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Growth Performance of *Litsea philippinensis* Merr. Seedlings as Affected by Two Organic Concoctions and Vermicast

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Abstract

The study was conducted to evaluate the effects of the two organic concoctions namely Indigenous Microorganism (IMO) and Oriental Herbal Nutrient (OHN), vermicast and inorganic fertilizer on the growth performance of Bakan (*Litsea philippinensis* Merr.) seedlings. The study was conducted at the Forest Resource Development Division (FRDD) Nursery using Completely Randomized Design (CRD) with six (6) treatments replicated three (3) times. The variables evaluated include root collar diameter, seedling height, number of leaves, percent survival, and disease severity. Results show that the application of complete fertilizer and organic concoctions (IMO and OHN) demonstrated a significant increase in height, root collar diameter, and percent survival of Bakan seedlings compared to the control. However, the effects on the number of leaves, percent survival, and disease severity of leaf spot and leaf blight were statistically not significant. Moreover, the results also show that the two organic concoctions outperformed the inorganic fertilizer in terms of the height of the seedlings. Indeed, it is concluded that the two concoctions used could be good substitutes or alternatives to inorganic fertilizer. Hence, the use of these concoctions may set an as good example to indicate that organically-based products will yield relatively comparable results with inorganic fertilizers.

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Introduction

The plant kingdom is recognized as the most efficient producer of chemical compounds, synthesizing many products that are used in defense against different pests (Isman and Akhtar, 2007). Perceived to be inherently less harmful with potential benefits to agriculture and human health, the use of indigenous plant materials as biopesticides and biofertilizers has been gaining prominence in recent years. Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. Biopesticides fall into three major categories as microbial, plant and biochemical pesticides. Microbial pesticides contain microorganisms (bacterium, fungus, virus, protozoan, or alga) as the active ingredient.

Biochemical pesticides are naturally-occurring substances that control pests by non-toxic mechanisms. These include substances that interfere with growth or mating, such as plant growth regulators, or substances that repel or attract pests, such as pheromones. Moreover, the most commonly used biopesticides contain living microorganisms that are pathogenic for the pest of interest are known as bio-fungicides (*Trichoderma*), bioherbicides (*Phytophthora*) and bio-insecticides (*Bacillus thuringiensis*) (Gupta and Dikshit, 2010).

In the Philippines, research on the development of biopesticides and or related products had been initiated as early as the 1970s, however, this did not gain momentum due to shifting research interests and priority and most of all, limited funding sources.

Had these researches been able to develop products, it could have benefited much the farmers who are dependent on synthetic or inorganic fertilizers and pesticides for crop production. In like manner, researches on the application of biopesticides and biofertilizers in forestry, specifically in nursery and seedling productions, were also very limited and just like in agriculture, the production of healthy and quality seedlings were much dependent on the use of synthetic chemicals for pest and disease control.

Associated with the over-dependence on synthetic chemicals in production is the alarming rate of pollution and environmental degradation as well as the ill-effects to human health. Hence, this necessitated for ecological-friendly alternatives. Moreover, the use of synthetic chemicals has also been restricted because of the carcinogenicity, teratogenicity, high and acute residual toxicity, ability to create a hormonal imbalance, long degradation period and food residues (Feng and Zheng, 2007; Pretty, 2009; Dubey *et al.*, 2011; or Khater, 2011). Thus, this research was conducted to evaluate the effects of organic concoctions on the growth and survival of *Litsea philippinensis* Merr.

Materials and methods

Location of the study site

The experiment was conducted at the Clonal Forest Nursery of Central Mindanao University Campus situated in the province of Bukidnon, Philippines. The area is geographically located at 7˚51'35"N latitude and 125˚2'49"E longitude having an elevation of approximately 360 meters above sea level.

Experimental design

The study was laid out in a Complete Randomized Design replicated three (3) times. The treatments were: T_1 – Control (Negative Check); T_2 – Oriental Herbal Nutrient (OHN); T_3 – Indigenous Microorganism (IMO); T_4 – Inorganic Fertilizer (Positive Check); T_5 – OHN + Vermicast; and T_6 – IMO + Vermicast.

