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Performance of Jute(Corchorus Capsularis L.) as Affected by the Application of Combined Inorganic and Vermicompost Fertilizers

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***Abstract* — This study was conducted to determine the performance of Jute (*Corchorus capsularis L.*) applied with vermicompost combined with inorganic fertilizer. Specifically, the objective of the study was to determine the best level of vermicompost combined with inorganic fertilizer on the performance of jute. This study was conducted at Infanta, Pangasinan during season 2016. The experimental design used was the Randomized Complete Block Design (RCBD). A total area of 85 m^2 was divided into three equal blocks representing the number of replications and each block was further subdivided into five equal plots corresponding to the different treatments used. Results of the study revealed that the use of any fertilizer combinations did not significantly affect the production of jute in terms of growth and yield. However, in terms of cost and return analysis, Treatment 3 (50% inorganic + 50% vermicompost fertilizer) obtained the acceptable net income, return on expenses, return above operating expenses and average production cost.**

Keywords* — *Jute, Vermicompost, Inorganic Fertilizer, Performance

I. INTRODUCTION

Jute can almost grow anywhere in the Philippines, which is sometimes overlooked by people. Also, despite its nutritional and economic importance, it has been neglected by scientific research and development in the Philippines. Jute is a hard plant that is resistant to pests and requires little care. It can be found in the wild but it can also be grown in a farm. It is considered nutritious and known as the golden fiber (Islam, 2013).

In the Philippines, according to the Food and Agricultural Organization (2010), malnutrition is caused by interrelated factors such as health, physical, social, and economic. Food production in the country as well as its distribution and consumption by the population has consequent impact on the overall nutritional status of the society. Whereas, reports show that there is enough food to feed the country, but still, many Filipinos continue to experience hunger and become malnourished due to inadequate intake of nutritious food. This situation may reflect that Filipinos lack sufficient awareness on utilizing the available edible foods that can be found within the surroundings, such as indigenous plants that grow unnoticed within the areas like jute (*Corchorus capsularis L)*. They naturally contain phytochemicals which possess health protective or disease-preventing properties. These plants are called functional foods because they provide health benefit beyond basic nutrition (Adedosu et al., 2015; Sule et al. 2017).

In the Philippines, Jute are eaten as vegetable, particularly by the Ilokanos who call it "*saluyot*" which is considered an indigenous leafy vegetable which is rich in calcium, iron, protein, vitamins A, C and E, thiamin, riboflavin, niacin, foliate, dietary fibers, and has been medically proven to lower blood cholesterol in human (Sule et al. 2017). Aside from its nutritional value, they act as thickeners in soups, stews, and sauces (Islam, 2013).

Organic crop production has positive impacts such as soil conservation and improvement of soil fertility that consequently sustain food production for future generations, stability and food security in diversified cultures and environmental impact using manures, plant residues and vermicomposts (Pierre et al. 2015).

Excessive and indiscriminate use of chemical fertilizers leads to soil degradation and impose a

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serious threat to human health (Fujimoto, 1998; Pierre et al. 2015). This practice should gradually shift to organic farming for sustainable crop production system. This study was carried out to determine the performance of jute in terms of growth and yield as influenced by fertilizer variations and to determine the best level of vermicompost combined with inorganic fertilizer.

II. MATERIALS AND METHODS

A. Experimental Design and Treatment

A total land area of 85 square meters was laid out using the Randomized Complete Block Design (RCBD). This was divided into three equal blocks representing the number of replications with the distance of 1 meter between blocks.

