BIBLIOGRAPHY

CARIÑO, JULIE R. APRIL 2009. Effect of Green Manures on the Growth and Yield of High Yielding Varieties of Rice in Tuba, Benguet. Benguet State University, La Trinidad Benguet.

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ABSTRACT

This study was conducted to (1) evaluate the response of high yielding varieties (HYV's) of rice to green manuring; (2) determine the effect of green manure on the growth and yield of HYV's in Tuba, Benguet; (3) determine the interaction effect of variety and green manure on the growth and yield of rice; and (4) determine the profitability of growing HYV's of rice applied with green manures.

Significant differences among the green manures used were observed on the number of days to tillering and to booting, number of days from booting to heading, number of tillers at maximum tillering stage, number of productive tillers, length of panicle, height at maturity, grains per panicle and grain yield per plot and per hectare. Plants applied with madre de cacao had the highest grain yield.

Plants applied with sunflower were the earliest to boot and to ripen. Plants applied with ipi-ipil had the highest number of tillers while the unfertilized plants were the earliest to produce tillers and to boot but they were the latest to ripen. Madre de cacao was the best green manure in terms of all the parameters considered in this study particularly the grain yield per plot. Green manuring could play an important role to

promote favorable soil properties and provide nutrition to the rice plant for a sustainable rice production.

The rice varieties tested significantly differed in terms of the parameters considered in this study. IR 64 had the tallest seedlings before transplanting, highest number of productive tillers and highest grain yield per plot and per hectare. IR 34 was the tallest at harvesting stage and had the longest panicle, but the latest to produce tillers, to boot and to ripen. PSB Rc 82 had the highest number of grains per panicle and the earliest to mature. Significant interaction effect of variety and green manures was observed on the number of days from transplanting to tillering, number of days from booting to heading and on the height of rice at maturity.

Based on the results of this study, farmers could grow IR 64 and IR 34 varieties of rice and use madre de cacao as green manure to produce good grain yield and to have the high return on cash expense.

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INTRODUCTION

There is no possibility of expanding the areas devoted to planting rice. Presently, they are deliberately decreased because of the increasing demands for residential lots and the pressing need for areas devoted to industrial and business and establishment. To face this challenge of increasing production is to intensify production in existing fields and make production sustainable.

Rice (*Oryza sativa L.*) is well known cereal plant in warm and cool climates but usually rice plant grows faster in warm places. In the Philippines, wild and commercially grown varieties of rice are both preserved and are commonly grown because rice is the main staple crop of the Filipinos. According to UPCA (1983), rice production should be given priority so that the increasing population will have enough supply. Farmers should be encouraged to produce more to minimize the importation of rice. To increase rice production, adapted and high performing varieties and appropriate cultural management practices like fertilizer application must be considered. Since commercial fertilizers are expensive and excessive application of it makes the soil acidic, reduced farm nutrients and caused soil degradation and environment pollution. And to avoid this problem, organic farming might be a good solution to sustain productivity and replenish the soil depleted nutrients.

Rice production in the country had not yet come up to the level of sufficiency as shown by straggering quantities of rice importation yearly to fill up the difficiency. The use of organic fertilizer like compost may enlighten the farmers to improve soil properties which lead to increase the production of high yielding varieties of rice. Such farmers may utilize their ricelands to the fullest with high yields, and make the soil

favorable and productive. The use of green manures is less expensive since it is abundantly available in the locality.

This study aimed to:

1. determine which high yielding varieties (HYV's) of rice is most responsive to green manuring;

2. determine the effect of green manure on the growth and yield of HYV's of rice in Tuba, Benguet;

3. determine the interaction effect of green manure and HYV's on the growth and yield of rice; and

4. to determine the profitability of growing HYV's of rice applied with green manure in Tuba, Benguet.

This study was conducted at farmer's field in Nangalisan Tuba, Benguet from December 2007 to April 2008.

REVIEW OF LITERATURE

About the Crop

Rice belongs to the Graminae family, subfamily Oryzoideae, tribe Oryzeae, genus Oryza. It is probably originated in India or Southeastern Asia. Oryza contains 22 species, both annual and perennial. Cultivated rice, both Asiatic and African, is an annual grass with culms terminated by loose panicle inflorescence having single, perfect flowered spikelets. Plants may reach 16 feet (deep water types in Southeast Asia) but most modern U.S. cultivars may reach 3 to 4 feet, culms are round and hallow except for nodes.Leaves are narrow, joined to sheaths and collars. Leaf auricles are well defined, sickle shaped and hairy in cultivated rice. Ligules may be acute to acuminate or may be biclefted (Smith, 1995).

Organic Rice Production

According to Sullivan (2003), leguminous green manure crops can supply 30% to 50% of the nitrogen needs of high yielding varieties of rice depending on the quantity, quality and type of green manure crop, the time and method of application, soil fertilizer, and cropping method. The clover provides enough nitrogen to produce high yield without additional nitrogen at one location. And it was found that organic rice price is two to three times higher than the conventionally grown rice but organic rice cost more to produce.

Importance of Organic Fertilizer

At present, rice growers are facing of many problems. One of which is the low soil fertility. Fertile lands that were successively cultivated for a long period have turned acidic due to inaccurate system of management.

Organic matter influences physical and chemical properties of the soil. It represents an accumulation of particularly synthesized plant and animal residues, which are continually broken down by the soil microorganism and consequently of a transitory soil constituent (Brandy, 1985).

Furthermore, soil high in organic matter tends to increase the population of microorganism and through this organism, it would eventually return to the soil in mineralized form.

Organic fertilizers generally provide the elements essential for the plant growth. It is at least 50% to 60% cheaper than inorganic fertilizer and is effective is increasing yield (Laurean, 1984). It can also maintain the soil good physical condition and increase the water holding capacity of the soil in a maximum utilization of the rain (Singh, 1983).

Effect of Organic Matter on Soil

Organic matter attract and hold cation nutrients and trace elements in an available state reducing leaching losses. Bind soil particles into aggregates, produced a granular structure which permits the accessibility of air to roots, the capillary movement of water and the penetration roots through the soil. Organic matter are transformed into vitamins, hormones and other substances which stimulate growth in plants and microorganism (Parnes, 1986).

Kinoshita (1970), revealed that organic matter turn heavy soil lighter, more crumbly, friable and hold light soil particles to act as an anchor against erosion and to increase the water holding capacity of the soil. They provide some of the large quantities of nitrogen needed by the plants and release nutrients present in the soil by turning them into soluble compound that can be absorbed by the roots of the plants. Finally, they carry considerable quantity of elements often insufficient in the soil and provide readily available microelements, both activities promote plant growth.

Effect of Organic Fertilizer to Plant Growth

Soil vary in their capacity to supply the mineral nutrients for the plants factors. Responsible for the variation are soil origin, stage of soil development, organic matter content and soil management practices with passage of time individual elements in the soil minerals are slowly released ions capable of being taken up by plants. The rate of this release dependent on factors such as the kind of soil minerals climate, vegetation growing on the soil (Pandy,1987).