Experimental seedling preparation

A total of 180 potted seedlings of *Litsea philippinenses* Merr. Were prepared on a separate nursery bed. The seedlings were inspected to make sure that these were disease-free. Initial data on the diameter, height and number of leaves were gathered before the plants were subjected to experimentation.

Preparation of organic concoctions

Oriental Herbal Nutrient (OHN): A kilo of ginger (*Zingibera officinale* L.) was prepared, thoroughly washed, dried and chopped. The chopped pieces of ginger were mixed with one-liter molasses in a clay pot then covered with a thick paper before this was securely fastened with twine. The preparation was stored in a cool dry place for seven days to allow fermentation. After seven days, the fermented mixture was strained using a clean cloth. The concoction was then stored in a clean sterilized container (Adopted from Sarian, 2009).

Indigenous Microorganism (IMO): A kilo of freshly cooked rice was placed in a sterilized bamboo culm and then properly sealed. The culm was buried in the soil for 3 days. After 3 days, the buried culm was unearthed and the molded cooked rice was taken out and was mixed with 800 ml of molasses. The mixture was then placed back into the bamboo culm and 200 ml of molasses were placed on the mixture as toppings. The culm was then sealed and the mixture was allowed to ferment for 7 days. After seven days, the extract developed from the mixture was obtained by straining using a clean cloth. The concoction was then stored in a clean sterilized container.

Rate and frequency of application

For the application of the organic concoction, three (3) tablespoons were mixed into a liter of tap water. The mixture was applied using a hand-held sprayer unto the leaves of the experimental seedlings and on the soil. The weekly application was performed late in the afternoon for 15 weeks.

Data collection and statistical analysis

The study was conducted for three months. The data collected weekly include the number of leaves, stem diameter (mm), seedling height (cm), percent survival, and disease severity. For disease severity, leaf spot and leaf blight diseases were assessed using the scale of infection (Tables 1 and 2).

The assessments were done before experimentation and after the termination of the study using the following formula:

$$\%\ \text{Disease Severity} = \frac{0n_0 + 1n_1 + 2n_2 + \ldots + 9n_9}{9N} \times 100$$

Where:

n= number of samples exhibiting a rating of 0 to 9

N= number of samples assessed

9= highest rating scale

Data analysis

The result was analyzed using SPSS. The differences in the growth performance of the experimental seedlings were determined using analysis of variance (ANOVA) and the mean difference of treatments was done by Tukey's.

Results and discussion

Root collar diameter (mm)

The application of inorganic fertilizer and two organic concoctions showed a significant difference ($P<0.05$) on the root collar diameter of Bakan seedlings.

The biggest increment was recorded in Treatment 4 (inorganic fertilizer) with 5.52 mm while the least increment was observed in Treatment 1(Control) seedlings with 4.84 mm. On the other hand, Treatment 3 (IMO with vermicast) had comparable results with Treatment 4 (inorganic fertilizer) with a mean of 5.08 mm (Fig.1).

Table 1. Scale of infection for leaf spot (Jadhay and Patil, 2016).

Scale	Percent	Description
0	0%	No lesion/spots
1	1%	Leaf area covered with lesion/spots
3	1.1 to 10%	Leaf area covered with lesion/spots, no spots on stem
5	10.1 to 25%	Leaf area covered with lesion/spots, no defoliation; little damage
7	25.1 to 50%	Leaf area covered with lesion/spots; some leaves drop; death of few plants; damage conspicuous
9	50% of Above	More than 50% area covered, lesions/spots very common on all parts, defoliationcommon; death of palnts common; damage more than 50%

This implies that plants applied with inorganic fertilizer may respond well because the macroelements needed are directly available upon application of the fertilizer into the soil. Once this inorganic fertilizer dissolves in water, uptake or assimilation by plants eventually follows via the root system.

