BIBLIOGRAPHY

RAGODO, HELARDO JR. C. APRIL 2009. Effect of Animal Manure Application on the Growth and Yield of Three Rice Varieties in Bolinao, Pangasinan.Benguet State University, La Trinidad, Benguet.

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ABSTRACT

This study was conducted to evaluate the growth and yield of three rice varieties applied with animal manure, determine the effect of animal manure application on growth and yield of rice, determine the interaction effect of variety and animal manure on rice growth and yield, and to determine the profitability of growing three varieties of rice applied with decomposed animal manure in Bolinao Pangasinan.

Results showed that NSCI Rc 128 and NSIC Rc 130 performed best giving better growth and higher yield and return on cash expense. Plants applied with cow manure and carabao manure exhibited better growth and produced the highest yield per hectare. Based on return on cash expense, NSIC Rc 128 (90.28%) and plants grown in plots with no fertilizer (81.46%) gave the highest return on cash expense.

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INTRODUCTION

Rice is a semi-aquatic plant scientifically known as *Oryza sativa L.* It is one of the world's most important food crops. More than half of the people in Asia eat this grain as the main part of their meals (Teason, 1994).

In Bolinao, Pangasinan farmers usually use inorganic fertilizer in order to obtain more profitable yields in rice production. However, inorganic fertilizers has some disadvantageous effects on soil properties such as destroying soil texture, soil structure and humus content that may lead to reduce production in the long term.

In view of the above bad effects on continuous use of inorganic fertilizers, there is a need to use alternative sources of fertilizer like farm wastes which are readily and economically available sources of both macro elements and micro elements.

The use of organic fertilizers in rice production to substitute for the chemical fertilizers can increase productivity and sustainability of Philippine farm as well as clean the environment of abundant wastes emanating from crop and livestock farms of various industries (FAO, 1990).

In addition organic fertilizer regardless of source proved to be effective in improving the productivity of this scraped soil for wetland rice production (Jearbunyok, 1985).

In Bolinao, Pangasinan, farmers had been planting rice varieties that have long maturity period. Those varieties had decreasing yield due to existing erratic weather condition in the locality. Variety evaluation is necessary to find high yielding varieties to serve as alternate to degenerated cultivars.

This study was conducted to:

1. evaluate the growth and yield of three varieties of rice as affected by animal manure application,

2. determine the effect of animal manure application on growth and yield of rice,

3. determine the interaction effect of variety and animal manure on rice growth and yield,

4. determine the profitability of growing three rice varieties applied with decomposed animal manure in Bolinao, Pangasinan.

The study was conducted from October 2007 to February 2008.

REVIEW OF LITERATURE

Importance of Organic Fertilizers

Organic fertilizers are produced from animal manure and crop residues. Organic fertilizers have low nutrient composition and bulky, but it has ability to improve the physical, chemical and microbial status of soils. Application of organic fertilizers is one of the favored methods or rejuvenating depleted soils and sustaining fertility levels (PCARRD, 1999).

Parnes (1986) cited that organic matter is a principal source of nitrogen, phosphorus, and sulfur become available as the organic matter continuous to decompose. Most of the calcium, magnesium and potassium in the decaying organic residue are discarded by the soil organisms during the first stages of decomposition and these nutrients are quietly available to plants organic matter.

The use or organic manure to fertilized agricultural lands is positive from perspective of a recycling economy. The application of organic matter to soils directly maintains an adequate level of soil organic matter, a critical component of soil fertility and productivity.

Organic manure is considered as slow-release N fertilizer because it releases or mineralizes only a fraction of its total N content during the application season.

FAO (1990) cited that organic fertilizer can supply nearly the essential nutrients needed by plants although these nutrients are present in low concentration, continuous application can build up the supply in the soil in the long term.

Effect of Animal Manure

Animal manures are good sources of N and P which are needed by decomposer organisms for their growth and multiplication. The presence of manures as substrates in composting hastens the decomposition process. In addition, ripe compost with manure normally have better nutrient composition than those without (Cuevas, 1992).

Lekasi (1998-1999) cited that manure recommendations appear to be made generally with respect to soil N and P levels rather than with respect to its impact on soil physical properties. In the Kenyan highlands, the price set on livestock derived manures is high at approximately five times the price that can be calculated from the content of nutrients alone (artificial fertilizers price), indicating the value farmers place on the physical benefits to soil quality derived from using manure.

In addition high initial applications to build up the organic pool and cut back in subsequent years could be appropriate. In applying the nutrient requirements the amount of manure applied can be calculated based on the rate of N applied and the rate of organic N mineralization in the application season (Chong, 2005).

Effect of Organic Fertilizer on
Soil Characteristics

Organic matter level in soil could be maintained by the liberal use of farm and green manures to the soil. Organic fertilizers supply some amount of the nutrient requirement of the crop and promote favorable soil properties, such as granulation and good tilth for efficient aeration easy root penetration, and improvement water holding capacity (PCARRD, 1982).

Organic matter can play a central role in maintaining or increasing productive by improving soil temperature, moisture and structure and by reducing the danger or erosion. Organic matter especially as mulch can help to increase water infiltration and reduce evaporative moisture loses, it can also stimulate root growth and thus improve utilization of soil water (Sanchez, 1981).

Effects of Organic Fertilizer on Growth and Yield of Crops

Brady (1990) cited that farm manure is valuable to crops because of its nitrogen content and influence in the soil. Farm manure increases crop yield, and the value of farm manure is determined not only by organic matter it furnishes but especially by the quality of nitrogen supplies.

Fertilizer is a substance that is added to the soil to help plant grow. It contains nutrients that are essential for plan growth. Some fertilizers are made from organic materials like manure while others are manufactured from certain materials or are produced as synthetic compounds in factories (World Book, 2004).

Varietal Evaluation

Modern varieties have greater yield potential than traditional varieties even under the best conditions. Use of fertilizer and improved farming practices will increase grain yield more in modern varieties than traditional ones. The used of improved varieties is the cheapest single innovation that has built-in capability for increasing yield substantially (Vergara, 1992).

