Original Research Article

ASSESING THE BENEFICIAL EFFECT OF SPENT COFFEE GROUND COMPOST UNDER MUSTARD PLANTS (Brassica Juncea L)

ABSTRACT

Aims: Spent Coffee Ground (SCG) compost is a compost made with raw materials SCG, cow dung, and chicken manure, with the addition of *Aspergillus sp.* and *Penicillium sp.* starters. The nutrients contained in the SCG compost are very good when implemented in horticultural crops. Therefore, it is necessary to study the benefits of SCG compost in plants. One of the horticultural crops that is widely cultivated by farmers is mustard greens.
Study design: the design of the study here is descriptive. Data will show in table and graphic.
Place and Duration of Study: Department of Agricultural Product Technology University of Jember, between January 2023 and June 2023.
Methodology: The concentration of the compost added to each pot was 1, 2, 3% of the total soil. The amount of soil used in each polybag is 50 gr. The implementation of the compost SCG is carried out during the vegetative phase of the plant (21 days). The mustard seed and soil used are commercial. The type of soil used is pure soil and less on nutrition or without a mixture of fertilizers. The samples were oven dried at 65 °C for 48 h to constant weight and ground for nutrient analysis. In all analyses, three repetitions were performed for each sample.
Results: Plants with the addition of SCG compost (C2) as much as 3% have the best results when compared to the addition of commercial compost (C1) and compost control (C0) in terms of plant physical and nutrients contained therein. Likewise with the biomass produced. The results of the in vitro germination index analysis also proved that the fungi starter implemented in the Mustard plant had the best GI value, namely 200.4%.
Conclusion: Adding compost have positive effect for plant growth especially for length of stem and width of leaves.

Keywords: Spent coffee grounds, compost, mustard plants.

1. INTRODUCTION

Spent Coffee Ground (SCG) compost is a compost made with raw materials SCG, cow dung, and chicken manure, with the addition of Aspergillus sp. and Penicillium sp. starters. The nutrients contained in the SCG compost are very good when implemented in horticultural crops. Compost SCG has a C / N ratio below 10, normal pH and is rich in minerals, such as potassium, phosphorus, calcium and magnesium (Afriliana et al., 2020). These elements are used in relatively large amounts by the plant and are called macronutrients. Using compost particularly, in intensive industries such as vegetable production, has demonstrated potential to reduce the need of fertilizer, irrigation and pesticides, and to improve

marketable yields (Paulin and Malley, 2008). It also can improve soil fertility, water holding capacity, organic matter content, and ultimate crop yields, improve product quality, and extend shelf life (Stofella et al., 2014).
In the final compost product, the number of microorganisms, fungi in the compost SCG that we previously made was still high, around 6.94 log cfu/ml. This could be an advantage or potential of SCG compost. In previous research, enrichment of compost in terms of increasing the nutrient content of final compost product had been studied (Shinde et al, 1990a; Bhanawase Hajra et al., 1994; Zayed and AbdelMotaal, 2005; Gaind et al., 2006). Microbial enrichment technique with bio-inoculants to composting material had been shown to improve the quality of compost (Gaur, 1982, Rasal Shinde et al., 1990b; Arora and Garg, 1992; Arora et al, 1994) and even in lowgrade city compost (Talashilkar, 1985). Further, the most of the work relating to compost enrichment is done during the composting period.
Aspergillus and Penicillium are types of fungi that can convert insoluble phosphate into soluble phosphate or what is called Phosphate solubilizing fungi (PSF). They produce low molecular mass organic acids (Deubel and Merbach, 2005), which 116 attack the phosphate structure and transform phosphorus from non-utilizable to the utilizable form for the plants (Ivanova et al., 2006). PSF are able to improve the phosphorus nutrition and stimulate the plant growth. Solubilization is due to the secretion of organic acids by microorganisms which reduces the pH or by complexing cation that is bound to phosphorus, in turn decreasing the particle size. However, the role of organic acids and low pH, holds a major role to play in phosphate availability in vitro and in vivo (Kim et al., 1997).
The PSF-rich SCG compost can also act as Plant Growth promoting Fungi (PGPF). PGPF are heterogeneous groups of non-pathogenic saprotroph fungi. They are the group of rhizosphere fungi that colonize plant roots and enhance plant growth. Over the decades, varieties of PGPF have been studied including those belonging to genera Penicillium, Aspergillus, Trichoderma, Phoma and Fusarium (Hossain et al., 2020). Studies have shown that PGPF modulates plant growth and enhances resilience to plant pathogens without environmental contamination (Hossain et al., 2017). The positive effects of PGPF on plants and the environment make them well fitted to organic agriculture.
Therefore, it is necessary to study the benefits of SCG compost in plants. One of the horticultural crops that is widely cultivated by farmers is mustard greens. According to Inonu et al (2014), mustard greens are a type of vegetable with high economic value. In addition, the harvest age is relatively short, namely 40-50 days after planting. Demand for mustard plants always increases with increasing population and awareness of nutritional needs (Haryanto et al., 2006). PGPF exhibit traits beneficial to plants and as such, their capacity to enhance plant growth and development is well founded. PGPF mediates both short- and long-term effects on germination and subsequent plant performance. Improvement in germination, seedling vigor, shoot growth, root growth, photosynthetic efficiency, and yield are the most common effects decreed by PGPF. A particular PGPF may condition plant growth by exerting all or one or more of these effects (Hossain et al., 2020).