Some local experiments have been conducted on the use of organic fertilizer. In 1976, Mejia work on sweet pepper and she found out that different organic fertilizer had variable effect on the growth of the plants. The applied 4 tons of chicken dung per hectare registered the highest weight of roots and vegetative growth.

Bal- iwang (1994), found out the different fertilizers had variable effect on the rice growth. The rice plant applied with two tons of chicken dung per hectare registered the highest plant at maturity and highest number of productive tillers.

The addition of manure increased the rate of growth of rice plants. Manures materially hastened the emergence of the panicles of the rice plants during dry season,

but did not increase the tillers of the plants and yield during wet season (Ballesteros, 1949).

Effect of Sunflower

Pandosen (1986), stated that in the absence of manure, wild sunflower that is abundant in highland can be perfect substitute for organic nitrogen source. Sunflower is quite easy to compost and it hastens decomposition. Furthermore, she stated that wild sunflower has been known to be good supplementary source of organic nitrogen. Fresh sunflower contains 3.76 % N and wild sunflower based compost has 3.22% N. Besides being free, wild sunflower is readily available in the Cordillera region. The use of wild sunflower as a source of organic N may provide important findings related to minimizing the use of inorganic N and could be good basis for recommendation.

Effect of Ipil – Ipil

Ipil –ipil is an excellent source of organic fertilizer and soil improver, and it is being used as a fertilizer and erosion controller in corn, tobacco and onions according to Benge (1977). Application of ipil – ipil leaves as organic fertilizer is as effective as the commercial inorganic fertilizer (ammonium sulfate) in providing ammonium nutrition of rice both under flooded and non flooded condition.

Effect of Madre de Cacao

Madre de cacao also locally known as kakawete is a nitrogen fixing tree. It is used as ripening agent of harvested banana and can be utilized as fertilizer to lessen the farm inputs. Application of organic materials just like madre de cacao is a good agricultural practice to maintain soil nutrient level and ameliorate the properties of soil to

sustain crop production. Effect on the crops performance and yield as well as its beneficial effect on the soil physical and chemical properties, further study is strongly recommended. Similarly, the economic benefits of applying organic materials as soil amendment and its potential as an alternative to inorganic fertilizers should also be evaluated (Archives 2004).

Effect of Green Manures on Soil Organic Matter

According to MacRae (2009), green manures affect the microbial activity of the soil and it is generally accepted that low- nitrogen green manures (1.5% N or less) can be effective in improving soil organic matter levels. Furthermore, stated that it is also improved soil physical conditions create the potential for increased crop growth.

Importance of High Yielding Varieties (HYV's)

The use of high yielding varieties (HYV's) can lessen the production cost and ease the burdens of the farmers according to Sallatic (1999). Due to their earliness in maturity than the traditional varieties, two croppings in a year could result in greater production and profit. Vergara (1992), stated that modern varieties of the high yielding varieties of rice gave greater potential than traditional varieties even under the best condition. Traditional varieties do not yield more than modern varieties.

Pests and Diseases

Rice bug locally known as "atangya" in Tagalog and "dangaw" in Ilocano, sucks the content of the rice grain during milk stage resulting to empty grains.On the otherhand, rice blast is one of the most destructive fungal disease of rice. It inflicts as much as 50% loss areas where severe outbreaks occur. However, rice blast is controlled by planting

resistant varieties, integrated with some cultural management practices which include raising seedling in wetland condition (UPLB, 1983).

Disease and insect problems are common in rainfed lowland rice environment which are more serious during rice second crop. However, for the successful production of rice crops, rice cultivars planted should be resistant to insects, pests and disease like stemborers and rice bugs which are the common insect problem as well as bacterial blight and brown spot (Ingram, 1995).

MATERIALS AND METHODS

An area of 216 sq m. was thoroughly prepared for wet seedbeds. The area was divided into three blocks representing three replications. Each replication was subdivided into 12 plots measuring 1m x 5m each. Earthened bunds measuring 20 cm wide and 30 cm high were constructed in between treatments to avoid fertilizer mixing during irrigation.

The different green manures were mixed thoroughly with the soil during last harrowing which was one week before transplanting. One rice seedling per hill was transplanted in a straight row with a distance of 20 cm between hills and 20 cm between rows. The experiment was laid out following 3 x 4 factor–factorial arrangement in Randomized Complete Block Design (RCBD) with three replications. The high yielding varieties (HYV's) were considered as Factor A and the different green manures were considered as Factor B.

Factor A: High Yielding Variety (V)	Factor B: Green Manure (GM)
V_1-IR 64	GM_0 – no fertilizer/control
V_2- IR 34	GM_1 – Sunflower (5kg/plot)
V_3- PSB Rc 82	GM_2 – Madre de cacao (5kg/plot)
	GM_3 – Ipil – ipil (5kg/plot)

Hand weeding was done 20 days after transplanting. From then on the plots were kept weed free. Insect pests and diseases were controlled and monitored to reduce economic losses. Other recommended cultural management practices were followed to ensure better yield.

Soil samples were gathered from the experimental area before and after the study to determine the pH, organic matter (OM), nitrogen, potassium, and phosphorus content at Baguio Soils Laboratory Pacdal, Baguio City for initial analysis and at the Bureau of Soils San Fernando City, La Union for final analysis.

Data Gathered:

1. Height of seedling before transplanting (cm). The height of rice seedlings before transplanting was measured from the base of the plant to the longest leaf before transplanting using 10 samples per plot.

2. Number of days from transplanting to tillering. This was recorded when at least 50% of the total plants per plot started producing tillers.

3. Number of tillers at maximum tillering stage. This was counted and recorded when 50 % of the total plants in each plot produced flag leaf.

4. Number of productive tillers. The number of productive tillers were counted using 10 random sample hills per plot.

5. Number of days from transplanting to booting. This was taken when at least 50% of the total plants in a plot booted.

6. Numbers of days from booting to heading. This was taken when at least 50% of the total plants in a plot produced heads.

7. Length of panicle (cm). This was taken by measuring the panicle from its base up to the tip of the last grain excluding the awn for ten sample plants per treatment.

8. Plant height at maturity (cm). The height of the plants was measured from the base of the plant at ground level to the tip of the longest panicle at harvest using ten random sample hills per plot.

9. Number of grains per panicle. This was taken using ten random panicle samples per plot.

10. Grain yield per plot (kg/5m^2). This was taken by removing the grains after drying the grains and separating the filled grains from the unfilled grains. Only the weight of filled grains per plot was recorded.

11. Computed grain yield per hectare (t/ha). This was taken by converting the weight of filled grains per plot into yield per hectare using the following formula:

$$\text{Yield/ hectare (t/ha)} = \frac{\text{Yield (kg)}}{5\text{m}^2} \times 2$$

Where 2 was the factor used to convert yield per plot in kg/5m^2 to computed yield per hectare in t/ha using one hectare effective area.