Each block was subdivided into 5 plots with a dimension of 3×1 meters each plot. A distance of 0.5 meter between plots was done. The distance of planting was 30 cm between rows and 17.78 cm between hills. The different treatments used were as follows:

T1 –100% Inorganic fertilizer
T2 – 75% Inorganic fertilizer + 25% Vermicompost
T3 – 50% Inorganic fertilizer + 50% Vermicompost
T4 – 25% Inorganic fertilizer + 75% Vermicompost
T5 – 100% recommended rate of Vermicompost

B. Cultural Management Practices and Land Preparation

The field was prepared thoroughly by plowing and harrowing using a hand tractor. A block was constructed by 5 meters wide with length of 17 meters. Each block was divided into 5 plots with 100 cm wide and 20 cm high with length of 300 cm.

Planting

The method of planting used for jute was line sowing. Before planting, jute seeds were soaked to boiling water for 10-15 seconds. It was air dried for one hour before sowing. The seeds were covered with fine soil after sowing and the plots were watered every day until germination.

Water Management

Jute was watered immediately after planting. This was done regularly until the harvesting stage of the jute after sowing was reached.

Weed and Cultivation

Hand weeding was employed rather than using herbicides. Weeds were uprooted to avoid competition and to eliminate alternate host for pests and diseases. Hilling-up was also done twenty days after sowing.

Fertilizer Application

The test plants were fertilized based on their recommended rate as shown in Table 1. The computed fertilizers are shown in Table 2.

TABLE 1. Fertilizer application program for Jute (per hectare basis)

KIND OF FERTILIZER	RATE OF APPLICATION (kg/ha)	METHOD OF APPLICATION
Vermicompost	58,000.00	Basal
CF (14-14-14)	507.14	Basal
Urea (46-0-0)	241.30	Basal
OSP (0-60-0)	15.00	Basal

Legend: CF (Complete Fertilizer), OSP (Ordinary Superphosphate)

TABLE 2. FERTILIZER APPLICATION RATE ACCORDING TO TREATMENTS

TREATMENT	COMPLETE (14-14-14-) (g/plot)	UREA (46-0-0) (g/plot)	ORDINARY SUPER PHOSPHATE (0-60-0) (Grams/plot)	VERMICOMPOST (0.88-0.44-4.75) (g/plot)
T1 100% IF	152	72	5	--
T2 75% IF + 25% VC	114	54	4	4,350
T3 50% IF + 50% VC	76	36	3	8,700
T4 75% IF + 25% VC	38	18	2	13,050
T5 100% VC	--	--	--	17,400

Legend: IF, inorganic fertilizer; VC, Vermicompost

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Harvesting. Harvesting was done at 40 days after emergence. Shoots were cut, 10 inches from the base using a sharp scythe. The shoots were bundled and put to plastic bags to maintain freshness.

C. Data Gathered

Height of plants

This was done by measuring the height of the plants (cm) starting from the base of the plant at the soil level to the tip of the plant at 20, 30 and 40 days after sowing (DAS).

Height Increment of Plants

This was calculated from the gathered height (cm) at 20 DAS up to 40 DAS or at the end of the study, using the formula:

Height Increment of Plants = Final height at 40 DAS – Initial height 20 DAS

Yield per hectare

This was obtained from the calculated yield (foliage) per plot by using the formula:

$$\text{Yield}\left(\frac{\text{Tons}}{\text{ha}}\right) = \frac{\text{Plot yield(kg)}}{\text{Plot area}(\text{m}^2)} \text{x} \frac{\frac{10{,}000\text{m}^2}{\text{ha}}}{1{,}000\frac{\text{kg}}{\text{ton}}}$$

D. Cost and Return Analysis

All the expenses incurred and net income were calculated in this study. The incurred costs and returns were used to determine the gross income, the total production cost, as well as to compute the return above operating expenses, return on total expenses, average production cost and the breakeven yield.

Total Production Cost

This was obtained by summing the values of all inputs used in production of jute per treatment.

Gross Income

This was determined by multiplying the yield per treatment and the prevailing farm gate price of jute.

$$Gross\ Income = Yield/treatment\ x\ farm\ gate\ price$$

Net Income

This was computed by obtaining the difference between the gross income and the total production cost according to treatments.