Table 2. Scale of infection for leaf blight (Nutter *et al.*, 2006).

Scale	Percent	Description
1	0%	No disease
2	1 - 25%	Few lesion
7	25 - 50%	Only top leaves are green
9	100%	Foliage completely destroyed

In contrast, the nutrients in the concoctions may take a longer time to effect unlike inorganic fertilizer because organic nutrients need to be converted first via the mineralization process before plants could utilize such nutrients. Mineralization is the decomposition or oxidation of the chemical compounds in organic matter releasing the nutrients contained in those compounds into soluble inorganic forms that may be plant-accessible.

Therefore, any organic material or matter applied in the soil would exhibit a “slow-release” process due to such conversion into an inorganic state for them to become available to plants.

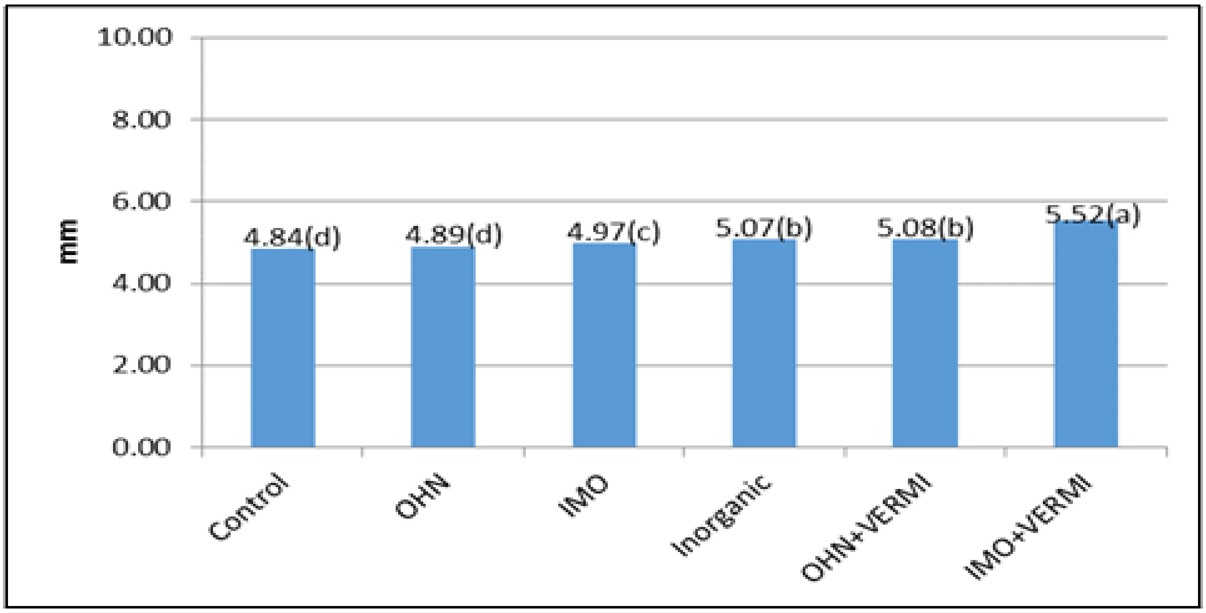

Fig. 1. Root collar diameter of Bakan seedlings treated with organic concoctions and vermicast.

Seedling height (cm)

The height increment of Bakan seedlings was significantly affected ($P<0.05$) by the different treatments applied. In comparison to the control seedlings (T1), all of the other treatments applied significantly influenced the height of the seedlings. Results showed that seedlings treated with OHN and vermicast (T5) had 58.7 cm and IMO and vermicast (T6) had 44.57 cm which outperformed those seedlings applied with inorganic fertilizer (T4) having a mean height of 29.52cm (Fig. 2).