12. Resistance to lodging. This was recorded at maturity using the following scale used by Phil Rice (1996):

Scale	Description	Remarks
1	No lodging	Resistant
2	25% lodging	Moderately resistant
3	50% lodging	Moderately susceptible
4	75% lodging	Susceptible
5	100% lodging	Very susceptible

13.Reaction to stemborer. Evaluation of stem borer infestation expressed in percent whiteheads was done at heading time using the following standard scale (Phil Rice, 1996):

Rating index	% Whiteheads	Remarks
1	1-5	Tolerant
2	6-10	Moderately tolerant
5	11-15	Intermediate
7	16-25	Moderately susceptible
9	26-above	Susceptible

14. Reaction to blast (neck rot). Evaluation on the severity of rice blast or neck rot was taken from the plants at the center rows, using the following formula for infection and rating scale used by Phil Rice (1996):

$$\text{Percent Infection} = \frac{\text{No. of panicles infected}}{\text{Total No. of panicle considered}} \times 100$$

Index	Percent Blast infectation	Remarks
1	0-5	Resistant
2	6-25	Intermediate
3	26-above	Susceptible

16. Return on cash expenses (ROCE). The total production costs per plot were recorded and net profit was computed. The return on cash expenses was computed using the following formula:

$$\text{ROCE} = \frac{\text{Net profit}}{\text{Total cost production}} \times 100$$

Data Analysis

All the quantitative data gathered in this study were statistically analyzed using the 3 x 4 factor- factorial arrangement in Randomized Complete Block Design (RCBD) with three replications. The significance of differences among treatment means was determined using the F- test and Duncan's Multiple Range Test (DMRT) at 5% level 0f significance.

RESULTS AND DISCUSSION

Soil Chemical Properties

Table 1 shows the result of the soil analysis before planting and after harvesting. Before planting the soil pH was below 6.0 and there was an increase in pH after harvesting. The organic matter of the experimental plots also increased. Likewise, the N, P and K contents of the soil also increased. This finding indicated that the application of green manure in the rice field increased the chemical properties of the soil.

Plant Height at Seedling Stage and at Maturity

Variety. The seedlings of IR 64 and IR 34 were taller than the seedlings of PSB Rc 82 (Table 2). At maturity, the height of plants among varieties tested was comparable.

Green manure. The different green manures used in this study did not significantly affect the plant height at seedling stage. The green manures incorporated in plots increased the plant height of rice at maturity (Table 2). Plants applied with madre de

Table 1. Soil chemical properties

TREATMENT	pH	OM (%)	N (%)	P (ppm)	K (ppm)
Before planting	5.92	1.5	0.05	12	70
After harvesting					
Control	6.3	3.5	0.92	63	62
Sunflower	6.0	2.0	0.90	30	53
Madre de cacao	6.0	3.0	1.64	66	50
Ipil- ipil	6.2	3.5	0.66	35	43

cacao were the tallest. This was followed by those plants applied with ipil – ipil and sunflower. Finally, the unfertilized plants were the shortest. This results shows that rice plants responded well when applied with green manure. This probably was due to nitrogen content of the green manures used that enhanced growth of HYV's.

Interaction effect. Varieties and green manures did not significantly interact on the height of seedling before transplanting. The varieties and green manures had significantly interaction effect on plant height of rice at maturity (Table 2). Without green

Table 2. Plant height at seedling stage and maturity of rice varieties applied with different green manure

TREATMENT	PLANT HEIGHT (cm)	
	SEEDLING STAGE	MATURITY
Variety (V)		
IR 64	27.81[a]	85.03[a]
IR34	27.37[a]	86.32[a]
PSB Rc 82	26.74[b]	85.50[a]
Green Manure (GM)		
Control	27.22[a]	79.38[c]
Sunflower	27.06[a]	86.16[b]
Madre de cacao	27.53[a]	90.04[a]
Ipil – ipil	27.42[a]	86.89[ab]
V x GM	ns	*
CV (%)	2.29	4.32

*Means with the same letters are not significantly different at 5 % level using DMRT.

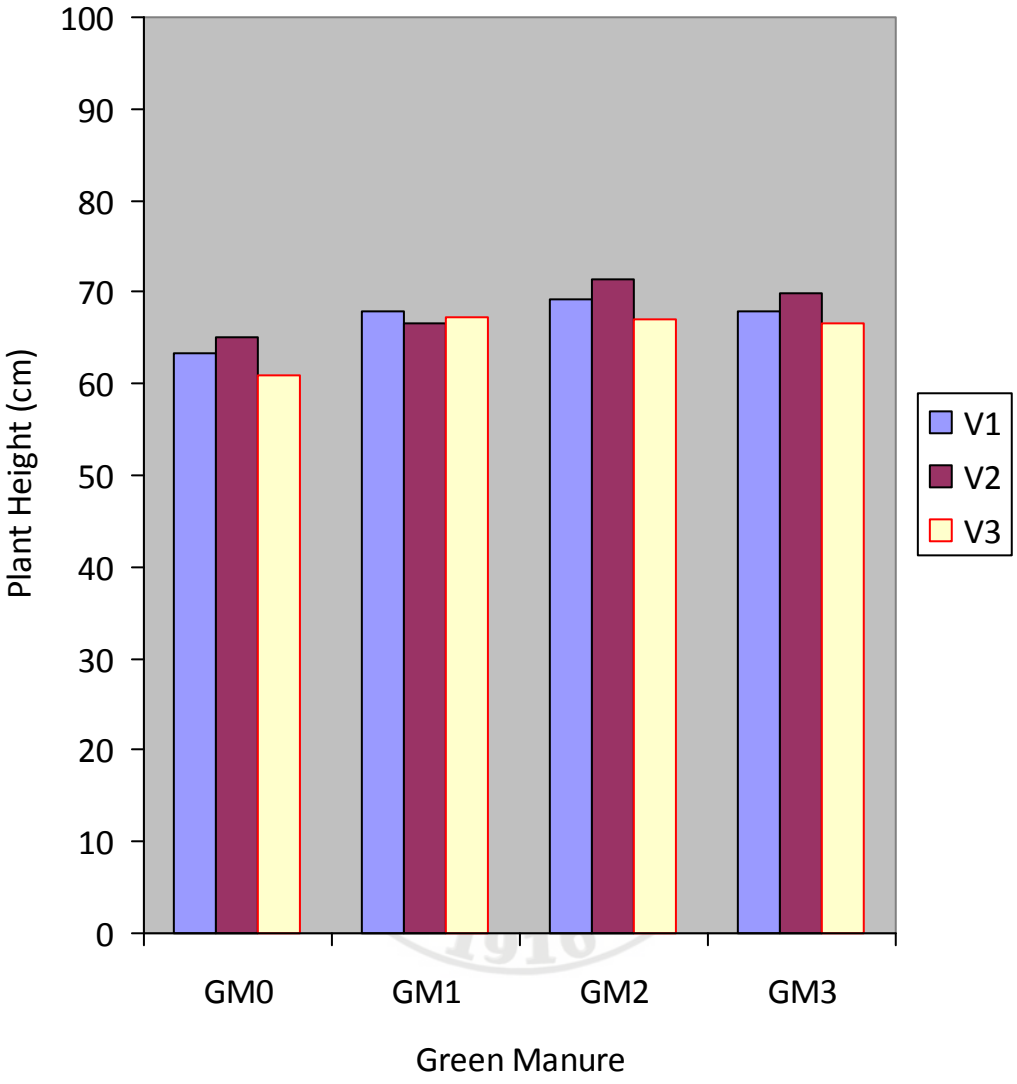
manure IR 34 had the tallest plant but with sunflower as green manure all the three HYV's had comparable plant height. With madre de cacao and ipil–ipil as green manure, IR 34 produced the tallest plants among the three HYV's evaluated (Figure 1).

