Efficacy of Fertilizer from Tubang-Bakod (JatrophaCurcas Linn) Compost

Asia Pacific Journal of Multidisciplinary Research
Vol. 3 No. 4, 36-42
November 2015 Part IV
P-ISSN 2350-7756
E-ISSN 2350-8442
www.apjmr.com

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Date Received: September 29, 2015; Date Revised: October 28, 2015

Abstract –*In order to determine the efficacy of fertilizer from Tubang-Bakod (Jatophacurcas Linn) compost, an experiment was carried out in complete randomized block design based on 3 replications. Varied ratios of commercial organic fertilizer (COF) and Jatropha compost (JC) are 100:0, 50:50 and 0:100 and commercial inorganic fertilizers (CIF) were used in planting. Parameters such as number of leaves, length of stems, size and color of leaves were determined after harvesting. The maximum number of leaves was noted in 100:0ratios of JC and COF; the lengthiest stem was noted in vegetables grown with 100:0 JC; while the largest size of leaf was noted in CIF. The color of leaves was the same for the varied ratios with a reading of 4 while the CIF has a reading of 5 in the leaf color chart. The macronutrients of JC have 2.09% N, 1.98%P and 17. 49%K.However the micronutrients of the compost were 203.66 ppm Zn, 326.27 ppmMnand 3997.30 ppmFe. These nutrients are essential for the plant growth. It was observed that potassium (K) exceeded the standard for the COF which is 3.66 wt. %. K hastens maturity and increase the size and quality of vegetables.*

Keywords –*commercial organic fertilizer (COF),commercial inorganic fertilizer (CIF), Jatropha compost (JC), Tubang-Bakod (Jatophacurcas Linn)*

INTRODUCTION

Most soils in the Philippines are in low state of fertility and current crop varieties have high nutrient demands that it is almost certain that unfertilized crop land will produce mediocre yields. For the past years, farmers accepted that fertilizers are necessary in increasing crop production, meeting all the demands of people for food and producing healthy and vigorous plants.

Fertilizers can either be organic, from animal manure and plants; or it can be inorganic which is composed mainly of chemicals. The use of inorganic fertilizer is a usual practice by farmers in the tropics and subtropics. These are easy to handle and can bring out increase in crop yield but as a whole, the effects of such fertilizers to the soil and environment are disregarded.

Disregard of the effects of inorganic fertilizer, however, can bring about detrimental effects to the plants, and the soil as well. Over usage of this fertilizer can burn or destroy plant structures, it also contains certain salts that can accumulate in the soil, change the soil's chemistry, and render the soil unable to be used in the future.

Aside from the harmful effects of the over usage of the inorganic fertilizer, another disadvantage of it is leeching. The nutrients, are already in their most basic components, and therefore, can be washed away easily.

However, the growing awareness of the effects of inorganic fertilizers to soil and product promotes the use of alternative sources of fertilizer, one of which is organic fertilizer [1]. According to some scientists and environmentalists, organic fertilizers are environmental friendly, have no health risk to people who consume plant breed and less costly [2].

An organic fertilizer not only gives nutrients to the plants, but to the soil as well. The advantage of its slow release of nutrients is that it makes the plant absorbs just the right amount, and that the plant would have a constant source of nutrients [3].

Organic fertilizers come from plants and animal compost. Another organic source that can be looked into is Jatrophacurcas Linn compost.

Jatrophacurcas Linn is known locally as Tangan-tangan tuba and Tubang-bakod in Tagalog. It was introduced to the country from Mexico during the early Spanish era. The plant has been used as folk medicine in different countries to treat different ailments in humans. In the local community it is utilized for medicinal purposes and for the production of biodiesel [5].

The Batangas State University administrator recognizes the importance of Jatropha and allowed the planting of Jatropha on its four-hectare field in Lagadlarin, Lobo, Batangas as part of a research project funded by the university.