2. MATERIAL AND METHODS

2.1. MATERIAL

The concentration of the compost added to each pot was 1, 2, 3% of the total soil. The amount of soil used in each polybag is 50 gr. Here are the details for samples.

1. S: soil
2. C0: compost control
3. C1: SCG compost with adding commercial starter
4. C2: SCG compost with adding fungi starter
5. P0: plant without adding compost
6. PC0 1%: plant with adding sample C0 1% of amount soil
7. PC0 2%: plant with adding sample C0 2% of amount soil
8. PC0 3%: plant with adding sample C0 3% of amount soil
9. PC1 1%: plant with adding sample C1 1% of amount soil
10. PC1 2%: plant with adding sample C1 2% of amount soil
11. PC1 3%: plant with adding sample C1 3% of amount soil
12. PC2 1%: plant with adding sample C1 1% of amount soil
13. PC2 2%: plant with adding sample C1 2% of amount soil
14. PC2 3%: plant with adding sample C1 3% of amount soil
15. PCL 1%: plant with adding liquid commercial compost 1% of amount soil
16. PCL 2%: plant with adding liquid commercial compost 2% of amount soil
17. PCL 3%: plant with adding liquid commercial compost 3% of amount soil

The implementation of the compost SCG is carried out during the vegetative phase of the plant (21 days). Vegetative phase is the growth phase of the plant from first growing. The juvenile / vegetative phase leads to the formation or growth of leaves, roots, and stems and branching (vegetative organs as source and sink). The mustard seed and soil used are commercial. The type of soil used is pure soil and less on nutrition or without a mixture of fertilizers. Plant samples were obtained from the vegetative phase for nutrient analysis. The samples were oven dried at 65 °C for 48 h to constant weight and ground for nutrient analysis. In all analyses, three repetitions were performed for each sample

2.2 METHODS

2.2.1 Physic and Chemical Analysis

1. Physic analysis Plant physical analysis was carried out after 3 weeks of seeding. The analysis is to calculate the length of the stem and the width of the leaf. The data is displayed in the form of a graph and figures.
2. SEM and Germination index Each compost used was observed under SEM (Scanning Electron Microscopy) (Kalab et al., 2008). While for each starter, a Germination Index (GI) analysis was performed (Zucconi et al. 1981). Both types of analysis are to determine the types of microorganisms in the compost as well as to determine their potential for enrichment of compost nutrients
3. Nutrient analysis In all compost and plant samples, macromolecule and mineral content were analysed. Total Carbon and Nitrogen analysis was done using Macro corder. Meanwhile, mineral content analysis such as Ca, Mg, and K was carried out with AAS 6300, and total phosphorus by UV spectrophotometer. The physical-chemical properties of samples were determined by the standard method (Embrapa, 2009).
4. Biomass Plants were shaken gently to remove all adhering soil particles, then placed in an oven at 70 C until constant weight to record DW (Dry Weight) as Biomass (Rady et al., 2016). The data is displayed in the form of a graph completed with a quadratic curve.
5. Nutrient uptake Total uptake of N/P/K was calculated separately by the following formula (Sharma et al., 2012):

$$Nutrient\ uptake\ \left(\frac{kg}{ha}\right) = \frac{\text{N\% or P\% or K\% x dry matter } \left(\frac{\text{kg}}{\text{ha}}\right)}{100}$$