Maturity

Variety. Table 3 shows that PSB Rc 82 was the earliest to produce tiller, boot and ripen from transplanting among the three rice varieties used in this study. PSB Rc 82 took about two weeks from booting to heading and it reached heading 2 days earlier than the other two varieties of rice studied.

Green manure. Significant differences were noted among the plants applied with different green manures used in terms of the number of days from transplanting to tillering, booting and ripening. The plants applied with green manures produced tillers two days after tillering of unfertilized plants. However, they booted and ripened one day earlier than the unfertilized plants except for those applied with ipil- ipil which ripened at similar days with plants grown in plots without green manure. Application of fertilizers hasten the number of days from booting to heading of rice by one day earlier than the unfertilized one (Table 3). According to Vergara (1992), fertilizers hastened earlier flowering and maturity of rice plants because of their nutrient contents which gave faster effect on the growth and development of rice plants.

Interaction effect. Highly significant interaction effect of varieties and green manure applied was observed on the number of days from booting to heading of rice (Fig. 3).The three HYV's had almost similar response to all green manures applied in terms of days from booting to heading. Only PSB Rc 82 was the earliest to heading from booting



Legend: Variety (V)

V_1 – IR 64
V_2 – IR 34
V_3 – PSB Rc 82

Green Manures (GM)

GM_0 – Control
GM_1 – Sunflower
GM_2 – Madre de cacao
GM_3 – Ipil – ipil

Figure 1. Interaction effect of rice varieties and green manures on plant height at maturity

while IR 64 and IR 34 formed head from booting at the same period regardless of green manure applied.

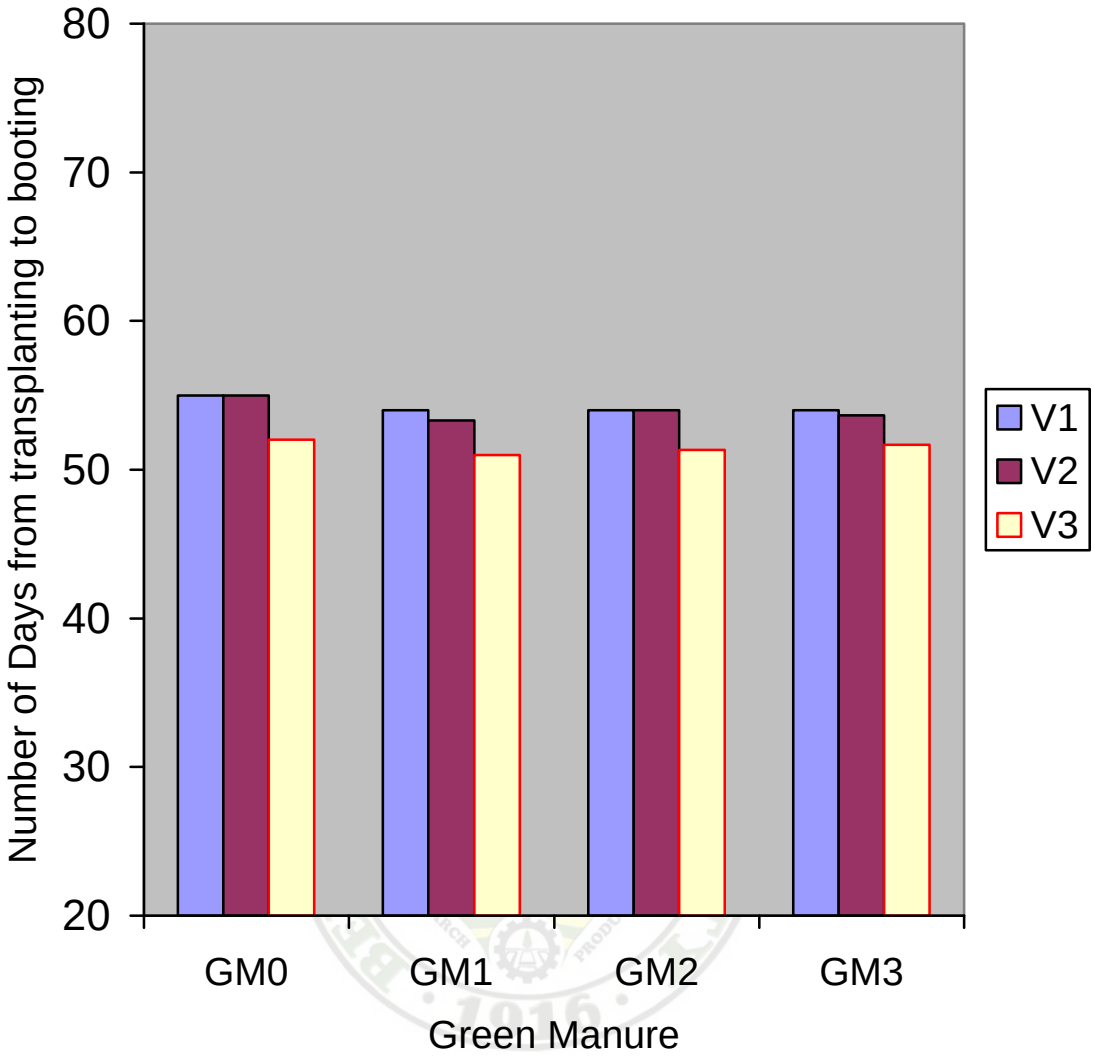
Number of Tillers and Productive Tillers Per Hill

Variety. No significant differences on the number of tillers at maximum tillering stage of rice was observed among the three rice varieties tested (Table 4). IR 64 produced more than 9 tillers per hill while both IR 34 and PSB Rc 82 produced ten tillers per hill. PSB Rc 82 had the lowest number of productive tillers per plant among the HYV's

Table 3. Number of days from transplanting to tillering, booting and ripening and from booting to heading of the rice varieties applied with different green manures

TREATMENT	NUMBER OF DAYS FROM TRANSPLANTING TO:			NUMBER OF DAYS FROM BOOTING TO HEADING
	TILLERING	BOOTING	RIPENING	
Variety (V)				
IR 64	16.66[a]	15.25[a]	20.50[b]	16.50[a]
IR 34	16.87[a]	15.25[a]	21.00[a]	16.50[a]
PSB Rc 82	14.99[b]	13.00[b]	18.25[c]	14.04[b]
Green Manure (GM)				
Control	14.63[b]	15.33[a]	20.44[a]	18.67[a]
Sunflower	16.42[a]	14.00[c]	19.56[b]	17.00[b]
Madre de cacao	16.74[a]	14.33[b]	19.56[b]	16.33[d]
Ipil – ipil	16.89[a]	14.33[b]	20.11[ab]	16.67[c]
V x GM	ns	**	ns	**
CV (%)	3.02	0	2.87	0.32

*Means with the same letters are not significantly different at 5 % level using DMRT.