Thus, the study tries to lessen the country's dependence on commercially available inorganic fertilizer. Likewise, it can be utilized as an alternative feedstock in the production of fertilizer. It can help increase the farmers' income by reducing fertilizer cost in the production. Further, it can also help promote and develop the use of organic fertilizer in agriculture. However, the study also revealed the advantages of plant compost as fertilizer in enhancing plant growth and ensures healthy production of crop thereby lessening harmful effects to the soil.

Hence, the importance of the plant parts including the bark, fruit, leaf and seed, encouraged the researchers to discover other products from the Jatrophacurcas Linn which can be of economic use.

OBJECTIVES OF THE STUDY

The study aimed to determine the efficacy of the fertilizer from Tubang-bakod*(Jatrophacurcas Linn)* compost. Specifically, it aimed to determine the macronutrients (N, P, K) and micronutrient content (Zn, Mn, Fe) of the Jatropha compost; to test the significant difference in the macronutrient content and the growth response of vegetable using different commercial organic fertilizer (COF) and Jatropha compost ratio (100:0, 50:50, 0:100) in terms of Number of leaves, Length of stems, Size of leaves, and Color of leaves; to determine how does the varied COF and Jatropha compost ratio compare with the commercial inorganic fertilizer in terms of the growth response; and to determine how do the macronutrient contents of pure Jatropha compost compare with the commercial organic fertilizer.

MATERIALS AND METHODS

The study was an experimental research wherein varied ratios of COF and JC (100:0, 50:50, 0:100) were used. These fertilizers were utilized in vegetable production.

The study considered the determination of nutritive analysis of the fertilizers. The efficacy on vegetable production was also determined experimentally by observing the physical properties of the vegetable.

Preparation of the Fertilizers

Collection of Materials

The Jatropha seed husks were obtained from the university's field in Lagadlarin, Lobo, Batangas. The other commercial organic and inorganic fertilizers and the vegetable seeds were obtained from the market.

Preparation of Compost

The Jatropha seed husks along with other organic wastes, with a mass ratio of 4:1, were used in the preparation of the compost. The compost was prepared in a compost bin to provide the ideal controlled environment for aerobic decomposition to occur more completely and rapidly.

Characterization and Analysis of the Jatropha compost

A sample of the compost was brought to Regional Soils Laboratory, Department of Agriculture for analysis. The analysis included the determination of the macronutrient and micronutrient content of the fertilizers.

Application of Ratios of COF and JC and CIF on the vegetable

Planting of Vegetables

The vegetable seeds were planted in seed trays. After ten days of germination, the plants were transferred to a seed bed with corresponding fertilizers to assure the plant's optimum growth. The amounts of fertilizers used each treatment were recommended by the Regional Soils Laboratory, Department of Agriculture.

Monitoring of the Planted Vegetables

Proper care during the growing period was employed. The plants were watered once a day.

Harvesting and Determination of the Effects of the Fertilizer to the Plant

The plants were harvested after 4 weeks since germination. The effects on the physical properties of the vegetable were observed. The observed growth responses were number of leaves, length of stems, size of leaves, and color of leaves.

Table 1.Macronutrient Analysis of JC

Parameter		Result
Macronutrient (%)	N	2.09
	P	1.98
	K	17.49
Micronutrient (ppm)	Zn	203.66
	Mn	326.77
	Fe	3997.30

Table 2 shows the macronutrient content of the formulated JC. The N content is 2.09%, the P content is 1.98%, and the K content is 17.49%. Various reports indicate that the % nitrogen and the % phosphorus found in the formulated compost are within the desirable range which is 0.4 to 3.5%, and 0.3 to 3.5%, respectively. However, the % potassium greatly exceeds the desirable range, which is 0.5 to 1.8%. N is the important part of plant parts such as chlorophyll, amino acid, proteins and pigments. N affects growth and development of many leafy vegetables through its effect on cell division and hence leaf expansion. It also makes leafy vegetables and fodder more succulent, and increases the protein content of food and feed. P promotes early root formation and growth, promotes early shoot growth, hastens ground cover for erosion protection, affects the quality of fruit, vegetable and grain crops, and is vital to seed formation. Adequate phosphorus nutrition enhances many aspects of plant development including flowering, fruiting and root growth. K helps plants to resist drought and effects from excessive temperatures. It also increases crop resistance to disease, and aids plant in the production of starches, controls root growth, and regulates the opening and closing of pores in plant cells, which is important for efficient water use. Studies have shown that adequate amounts of potassium may promote the growth of long, strong cotton fibers; increase the shelf life of fruits; and increase the size and quality of fruits, grains, and vegetables.