This implies that the two organic concoctions can influence the height of Bakan seedlings. A similar result was also observed in the study of Kokularathy *et al.* (2016) on the growth and yield performance of rice applied with conventional farming (i.e. commercial fertilizer) and natural farming (i.e. IMO, OHN and the combination of IMO, OHN and vermicast). The results revealed that the latter obtained the tallest plants and the highest yield and outperformed the conventional farming system.

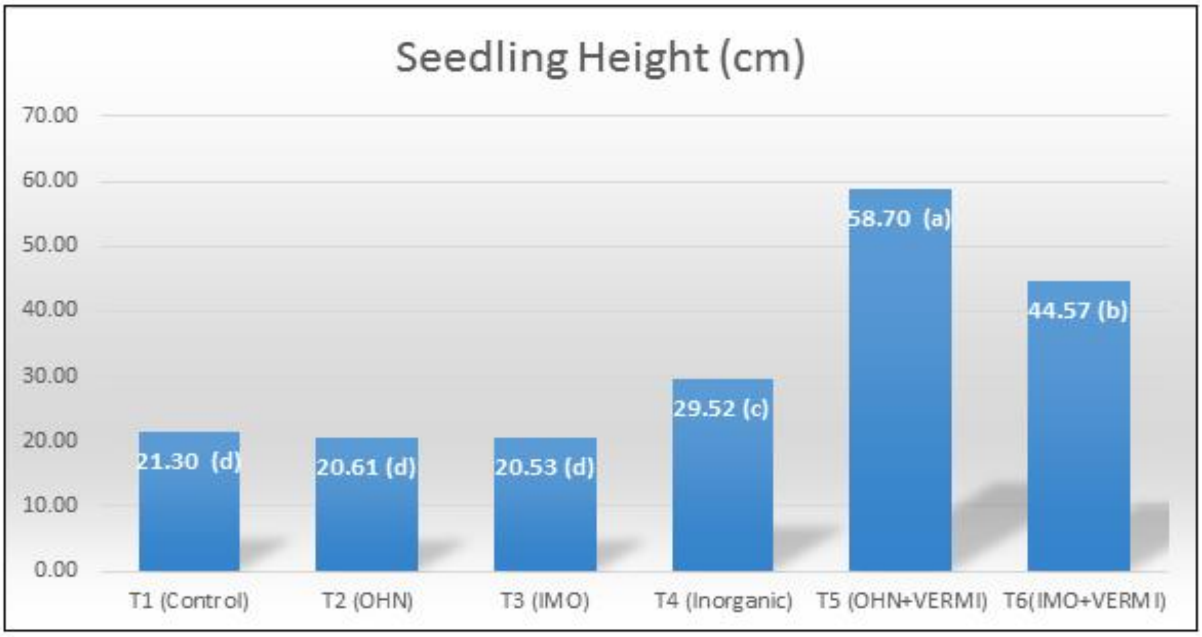

Fig. 2. Height of Bakan seedlings treated with organic concoctions and vermicast.