Legend: Variety (V)
V_1 – IR 64
V_2 – IR 34
V_3 – PSB Rc 82

Green Manures (GM)
GM_0 – Control
GM_1 – Sunflower
GM_2 – Madre de cacao
GM_3 – Ipil – ipil

Figure 2. Interaction effect of rice varieties and green manures on number of days from transplanting to booting

studied. IR 64 had the highest number of productive tillers which was followed by IR 34 (Table 4).

Green manure. Green manure application significantly increased the number of tiller per plant by one tiller than those of the unfertilized plants (Table 4). The unfertilized plants produced the highest number of productive tillers followed by the plants applied with ipil- ipil and with madre de cacao. The lowest number of productive tillers was recorded in plants applied with sunflower.

Table 4. Number of tillers per hill at maximum tillering stage and productive tillers per hill of the rice varieties applied with different green manures

TREATMENT	NUMBER OF TILLERS PER HILL AT MAXIMUM TILLERING STAGE	NUMBER OF PRODUCTIVE TILLERS PER HILL
Variety (V)		
IR 64	9.63[b]	54.33[a]
IR 34	10.21[a]	54.00[b]
PSB Rc 82	10.03[a]	51.50[c]
Green Manure (GM)		
Control	9.17[b]	54.00[a]
Sunflower	10.09[a]	52.78[c]
Madre de cacao	10.04[a]	53.11[bc]
Ipil – ipil	10.52[a]	53.22[b]
V x GM	ns	ns
CV (%)	8.49	0.72

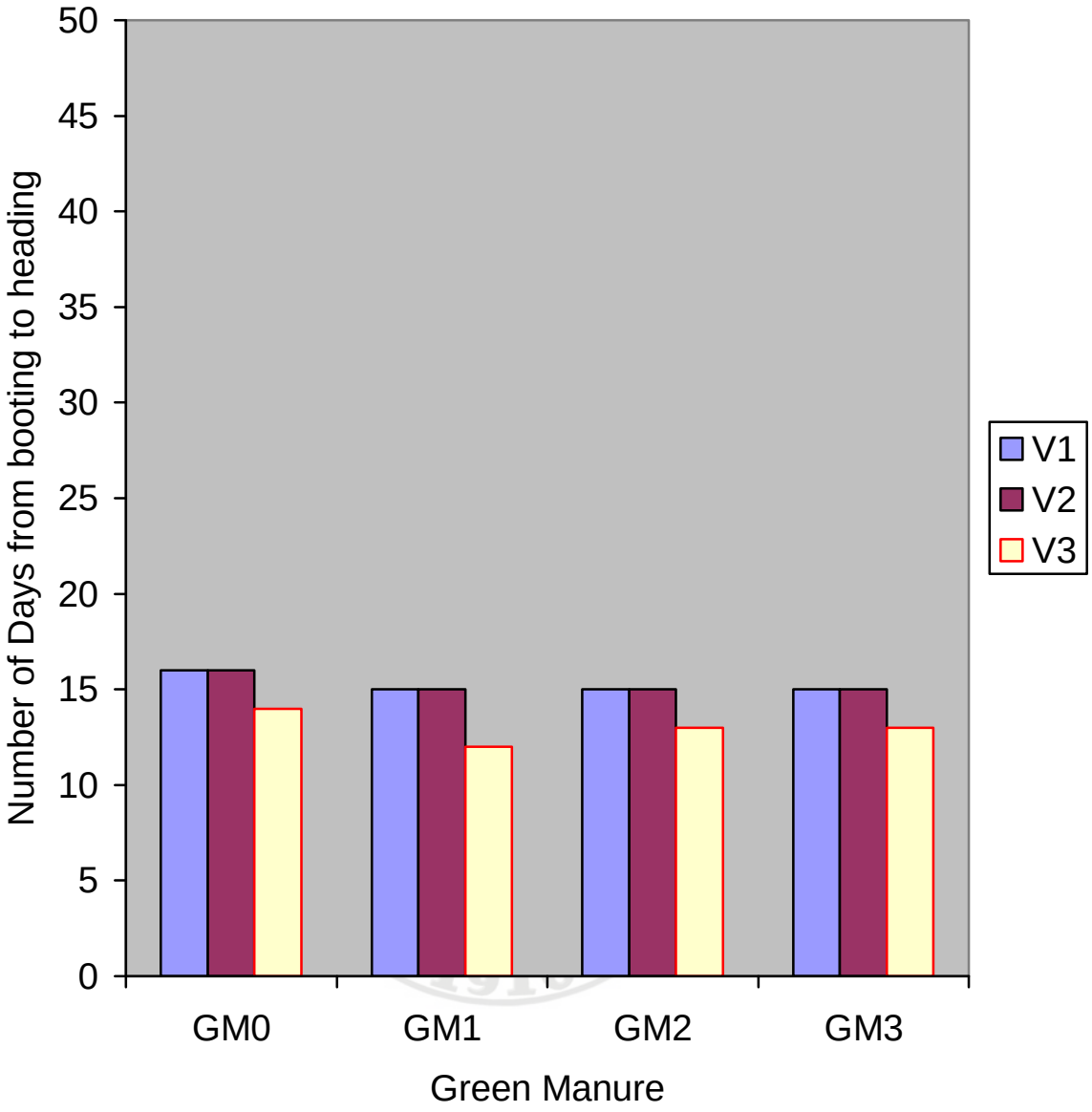
*Means with the same letters are not significantly different at 5 % level using DMRT.

Interaction effect. There was no significant interaction effect of rice varieties and green manures used on the number of tillers at maximum tillering stage of rice. According to Yoshida (1981) the tillering performance of rice is related to the nutrient status of the plant that is the more nutrients present, the more tillers to produced. Varieties and green manures had no significant interaction effect on the number of productive tillers (Table 4). In order to produce more tillers according to PhilRice (1991) rice plants need adequate NPK content of the soil. Probably the amount of nutrients supplied by green manures mixed with the soil in plots, were not yet available for rice utilization to produce numerous and productive tillers.