The area to calculate dry matter (kg) in hectares (ha) is by calculating the area of the pot used for hatchery. By adding up the area of the blanket and the bottom of the pot, with the formula below:
Total pot area= πdt + πr^2
Diameter = 8 cm, and height= 7 cm

3. RESULTS AND DISCUSSION

3.1. MATERIAL PROPERTIES

Material properties used in this research were soil and SCG compost. The chemical properties of the soil are represented in Table 1. The nutrient content of the compost is represented in Table 2.

Table 1. Chemical properties of soil

Soil Properties	Values
Total Carbon (%)	28.88
Total Nitrogen (%)	0.92
pH	6.33
EC (ms/cm)	1.44
CEC (meq/100g)	16.53
Phosphorus (mg/l)	2.77

Data are expressed as mean of three replicates

Table 2. Nutrient content of SCG Compost

Nutrient	C0	C1	C2
Total Carbon (%)	17.3	15.28	15.49
Total Nitrogen (%)	2.07	2.02	2.22
C/N ratio	8.33	7.56	6.97
Phosphorus (%)	2.42	5.64	3.29
Potassium (%)	3.73	3.75	4.15
Magnesium (%)	7.83	9.54	8.07
Calcium (%)	12.36	21.18	9.537
pH	7.68	7.53	7.67
EC (ms/cm)	6.27	6.98	6.94
Population microorganism (log	7.01	6.98	6.94

cfu/ml)

Data are expressed as mean of three replicates

From the results of the analysis in table 1, soil pH is included in the slightly acidic category (6.33). While the SCG compost showed a slightly alkaline pH (7.53- 7.68). The use of SCG compost is expected to increase soil pH so that it becomes normal and is better for seeding mustard plants. Soil pH plays an important role in determining whether nutrient elements are easily absorbed by plants. Nutrients are generally well absorbed by plants at a neutral pH. Nitrogen (N) has an important role for plant growth. Nitrogen can be absorbed by plants from the soil in the form of NH4 + and NO3 - . Total N is a macro element needed by plants in large quantities and makes up 1.5% of the plant weight (Mahler, 2004). N functions in the formation of protein (Hanafiah 2009). The availability of nitrogen in the soil is included in the medium category (0.92%). Meanwhile, the nitrogen content in compost is high (around 2%).

The phosphorus (P) content in the soil is in the low category. The P content of soil is 2.77 mg / l or equal to 0.027%. While compost SCG is classified into high category up to 2-3%. This is very good, the addition of SCG compost can increase soil phosphorus thus increasing plant nutrition. Next to nitrogen, phosphorus (P) is the second most important macronutrient as an essential plant nutrient (Srinivasan et al., 2012). It is a key nutrient for higher and sustained agricultural productivity (Scervino et al., 2011) and which limits plant growth in many soils. Phosphorus forms an important component of the organic compound adenosine triphosphate (ATP), which is the energy currency that drives all biochemical processes in plants (Brady et al., 2008). It is also an integral component of nucleic acids, coenzymes, nucleotides, phosphoproteins, phospholipids and sugar phosphates as well as intermediates of signal transduction events (Khan et al., 2010; Plaxton et al., 2015; Razaq et al., 2017). It is also involved in an array of processes in plants such as photosynthesis, respiration, nitrogen fixation, flowering, fruiting, and maturation (Brady et al., 2008; Plaxton et al., 2015; Xiang et al., 2012). Despite the important role played by soil P in plants, however, phosphorus deficiency in soil is the most common nutritional stress in many regions of the world, affecting 42% of the cultivated land in the world (Liu et al., 1994). The P deficiency is caused either by low P content in the soils parent materials or by transformations of P.

Potassium (K) in SCG compost is classified as very high. Elemental K used by plants is only a small part. The potassium that is dissolved and the potassium that is exchanged is potassium which is considered available. Herawati (2015) explains that the K ion is classified as an element that is easy to move so that it is easily lost from the soil through washing, because K is not firmly held by the soil colloid surface. The high K in SCG compost is also an advantage over compost when added to slightly acidic soil. The cause of high and low potassium in the soil is influenced by the parent material and also the soil pH. Acidic soil pH will cause an increase in potassium fixation, causing a decrease in the availability of elemental K in the soil.