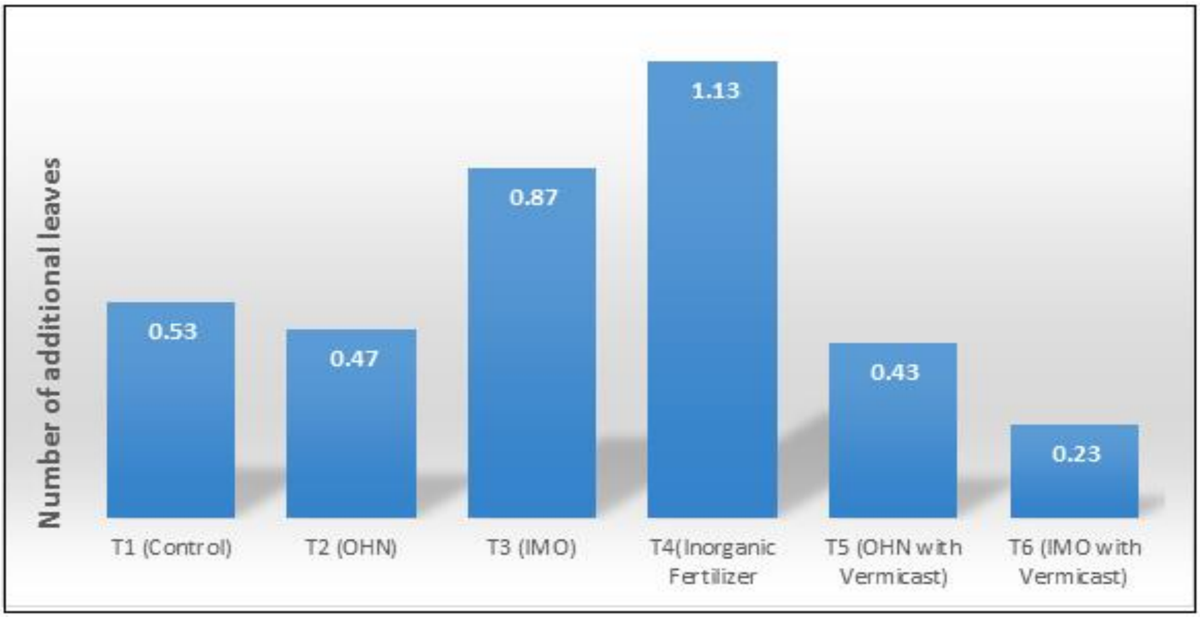

Fig. 3. Number of additional leaves of Bakan seedlings treated with organic concoctions and vermicast.

Number of additional leaves produced

The application of the inorganic fertilizer and two organic concoctions showed a non-significant difference in the number of leaves of Bakan even if the two concoctions were added with vermicast (Fig. 3). The seedlings applied with inorganic fertilizer were found to have the highest mean number of leaf produced at 1.13. However, the increase was not statistically different from an indigenous microorganism (IMO) suggesting that both can be utilized to induce a higher number of leaf production.

Percent survival

The application of inorganic fertilizer and two organic concoctions significantly influenced the percent survival of Bakan seedlings. Among the treatments, the Control set-up had the least percentage survival at 93% while those of the other treatments ranged from 97% to 100% (Fig. 4). The result shows that using vermicast combined with any of the two concoctions, Oriental Herbal Nutrient (OHN), and Indigenous Microorganism (IMO), and with inorganic fertilizer can promote height and diameter growth of Bakan seedlings. The findings of the study can be parallel to the results reported by Singh and Verma (2015) on the survival and growth performance of Stevia cuttings, where the growing media such as vermicompost + soil+ FYM significantly influenced the high survival rate, growth and development.