Improved rice varieties would vary according to the ecological conditions in which these are grown. Agronomic characters generally associated with high yield potential and nitrogen responsiveness in irrigated lowland varieties possesses short or semi dwarf stature, lodging resistance, high tillering ability, non-spreading culms, and relatively short erect leaves, strong seedling vigor, insensitivity to photoperiod, medium threshing ability and moderate grain dormancy and other available traits (UPLB, 1983).

According to the IRRI (1994) the grain size of any hybrid is highly uniform, irrespective of the size and shape of grain in the parents. The endosperm of the hybrid rice is primary amylase content look fluffy but become dry upon cooking.

Some varieties are productive under climatic conditions of the country and others are productive only in specific regions. However, the varieties differ in yield capacity and resistance to pest and diseases. The performance of a variety also depends upon their ability to respond favorably to environment and cultural condition it is grown (UPLB, 1983).

MATERIALS AND METHODS

An area of 180 sq m was thoroughly prepared and divided into three blocks representing three replications. Each replication was subdivided into eight plots measuring 1 m x 5 m each. The experiment was laid out following 3 x 4 factor-factorial arrangement in Randomized Complete Block Design (RCBD) with three replications. The varieties serves as Factor A and the different animal manures were considered as factor B as follows:

Factor A: Variety (V)

Code		Source
V1	PSB Rc 82 (check)	Bolinao
V2	NSIC R 128	BPI-NSQCS
V3	NSIC Rc 130	BPI-NSQCS

Factor B: Animal Manure (AM)

Code		Rate
AMO	Control	0 /tons/ha
CoM	Cow manure	144 /tons/ha
CaM	Carabao manure	144 /tons/ha
GoM	Goat manure	108 tons/ha

Before seedbed preparation and after harvesting soil samples were taken for soil analysis to determine the initial pH, OM, and NPK contents. The soil analysis was done in San Fernando, La Union. Animal manures were thoroughly incorporated two weeks before transplanting. The high yielding varieties or rice (HIV's) were transplanted one week after incorporation of the different animal manures.

One seedling per hill was transplanted in a straight row with a distance of 20 cm between hills and rows.

Data Gathered

1. Days to recovery. The number of days from transplanting to full recovery of seedlings was recorded when rice plants in the paddy rice fields were almost dark green in color.

2. Number of tillers at maximum tillering stage. This was taken when the flag leaf of the rice plant came out using 10 hills per treatment.

3. Number of productive tillers per hill. The number of tillers was counted using 10 sample hills at random. Only the rice plants with panicles were used as samples.

4. Number of days from booting to heading. This was recorded when 50% of the total plants in a plot booted.

5. Number of days from transplanting to ripening. This was recorded when 80% of the panicles turned yellow.

6. Length of the panicle at harvest (cm). The distance from the base to the tip of panicle at harvest was measured from sample plants.

7. Number of grains per panicle. This was recorded using five samples per plot.

8. Grain yield per plot (kg). this was taken when the moisture content is approximately 14% after sun drying for about 2-5 days after winnowing.

9. Computed yield per hectare (tons/ha). This was taken by converting the grain yield per plot into hectare basis using the following formula as follows:

$$\text{Yield/hectare} = \frac{\text{Yield}}{1\text{ m x }5\text{ m}} \times \frac{X}{10{,}000\text{m}^2}$$

10. Return on Cash Expense (ROCE). This was computed by subtracting the total expenses from gross sales divided by total expenses multiplied by 100 as follows:

$$\text{ROCE (\%)} = \frac{\text{Gross sale – Total Expenses}}{\text{Total expenses}} \times 100$$

11. Stem borer (white heads). The reaction of HYV's to stem borer expressed as white heads was rated at heading time. The following standard scale was used (Phil Rice, 1996):

Rating	Percent White heads (%)	Remark
1	1-5	Resistant
2	6-10	Moderate
5	11-15	Intermediate
7	16-25	Moderate Susceptible
9	26 and above	Susceptible

12. Blast (Neck rot). The severity of rice blast was taken per treatment from the plant at the center row using ten hills sample per treatment combination using following (PhilRice 1996).

Index	(%)Blast	Remark
1	0-5	Resistant
2	6-25	Intermediate
3	26 and above	Susceptible

All data gathered statistically analyzed using 3 x 4 factor-factorial arrangement in Randomized Complete Block Design (RCBD) with three replications. Differences among treatments were determined using F-Test and Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Days to Recovery

Effect of rice varieties. NSIC Rc 128 and NSIC Rc 130 recovered within 22 days after transplanting (DAT). One day earlier than the days to recovery of PSB Rc 82.

Effect of animal manure. Statistically, significant differences were observed on the days to recovery of rice varieties applied with different animal manures. Plants applied with cow and carabao manure recovered earlier than the plants applied with goat manure. The latest to recover were those plants planted in unfertilized plots.

Interaction effect. There was significant interaction of variety and animal manure on the days to recovery after transplanting of rice. It was observed that rice varieties applied with cow and carabao manures recovered earlier than those plants applied with goat manure and those without fertilizer. This result could be attributed to the nutrient available in the animal manure used which enhanced early recovery of rice plants (Figure 1).