Cation exchange capacity (CEC) is one of the chemical properties of soil that is closely related to the availability of nutrients for plants and is an indicator of soil fertility. CEC is the capacity of soil to absorb and exchange cations. CEC is influenced by soil content, soil type and organic matter content. Soil CEC describes soil cations such as Ca, Mg, Na, and can be exchanged and absorbed by plant roots (Herawati 2015). From table 1, the land CEC is in the medium category, 16.53 meq /100 gr.

4.2. SCG COMPOST WITH PGPF

After analysing the number of microorganisms in SCG compost, it was found that the compost still contained many microorganisms, C0 (log 7.01 cfu / g), C1 (log 6.98 cfu / g), and C2 (log 6.94 cfu / g). The observation was continued by observing each SCG compost under SEM (Scanning Electron Microscopy) to determine which type of microorganism grew the most in the sample. The three samples showed that the majority of microorganisms in SCG compost were fungi (Figure 1). The composting process at 300 Celsius is a good temperature for mushroom growth. Until the end of composting the mushrooms were still there even though they had decreased a lot. This is different from natural composting, where at the end of composting, usually microorganisms will experience a death phase until the number drops dramatically. This very significant reduction is usually due to natural composting, temperatures can reach 60-700 Celsius (thermophilic phase), so that many microorganisms will die in this phase.

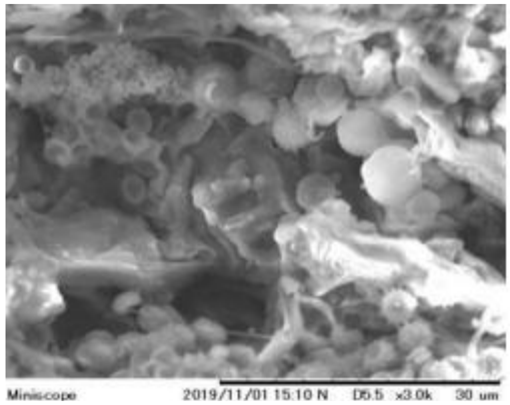

Fig. 1. SCG compost (C2) observation under SEM, magnification 3000 times

The availability of fungi in the SCG compost is the potential of this compost. Especially because the types of fungi contained in the compost are Aspergillus and Penicillium. These two types of fungi are PGPF (Plant Growth Promoting Fungi). PGPF are heterogeneous groups of nonpathogenic saprotroph fungi (Hossain, 2020). PGPF exhibit traits beneficial to plants and as such, their capacity to enhance plant growth and development is well founded. PGPF mediates both short- and long-term effects on germination and subsequent plant performance. Improvement in germination, seedling vigor, shoot growth, root growth, photosynthetic efficiency, flowering, and yield are the most common effects decreed by PGPF.
In addition to observations under SEM, a Germination Index (GI) analysis is also carried out on both commercial and fungal starters (Figure 1). This is to determine the effect of using a starter that is rich in microorganisms on plant growth. The GI results in the starter fungi show a higher value (200.4%) when compared to the GI in commercial starters (164.84%), as described in Table 3.

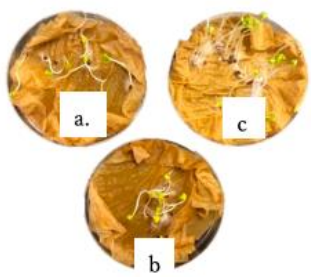

Fig. 2. (a) Germination Index of plants with no starter; (b) Germination Index of plants with commercial starter; (c) Germination Index of plants with fungi starter

From Figure 2 above, it can be seen that the application of starter fungi to mustard plant seeds gives excellent results when compared to commercial starter applications. More seeds sprouted, and the roots grew longer.

Table 3. Germination index data for each starter

Starter	Seed germination (%)	Root elongation (%)	Germination index (%)
Fungi	120	167	200.4
Bacillus	108	156	164.84

Data are expressed as mean of three replicates

In the previous study, treatment with PGPF, particularly of the genus Aspergillus and Penicillium has been reported to improve seed germination and seedling vigor in different agronomic and horticultural crops. Scarified seeds inoculated with spores from Aspergillus had significant increases in germination of Utah milkvetch (Astragalus utahensis). The Aspergillus treated seeds performed an increase of 30% in seedling cucumber plants (Hossain, 2017). Penicillium spp also enhanced leaf chlorophyll content in cucumber and chili (Hossain, 2020).