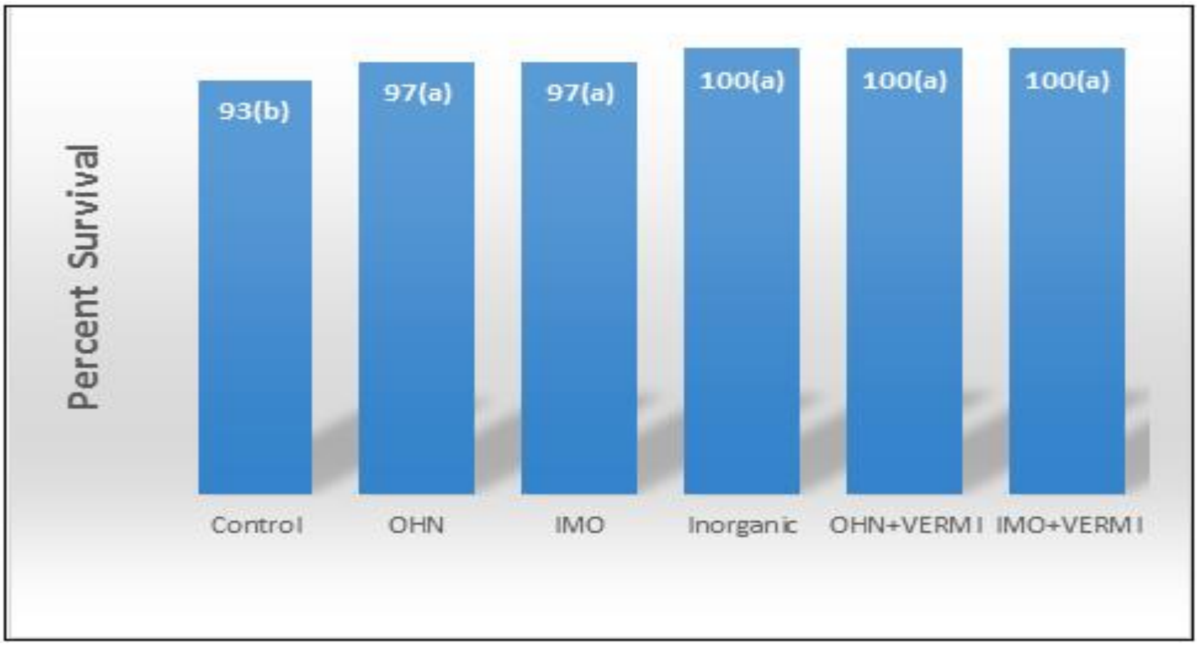

Fig. 4. Percent survival of Bakan seedlings treated with organic concoctions and vermicast

Fig. 5. Leaf spots and leaf blights observed on leaves of Bakan seedlings.

Disease assessment

There was no significant variation among the various treatments applied to the severity of leaf spot and leaf blight (Fig. 5, 6 and 7). However, the least leaf spot rating was recorded in seedlings applied with OHN while the lowest percentage severity of leaf blight was noted in plants applied with IMO and vermicast.

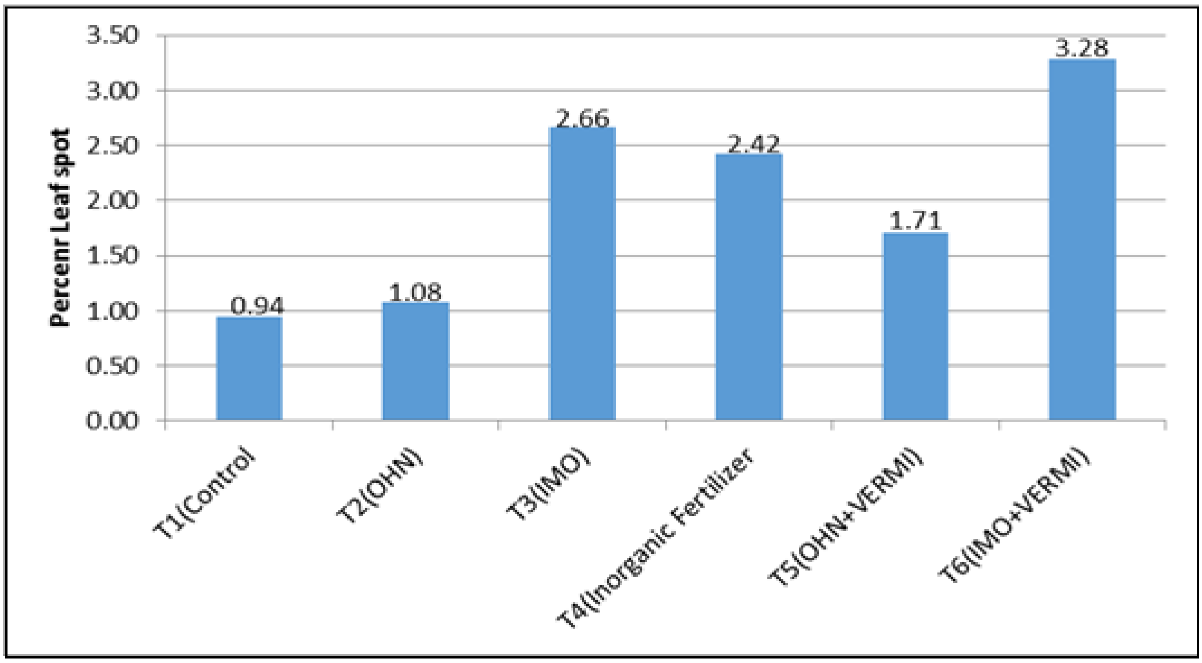

Fig. 6. Mean severity rating of leaf spot on Bakan seedlings treated with organic concoctions and vermicast.