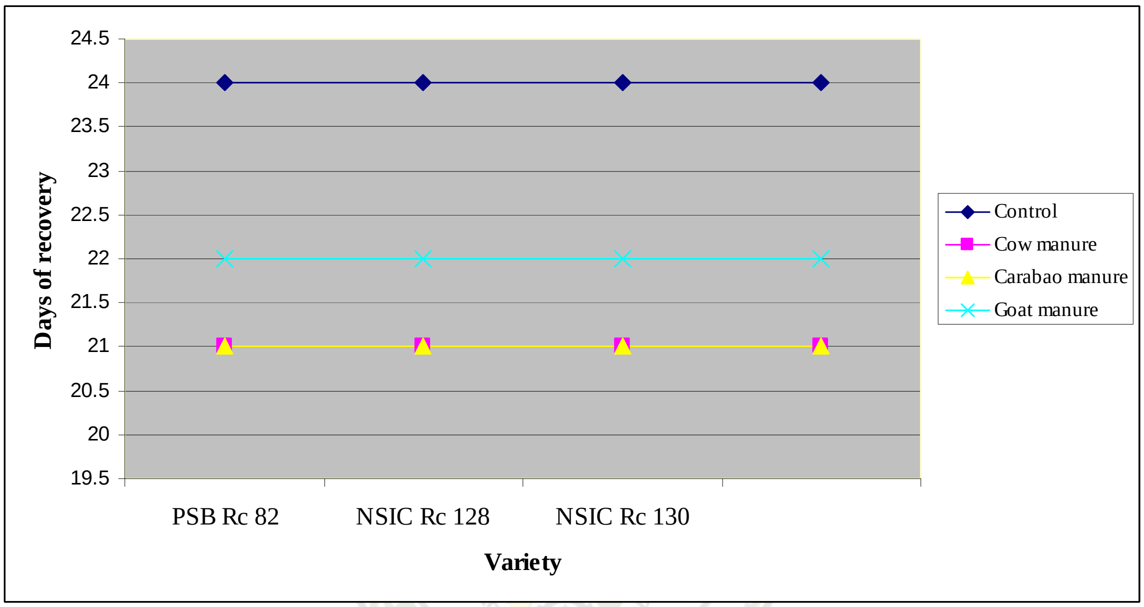

Figure 1. Interaction of variety and animal manure on the days to recovery of rice

Number of Tillers at Maximum Tillering Stage

Effect of rice varieties. NSIC Rc 130 produced higher number of tillers among the rice varieties used (Table 1). NSIC Rc 128 and RSB Rc 82 (check) produced lower number of tillers. This could be due to varietal characteristics.

Effect of animal manure. Plants fertilized with cow manure and carabao manure registered the highest number of tillers. The higher nitrogen, potassium, and phosphorus contents of animal manures might have enhanced the production of tillers of the rice plants.

Interaction effect. There was no significant interaction of varieties and animal manures on the number of tillers at maximum of tillering stage of rice (Table 1).

Table 1. Number of tillers at maximum tillering stage and number of productive tillers per hill of three rice varieties applied with different animal manures

TREATMENT	NUMBER OF TILLERS	
	MAXIMUM TILLERING STAGE	PRODUCTIVE PER HILL
Variety (A)		
PSB Rc 82 (check)	14^{ab}	7^{bc}
NSIC Rc 128	14^{ab}	7^{b}
NSIC Rc 130	15^{a}	8^{a}
Animal manure (B)		
No fertilizer	13^{a}	6^{c}
Cow manure	15^{a}	8^{a}
Carabao manure	15^{ab}	8^{a}
Goat manure	14^{b}	7^{b}
A x B	ns	*
CV%	2.77	4.80

Means followed by the same letter are not significantly different at 5% level using DMRT.

Number of Productive Tillers Per Hill.

Effect of rice varieties. Among the three varieties evaluated NSIC Rc 130 registered the higher number or productive tillers per hill than NSIC Rc 128 and PSB Rc 82 (Table 1). This varietal difference could be attributed due to varietal character indicating high yielding potential of NSIC Rc 130 which produced more tillers per hill.

As stated by Vergara (1992) the number of tillers produced depend upon many factors such as variety and certain conditions in the field.

Effect of animal manure. Similarly, plants applied with cow and carabao manuresregistered higher productive tillers than those applied with goat manure. This indicated that cow and carabao manurehastened development of productive tillers in rice.

Interaction effect. Significant interaction of variety and animal manure was observed on the number of productive tillers per hill of rice.

As shown in Figure 2 it was observed that all rice varieties responded to cow and carabao manure application favorably higher than goat manure application.

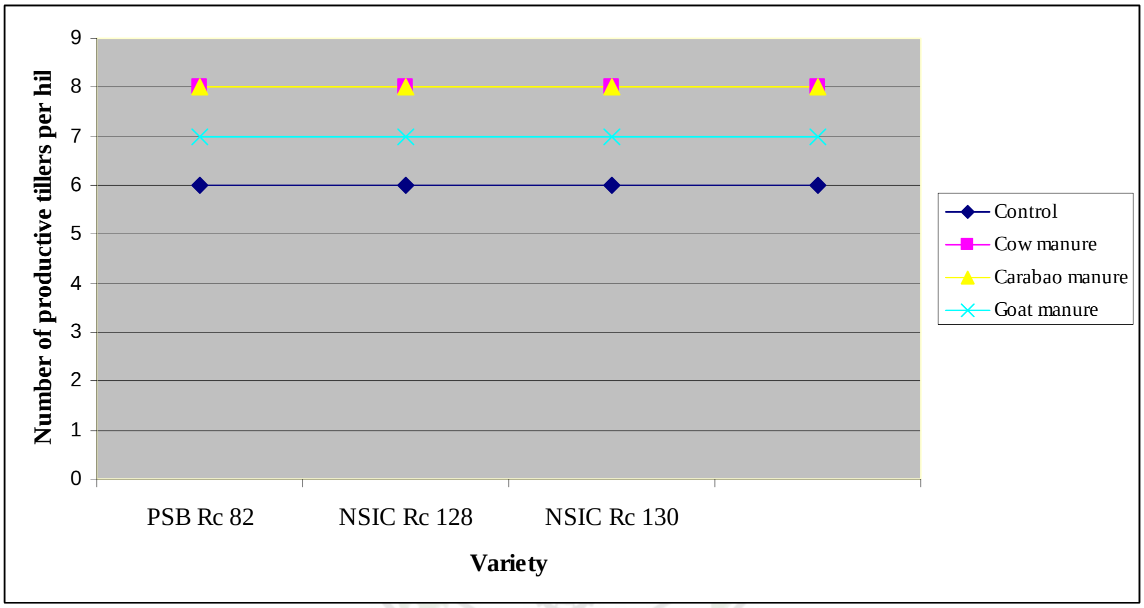

Figure 2. Interaction effect of varieties and animal manure on the number of productive tillers per hill of rice

Number of Days From Booting to Heading

Effect of varieties. PSB Rc 82 produced heads 13 days after booting. NSIC Rc 128 and NSIC Rc 20 were the latest to produce heads at 17 days from booting to heading (Table 2). Factors affecting early booting and heading of rice plants evaluated could be varietal characteristics and the environment.