4. 3. PHYSICAL ANALYSIS

The addition of compost has a very good impact on the growth of mustard plants. After 3 weeks of seeding, the plant stems are taller and the leaves are wider, as shown in Figure 3. This of course is closely related to the macro mineral

content in the compost and soil which is absorbed by plant roots. Whereas in the control treatment without compost, plant growth was inhibited due to lack of nutrients, such as Nitrogen, Phosphorus, Potassium, Magnesium, Calcium.
According to Gardner et al (1991), stems is a competitive area within hoard the results of plant assimilation, so that observations of plant height used to determine physical diversity Plants that make a large contribution in forming dry plant matter. Leaves are a carbohydrate factory, where the more the number of leaves on a more and more plants light that can be converted into photosynthate through the process of photosynthesis.

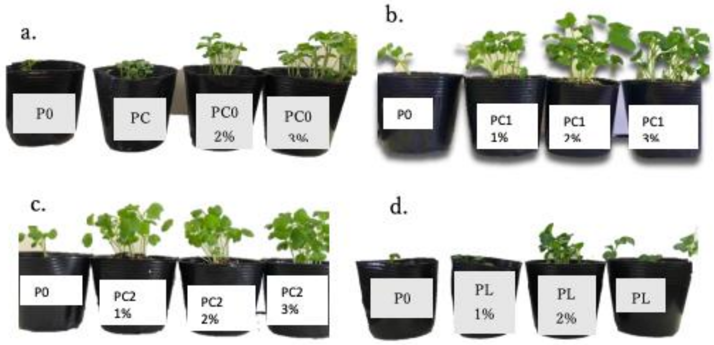

Fig. 3. (a). Plant growth after implementation of SCG compost control; (b). Plant growth after implementation of SCG compost C1; (c). Plant growth after implementation of SCG compost C2; (d). Plant growth after implementation of commercial compost

After observing the physical plants, the height and width of the leaves were also calculated (Figure 4)

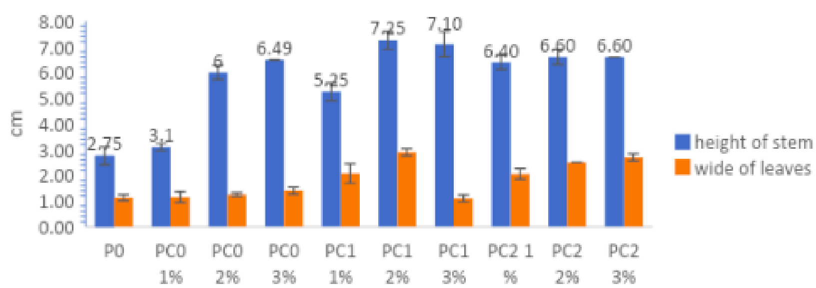

Fig. 4. Physical of Mustard Plants after 3 weeks seeding

From Figure 4. above, it can be seen that the addition of SCG compost is very good for plant growth. When compared with the control, after 21 days of seeding, the length of the stem and leaf area became longer and wider. SCG compost with the addition of commercial starter (C1) at 2 and 3% has a better effect on mustard plants than adding SCG compost with fungi starter (C2). The addition of SCG compost to the seeding mustard plant had better results for stem height and leaf width when compared to no compost added at all (P0). This proves that compost SCG has good nutrition for plant seeding. Primarily are nutrients that plants need for the growth of leaves and stems, such as nitrogen, magnesium, phosphorus, and potassium (macronutrient). According to Rosmarkam (2007), plants that are sufficiently supplied with N can stimulate plant vegetative growth, including increasing plant height, making plants greener because they contain lots of chlorophyll, and are a building block of protein and fat.
Sutiyoso (2003) also mentions that the increase in leaf width is significant because it is influenced by nutrients in organic fertilizers. Leaf width growth is influenced by sufficient N content for plants. In addition to sufficient N nutrients, it is also caused by sufficient Mg levels. Magnesium (Mg) is a nutrient that plays a role in the formation of chlorophyll, activating the phosphorylation process that supports the work of Phosphorus (P) in the energy transfer of ATP (adenosine triphosphate). In addition, at the time of seeding the macronutrient that is no less important is potassium (K). Potassium (K) is the most abundant inorganic cation, and it is important for ensuring optimal plant growth (White and Karley, 2010). K is also very important for cell growth, which is an important process for the function and development of plants (Hepler et al., 2001). As mentioned in Table 2, macronutrient content in SCG compost is very high. Therefore, it is better to stimulate plant growth.