Length of Panicle

Variety. IR 64 and IR 34 recorded longer panicle than PSB Rc 82 (Table 7). Rice plants applied with madre de cacao had the longest panicle of 69.27 cm. It did not significantly differ from the panicle length measured in plants applied with ipil – ipil but significantly different from the length recorded from the plants applied fertilized with sunflower. This could be attributed to better growth and development of rice plants applied with green manures.

Green manure. The plants grown in plots without green manure had the shortest panicle. This goes with the findings of Sung-ag in 1997 that application of organic fertilizer produce longer panicles and due to availability of sufficient NPK from the fertilizer used.



Legend: Variety (V)

V_1 – IR 64
V_2 – IR 34
V_3 – PSB Rc 82

Green Manures (GM)

GM_0 – Control
GM_1 – Sunflower
GM_2 – Madre de cacao
GM_3 – Ipil – ipil

Figure 3. Interaction effect of rice varieties and green manures on number of days from booting to heading

Interaction effect. Different green manures and rice varieties tested in this study did not significantly interact with each other on the length of panicle of rice.

Number of Grains per Panicle

Variety. PSB Rc 82 had the higher number of grains per panicle than both IR 34 and IR 64 (Table 5).

Green manure. Green manure application significantly enhanced the number of grains per panicle. Plants applied with madre de cacao and ipil – ipil recorded the highest number of grains per panicle and the lowest was recorded in plants grown without green

Table 5. Length of panicle and number of grains per panicle of the rice varieties applied with different green manures

TREATMENT	PANICLE LENGTH (cm)	NUMBER OF GRAINS PER PANICLE
Variety (V)		
IR 64	67.11[a]	84[b]
IR 34	68.27[a]	85[b]
PSB Rc 82	65.49[b]	94[a]
Green Manure (GM)		
Control	63.12[c]	82[c]
Sunflower	67.26[b]	87[b]
Madre de cacao	69.27[a]	92[a]
Ipil – ipil	68.18[ab]	91[a]
V x GM	ns	ns
CV (%)	2.66	6.47

*Means with the same letters are not significantly different at 5 % level using DMRT.

manure. This finding indicates that green manure increases grain number per panicle. This confirmed the findings of Donahue (1978), who further stated that fertilizers specially their NPK contents aid in seed formation.

Interaction effect. No significant interaction effect between the green manures used and the varieties of rice tested was noted on the number of grains per panicle of rice.

Yield per Plot and per Hectare

Variety. IR 64 and IR 34 gave comparatively higher yield per plot and per hectare than PSB Rc 82 (Table 6 and Fig. 4). PSB Rc 82 had lower yield because it was affected

Table 6. Grain yield per plot and per hectare of rice varieties applied with green manures

TREATMENT	GRAIN YIELD	
	kg/5m^2	t/ha
Variety (V)		
IR 64	2.42[a]	4.84a
IR 34	2.38[a]	4.76[a]
PSB Rc 82	2.10[b]	4.20[b]
Green Manure (GM)		
Control	1.90[d]	3.80[d]
Sunflower	2.41[b]	4.82[b]
Madre de cacao	2.66[a]	5.32[a]
Ipil – ipil	2.24[c]	4.48[c]
V x GM	ns	ns
CV (%)	3.99	3.99

*Means with the same letters are not significantly different at 5 % level using DMRT.

by rice blast and had the lowest number of productive tillers.

Green manure. Green manure application increased the grain yield per plot and per hectare of rice. The plants without green manure produced the lowest yield per plots and per hectare. The plants applied with madre de cacao recorded the highest yield per plot and per hectare. Plants applied with sunflower and ipil-ipil produced higher yield than the plants grown in plots without green manure.

Interaction effect. The different kinds of green manures and varieties of rice tested did not have significantly interaction effect on the grain yield of rice (Table 6).

Resistance to Lodging, Stemborer and Rice Blast

All varieties used were resistant to lodging. The plants grown without green manure were noted to have moderately resistance to lodging while plants with different green manures were all rated resistant to lodging.

Similarly, all the HYV's used were resistance to whiteheads caused by stemborer and rice blasts. Green manures did not significantly affect resistance of rice to stemborer and rice blast. Furthermore, there was no significant interaction effects of HYV's and green manures on lodging, stemborer and rice blast of rice.

Cost and Return analysis

IR 64 gave the highest gross income of 60.50 with a total expenses of 35.00 and a net income of P25.50. the PSB Rc 82 registered the lowest with P 52.50 gross income and a net income of P17. 50. A positive return on cash expenses (ROCE) was observed in All the varieties tested. IR 64 obtained the highest ROCE of 72.86% and PSB Rc 82 had the lowest ROCE of 50.00% (Table 7).

Figure 4. Grains of the rice varieties applied with different green manures

A positive ROCE was noted in rice grown in plots without green manure and in plots with madre de cacao. Negative net income and ROCE were noted in plants applied with sunflower and ipil – ipil as green manures. This is due to lower yield and high of production cost increased like in the plots without green manure which had the lowest yield and low cost of production so it gave highest ROCE.

Table 7. Return on cash expense (ROCE) of rice varieties applied with different green manures

TREATMENT	YIELD PER PLOT (kg)	GROSS INCOME (PhP)	COST OF PRODUCTION (PhP)	NET INCOME (PhP)	ROCE (%)
Variety (V)					
IR 64	2.42	60.50	35.00	25.50	72.86
IR 34	2.38	59.50	35.00	24.50	70.00
PSB Rc 82	2.10	52.50	35.00	17.50	50.00
Green Manure (GM)					
Control	1.90	47.50	35.00	12.50	35.71
Sunflower	2.41	60.25	65.50	-5.25	-8.02
Madre de cacao	2.66	66.50	65.50	1.00	1.53
Ipil – ipil	2.24	56.00	65.50	-9.50	-14.50

* Note: The selling price of rice grains is based on P25.00 per kilo

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted to evaluate the response of high yielding varieties (HYV's) of rice to green manuring; to determine the effect of green manure on the growth and yield of HYV's of rice to determine the interaction effect of variety and green manure on the growth and yield of rice; and to determine the profitability of growing HYV's of rice applied with green manures in Tuba, Benguet.

Based on the result of the study, the rice varieties tested were significantly different in all the parameters studied. IR 64 had the tallest seedling before transplanting, highest number of productive tillers and highest grain yield per plot and hectare. IR 34 was the tallest at harvest and had longest panicle, and latest to produce tillers, to boot and to ripen. PSB Rc 82 had the highest number of grains per panicle and was the earliest to mature. IR 64 and IR 34 could be grown because of their good growth and yield in Tuba, Benguet.