On the other hand, the other vital nutrients found within the formulated JC. The JC contains 203.66 ppm of Zn, 326.27 ppm of Mn, and 3997.30 ppm of Fe. These trace minerals may be helpful in the growth and development of crops.

Zn is important for root development, and for the transformation of carbohydrates. It affects the rate of maturation of both seed and stalks, and also regulates consumption of sugars. Mn increases seed germination rates and reduces time to harvest because it increases P and calcium (Ca) availability to the crop. It also functions with enzyme systems involved in breakdown of carbohydrates, and N metabolism. Iron is essential for the formation of chlorophyll[6].

Comparison of the Growth Responses of the Vegetables Grown from Varied Ratios of COF and JC

After 4 weeks of planting, the vegetables were harvested and its macronutrients and growth responses were measured. The growth responses were in terms of the number of leaves, the length of the stems/leaves, and the size of the leaves. The measured results of the macronutrients and growth responses on the vegetable were presented in table 4.

Table 4.Effect of Varied Ratios of COF and JC and Inorganic Fertilizer on the Growth Response and Macronutrient contents of the Vegetable

Parameter	Varied Ratios of COF and Jatropha Compost			Inorganic
	100:0	**50:50**	**0:100**	
Number of Leaves	10	8	9	10
Length of Leaves (cm)	19	14	16	18
Size of Leaves	10	9	10	11
Macronutrients(wt. %)				
N	4.611	4.255	5.618	4.674
P	0.754	0.821	0.743	0.808
K	3.984	4.966	5.695	4.950

As shown in Table 4 it can be observed from the results that 100:0 yielded the greatest number of leaves, length of stems and size of leaves among the varied ratios of COF and JC.

This is comparable to the study where the effects of organic fertilizer on the growth and yield of lettuce were determined. It was stated that the chicken litter fertilized plants had relatively higher average leaves length, leaves breadth and number of leaves compared with other organic fertilizers used and the CIF [7].Moreover, it was observed that plant height, total number of tiller per hill, flag leaf length and dry matter were significantly increased in all the treatments over control in their study that involved the determination of the effect of organic fertilizer on growth and yield components in rice [8].

The macronutrients of the vegetable plants were determined and it was observed that the vegetables grown with 0:100 COF and JC ratio had the highest nitrogen and potassium values of 5.618 and 5.695, respectively, while 50:50 had the highest phosphorus value of 0.821.

Table 5.ANOVA of the Varied Ratios of COF and JC on the Growth Response of the Vegetable

Parameter	p-values	Computed f-ratio	Decision on Ho	Verbal Interpretation
Number of Leaves	0.048	5.225	Reject Ho	Significant
Length of Leaves (cm)	0.004	15.914	Reject Ho	Significant
Size of Leaves	0.613	0.532	Failed to Reject	Not Significant

α=0.05 <significance

The p-values of the parameters were presented in the Table 5. It can be observed that the number of leaves and the length of stems had a p-value of less than 0.05 which were 0.048 and 0.004, respectively. This meant that there were significant differences on these parameters upon application of varied ratios of COF and JC. However, it can be observed that the length of stems is highly significant. Hence, the null hypothesis was rejected. On the other hand, the size of leaves had a p-value of 0.613 which failed to reject the null hypothesis.