Effect of animal manure. Plants applied with cow manure and carabao manure were the earliest to produce heads within 15 days after booting that was one day ahead than those plants applied with goat manure. Plants grown in plots with no fertilizer applied were the latest to produce heads which took 17 days from booting. This could be due to NPK content of animal manures that enhanced heading or rice plants.

Table 2. Number of days from booting to heading and from transplanting to ripening of three rice varieties applied with different animal manures

TREATMENT	NUMBER OF DAYS FROM:	
	BOOTING TO HEADING	TRANSPLANTING TO RIPENING/MATURITY
Variety (A)		
PSB Rc 82 (check)	13^{b}	93^{c}
NSIC Rc 128	17^{ab}	118^{a}
NSIC Rc 130	17^{a}	110^{b}
Animal manure (B)		
No fertilizer	17^{a}	112^{q}
Cow manure	15^{c}	109^{c}
Carabao manure	15^{c}	109^{c}
Goat manure	16^{b}	110^{b}
A x B	**	**
CV%	1.08	0

Means followed by the same letter are not significantly different at 5% level using DMRT.

Interaction effect. Significant interaction effect of variety of rice and animal manure on the number on days from booting to heading was observed (Figure 3). It was observed that all the three varieties applied with cow and carabao application were the earliest to produce heads than those plants applied with other fertilizer treatments. Significant differences could be due to NPK content available in animal manures used.

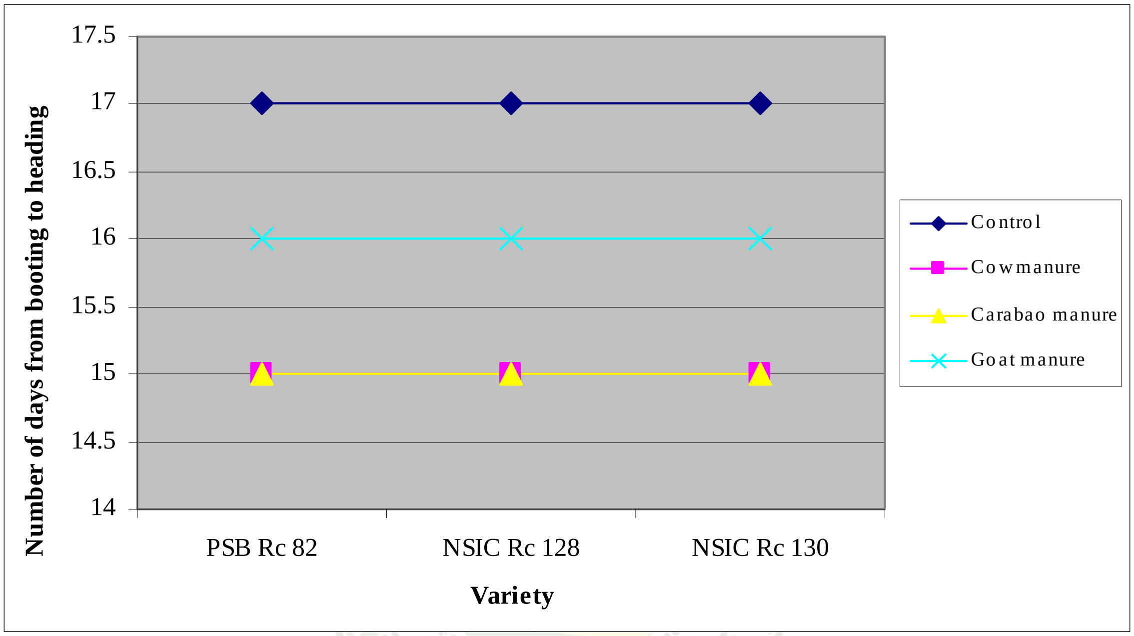

Figure 3. Interaction of varieties and animal manure on the number of days from booting to heading

Number of Days from Transplanting to Ripening

Effect of varieties. The earliest to mature was PSB Rc 82 (check) 93 days after transplanting (DAT), followed by NSIC Rc 130 which matured 24 days later (Table 2). The latest to mature was NSIC Rc 128 at 118 (DAT). The maturity of a rice plant is strongly influenced by its varietal characteristics and the length of the day during the season in which the crop was grown.

Effect of animal manure. Plants applied with cow manure and carabao manure were the earliest to ripen at 109 days from transplanting. The unfertilized plants were the latest to ripen. This could be due to insufficient NPK content available in the soil for better growth and development of rice plant.

Interaction effect. Highly significant interaction of varieties of rice and the different animal manures was observed on the number of days from booting to heading (Table 2). As shown in Figure 4 it was observed that the response of rice varieties to cow and carabao manure application were earlier than other animal manure used. Significant differences of animal manures could be due to genetic make-up of the rice varieties and different nutrient contents animal manures used.

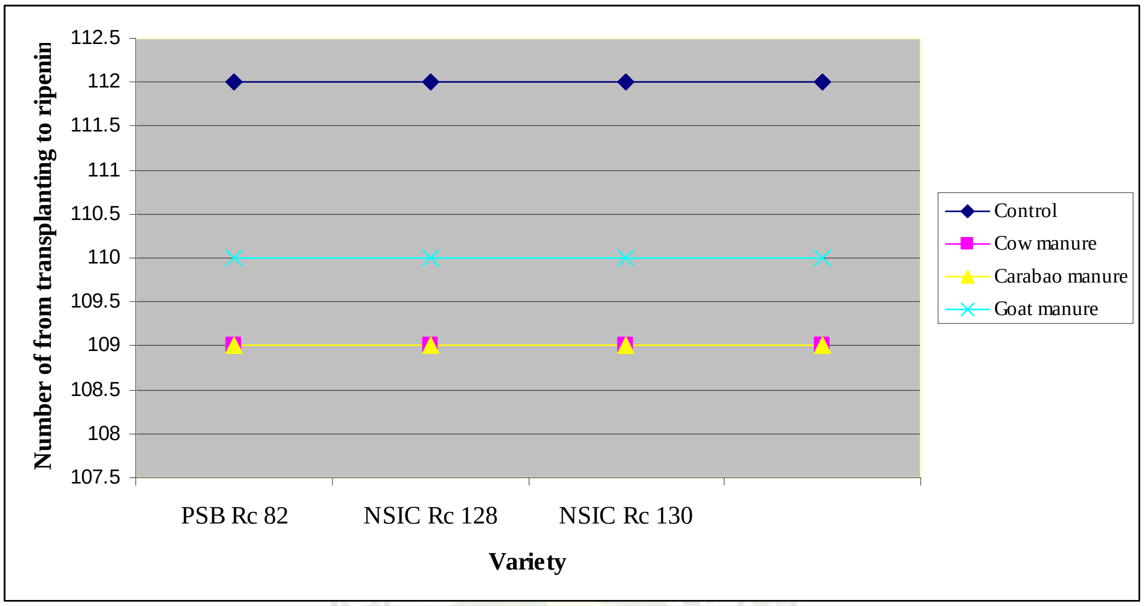

Figure 4. Interaction of variety and animal manures on the number of days from transplanting to ripening

