TREATMENT OF LOW QUALITY SOIL WITH PREPARED BIOFERTILIZERS AND CULTIVATION OF CUCUMBER, *CUCUMIS SATIVUS* L.

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Abstract

Fertilizer application is known to increase crop yields and mitigate net soil nutrient mining due to continuous removal. In this paper, the effect of three biofertilizers (C1, C2 and C3) containing (2:1:1), (1:2:1) and (1:1:2) in the ratio of chicken manure, coconut husk powder, rice husk ash and indigenous microorganisms is used as digestion agent. Cultivation of cucumber was carried out with three prepared biofertilizer with the help of fish amino acid as foliar spray and oriental herbal nutrient as insect repellent on low quality soil in Sidi Village, Bago Region. Physicochemical properties of ingredient of natural farming were measured. Field experiments were carried out at Sidi Village in Bago Region from 1st March 2022 to 15th April 2022. The effects of bio-fertilizers (C1, C2, C3 and Control) on growth, yield and plant morphology of cucumber were studied. In this study, the prepared biofertilizer "C1" is the best for cultivation of cucumber in summer. After harvesting, physicochemical properties, texture and nutrient values of the soil before and after cultivation were compared. Soil texture and nutrient values after cultivation were better than before cultivation. Therefore, the prepared biofertilizer C1 was used for treatment of low quality soil. This study concluded that application of biofertilizer significantly increases the yield, biomass production of the soil and was economically efficient.

Keywords: biofertilizer, cultivation, indigenous microorganisms, fish amino acid, oriental herbal nutrient

Introduction

Fertilizer is any organic or inorganic materials of natural or synthetic origin that is added to a soil to supply one or more plant nutrients essential to the growth of plants (Parr *et al*., 1992). Fertilizer is substance containing some or all of a range of about 20 chemical elements necessary for healthy plant growth, use to compensate for the deficiencies of poor or depleted soil (Rajni *et al.,* 2001). Fertilizers are broadly divided into organic fertilizers (composed of organic matter of plant or animal) or inorganic fertilizers (composed of synthetic chemical and minerals) (Barker and Pileam, 2007). Fertilizer, natural or artificial substance contains the chemical elements that improve growth and productiveness of plants (Audu and Zubairu, 2013).

Fertilizers are applied to corps both as solid and as liquid. About 90% of fertilizers are applied as solids. Solid fertilizer is typically granulated or powdered. Fertilizer burn can occur when too much fertilizer is applied, resulting in damage or even death of the plant (Bhatia, 2010). Fertilizers are able to provide a better growing condition for plants compared to natural soil (Chow, 2002). Fertilizers provide large amount of macronutrients such as nitrogen, phosphorus and potassium while natural soil may not contain sufficient amount of this macronutrients. Fertilizers also provide trace elements such as magnesium, calcium and copper that are crucial in plant growth (Tan, 2015).

In this study, biofertilizers were prepared from organic waste materials (chicken manure, coconut husk powder and rice husk ash). In the first part of this research, some physicochemical

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properties of raw materials (chicken manure, coconut husk powder and rice husk ash) were determined. The second part was concerned with the preparation of bio-fertilizers from raw materials. The third part dealt with the effect of bio-fertilizers on the growth and yields of cucumber on low quality soil on summer. The last part included the comparison between soil parameters of uncultivated and harvesting soil.

Materials and Methods

The scientific name of *Cucumis sativus* L. (cucumber) belonging to the family cucurbitaceae was identified by authorized botanist at Botany Department, Bago University.

Collection of Samples

Coconut husk powder and rice husk ash were collected from Sidi Village, Bago Region. The chicken manure was collected from Sarkalay Quing Village, Bago Region.

Preparation of chicken manure, coconut husk powder and rice husk ash

Chicken manure, coconut husk powder and rice husk ash were dried in room temperature and ground in grinding machine to obtain chicken manure powder, coconut husk powder and rice husk ash powder. These powders were sieved with 80 mesh size sieve to obtain dry and fine powder. These samples were stored in the air-tight container so that the samples were free from getting molds to prevent moisture as well as other contaminations and were ready to be used for the experimental works.

Preparation of indigenous microorganisms

Indigenous microorganisms (IMO) was prepared using steam rice and brown sugar. Stream rice was mixed with the brown sugar in a ratio of 1:1 and the treatment was left for three weeks. After three weeks, IMO was used as decaying matter for composting processes.