Significant differences among the green manures used were observed on the days to tillering and to booting, days from booting to heading, and days from heading to ripening, number of tillers at maximum tillering stage, number of productive tillers, length of panicle, height at maturity, grains per panicle and grain yield per plot and per hectare. Plants applied with madre de cacao had the tallest seedling before transplanting, tallest plant at maturity, longest panicle and highest number of grains per panicle and grain yield. Plants applied with sunflower were the earliest to boot and to ripen. Plants applied with ipil-ipil had the highest number of tillers. The unfertilized plants were the earliest to produce tillers, to boot but latest to ripen, and gave the lowest grains per

panicle and grain yield. Among the green manures applied, madre de cacao was the best because it gave the highest yield. Green manuring could play an important role to promote favorable soil properties and provides nutrition to the rice plant for a sustainable rice production.

Significant interaction effect of variety and green manure was observed on the number of days from transplanting to booting, number of days from booting to heading and on the height at maturity.

Conclusions

Based on the results of the study, IR 64 and IR 34 are the most responsive HYV's to green manuring because they exhibited good growth and high grain yield.

The different fertilizers applied significantly affect the number of days from transplanting to tillering, booting and ripening, number of days from booting to heading, plant height at maturity, number of tillers at maximum tillering stage, number of productive tillers, length of panicle, number grains per panicle and yield per plot and computed yield per hectare.

High yielding varieties of rice and green manures had significant interaction effect on maturity and plant height of rice at harvest.

Recommendations

Based on the results of the study, IR 64 and IR 34 could be grown in Tuba, Benguet due to their relatively higher tillers and number of grains per panicle and grain yield. They were also found to be resistant to stemborer and rice blast. Green manures

like madre de cacao could also be used by the farmers in Tuba as substitute to inorganic fertilizers to realize higher return on cash expenses.

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APPENDICES

APPENDIX Table 1. Height of seedling (cm) before transplanting of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	20.06	27.44	27.07	83.57	27.86
GM_1	28.15	27.90	27.01	83.06	27.69
GM_2	28.20	28.00	27.90	83.10	27.70
GM_3	27.90	27.00	28.10	83.00	27.67
V_2GM_0	28.80	27.00	26.90	82.70	27.57
GM_1	27.40	27.40	26.00	80.80	26.93
GM_2	26.90	28.00	27.90	82.80	27.60
GM_3	27.14	27.00	28.00	82.14	27.38
V_3GM_0	26.88	26.34	25.49	78.71	26.24
GM_1	26.78	26.00	26.90	79.68	26.56
GM_2	27.00	27.00	26.90	80.50	26.83
GM_3	28.00	27.15	26.50	81.65	27.22
TOTAL	108.66	106.49	105.79	320.54	106.85

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	27.86	27.69	27.70	27.67	110.92	27.73
IR34	27.57	26.93	27.60	27.38	109.48	27.37
PSB Rc 82	26.24	26.56	26.83	27.22	108.85	26.71

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F 5%	TABULAR F 1%
Block	2	2.6402	1.3201			
V	2	6.8838	3.4419	8.84**	3.44	5.72
GM	3	1.1953	0.3984	1.02^{ns}	3.05	4.82
V x GM	6	1.6078	0.2680	0.69^{ns}	2.55	3.76
Error	22	8.5694	0.3895			
Total	35					

**- highly significant
ns- not significant

Coefficient of Variance (CV) = 2.29%

APPENDIX Table 2. Number of days from transplanting to tillering of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	25	25	25	75	25
GM_1	23	23	23	69	23
GM_2	24	24	24	72	24
GM_3	24	24	24	72	24
V_2GM_0	25	25	25	75	25
GM_1	24	24	24	72	24
GM_2	24	24	24	72	24
GM_3	24	24	24	72	24
V_3GM_0	23	23	23	69	23
GM_1	22	22	22	66	22
GM_2	22	22	22	66	22
GM_3	23	23	23	69	23
TOTAL	283	283	283	849	283

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	25	23	24	24	96	24
IR34	25	24	24	24	97	24.25
PSB Rc 82	23	22	22	23	90	22.50

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F 5%	TABULAR F 1%
Block	2	1.8955	0.9478	3.97		
V	2	25.3472	12.6736	53.10**	3.44	5.72
GM	3	29.4455	9.8152	41.12**	3.05	4.82
V x GM	6	2.9128	0.4855	2.03ns	2.55	3.76
Error	22	5.2511	0.2387			
Total	35	64.8522				

**- highly significant
ns- not significant

Coefficient of Variance (CV) = 3.02%

APPENDIX Table 3. Number of days from transplanting to booting of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	55	55	55	165	55
GM_1	54	54	54	162	54
GM_2	54	54	54	162	54
GM_3	54	54	54	162	54
V_2GM_0	55	55	55	165	55
GM_1	53	54	53	160	53.33
GM_2	54	54	54	165	54
GM_3	54	53	54	161	53.67
V_3GM_0	52	52	52	156	52
GM_1	51	51	51	153	51
GM_2	51	52	51	154	51.33
GM_3	52	51	52	155	51.67
TOTAL	630	630	630	1917	630

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	55	54	54	54	217	54.25
IR34	55	53.33	54	53.67	216	54
PSB Rc 82	52	51	51.33	51.67	206	51.50

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	0.0000	0.0000			
V	2	40.5000	20.2500	99999.99**	3.44	5.72
GM	3	9.0000	3.0000	99999.99**	3.05	4.82
V x GM	6	1.5000	0.2500	99999.99**	2.55	3.76
Error	22	0.0000	0.0000			
Total	35	51.0000				

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 0%

APPENDIX Table 4. Number of days from booting to heading of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	16	16	16	48	16
GM_1	15	15	15	45	15
GM_2	15	15	15	45	15
GM_3	15	15	15	45	15
V_2GM_0	16	16	16	48	16
GM_1	15	15	15	45	15
GM_2	15	15	15	45	15
GM_3	15	15	15	45	15
V_3GM_0	14	14	14	42	14
GM_1	12	12	12	36	12
GM_2	13	13	13	39	13
GM_3	13	13	13	39	13
TOTAL	174	174	174	522	174

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	16	15	15	15	61	15.25
IR34	16	15	15	15	61	15.25
PSB Rc 82	14	12	13	13	52	13

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F 5%	TABULAR F 1%
Block	2	0.1667	0.0833	1.00		
V	2	152.0000	76.0000	912.00**	3.44	5.72
GM	3	29.0000	9.6667	116.00**	3.05	4.82
V x GM	6	4.0000	0.6667	8.00**	2.55	3.76
Error	22	1.8333	0.0833			
Total	35	187.0000				

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 0.32%

APPENDIX Table 5. Number of tillers at maximum tillering stage of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	15.0	14.7	16.3	46	15.33
GM_1	16.8	17.2	17.3	51.3	17.1
GM_2	17.0	18.1	16.9	52.0	17.33
GM_3	16.9	17.0	16.7	50.6	16.87
V_2GM_0	15.3	15.0	16.2	46.5	15.5
GM_1	16.0	16.8	17.3	50.1	16.7
GM_2	17.1	17.8	16.9	51.8	17.27
GM_3	18.1	17.9	18.0	54.0	18.0
V_3GM_0	13.2	13.1	12.9	39.2	13.07
GM_1	14.5	16.0	15.9	46.4	15.47
GM_2	15.0	15.8	16.1	46.9	15.63
GM_3	15.3	16.2	15.9	47.4	15.8
TOTAL	190.2	195.6	196.4	582.2	194.07