Length of Panicles at Harvest

Effect of varieties. Among the rice varieties evaluated NSIC Rc and NSIC Rc 128 registered longer panicles more than 30 cm (Table 3). Shorter panicles were noted from PSB Rc 82 with 29.92 cm. The highly significant differences noted among varieties could be attributed to varietal characteristics.

Table 3. Length of the panicles at harvest and number of grains per panicle of three rice varieties applied with different animal manures

TREATMENT	LENGTH OF PANICLES (cm)	NUMBER OF GRAINS PER PANICLE
Variety A		
PSB Rc 82 (check)	29.92[b]	86[c]
NSIC Rc 128	30.50[ab]	90[b]
NSIC Rc 130	31.11[a]	94[a]
Animal manure (B)		
No fertilizer	29.25[b]	87[d]
Cow manure	31.07[a]	93[a]
Carabao manure	31.07[a]	91[b]
Goat manure	30.74[ab]	89[C]
A x B	ns	ns
CV%	2.68	2.00

Means followed by the same letter are not significantly different at 5% level using DMRT.

Effect of animal manure. Statistically, highly significant differences on the length of the panicle of rice plants applied among different animal manures. Plants applied with cow manure and carabao manure had the longest panicle of 31 cm. Plants fertilized with no fertilizer applied noted the shortest panicle at harvest. This could be due to the genetic make up of the rice plants to different animal manures.

Interaction effect. No significant interaction effect of variety and animal manure was observed or the length of the panicle at harvest.

Number of Grains Per Panicle

Effect of varieties. NSIC Rc 130 had the highest number of grains per panicle (94) while RSB Rc 82 had the least number of grains (Table 3). NSIC Rc 130 which had the highest number of productive tillers although matured later had the most number of filled grains. According to Vergara (1983) varieties which mature longer often give the highest number of filled grains. Such varieties permit the production of sufficient tillers and leaf area that result in well filled grains.

Effect of animal manure. The highest number of grains per panicle was noted in plants applied with cow and carabao manures. The lowest number of grains per panicle was recorded from unfertilized plants. This could be due to lack of nutrients in the soil which rice plants developed lower number of grains.

Interaction effect. It was observed that animal manure and variety had no significant interaction effect on the number of grains per panicle of rice. It was observed that plants applied with cow manure had the highest number of grains produced than those other animal manures. This could be due to higher nutrients available in cow manure than in other animal manures used.

Grain Yield Per Plot

Effect of varieties. NSIC Rc 128 had the highest grain yield per plot ($5m^2$) as compared to NSIC Rc 130 and PSB Rc 82 (Table 4). Higher grain yield per plot of NSIC Rc 128 may be attributed to their long panicles that contained more grains.

Effect of animal manure. Higher yield was recorded in plants grown in fertilized plots than those plants grown in unfertilized plots (Table 4). Plants applied with cow manure produced the highest grain yield per plot. Higher yield could be attributed mainly to the nutrients available on animal manures used.

Interaction effect. Variety and animal manure manure had no significant interaction effect on the grain yield of rice per plot.

Table 4. Grain yield per plot and computed yield per hectare of three varieties of rice applied with different animal manures

TREATMENT	GRAIN YIELD PER PLOT (kg)	COMPUTED YIELD PER HECTARE (tons/ha)
Variety A		
PSB Rc 82 (check)	2.11^{c}	4.05^{b}
NSIC Rc 128	2.74^{a}	5.48^{a}
NSIC Rc 130	2.62^{b}	5.24^{a}
Animal manure (B)		
No fertilizer	1.21^{b}	2.42^{b}
Cow manure	3.05^{a}	6.42^{a}
Carabao manure	2.86^{ab}	5.72^{a}
Goat manure	2.83^{ab}	5.66^{a}
A x B	ns	ns
CV%	15.21	12.15

Means followed by the same letter are not significantly different at 5% level using DMRT.

Computed Yield Per Hectare

Effect of varieties. Higher computed yield per hectare noted was in NSIC Rc 128 and NSIC Rc 130 which produced more than 5 tons/ha. It was one ton higher than the yield per hectare of PSB Rc 82 (Table 4).

Effect of animal manure. Plants applied with animal manures registered the higher yield per hectare than the unfertilized plants. This could be attributed due to more grains of rice plants applied with animal manures than those unfertilized plants which had the lower yield per hectare.

Interaction effect. There was no significant interaction effect observed or computed yield per hectare (tons/ha) of three varieties applied with different animal manures.

Reaction to Blast and Stem Borer

Effect of varieties. It was observed that all varieties exhibited resistant reaction to rice and stem borer.

Effect of animal manure. The plants applied with animal manure were resistant to blast and stem borer.

Interaction effect. There was no significant interaction effect observed on the reaction to blast and stem borer of three rice varieties applied with different animal manures.

Return on Cash Expense (ROCE)

NSIC Rc 128 gave the highest ROCE (90.28%) while PSB Rc 852 had the lowest (Table 5).

The unfertilized plants registered the highest ROCE (81.46%) while those plants applied with cow, carabao, and goat manures had the lowest ROCE. This implies that high ROCE realized from the rice grown in plots with no fertilizer treatment was due to lower cost of production.