Preparation of chicken manure biofertilizer

Three composted piles were prepared by plastic sheets and the size of each pile was approximately 1.5 meter length, 1.5 meter width and 1.5 meter height. Bio-fertilizers can be prepared with chicken manure, coconut husk powder and rice husk ash in the ratios of 2: 1: 1 (C-1), 1: 2: 1 (C-2), and 1: 1: 2 (C-3) with the addition of indigenous microorganism (IMO) by compost heap layer method. Temperature was key parameter, which determined the success of composting operations. During the composting process temperatures of three different composting piles were measured at 9 am daily. The daily temperature of compost was recorded up to 90 days. After three months later, the compost became ready to use on the field.

Preparation of fish amino acid fertilizer

Fish amino acid (FAA), a liquid organic fertilizer was prepared using the waste product from the fish and brown sugar. A waste product from the fish was mixed with the brown sugar in a ratio of 1:1 and the treatment was left for three weeks. After three weeks, the solution was filtered and FAA was diluted with distilled water in a ratio of 1: 1000. It was used as foliar spray.

Preparation of oriental herbal nutrient

Oriental herbal nutrient (OHN) was prepared using ginger waste and brown sugar. The ginger waste was mixed with the brown sugar with 1:1 weight ratio (g) and the mixture was left for three weeks. After three weeks, equal amount of edible alcohol (v/v) was added in the mixture and stored for two weeks. After two weeks, the solution was filtered and OHN was diluted with distilled water in a ratio of 1: 1000. It was used as insect repellent for plant.

Physicochemical Properties, Nutrient Values of Raw Materials, Prepared BioFertilizer, Soil before and After Cultivation

Physicochemical properties of (chicken manure, coconut husk powder and rice husk ash) raw materials, selected biofertilizer, soil before and after cultivation were studied. Measurement of pH was carried out by a pH meter and the moisture content was determined by a moisture analyzer. The electrical conductivity was determined by a conductivity meter. The nitrogen content was determined by Kjeldahl's method. The potassium content was determined by Flame photometric technique and the phosphorus content was determined by UV-visible spectrophotometric technique. Calcium and magnesium contents were determined by titration method.

Application of Bio-Fertilizer

Field experiments were carried out at Sidi Village in Bago Region from 1st March 2022 to 15th April 2022 and were also studied with the effect of biofertilizers (C-1, C-2, C-3 and control) on growth and yields of cucumber. Foliar spray of FAA and the use of OHN as an insect repellent were employed during the cultivation process.

Determination of plants morphology for field experiment

Plant morphology was measured on 15 days, 30 days and 45 days after cultivation. Plant height, fruit length, number of fruit per plant, root length and total yields were measured for experiment until.

Comparison between Physicochemical Parameters, Nutrient Values and Texture of Selected Soil before and After Cultivation

The original soil was not good for cultivation. After addition of biofertilizer, the quality of soil was suitable for plantation. So, the prepared biofertilizer can be used to treat the low quality soil. Physicochemical parameters, nutrient values and texture of selected soil were determined before cultivation and after harvesting.

Results and Discussion

Some Physicochemical Properties of Chicken Manure, Coconut Husk Powder and Rice Husk Ash

Before preparing biofertilizers, some physicochemical properties and nutrient values of raw materials (chicken manure, coconut husk powder and rice husk ash) were determined. Tables 1 and 2 show some physicochemical properties, N, P, K, Ca and Mg contents of prepared raw materials.

Table 1. Physicochemical Properties of Chicken Manure, Coconut Husk Powder and Rice Husk Ash

Parameters	Physicochemical properties		
	Chicken mnure	Coconut husk powder	Rice husk ash
Moisture (%)	2.00	14.06	2.67
Ash (%)	16.34	5.55	92.65
pH	7.30	7.40	7.60
Bulk density (g/mL)	0.31	0.36	0.27
Organic carbon (%)	48.76	54.60	25.35

Table 2. N, P, K, Ca and Mg Contents of Raw Materials (Chicken Manure, Coconut Husk Powder and Rice Husk Ash)

Parameters	Nutrient Values		
	Chicken manure	Coconut husk powder	Rice husk ash
Nitrogen (%)	2.03	1.31	0.70
Phosphorus P_2O_5 (%)	3.10	2.90	2.10
Potassium K_2O (%)	4.48	4.17	5.56
Calcium (ppm)	63.67	21.54	12.3
Magnesium (ppm)	39.18	3.747	2.47

Physicochemical Properties of Indigenous Microorganisms (IMO), Fish Amino Acid (FAA) and Oriental Herbal Nutrient (OHN)

Physicochemical properties of indigenous microorganisms (IMO), fish amino acid (FAA) and oriental herbal nutrient (OHN) are shown in Tables 3-5.

