Performance of String Beanns (*Phaseolus Vulgaris L.*) Applied with Bokashi Made from Different Substrates

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Abstract

The study was conducted to evaluate the performance of string beans applied with bokashi from different substrates. The parameters were gathered in a two-cropping season, laid out in a 2×4 factorial experiment using Randomized Complete Block Design (RCBD) with three replications. Factor A was the cropping seasons, such as A1- first cropping (January- May) and A2- second cropping (June-September). Factor B was bokashi made from various substrates such as B1- Bokashi with Rice Bran, B2- Bokashi with Sawdust, and B3- Bokashi with Cocodust. The data were analyzed using STAR software and LSD test for mean comparisons. The field experiment study revealed that bokashi from various substrates manifested a comparable effect on the growth and yield of string beans. During the cropping season, they influenced the diameter of fruit, weight of non-marketable fruit, number of marketable fruit, number of non-marketable fruit, plant height, stem girth, number of productive branches, weight of roots, length of longest roots, and biomass. There was no interaction effect between the different substrates in making bokashi and the season of growing the crop.

Keywords: Bokashi, string beans, substrates, cropping season

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Introduction

Phaseolus Vulgaris L., the common bean, is a herbaceous annual plant grown worldwide for its edible bean, popular both dry and as a green bean. It is one the most popular vegetables in the country, grown for its tender pods, although its young leaves and stem are edible when boiled. Although it is a leguminous crop and can fix atmospheric nitrogen, it still requires inorganic fertilizer recommendations reaching as much as 135 kg/ha N, 135 kg/ha P205, and 112 kg/ha K20, depending on the soil analysis. This fertilizer recommendation requires a voluminous amount of fertilizer when satisfied.

The soil fertility amendment bokashi is being applied in agricultural systems worldwide, yet very little is known about its characteristics and capabilities. Bokashi (organic material rich in microbial biological resources) results from organic material fermentation with stocks of effective microorganisms. This can be used as an organic fertilizer to nourish the crops, increase the growth and production of plants (Karimuna et al., 2016; Zaman et al., 2016; Anhar et al., 2018), improve better soil structure (Xiaohou et al., 2008; Hernández et al., 2014; Barajas-Aceves, 2016), and increase the volume of water contained and stored in the soil which means increasing the water available to the plants (Djajadi et al., 2011; Yulnafatmawita et al., 2010).

The EM in Bokashi consists of mixed cultures of beneficial and naturally occurring microorganisms that can increase microbial activity when applied to the soil. It contains up to 80 different species belonging to five primary groups of microorganisms, such as predominant populations of lactic acid bacteria (Lactobacillus plantarum, L. casei, L. fermentum, L. salivarius, L. delbrueckii) and yeasts (Saccharomyces cerevisiae), smaller numbers of photosynthetic bacteria (Rhodobacter sphaeroides, R. capsulatus and Rhodopseudomonas palustris), actinomycetes and mold fungi. All of these microorganisms are mutually compatible (Ginting, 2019).

Bokashi made from different substrates could increase the yield of various crops. Bokashi, made from burned rice husk and bokashi sago dregs, increased soybean production (Glycine et al.). In contrast, those made from biomass of secondary vegetation have been found to increase the production of maize and peanut (Arachis hypogaea L.). Bokashi from water hyacinth (Eichhornia crassipes) was reported to provide better soil conditions for producing soybean, corn, and rice grown in dry land soil. A combination of LCC (Legume et al.: Centrosema pubescent, Calopogonium mucunoides, and Pueraria javanica) and Bokashi had a significant effect on raising C-Organic, P and K of soil along with the increasing of Fe and Mn uptake by LCC, while application of Bokashi cow-manure coupled with NPK inorganic fertilizer increased significantly soil Corganic, N-fixing bacteria, P-solubilizing bacteria and bulb production of shallot (Allium ascalonicum) (Ginting, 2019).

As observed, bokashi from various sources impacts soil properties and crop growth differently. With this, the researchers thought of formulating bokashi using locally available materials and testing its effect on the growth and yield of string

beans. Hence, this study was conducted.

Materials and Methods

A two-factor study was conducted at the Organic Agriculture area of CapSU Burias, Mambusao, Capiz, and was laid out using Randomized Complete Block Design (RCBD), replicated five times. Factor A was the different cropping seasons comprising A1- first cropping (January-May) and A2- second cropping (June-September). Factor B was bokashi made from various substrates such as B1- Bokashi with Rice Bran, B2- Bokashi with Sawdust, and B3- Bokashi with Cocodust. The parameters gathered were plant height, stem girth, number of marketable fruits, number of non-marketable fruits, length of fruit, the diameter of fruit, weight of marketable fruits, the weight of non-marketable fruits, number of productive branches, number of lateral branches, the weight of roots, length of longest roots, and biomass. The data was analyzed using STAR software.