4.3. NUTRIENT ANALYSIS

Analysis of plant nutrition after seeding is very important to do. To determine the effect of compost implementation on plant growth, especially during the vegetative period of the plant. The results of nutrient analysis mustard plants are represented in table 4.

Table 4. Nutrient content in mustard plants after seeding

Samples	C (%)	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
P0	32.11	7.11	7	7.87	71	17.92
PC0 1%	30.68	6.74	3.38	155.75	86.75	12.25
PC0 2%	31.36	6.85	12.28	180	87.75	10
PC0 3%	31.75	6.90	29.9	605	67.5	13
PC1 1%	31.82	7.16	13.1	256.25	86.75	16.25
PC1 2%	32.12	7.32	15.23	222.5	87.75	18
PC1 3%	32.65	7.56	17.19	525	81.25	29.25
PC2 1%	30.82	7.57	19.01	460	92	17.25
PC2 2%	31.77	7.59	13.05	650	98	16
PC2 3%	32.48	7.68	6.38	837.5	83	15.5
PCL 1%	30.55	7.14	14.68	122.5	65.75	8.25
PCL 2%	30.83	7.22	14.76	155	74	8.25
PCL 3%	31.28	7.31	12.71	427.5	58.5	10

Data are expressed as mean of three replicates

From table 4 above, plants without fertilizer application (P0) have higher macronutrient content such as Carbon, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium when compared to plants that have been given SCG compost and commercial compost. From table 4, it can also be seen that the addition of commercial compost has a lower macronutrient than the addition of SCG compost.

Sample P0 has the lowest macronutrient. This is because the nutrients for plant growth are inadequate. The addition of SCG compost increases the nutrients in the plant. The best addition of compost SCG for plants is 3%. This is almost similar to previous research by Chrysargyris et al (2020), on horticultural cabbage. Seed emergence was stimulated in 2.5% of SCG compost. The incorporation of SCG compost impacted the mineral content accumulated in plants with increases in nitrogen, potassium, and phosphorus and decreases in magnesium and calcium.

Soheil et al. (2012) determined the effects of Municipal Waste Compost (MWC) on corn plant responses in pot experiment. They also tested the concentrations of N, P, K and micronutrient elements in the dry matter of the aerial part of the plant. The result showed that N, P and K content and concentration of micronutrients in plant increased with increase of compost concentration. Amount of the waste compost was significantly increased concentrations of macro and micronutrients in dry matter. I

n Table 4 above, it can also be seen that commercial compost has an effect on increasing nutrients in plants when compared to compost plants. However, when compared to plants treated with SCG compost, plant nutrients with commercial compositions were still lower. This proves that, compost SCG has a better effect on mustard plants.

4.4. BIOMASS

Biomass analysis on generally can be used as an illustration the ability of plants to accumulate dry material that can be used as hints of growth traits. Higher the amount of photosynthate means more a lot of dry matter that can be stored (Jumin, 2010). Data biomass of mustard plants can be seen in curve Figure 5.