Indigenous microorganism (IMO) had a moisture content of 60.22%, which was high because yeast, fungi, and microorganisms require high humidity for digesting waste materials. The PH value of IMO was 4.48, indicating an acidic nature, as a law PH is required for the

fermentation process. The electrical conductivity was 194.2 μs/cm due to the presence of exchangeable cations in the sample.

Fish amino acid (FAA) had a viscosity of 84400 m Pa/s, making it a very viscous solution. It was turbid, appearing as dense dark brown. The PH value was of FAA was 5.11, indicating an acidic nature due to the fermentation process involving brown sugar. The electrica conductivity was 194.2 μs/cm.

Oriental herbal nutrient (OHN) was found to have low burbidity of 5.65 NTU. Its PH was 5.36, showing an acidic condition due to the brown sugar fermentation process. The Viscosity was 13550 m Pa/s, which was lower than that of fish amino acid. The electrical conductivity of OHN was 178.5 ms/cm, which was reduced due to the addition of alcohol during fermentation.

Table 3. Physicochemical Properties of Indigenous Microorganisms (IMO)

Parameters	IMO
Moisture (%)	60.22
Ash (%)	0.33
pH	4.48
Conductivity(μS/cm)	182.4

Table 4. Physicochemical Properties of Fish Amino Acid (FAA)

Parameters	FAA
Viscosity (mPa/s)	84400
Colour	turbid
pH	5.11
Conductivity(μS/cm)	194.2

Table 5. Physicochemical Properties of Oriental Herbal Nutrient (OHN)

Parameters	OHN
Viscosity (mPa/s)	13550
Turbidity(NTU)	5.65
pH	5.36
Conductivity(μS/cm)	178.5

On the aspects of preparation of bio-fertilizer

Biofertilizer (C-1, C-2 and C-3) can be prepared with chicken manure, coconut husk powder and rice husk ash in the ratio of (2: 1: 1), (1: 2: 1) and (1: 1: 2) by compost heap layer method. In the composting process, the temperature of compost began at 26 ˚C and then temperature was gradually increased to approximately 41 ˚C about 50- 60 days. The increase in

temperature during the composting process was the heat generated from the decomposition of waste materials by IMO. The increment of temperature is a good indicator for digestion. The temperature pattern showed that there was a rapid process for decomposition. The temperature was decreased after 60 days. The change in temperature showed the decomposition of organic matter during 90 days period. The compost processes were occurred between (26-41 ˚C). After three months, the compost became ready to use in the field. (Figure 1)

(a) (b) (c)

Figure 1. Photograph for prepared bio-fertilizer (a) C-1 (b) C-2 and (c) C-3

Field Experiment

Field experiments were carried out at Sidi Village in Bago Region from 1st March 2022 to 15th April 2022.

Effect of biofertilizer on cucumber

The growth, yields and quality of cucumber depends on nutrient availability in soil which is related to the judicious application of fertilizers. In continuous cropping area, the organic matter supply to the crop field through different maturing practices were made only to a minimum extent. The use of fertilizer may affect either directly or indirectly the availability of soil nutrients.

Effect of biofertilizer on the plant height of cucumber

Table 6 shows a progressive increase in plant height with the age of crop. The plant height of cucumber at (15, 30 and 45) days after cultivation were measured.

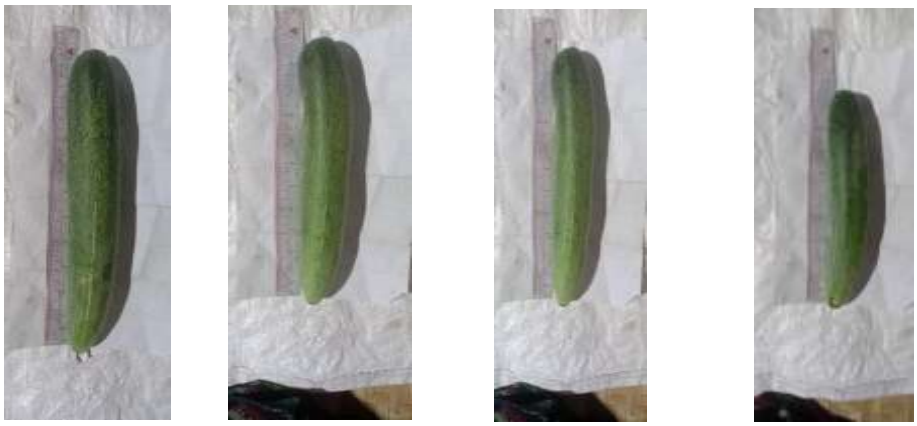
Table 6. Effect of Bio-fertilizers on the Height of Plant in Different Life Times