Net income = Gross Income – Total production cost

Return Above Operating Expenses (RAOE)

This was computed by dividing the Net Income to the Operating Expenses, the quotient then was expressed into percentage. This is done to determine the return of income based on the incurred operating expenses by treatment.

$$\text{RAOE} = \frac{\text{Net Income}}{\text{Operating Expenses}} \text{x } 100$$

Return on Total Expenses (ROE)

This was done by dividing the income by total cost of production then the quotient was multiplied by 100 in order to be expressed in percentage.

$$\text{ROE} = \frac{\text{Net Income}}{\text{Total Expenses}} \text{x } 100$$

Average Production Cost (APC)

This was computed by dividing the total expenses to the quantity of yield in order to determine the unit cost (PhP/kg) of producing jute according to treatments.

$$\text{APC} = \frac{\text{Net Income}}{\text{Quantity Produced per Bundle}}$$

Breakeven Yield

This was computed by dividing the total expenses to the current selling price (based on the farm gate price) in order to determine the target amount to be harvested (kg) in order to payback all the incurred expenses according to treatments.

$$\text{BEY} = \frac{\text{Total Expenses}}{\text{Selling Price per Bundle}}$$

E. Data Analysis

The analysis of variance was done to find out if there was a significant difference among the different treatment levels of organic and inorganic fertilizer applied to jute using IRRI STAR version 2.0.1 at 0.05 level of significance.

III. RESULTS AND DISCUSSION

Height of Jute at 20, 30, and 40 days after sowing

Height of jute at 20, 30, and 40 DAS is shown in Table 3. There were no significant differences in the height of jute at 20, 30, and 40 DAS after application with 100 % organic and 100% inorganic fertilizers. Similarly, the various combinations of organic and inorganic fertilizer at any rate were found to have no significant effect on the height of jute. Heights of plant at 20 DAS ranged from 13.20 cm to 19.80 cm;

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at 30 DAS, ranged from 34.50 cm to 48.00 cm and at 40 DAS, ranged from 50.77 cm to 70.37 cm. The insignificant differences are in conformity with the results of experiment conducted by Madisa et al. using the combination of animal manures and commercial fertilizers. He further discussed that the slow rate of decomposition of organic fertilizers could have caused the slow growth of plants at any rate and combined with commercial fertilizers.

Yield of Jute (tons/ha)

Table 4 shows the yield per plot and per 1 hectare for jute. Numerically, T3 (plants applied with 50% Inorganic and 50% Vermicompost fertilizer) registered the highest mean of 3.15 t/ha. This was followed by T1 (farmers practice) with a mean of 2.38 t/ha, T2 (75% Inorganic and 25% Vermicompost fertilizer) with a mean of 2.07 t/ha, T5 (100% Vermicompost fertilizer) with a mean of 1.80 t/ha, and the lowest yield was obtained from T4 (25% Inorganic and 75% Vermicompost fertilizer) with a mean of 1.57 t/ha. However, statistical analysis revealed no significant differences among treatment means. The results of the study is in contrast with the study conducted by Aluko et al. (2014) who demonstrated that increasing rate of inorganic fertilizers as combined with organic fertilizers stimulates plant vegetative growth which increase the rate of plant photosynthesis and thus higher yield obtained.

The favorable net income per hectare production of jute was obtained at Treatment 3 amounting to PhP 38,085.38 (Table 5). This was followed by treatments 1, 2, 5 and 4. This showed that the use of combined 50% inorganic and 50% vermicompost fertilizer resulted to financially viable jute production particularly in Western Pangasinan, Philippines. The average production cost for producing jute revealed that treatment 3 had the lowest production cost per bundle (PhP 4.37) as compared with treatment 1 (PhP 5.60), treatment 2 (PhP 6.54), treatment 4 (PhP 8.89), and treatment 5 (PhP 7.89). The lower the APC means lower production expenses. Likewise, the highest value of Return on Above Operating Expenses, Return on Expenses, Breakeven Yield were obtained from Treatment 3. The higher the RAOE and ROE means that the net income of treatment 3 is very capable of paying back all the incurred expenses in the one-hectare production of jute.