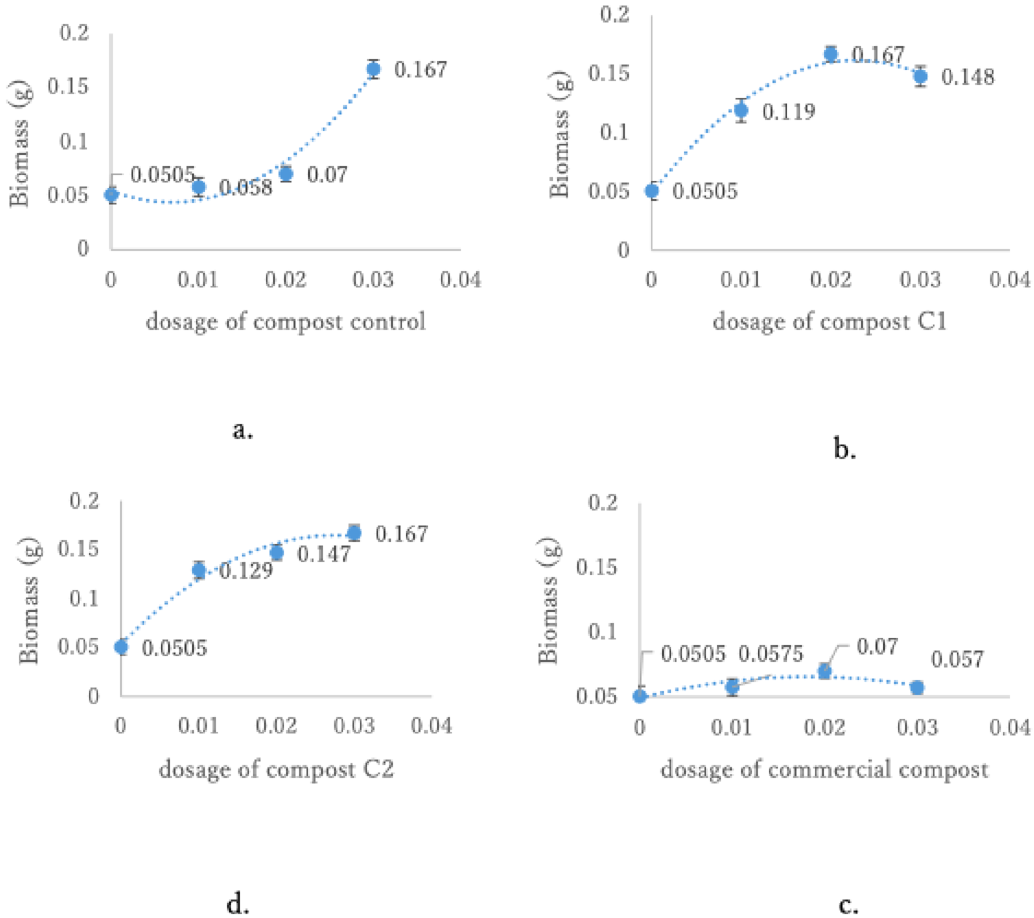

Fig. 5. Curve of Mustard Plant Biomass in Variation dosage of Compost

From Figure 5 above, the addition of control compost yields lower biomass at 1 and 2%. However, at the addition of 3%, biomass increased significantly. This is because, based on Table 2, the nutrients in the compost control (C0) are lower when compared to C1 and C2. So that to produce high biomass, more compost is needed. Biomass at the addition of compost C1, optimal at the addition of 2% dose. The addition of 3% compost dosage actually decreased the biomass yield. Slightly different from the addition of C2 compost, optimal compost dose is 3%. Meanwhile, the biomass in the addition of commercial compost shows an even smaller value when compared to the addition of compost control. This proves that the mineral content or nutrients in plants with the addition of SCG compost, both compost control, C1, and C2 are more than the mineral content in plants with the addition of commercial compost. This is also evidenced by the results of nutrient analysis which have been described in Table 4.

According to Harjadi (1984), plant growth is a function of efficiency in producing dry matter plant. Dry weight tightly to do with increased growth and development in absorbing nutrients for growth and development of the vegetative part. If dry weight is low then growth Vegetative plants will be inhibited, because of the nutrients which is absorbed a little so that it affects plant growth.

Plant dry weight reflects nutrient status and the amount of nutrients absorbed by plants and the rate of photosynthesis. Nutrients in plants play a role in the process of plant metabolism for producing dry material which it depends on the rate of photosynthesis. When the rates of photosynthesis are different, then the amount of photosynthate produced is also different, likewise with the dry weight of the plant is a reflection of the plant growth rate. Prawiranata et al. (1988) states the dry weight of a plant is the result of deep photosynthate build-up its formation requires nutrients, water, CO_2 and sunlight. This condition is supported by the opinion of Lakit (2004) which states that the dry weight of the plant reflects accumulation of organic compounds is the result of plant synthesis from compounds inorganic originating from water and carbon dioxide thus contributing to weight dry the plant.