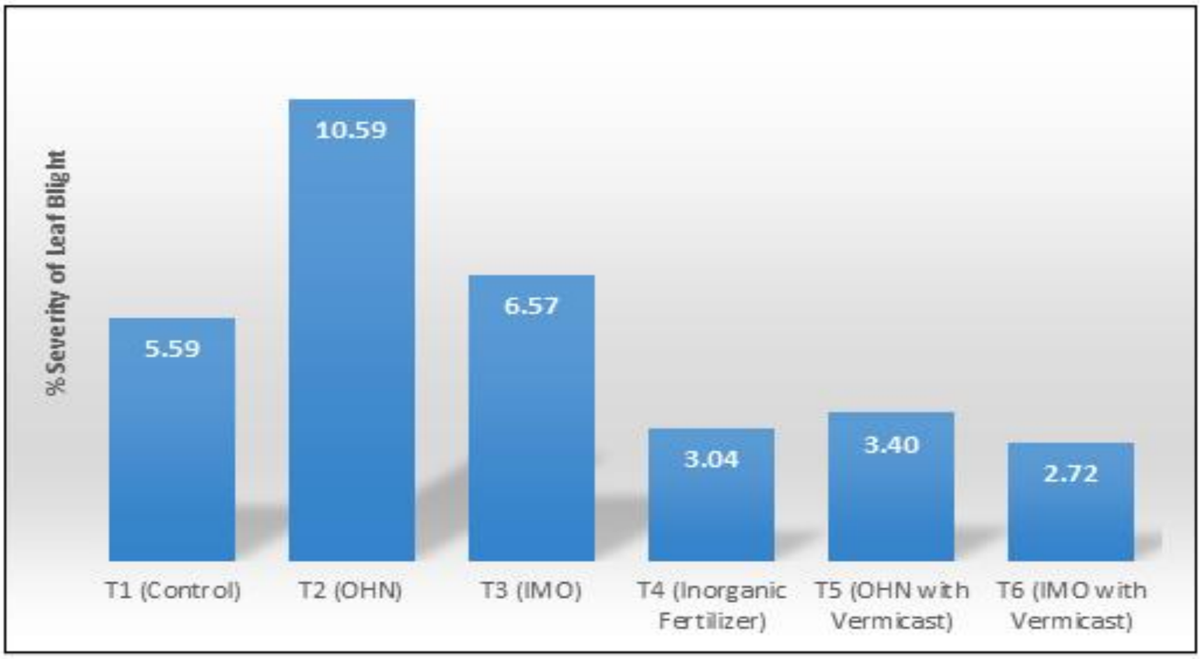

Fig. 7. Mean percent severity of leaf blight on Bakan seedling treated with organic concoctions and vermcast.

Conclusion

The application of inorganic fertilizer has significantly increased seedling diameter, however, such a result is more or less comparable to the other treatments applied with the organic concoctions. On the other hand, the height of the seedlings was greatly affected by the application of the two concoctions and even outperformed that of inorganic fertilizer. Besides, using Oriental Herbal Nutrient (OHN), Indigenous Microorganism (IMO) and inorganic fertilizer had a significant effect on Bakan seedlings. Moreover, despite having no significant effect of the treatments on the number of leaves and disease severity, it is, therefore, concluded that the concoctions used could be considered good substitute or alternative to inorganic fertilizer known to cause more adverse effects to the soil in terms of acidity, compaction, and structure among others. On the contrary, the use of concoctions may set a good example to show that organically-based products can yield relatively comparable results with those of inorganic fertilizers.

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