TABLE 3. *Height (cm) and height increment of Jute*

Treatment	Mean height (cm)			Height Increment (cm)
	DAS			**DAS**
	20^{ns}	**30**^{ns}	**40**^{ns}	**20-40**
T1 (100% Inorganic)	14.70	40.00	65.50	50.77
T2 (75% Inorganic + 25% Organic)	18.60	48.00	70.00	51.33
T3 (50% Inorganic + 50% Organic)	19.80	47.40	70.37	50.60
T4 (25% Inorganic + 75% Organic)	13.20	34.50	50.77	37.58
T5 (100% Organic)	16.00	39.80	58.13	42.13

Note: ns, *not significant*

TABLE 4. *Yield (foliage) of Jute*

TREATMENT	Yield (t ha^{-1})
T1 (100% Inorganic)	2.38
T2 (75% Inorganic + 25% Organic)	2.07
T3 (50% Inorganic + 50% Organic)	3.15
T4 (25% Inorganic + 75% Organic)	1.57
T5 (100% Organic)	1.80
Grand mean	2.19
F Computed	3.53^{ns}

Note: ns, *not significant*

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TABLE 5. SUMMARY OF COST AND RETURN ANALYSIS FOR ONE-HECTARE OF JUTE PRODUCTION

Item	Treatment				
	1	**2**	**3**	**4**	**5**
I. Gross Income					
Marketable Yield (No. of Bundles)	7,933.33	6,913.33	10,502.22	5,251.11	6,006.67
Total Gross Income	**63,466.67**	**55,306.67**	**84,017.78**	**42,008.89**	**48,053.33**
EXPENSES					
A. Operating Expenses					
1. Labor	***18,500.00***	***18,500.00***	***18,500.00***	***18,500.00***	***18,500.00***
2. Material Cost					
Seeds	4,720.00	4,720.00	4,720.00	4,720.00	4,720.00
Vermicompost fertilizer		4,833.00	9,666.00	14,500.00	19,333.00
Complete fertilizer	11,653.00	8,740.00	5,826.00	2,913.00	
Urea	4,608.00	3,456.00	2,304.00	1,152.00	
Ordinary Super Phosphate	173.00	138.00	104.00	69.00	
Sub Total (Material Cost)	***21,154.00***	***21,887.00***	***22,620.00***	***23,354.00***	***24,053.00***
Total Operating Expenses	**39,654.00**	**40,387.00**	**41,120.00**	**41,854.00**	**42,553.00**
B. Overhead Expenses					
Irrigation	950.00	950.00	950.00	950.00	950.00
Land Charge	3,040.00	3,040.00	3,040.00	3,040.00	3,040.00
Interest Capital	793.08	807.74	822.40	837.08	851.06
Total Overhead Expenses	**4,783.08**	**4,797.74**	**4,812.40**	**4,827.08**	**4,841.06**
III. TOTAL EXPENSES	**44,437.08**	**45,184.74**	**45,932.40**	**46,681.08**	**47,394.06**
IV. NET INCOME	**19,029.59**	**10,121.93**	**38,085.38**	**(4,672.19)**	**659.27**
RAOE (%)	47.99	25.06	92.62	(11.16)	1.55
ROE (%)	42.82	22.40	82.92	(10.01)	1.39
APC (Price per bundle)	5.60	6.54	4.37	8.89	7.89
BEY (No. of bundles)	5,554.64	5,648.09	5,741.55	5,835.14	5,924.26

Based on the findings of the study, the use of vermicompost and inorganic fertilizers combination did not significantly affect the production of jute in terms of plant height and yield. The performance of jute as applied by vermicompost combined with inorganic fertilizers are comparable to 100% commercial fertilizers. However, the combination of 50% inorganic + 50% vermicompost fertilizers is recommended for jute because of higher return above operating expenses (RAOE) and return on expenses (ROE) obtained.