Results and Discussion

Plant Height

Table 1. The plant height of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Plant height	
	Cropping **	
	First Cropping	Second Cropping
Bokashi with rice bran	183.87	293.82
Bokashi with sawdust	179.59	288.22
Bokashi with cocodust	174.75	291.66
Total	**538.21**	**873.7**
Mean	**179.41b**	**291.23a**

The height of string beans differed significantly by cropping seasons but not among the substrates of bokashi applied. The mean for the plant height affected by bokashi from different substrates applied ranged from 174.75 cm to 293.82 cm.

String beans grown in the second cropping had the tallest height of 291.23 cm compared to those grown in the first cropping. There was no interaction effect between substrate in making bokashi and the cropping season of growing string beans.

Stem Girth

Table 2. The plant stem girth of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Stem girth	
	Cropping*	
	First Cropping	Second Cropping
Bokashi with rice bran	8.15	10.08
Bokashi with sawdust	8.00	10.82
Bokashi with cocodust	6.61	10.28
Total	**22.76**	**31.18**
Mean	**7.59b**	**10.40a**

Significant results in the cropping season and not significant results in various substrates of bokashi applied in string beans were reflected in the results of ANOVA. This implies that the various substrates of bokashi did not influence the stem girth of string beans. The means for this parameter ranged from 6.61 mm to 10.82 mm. Furthermore, string beans grown in the second cropping obtained the most considerable stem girth with a mean of 10.40 mm, and string beans grown in the first cropping had the smallest stem girth with a mean of 7.59 mm. There was no interaction effect between the two factors.

Number of Productive Branches

Table 3. The plant number of productive branches of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Number of productive branches	
	Cropping**	
	First Cropping	Second Cropping
Bokashi with rice bran	11.08	6.90
Bokashi with sawdust	12.32	7.10
Bokashi with cocodust	10.54	6.74
Total	**33.94**	**20.74**
Mean	**11.31a**	**6.91b**

There was no significant difference observed in the number of productive branches of string beans as influenced by the various substrates of bokashi applied. Their mean value ranged from 6.74 to 12.32.

Analysis of variance revealed that the result across cropping seasons was highly significant. This denotes that the length of the longest leaf of string beans was highly affected by cropping seasons. The most productive branches were recorded from the string beans planted in the first cropping, while string beans planted in the

second cropping had the least productive branches. No interaction effect was noted between the cropping seasons and different substrates of bokashi.

Weight of Roots

Table 4. The plant weight of the roots of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Weight of roots	
	Cropping **	
	First Cropping	Second Cropping
Bokashi with rice bran	15.30	10.50
Bokashi with sawdust	14.92	12
Bokashi with cocodust	14.90	11.70
Total	**45.12**	**34.2**
Mean	**15.04a**	**11.40b**

The results of the study revealed that the stem weight of roots harvested from the first to the second season was not significantly affected by different substrates of bokashi applied. The means ranged from 10.50 grams to 15.30 grams.

In terms of the result across cropping seasons, the weight of roots varied significantly. String beans grown in the first cropping obtained the heaviest weight of roots with a mean of 15.04 grams, while the string beans grown in the second cropping obtained the lightest weight with a corresponding mean of 11.40 grams. No interaction effect was noted between the cropping seasons and different substrates of bokashi.

Length of Longest Roots

Table 5. The plant length of the longest roots of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Length of longest roots	
	Cropping*	
	First Cropping	Second Cropping
Bokashi with rice bran	31.42	29.09
Bokashi with sawdust	30.60	28.54
Bokashi with cocodust	31.04	27.41
Total	**93.06**	**85.04**
Mean	**31.04a**	**28.35b**

The analysis of variance for the length of longest roots revealed significant results in cropping seasons but not with the different substrates of bokashi applied. The mean for this parameter ranged from 27.41 cm to 31.42 cm.

String beans planted in the first cropping produced longer roots with a mean

of 31.04 cm, while string beans grown in the second cropping had shorter lengths of roots with a mean of 28.35 cm. The analysis also revealed no interaction effect between the two factors.