Bio-fertilizers	Plant height of cucumber (cm)		
	15 days	30 days	45 days
C1	70	140	150
C2	65	128	141
C3	50	110	135
Control	43	105	120

Biofertilizer C1 = Chicken manure, coconut husk powder and rice husk ash in ratio of (2:1:1)
Biofertilizer C2 = Chicken manure, coconut husk powder and rice husk ash in ratio of (1:2:1)
Biofertilizer C3 = Chicken manure, coconut husk powder and rice husk ash in ratio of (1:1:2)
Control = Without Bio-fertilizer

Effect of biofertilizers on plant morphology of cucumber

From the field experiment, it was found that the biofertilizers promoted the growth and yields of cucumber. For the life time of cucumber, cultivation to the harvesting was the time frame of 45 days. After harvesting, the plant morphology of cucumber was determined with plant height, fruit length, numbers of fruit per plant, fruit weight per plant, root length and total yields.



(a) (b) (c) (d)

Figure 2. Photographs of cucumber cultivated with (a) C-1 (b) C-2 (c) C-3 and (d) Control

Table 7. Effect of Bio-fertilizers on Plant Morphology of Cucumber

Treatments	Plant morphology					
	Life time (days)	Fruit length (cm)	Number of fruit per plant(mean)	Fruit weight per plant(g)	Root length (cm)	Total yield (kg) (15x15) ft^2
C1	45	28.7	35	560	18	1274.0
C2	45	27.9	30	530	11.5	1033.5
C3	45	26.2	24	450	10	702.0
Control	45	24.4	20	410	9	533.0

Comparison between Physicochemical Parameters, Nutrient Values and Texture of Selected Soil before and After Cultivation

Physicochemical parameter, nutrient values and texture of original soil uncultivated and after harvesting (C1, highest yields farm) are shown in Table 8. Before cultivation, the original soil is sandy loam and it was treated with biofertilizers for the cultivation process. After harvesting, the soil was loam due to the effect of increasing organic carbon content. Nitrogen, phosphorus, potassium calcium and magnesium contents were also increased.

Table 8. Comparison of Physicochemical Parameters, Nutrient Values and Texture of Selected Soil before and after Cultivation

No.	Parameter	Uncultivated Soil	Harvesting Soil (C1)
1	pH	5.61	6.09
2	Moisture (%)	0.26	2.15
3	Sand (%)	56.44	36.42
4	Silt (%)	39.02	49.36
5	Clay (%)	4.54	14.22
6	Texture	Sandy Loam	Loam
7	Organic Carbon (%)	0.48	0.86
8	Humus (%)	0.83	1.48
9	Nitrogen (%)	0.123	1.16
10	Phosphorus (%)	0.01	3.07
11	Potassium (K_2O) (%)	0.23	11.4
12	Exchangeable Cation (K^+) (meq/100g)	0.21	0.23
13	Calcium (ppm)	9.625	20.4
14	Magnesium (ppm)	1.6	3.27

Conclusion

The research work focused on the preparation of biofertilizers using waste materials such as chicken manure, coconut husk powder, and rice husk ash. The effectiveness of the prepared biofertilizers (C-1, C-2, and C-3) and a control group was evaluated by cultivating cucumber plants in low-quality soil during the summer. The study examined the impact of the biofertilizers and the control group on the morphology of the cucumber plants. After 45 days, the cucumber plants treated with biofertilizer C-1 exhibited the highest plant height (150 cm), fruit length (28.7 cm), fruit weight per plant (560 g), root length per plant (18 cm), and total yield (1244.0 kg in a 15 x 15 ft^2 area). The study also compared the physicochemical parameters, nutrient values, and soil texture before and after cultivation. The soil parameters of the harvested soil showed improvements in texture, nutrient values, and organic carbon content compared to the uncultivated soil. This improvement was attributed to the effect of the prepared biofertilizer, particularly C-1, which demonstrated the ability to enhance soil fertility. In conclusion, the prepared bio-fertilizer C-1 showed the highest yield and was found to be effective for cucumber cultivation during the summer. The study also indicated that the use of biofertilizers can positively impact soil fertility, as evidenced by the improved soil parameters after harvesting.

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