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APPENDIX

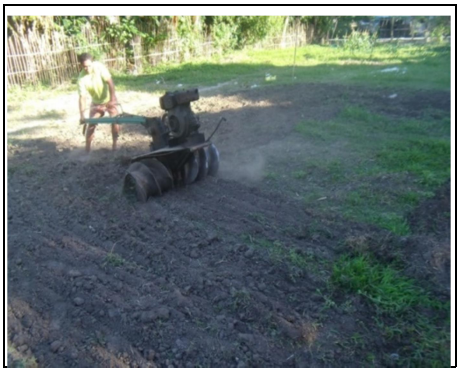

Figure 1: Land Preparation

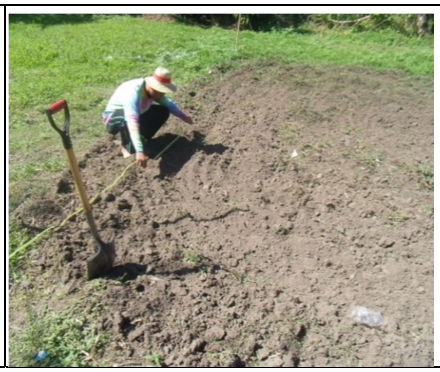

Figure 2: ***Block lay-outing and measuring using tape meter***

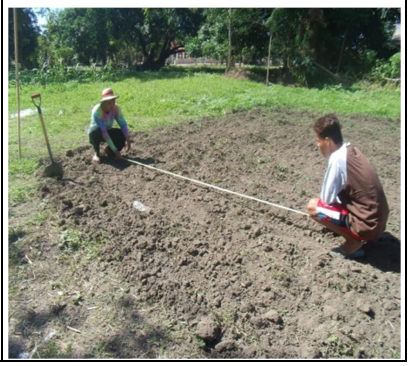

Figure 3: ***Plot lay-outing and measuring using tape meter.***

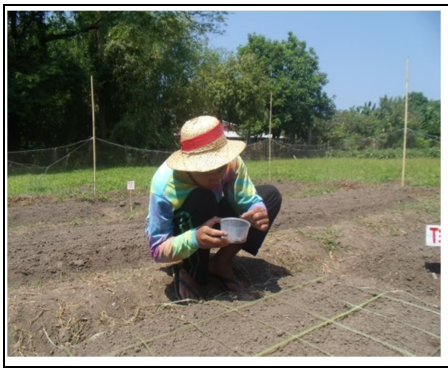

Figure 4: Sowing of jute seeds

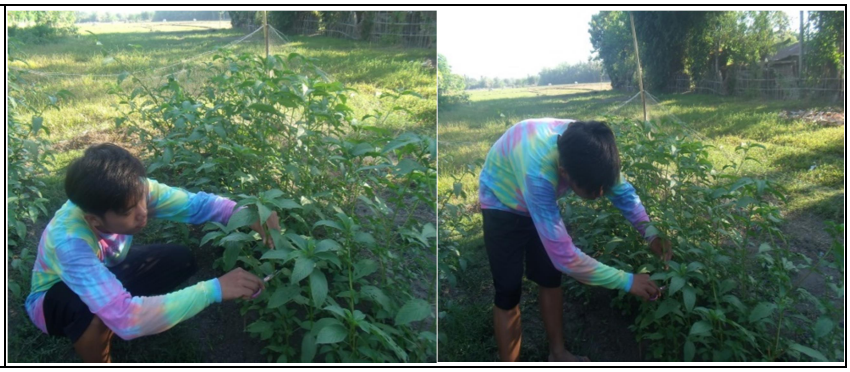

Figure 5: Harvesting of Jute foliage ready for market

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