Table 6.Pair-Wise Comparison on the Effect of Varied Ratios of COF and JC on the Growth Response of the Vegetable

Parameter		Mean Difference	p-values
Number of Leaves	100:0vs 50:50	1.`133	0.061
	100:0 vs 0:100	0.933	0.117
	50:50 vs 0:100	-0.200	0.869
Length of Leaves (cm)	100:0vs 50:50	4.713	0.004*
	100:0 vs 0:100	2.857	0.040*
	50:50 vs 0:100	-1.857	.168
Size of Leaves	100:0vs 50:50	0.943	0.613
	100:0 vs 0:100	0.433	0.896
	50:50 vs 0:100	-0.510	0.860

**Significant at p< a=0.05*

Table 6 presents the pair-wise comparison of the effect of varied ratios of COF and JC on the growth response of the vegetable. It can be observed that the number and size of leaves had no significant differences upon application of varied ratios of COF and JC. Although, the number of leaves had a significant difference on the ANOVA, it was not highly significant so it yielded no significant difference using the pair-wise comparison. However, the length of stems had a significant difference upon application of varied ratios of COF and JC.

Figures 4 to 6 shows the color of leaves of the vegetable plant upon application of varied ratios of COF and JC in comparison with the leaf color chart (LCC).

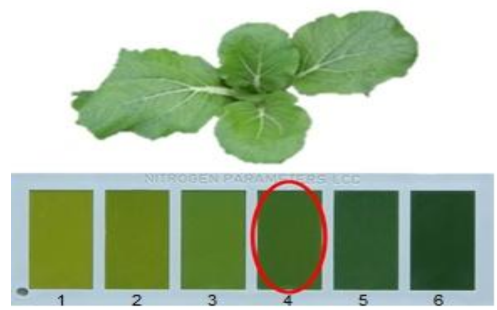

Figure 4. Vegetable treated with 100:0 COF and JC

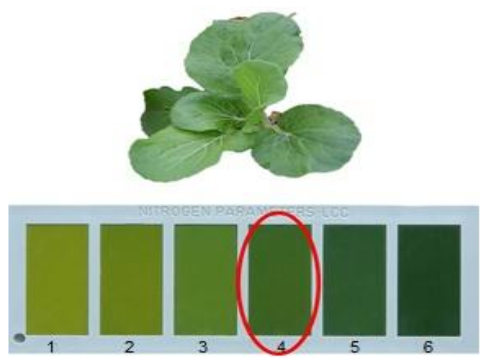

Figure 5. Vegetable treated with 50:50 COF and JC

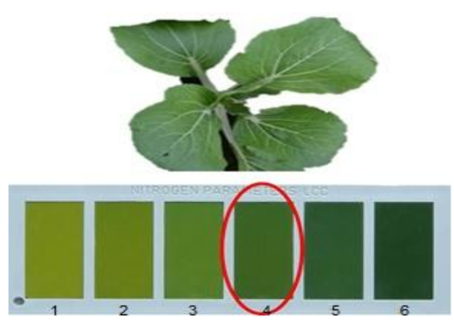

Figure 6. Vegetable treated with 0:100 COF and JC

Table 7.Color Analysis of the Vegetable

COF: Jatropha compost Ratio	Leaf Color Chart Reading
100:0	**4**
50:50	**4**
0:100	**4**

Table 7 presents the color analysis of the leaves; it can be observed that the color of the vegetable leaves conformed to the Leaf Color Chart (LCC) developed by International Rice Research Institute (IRRI) and Philippines Rice Research Institute (PhilRice) with an LCC reading of 4.

Use of LCC helps to determine nitrogen demand of the crop and guide right time of fertilizer nitrogen application so as to prevent unwanted nitrogen losses and their serious impacts on the ecosystem. An LCC reading of 4 indicates adequate amount of nitrogen absorbed by the plants.

Nitrogen is needed for vigorous vegetative leaf and stem growth and dark green leaf color (chlorophyll production)[8]. While the application of fertilizer on hybrid rice based on leaf color chart to maintain the optimal nitrogen content of the leaves was effective[10].