Table 5. Return on cash expense (ROCE) of three rice varieties applied with different animal manures per $5m^2$ plot

TREATMENT	YIELD (kg/plot)	GROSS SALE (PhP)	COST OF PRODUCTION (PhP)	NET INCOME (PhP)	ROCE (%)
Variety A					
PSB Rc 82	2.11	52.75	36.00	16.75	46.53
NSIC Rc 128	2.74	68.5	36.00	32.5	90.28
NSIC Rc 130	2.62	65.5	36.00	29.5	81.94
Animal manure (B)					
No fertilizer	1.21	30.25	16.67	13.58	81.46
Cow manure	3.05	76.25	50.25	26.00	51.4
Carabao manure	2.86	71.5	48.54	22.96	47.30
Goat manure	2.83	76.75	49.25	21.5	43.65

- Total expenses include land preparation, cost of animal manure care and management including weeding and irrigation.
- Sold at Php 25.00 per kilo in February 2008.

Soil Chemical Properties

Initial properties of the soil. The initial pH of the soil was 6-0 indicating that soil was slightly acidic with organic matter content of 2.0%. The nitrogen, phosphorus, and potassium contents of the soil were 0.15%, 20 ppm and 140 ppm respectively (Table 6).

Final pH of the soil. After harvest, the pH of the soil applied with different animal manures was similar at a pH of 6.0.

Organic matter content of the soil. The organic content of the soil applied with cow manure and goat manure had increased by 0.5% from the initial pH while the soil applied with carabao manure was similar with organic matter content of 2.0%.

Table 6. Soil pH, organic matter (OM), nitrogen, phosphorus, and potassium content of the soil before and after planting

TREATMENT	pH	OM (%)	N (%)	P (ppm)	K (ppm)
Before plating	6.0	2.0	0.15	20	140
After planting					
Cow manure	6.0	2.5	0.17	20	240
Carabao manure	6.0	2.0	0.15	18	200
Goat manure	6.0	2.5	0.20	32	204

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted in Bolinao, Pangasinan to evaluate the growth and yield of three varieties applied with different animal manures, determine the effect of animal manure application on growth and yield or rice, determine the interaction effect of variety and animal manure on rice growth and yield, and to determine the economic benefit of growing three rice varieties applied with decomposed animal manures in Bolinao, Pangasinan.

Based on the result of the study, the three HYV's of rice evaluated significantly differed in growth and yield as affected by animal manure application. NSIC Rc 128 and NSIC Rc 130 seedlings recovered within 22 days after transplanting. In terms of productive tillers per hill, NSIC Rc 130 registered the highest. The variety which first booted was PSB Rc 82. NSIC Rc 128 recorded the longest panicle. All HYV's were rated resistant to blast and stem borer resistance.

Highly significant differences among the decomposed animal manures use in this study were observed on the period of recovery, number of tillers at maximum tillering stage, number of productive tillers per hill, number of days from transplanting to ripening, length of the panicle at harvest, grain yield per plot, and computed yield per hectare.

No significant interaction effect of variety and animal manures observed on the number of tillers at maximum tillering stage, length of the panicle at harvest, grain yield per plot, computed yield per hectare and reaction to blast and stem borer.

Among the rice varieties tested NSIC Rc 128 gave the highest (ROCE) followed by NSIC Rc 130. The plants grown in plots with no fertilizer applied recorded the highest ROCE.

Soil chemical properties were improved with application of animal manure.

Conclusions

NSIC Rc 128 and NSIC Rc 130 are the best performing varieties since both had better growth and yield than check variety PSB Rc 82 in Bolinao, Pangasinan. The varieties obtained the highest number of tillers at maximum tillering stage, highest number of productive tillers per hill, longest panicle harvest, highest number of grains per panicle, highest computed yield per hectare and highest ROCE.

The best animal manure applied was cow manure. Plants applied with cow manure had the best growth and highest grain yield per plot. But based on computed yield per hectare, the application of animal manures like cow, carabao or goat manure resulted in significantly higher grain yield/ha than the yield of unfertilized plants.

The application of animal manures in rice did not give better ROCE. Highest ROCE was obtained from growing rice without animal manure application. However, the soil chemical properties were improved with the application of animal manure.

Recommendations

NSIC Rc 128 and NSIC 130 are recommended to rice farmers in Bolinao, Pangasinan to produce higher grain yield and profit. Application of animal manure may be done for better growth and yield of rice although resulted in lesser economic benefit, but soil chemical properties could be improved.

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APPENDICES

Appendix Table 1. Days to recovery of three rice varieties applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	24	24	24	72	24
F_1	22	22	22	66	22
F_2	22	22	22	66	22
F_3	22	22	22	66	22
V_2F_0	24	24	24	72	24
F_1	21	21	21	63	21
F_2	21	21	21	63	21
F_3	22	22	22	66	22
$V3F_0$	24	24	24	72	24
F_1	21	21	21	63	21
F_2	21	21	21	63	21
F_3	22	22	22	66	22
TOTAL	226	266	266	798	22.2

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0	0			
Variety (A)	2	2	1	∞* *	3.44	5.72
Organic Fertilizer (B)	3	43	14.3	∞* *	3.05	4.82
A X B	6	2	0.3	∞* *	2.5	3.76
Experimental Error	22	0	0			
TOTAL	35	47				

** highly significant

Cv = 0%

$S\overline{x}$(A) = 0

$S\overline{x}$ (B) = 0

$S\overline{x}$ (AxB) = 0

Appendix Table 2. Number of tillers at maximum tillering stage of three rice varieties applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	12.3	12.5	12.9	37.7	12.57
F_1	14.3	14.4	14.2	43.3	14.47
F_2	4.2	14.3	14.5.	43	14.33
F_3	13.3	13.2	13	39.4	13.17
V_2F_0	13.2	12.9	12.3	38.4	12.8
F_1	152	14.9	15.3	45.4	15.13
F_2	14.5	14.4	14.2	43.1	14.36
F_3	14.2	13.14	13.9	41.5	13.83
$V3F_0$	12.4	13.2	13.4	39	13
F_1	16.3	15.4	16.2	47.9	15.97
F_2	15.2	15.6	15.9	46.7	15.56
F_3	14.2	15.4	14.9	44.5	14.83
TOTAL	169.3	170.1	170.1	510.1	14.17