Biomass

Table 6. The plant length of the Biomass of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Biomass	
	Cropping **	
	First Cropping	Second Cropping
Bokashi with rice bran	386.81	181.73
Bokashi with sawdust	323.00	170.70
Bokashi with cocodust	338.50	189.00
Total	**1048.31**	**541.43**
Mean	**329.44a**	**180.48b**

The biomass of string beans differed significantly with cropping seasons but not among various substrates of bokashi used. The mean of biomass as affected by different substrates of bokashi ranged from 170.7 grams to 338.5 grams.

String beans grown in the first cropping had the heaviest weight, with a mean of 329.44 grams. The lightest weight was obtained in the second cropping. The variance analysis revealed no interaction effect between the cropping seasons and different substrates of bokashi in influencing the biomass of string beans.

Length of Fruit

Table 7. The plant length of the fruit of string beans during the wet and dry seasons is influenced by the bokashi made from the different substrates.

Treatment	Length of fruit	
	Cropping	
	First Cropping	Second Cropping
Bokashi with rice bran	42.72	47.95
Bokashi with sawdust	35.88	40.46
Bokashi with cocodust	40.95	48.04
Total	**119.55**	**136.45**
Mean	**39.85**	**45.48**

The length of string beans' fruit did not significantly vary among cropping seasons, and different substrates of bokashi were applied. The mean value for this parameter, as affected by the application of bokashi made from different substrates and cropping seasons, ranged from 35.88 cm to 48.04 cm.

Analysis of variance revealed that there was no interaction effect between the two factors of the study in influencing the diameter of the tuber of carrots.

Diameter of Fruit

The result of the study revealed that the diameter of the fruit of string beans harvested from the first to second cropping season was not significantly affected by the different substrates of bokashi applied. The means ranged from 4.03 mm to 8.42 mm.

In terms of the result across the cropping season, the diameter of the fruit varied significantly. String bean fruit harvested in the second cropping obtained the most significant fruit with a mean of 7.17 mm, while the fruit harvested in the first cropping had the most miniature fruit (4.53 mm).

There was no interaction effect between the different substrates used in making bokashi and the season of growing string beans.

Weight of Marketable fruit

The result of the study revealed that both experimental factors did not influence the weight of the marketable fruit of string beans. The means ranged from 33.65 grams to 50.39 grams.

No significant interaction effect was noted between the cropping seasons and the various substrates of bokashi in influencing the weight of marketable fruits of string beans.

Weight of Non-marketable Fruit

As noted in the result of the study, the weight of non-marketable fruit differed with the cropping seasons but not with the different substrates of bokashi applied. Means for this parameter ranged from 1.25 grams to 9.93 grams. The heaviest non-marketable fruit was obtained from string beans harvested in the second cropping (8.76 grams), and string beans harvested in the first cropping had the lightest weight of non-marketable fruit.

Likewise, there was no significant interaction between the two factors influencing the weight of non-marketable fruit.

Number of Marketable Fruit

Analysis of variance for the number of marketable fruits revealed significant results in cropping seasons and not significant results with the various substrates of bokashi applied. Means range from 1.68 to 2.70 respectively. The most marketable harvested fruit was obtained in the second cropping with a mean of 2.44, while the least harvested fruit was recorded during the first cropping.

There was no interaction effect observed between the two experimental factors of the study in influencing the number of marketable fruits harvested.

Number of Non-marketable Fruit

As noted in the study results, the number of non-marketable fruits was not significantly varied with the treatment used. The means for this parameter ranged from 0.09 to 1.59. LSD revealed that the most non-marketable fruit harvested was noted in the second cropping with a mean of 1.28, while the least non-marketable fruit harvested was obtained in the second cropping.

The variance analysis revealed no interaction effect between the cropping seasons and bokashi from various substrates influencing the number of non-marketable fruits of string beans.

Conclusions

Based on the results of the study, the following conclusions are drawn. All growth and yield parameters of string beans did not differ significantly with the application of bokashi made from different substrates. Parameters such as diameter of fruit, weight of non-marketable fruit, number of marketable fruit, number of non-marketable fruit, plant height, stem girth, number of productive branches, weight of roots, length of longest roots, and biomass were significantly affected by cropping seasons. There was no significant interaction effect on the bokashi from various substrates and cropping seasons.

Recommendations

Based on the result of the study, the following recommendations are forwarded. Use bokashi from the different substrates as soil ameliorants in growing string beans. Plant string beans from January to May or during the first cropping for the heavier and lesser-weight non-marketable fruits. Conduct more relevant studies to explore further the performance of string beans applied with bokashi made from different substrates as organic amendments

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