Table 8.Summary of t-values between the Growth Responses of the Vegetable Grown with Varied Ratios of COF , JC and CIF

Parameter	p-value	t-critical	t-values	Decision on Ho	Verbal Interpretation
100:0 vs Inorganic					
Number of Leaves	0	3.18	0.00	Failed to Reject	Not Significant
Length of Leaves (cm)	0.71	3.18	-0.44	Failed to Reject	Not Significant
Size of Leaves	0.28	4.30	1.47	Failed to Reject	Not Significant
50:50 vs Inorganic					
Number of Leaves	0.01	3.18	5.38	Reject Ho	Significant
Length of Leaves (cm)	0.02	2.78	3.73	Reject Ho	Significant
Size of Leaves	0.18	3.18	1.74	Failed to Reject	Not Significant
0:100 vs Inorganic					
Number of Leaves	0.06	3.18	2.98	Failed to Reject	Not Significant
Length of Leaves (cm)	0.06	3.18	3.05	Failed to Reject	Not Significant
Size of Leaves	0.08	3.18	1.33	Failed to Reject	Not Significant

From the results presented in Table 8, it can be observed that the growth responses of the 100:0 and 0:100 ratios compared to the commercial inorganic presented no significant difference. It can be deduced that the pure COF and the pure JC were comparable to the CIF.

For the comparison between the 50:50 COF and JC ratio, the number of leaves, and the length of the stems/leaves showed a significant difference. The size of the leaves did not show any significant difference. From this, it can be deduced that the 50:50 ratio of COF and JC failed to compare with the inorganic fertilizer in terms of the number of leaves, and the length of the stems/leaves, but it is comparable in terms of the size of the leaves.

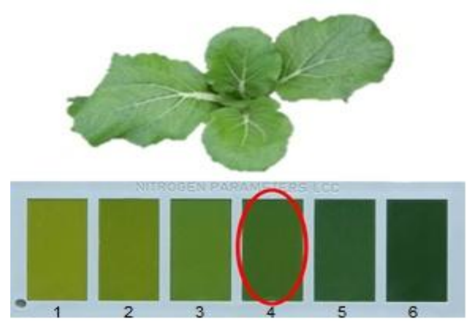

Figure 7. Vegetable treated with 100:0 COF and JC

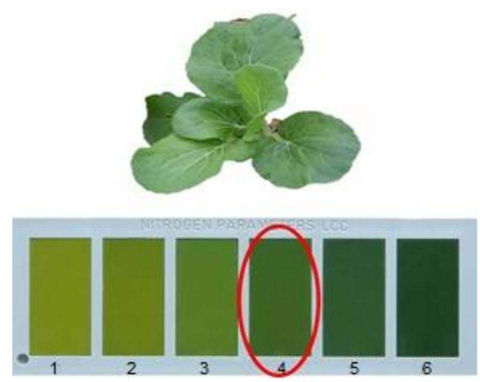

Figure 8. Vegetable treated with 50:50 COF and JC

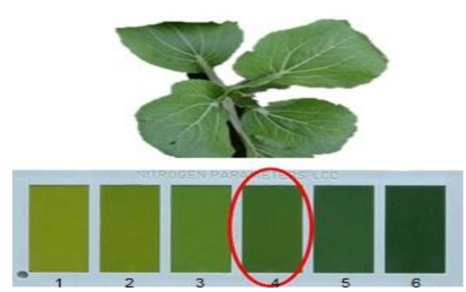

Figure 9. Vegetable treated with 0:100 COF and JC

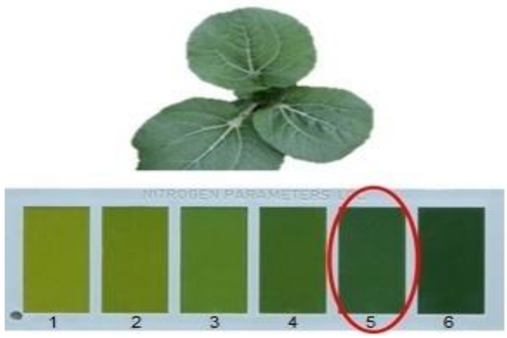

Figure 10. Vegetable treated with CIF

Figures 7 - 10, shows the color of leaves of the vegetable plant upon application of the best COF and JC ratio and CIF in comparison with the leaf color chart (LCC).