4.5 NUTRIENT UPTAKE

Data on phasic changes related to uptake of nutrients are presented in Figure 6. At 21-day growth stage, minimum concentration of nutrients (nitrogen, phosphorus, and potassium) in Mustard plants as well as their uptake was observed P0 and PCL. However, maximum was observed in control plots and increased subsequently with increase doses of compost (PC2). Minimum nitrogen uptake of 1.67 (PCL 1%) and 1.42 kg/ha (P0) and maximum of 5.42 (PC2 3%) and 5.47 kg/ha (PC0 3%). Nitrogen concentration varied between 6 to 7% in the samples (Table 4).

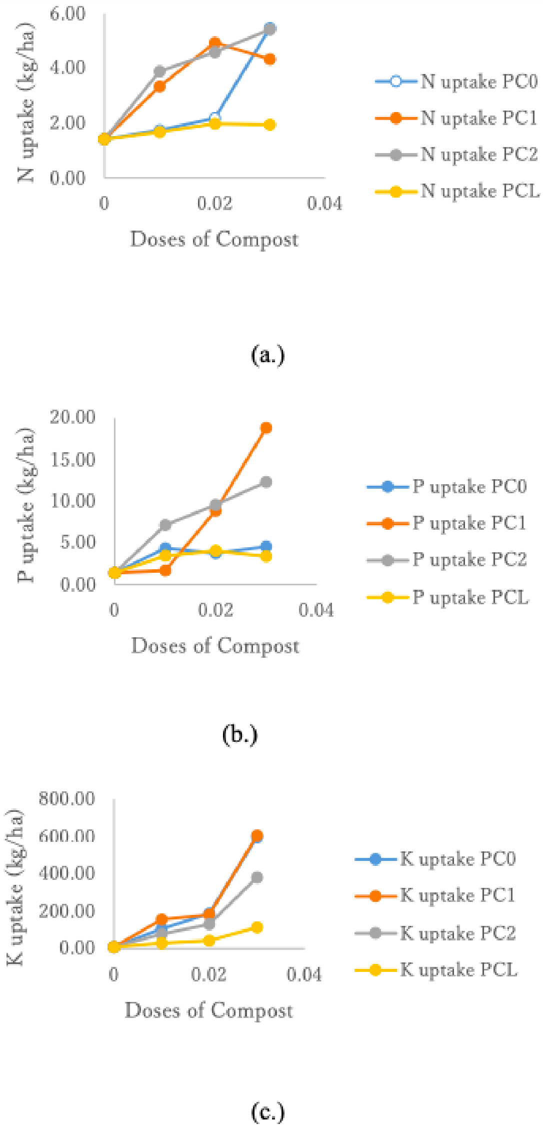

Fig. 6. Nutrients uptake by Plants

Phosphorus uptake varied between 1.39 (P0) to 19.5 kg/ha (PC1 3%). Following the similar trend of uptake, increase in concentration of phosphorus in mustard plants was a function of increasing doses of compost, it ranged between 3-15 %, whereas in control it was 7 %. Minimum potassium uptake (7.87 kg/ha in control), whereas maximum potassium uptake of 605 kg/ha (PC1 3%).

From the data above, the nutrient uptake by plants added with commercial compost is better than plants that are not added with compost. However, when compared to nutrient uptake by plants that have been added with compost, both control compost (C0), compost with starter fungi (C2), and compost with commercial starter (C1), and have a much higher nutrition uptake.

The addition of compost to the soil resulted greater biomass and nutrient uptake by Mustard plant, compared to where compost was not added to the soil. The concentration increased with compost addition. Thus, it is likely that the improvements in biomass associated with compost addition were in part due to soil P amelioration likewise with nitrogen (Nguyen et al., 2013; Duong et al., 2012; Hargreaves et al., 2008).

4. CONCLUSION

Adding compost have positive effect for plant growth especially for length of stem and width of leaves. Plants with the addition of SCG compost (C2) as much as 3% have the best results when compared to the addition of commercial compost (C1) and compost control (C0) in terms of plant physical and nutrients contained therein. Likewise with the biomass produced. The results of the in vitro germination index analysis also proved that the fungi starter implemented in the Mustard plant had the best GI value, namely 200.4%.

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