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0.0822	0.411			
Variety (A)	2	9.0939	4.5469	29.56* *	3.44	5.72
Organic Fertilizer (B)	3	30.0542	10.0181	65.12* *	3.05	4.82
A X B	6	1.7617	0.2936	1.91^{ns}	2.5	3.76
Experimental Error	22	3.3844	0.1538			
TOTAL	35	44.3764				

** highly significant
* - significant
ns – not significant

Cv = 0%
$S\overline{x}$ = 0
$S\overline{x}$ (B) = 0
$S\overline{x}$ (AxB) = 0

Appendix Table 3. Number of production tillers per hill of three varieties of rice applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	5.9	6.1	6.8	18.8	6.27
F_1	7.1	7.8	6.4	21.3	7.1
F_2	7.2	6.9	7.1	21.2	7.07
F_3	6.2	7.1	6.9	20.2	6.73
V_2F_0	6.1	6.3	6.8	19.2	6.4
F_1	8.2	7.9	8.3	24.4	8.13
F_2	7.2	7.8	8.0	23	7.67
F_3	7.0	7.2	7.4	21.6	7.2
V3F_0	6.2	6.3	6.5	19	6.33
F_1	8.9	8.2	8.7	25.8	8.6
F_2	8.1	8.4	8.6	25.1	8.37
F_3	7.1	7.3	7.8	22.2	7.4
TOTAL	85.2	87.3	89.3	261.8	87.27

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0.7006	0.3503			
Variety (A)	2	4.906	2.3953	19.62* *	3.44	5.72
Organic Fertilizer (B)	3	13.8811	4.6270	37.90* *	3.05	4.82
A X B	6	2.0139	0.3356	2.75*	2.5	3.76
Experimental Error	22	2.6861	0.1221			
TOTAL	35	24.0722				

** highly significant
* - significant

Cv = 4.80%
$S\bar{x}$ = 0.101
$S\bar{x}$ (B) = 0.117
$S\bar{x}$ (AxB) = 0.202

Appendix Table 4. Number of days from booting to heading of three rice varieties applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	14	14	14	42	14
F_1	12	12	12	36	12
F_2	12	12	12	36	12
F_3	12	13	13	38	12.7
V_2F_0	18	18	18	54	18
F_1	16	16	16	48	16
F_2	16	16	16	48	16
F_3	17	17	17	51	17
$V3F_0$	19	19	19	57	19
F_1	16	16	16	48	16
F_2	16	16	16	48	16
F_3	17	17	17	51	17
TOTAL	185	186	186	557	185.7

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0.7006	0.3503			
Variety (A)	2	4.906	2.3953	19.62* *	3.44	5.72
Organic Fertilizer (B)	3	13.8811	4.6270	37.90* *	3.05	4.82
A X B	6	2.0139	0.3356	2.75*	2.5	3.76
Experimental Error	22	2.6861	0.1221			
TOTAL	35	24.0722				

** highly significant

Cv = 1.08%
$S\bar{x}$ = 0.048
$S\bar{x}$ (B) = 0.056
$S\bar{x}$ (AxB) = 0.096

Appendix Table 5. Number of days from transplanting to ripening of three varieties or rice applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	94	94	94	282	94
F_1	92	92	92	276	92
F_2	92	92	92	276	92
F_3	92	92	92	276	92
V_2F_0	120	120	120	360	120
F_1	117	117	117	357	117
F_2	116	116	116	348	116
F_3	118	118	118	354	118
$V3F_0$	122	122	122	366	122
F_1	118	118	118	354	118
F_2	118	119	118	354	118
F_3	120	120	120	360	120
TOTAL	1319	1319	1314	3957	119.5

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0	0.3503			
Variety (A)	2	5478.5	2739.25	∞* *	3.44	5.72
Organic Fertilizer (B)	3	60.75	20.25	∞* *	3.05	4.82
A X B	6	7.5	1.25	∞* *	2.55	3.76
Experimental Error	22	0	0			
TOTAL	35	24.0722				

** highly significant

Cv = 0%
$S\overline{x} = 0$
$S\overline{x}$ (B) = 0
$S\overline{x}$ (AxB) = 0

Appendix Table 6. Length of the panicle at harvest (cm) of three rice varieties applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	26.29	29.43	29.71	85.43	28.48
F_1	30.47	30.55	30.65	91.67	30.56
F_2	31.22	30.29	30.38	90.54	30.18
F_3	29.87	30.04	30.16	90.07	30.02
V_2F_0	22.37	30.25	39.71	87.33	29.11
F_1	30.56	31.86	31.50	93.92	31.31
F_2	31.25	30.75	31.35	93.35	31.12
F_3	30.35	30.41	30.63	91.39	30.46
$V3F_0$	29.82	30.27	30.43	90.53	30.17
F_1	31.28	31.55	30.37	92.2	30.73
F_2	32.0	31.15	31.28	94.43	31.48
F_3	32.5	31.25	31.47	95.22	31.74
TOTAL	362.98	367.8	367.64	1096.07	365.42

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	1.2493	0.6246			
Variety (A)	2	8.5352	4.2676	6.40* *	3.44	5.72
Organic Fertilizer (B)	3	19.5255	6.5085	9.77* *	3.05	4.82
A X B	6	2.6092	0.4349	0.65*	2.5	3.76
Experimental Error	22	14.6599	0.6664			
TOTAL	35	46.5741				

** highly significant
ns - not significant

Cv = 2.68%
$S\overline{x}$ = 0.236
$S\overline{x}$ (B) = 0.272
$S\overline{x}$ (AxB) = 0.471

Appendix Table 7. Number of grain per panicle of three varieties of rice applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	78.4	88.6	83.4	250.4	83.47
F_1	87.4	88.2	88.9	264.5	88.17
F_2	84.6	85.1	86.4	256.1	85.37
F_3	83.8	84.4	86.7	255.9	85.3
V_2F_0	88.7	88.4	88.1	265.2	88.4
F_1	91.2	88.9	90.2	271.1	90.43
F_2	90.7	90.4	90.9	272	90.67
F_3	89.6	89.9	90.2	269.7	89.4
$V3F_0$	89.1	88.6	88.4	366.1	88.7
F_1	100.4	98.6	97.8	296.8	98.93
F_2	100.2	97.2	96.3	293.7	97.9
F_3	90.4	90.8	90.2	271.4	90.47
TOTAL	1083.5	1092.4	1072.5	3233.1	1077.7