Table 9. Color Analysis of the Vegetable

Fertilizer		**Leaf Color Chart Reading**
COF: Jatropha compost Ratio	100:0	4
	50:50	4
	0:100	4
Inorganic Fertilizer		5

Table 9 show that the observed color of the vegetable leaves conformed to the Leaf Color Chart (LCC) developed by International Rice Research Institute (IRRI) and Philippines Rice Research Institute (PhilRice) with an LCC reading of 4 for the 100:0 COF and JC and an LCC reading of 5 for the CIF. This is because the CIF contained more N which is the basic component of chlorophyll production responsible for the dark green color of the leaves [9].

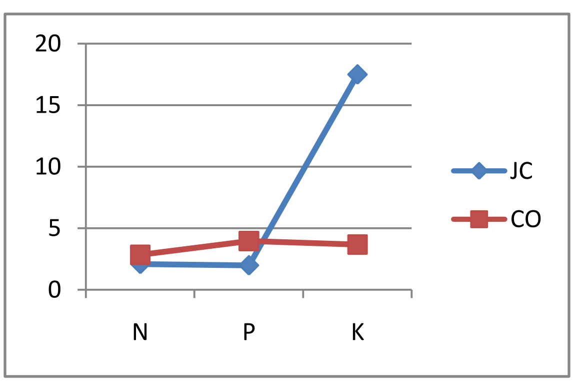

Figure 11.Macronutrient Content of the JC and the Standards for the Commercial Organic (CO) Fertilizer

JC from Figure11 contains 2.09% nitrogen which is less than that of COF that contains 2.84%. For P content the COF 3.95% which is greater than that of JC which only contain 1.98%. And for K content, JC contains 17.49% which is much greater than the COF that contain 3.66% K.

The obtained nitrogen and phosphorus content of the pure Jatropha were less than the given standards for organic fertilizer. The N and P requirement of a certain plant can be met by increasing the amount of the pure JC added to the soil. However, N is vital to good plant growth. While there is an oversupply of nitrogen makes plants grow too fast, become weak and spindly and may be more susceptible to disease, drought, and cold[11]. On the other hand, P is vital for seed germination, strong root systems, disease resistance, and flower and fruit formation. This nutrient is an active ingredient of the production of plant sugars. In addition, it provides the mechanism by which energy, released by the burning of sugars, is transferred within the plant. Meanwhile, it was observed that the potassium content of the pure JC exceeded the standard for organic fertilizer. K is essential to the life processes of plants, including the manufacture and movement of sugars and starches within the plant and to normal growth through the division of plant cells. Without sufficient K, plants tend to grow more slowly than is normal. The macronutrients are essential for the plant growth; still these nutrients should be well managed to yield the optimum growth of the plant.

IV. CONCLUSION AND RECOMMENDATION

Among the macronutrients (N, P, K), potassium is the most abundant nutrient found the JC. The micronutrients (Zn, Mn, Fe) are also present with Fe having the highest concentration.

There is a significant difference on the number of leaves and length of stems upon comparison of the varied ratios of COF and JC but no significant difference was observed on the size of leaves.

Apart from the length of stems, no significant difference was observed on the number, size, and color of leaves upon comparison of each of the ratio.

In comparison with the inorganic fertilizer, no significant difference was observed in the growth responses of the pure COF and of the pure JC. There is a significant difference on the number of leaves and no significant difference on the length of stems and size of leaves of 50:50 vs CIF. There is a difference on the color measurement of the varied ratios of COF and JC and CIF.

The N and P content of COF have higher value than that of the pure JC. Nevertheless, the K content of the pure JC has higher value than that of the COF.

Based on the thorough evaluation of the research design results, it is recommended to consider other varied ratios of COF and JC. And for future researchers, it is suggested to combine JC with other existing organic fertilizers. It is also recommended that the plants grown with the fertilizer must be tested if it contains toxic substances.

Future researchers can consider Jatropha compost to be combined with enzyme-acting activators such as manures from cow, goat, rabbit, etc. Furthermore, the macronutrient content of the vegetables grown and of the different fertilizers used should bestatistically compared. Likewise, plants grown with the fertilizer must be tested if it contains toxic substances.

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