other than that, the excessive amount of chemical fertilizer effected the plant growth, it is shown in Figure 14, and some of the specimen turn yellow due to burning effect. Meanwhile the specimen that use waste mussel shell fertilizer were healthy and in a good condition.

Figure 14: The leaf turn yellow due to burning effect

4. Conclusion

In conclusion, the waste mussel shell powder is a better enhancer towards the growth of plants. This study further showed that the application of organic fertilizer can stimulate growth of plants due to essential mineral composition of fertilizer. The performance growth of plants depending on a few factors which are amount of fertilizer, pH of soil, temperature, water and humidity. The amount of waste mussel shell powder which is 20g prove that it is much better than the other fertilizer. In addition, it is supported with the value of pH soil, the soil was using waste mussel shell fertilizer maintain in neutral condition, however; NPK fertilizer soil slightly reduces to acidic scale; it shown the side effect of chemical fertilizer towards the soil and development of growth performance. The application of

experimentally verified the application of natural fertilizer will provide good benefits to humans and the conservation of the environment.

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