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0.1788	0.0894			
Variety (A)	2	2.7082	1.3541	9.45* *	3.44	5.72
Organic Fertilizer (B)	3	19.7695	6.5898	0.76^{ns}	3.05	4.82
A X B	6	0.801	0.1336	0.93^{ns}	2.5	3.76
Experimental Error	22	3.1508	0.1432			
TOTAL	35	46.5741				

ns - not significant

Cv = 15.21%
$S\bar{x}$ = 0.109
$S\bar{x}$ (B) = 0.126
$S\bar{x}$ (AxB) = 0.219

Appendix Table 8. Grain yield per plot (kg) of three rice varieties applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	1.0	1.12	1.15	3.27	1.09
F_1	3.8	2.15	2.5	7.45	2.48
F_2	2.10	2.17	2.7	6.97	2.32
F_3	2.5	2.0	2.10	6.6	2.2
V_2F_0	1.9	1.15	1.0	4.05	1.35
F_1	3.0	3.10	3.5	9.8	3.26
F_2	3.15	3.0	3.5	9.85	3.28
F_3	3.5	3.0	3.10	9.6	3.2
$V3F_0$	1.0	1.5	1.10	3.6	1.2
F_1	2.9	3.1	3.4	9.4	3.13
F_2	3.0	2.9	3.2	9.1	3.03
F_3	2.8	3.5	3.0	9.3	3.1
TOTAL	30.6	28.69	30.25	88.99	15.26

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0.1788	0.0894			
Variety (A)	2	2.7082	1.3541	9.45* *	3.44	5.72
Organic Fertilizer (B)	3	19.7695	6.5898	46.01* *	3.05	4.82
A X B	6	0.8014	0.1336	0.93^{ns}	2.5	3.76
Experimental Error	22	3.1508	0.1432			
TOTAL	35	46.5741				

** highly significant
ns - not significant

Cv = 4.80%
$S\overline{x}$ = 0.109
$S\overline{x}$ (B) = 0.126
$S\overline{x}$ (AxB) = 0.219

Appendix Table 9. Computed yield per hectare (tons/ha) pf three varieties of the applied with different animal manures

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1F_0	2.0	2.24	2.3	6.52	2.17
F_1	5.6	4.3	5.0	14.9	4.97
F_2	4.2	4.34	5.4	13.94	4.65
F_3	5.0	4.0	4.2	13.2	4.4
V_2F_0	3.8	2.3	2.0	8.1	2.7
F_1	6.0	6.2	7.4	19.6	6.53
F_2	6.3	6.0	7.0	19.3	6.43
F_3	6.0	6.2	7.0	19.2	6.4
$V3F_0$	2.0	3.0	2.2	7.2	2.4
F_1	5.8	6.2	6.8	18.8	6.27
F_2	6.0	5.8	6.4	18.2	6.2
F_3	5.6	7.0	6.0	18.6	6.07
TOTAL	58.3	57.48	61.7	177.56	15.19

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR 5%	TABULAR 1%
Blocks	2	0.8070	0.4035			
Variety (A)	2	14.5620	7.2810	20.28* *	3.44	5.72
Organic Fertilizer (B)	3	75.6983	25.2328	70.29* *	3.05	4.82
A X B	6	2.6854	0.4476	1.25^{ns}	2.5	3.76
Experimental Error	22	7.8976	0.3590			
TOTAL	35	46.5741				

** highly significant
ns - not significant

Cv = 12.15%
$S\overline{x}$ = 0.173
$S\overline{x}$ (B) = 0.200
$S\overline{x}$ (AxB) = 0.346

Appendix Table 10. Reaction to stem borer (white heads) of three varieties rice applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	1	2	1	4	1.3
F_1	1	1	3	5	1.66
F_2	1	2	1	4	1.33
F_3	1	1	1	3	1.0
V_2F_0	1	1	2	4	1.33
F_1	1	1	1	3	1.0
F_2	3	1	1	5	1.66
F_3	2	1	1	4	1.33
$V3F_0$	2	1	2	5	1.66
F_1	2	1	1	4	1.33
F_2	1	1	2	4	1.0
F_3	1	2	2	4	1.33
TOTAL	17	14	17	47	

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	0.1667				
Variety (A)	2	0	0	0^{ns}	3.44	5.72
Organic Fertilizer (B)	3	0.222	0.0741	0.17^{ns}	3.05	4.82
A X B	6	1.7778	0.2963	0.66^{ns}	2.5	3.76
Experimental Error	22	9.8333	0.4470			
TOTAL	35	12.000				

ns - not significant

Cv = 14%
$S\overline{x}$ = 0.19
$S\overline{x}$ (B) = 0.223
$S\overline{x}$ (AxB) = 0.386

Appendix Table 11. Reaction to blast (neck rot) of three varieties of rice applied with different animal manures

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1F_0	1	1	2	4	1.33
F_1	2	1	1	4	1.33
F_2	1	3	1	5	1.66
F_3	1	2	1	4	1.33
V_2F_0	1	3	1	5	1.3
F_1	1	1	2	4	1.66
F_2	1	1	1	3	1.0
F_3	1	2	1	4	1.33
$V3F_0$	1	2	2	5	1.66
F_1	1	1	1	3	1.0
F_2	1	2	1	4	1.33
F_3	2	2	1	5	1.66
TOTAL	14	21	15	51	8.34

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR	
					5%	1%
Blocks	2	2.3889	1.1944			
Variety (A)	2	0.556	0.0278	0.07^{ns}	3.44	5.72
Organic Fertilizer (B)	3	0.556	0.1852	0.49^{ns}	3.05	4.82
A X B	6	1.2778	0.1130	0.57^{ns}	2.5	3.76
Experimental Error	22	8.2778	0.3763			
TOTAL	35	12.5558				

ns - not significant

Cv = 4.80%
$S\bar{x}$ = 0.109
$S\bar{x}$ (B) = 0.126
$S\bar{x}$ (AxB) = 0.219