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	15.33	17.10	17.33	16.78	66.54	16.64
IR34	15.50	16.70	17.27	18.00	67.47	16.88
PSB Rc 82	13.07	15.47	15.63	15.80	59.97	15.00

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	0.8089	0.4044	0.57		
V	2	2.1505	1.0753	1.50ns	3.44	5.72
GM	3	8.7222	2.9074	4.06*	3.05	4.82
V x GM	6	5.3694	0.8949	1.25ns	2.55	3.76
Error	22	15.7378	0.7153			
Total	35	32.7889				

**- highly significant
ns- not significant

Coefficient of Variance (CV) = 8.49%

APPENDIX Table 6. Number of productive tillers of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	8.6	8.1	8.9	25.6	8.53
GM_1	10.3	9.6	8.4	28.3	9.43
GM_2	11.4	10.7	9.3	31.4	10.47
GM_3	9.8	10.4	10.0	30.2	10.07
V_2GM_0	9.3	9.9	9.2	28.4	9.47
GM_1	10.6	9.7	10.0	30.3	10.1
GM_2	9.7	10.7	10.3	30.7	10.23
GM_3	12.3	9.1	11.7	33.1	11.03
V_3GM_0	8.8	10.0	9.7	28.5	9.5
GM_1	12.1	10.4	9.7	32.2	10.73
GM_2	8.7	9.6	10.0	28.3	9.43
GM_3	10.4	10.2	10.8	31.4	10.47
TOTAL	122.0	118.4	118.0	358.4	119.46

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	8.53	9.43	10.47	10.07	38.50	9.63
IR34	9.47	10.10	10.23	11.03	40.83	10.21
PSB Rc 82	9.50	10.73	9.43	10.47	40.13	10.03

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	0.0555	0.0278	0.19		
V	2	57.5555	28.7778	193.15**	3.44	5.72
GM	3	7.2222	2.4074	16.16**	3.05	4.82
V x GM	6	1.1111	0.1852	1.24ns	2.55	3.76
Error	22	3.2778	0.1490			
Total	35	69.2222				

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 0.72%

APPENDIX Table 7. Number of days from transplanting to ripening of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	93	93	93	279	93
GM_1	92	92	92	276	92
GM_2	90	90	90	270	90
GM_3	91	91	91	273	91
V_2GM_0	95	95	95	285	95
GM_1	93	93	93	279	93
GM_2	93	93	93	279	93
GM_3	93	93	93	279	93
V_3GM_0	90	90	90	270	90
GM_1	88	88	88	264	88
GM_2	89	87	88	264	88
GM_3	88	88	88	264	88
TOTAL	1095	1093	354	3282	1094

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	93	92	90	91	366	91.5
IR34	95	93	93	93	374	93.3
PSB Rc 82	90	88	88	88	354	88.5

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	0.1667	0.0833	0.26		
V	2	51.5000	25.7500	79.05**	3.44	5.72
GM	3	5.1944	1.7315	5.32**	3.05	4.82
V x GM	6	5.1944	0.1204	0.37ns	2.55	3.76
Error	22	7.1667	0.3258			
Total	35	64.7500				

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 2.87%

APPENDIX Table 8. Length of panicle (cm) of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	19.15	19.45	19.15	57.75	19.25
GM_1	20.48	21.31	21.57	63.36	21.12
GM_2	21.55	22.57	21.19	65.31	21.77
GM_3	22.35	21.08	21.49	64.92	21.64
V_2GM_0	19.90	20.26	19.95	60.11	20.04
GM_1	20.65	21.57	21.45	63.67	21.22
GM_2	21.35	22.00	21.45	64.80	21.60
GM_3	22.15	20.46	21.49	64.10	21.37
V_3GM_0	19.65	20.80	19.61	60.06	20.02
GM_1	21.51	21.05	21.16	63.67	21.24
GM_2	20.81	21.26	21.33	63.40	21.13
GM_3	21.64	21.92	21.75	65.31	21.77
TOTAL	251.19	234.28	251.59	756.51	251.17

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	19.25	21.12	21.77	21.64	83.78	20.95
IR34	20.04	21.22	21.60	21.37	84.23	21.06
PSB Rc 82	20.02	21.24	21.13	21.77	84.16	21.04

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	7.4955	3.7478	1.18		
V	2	46.6239	23.3119	7.33**	3.44	5.72
GM	3	194.5755	64.8585	20.39**	3.05	4.82
V x GM	6	26.8161	4.4693	1.41**	2.55	3.76
Error	22	69.9778	3.1808			
Total	35	345.4889				

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 2.66%

APPENDIX Table 9. Plant height (cm) at maturity of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	64.70	64.00	61.10	189.80	63.27
GM_1	67.00	68.60	68.40	204.00	68.00
GM_2	71.20	68.30	68.20	207.70	69.23
GM_3	67.40	68.00	68.40	203.80	67.93
V_2GM_0	65.10	65.30	65.10	195.50	65.17
GM_1	66.40	67.10	66.20	199.70	66.57
GM_2	77.70	68.50	68.10	214.30	71.43
GM_3	69.70	70.70	69.30	209.70	69.90
V_3GM_0	60.20	61.2	61.4	182.8	60.93
GM_1	67.2	67.3	67.1	201.6	67.2
GM_2	67.1	67.3	67.0	201.4	67.13
GM_3	66.3	67.5	66.3	200.1	66.7
TOTAL	810	803.8	796.6	2410.4	803.47

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	63.27	68.00	69.23	67.93	268.43	67.11
IR34	65.17	66.57	71.43	69.90	273.07	68.27
PSB Rc 82	60.93	67.20	67.13	66.70	261.96	65.49

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	59.6317	29.8158	2.18		
V	2	10.1267	5.0633	0.37ns	3.44	5.72
GM	3	543.9411	181.3137	13.27**	3.05	4.82
V x GM	6	235.5889	39.2648	2.87*	2.55	3.76
Error	22	300.6417	13.6655			
Total	35	1149.9300				

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 4.32%

APPENDIX Table 10.Number of grains per panicle of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	81.2	67.4	79.4	228.0	76.0
GM_1	85.6	84.1	83.0	252.7	84.33
GM_2	90.0	89.9	88.7	268.6	89.53
GM_3	89.6	86.0	88.1	263.7	87.9
V_2GM_0	81.4	79.0	80.2	240.6	80.2
GM_1	84.0	84.0	80.9	248.9	82.97
GM_2	88.6	89.0	89.4	267.0	89.0
GM_3	87.8	86.9	88.7	263.4	87.8
V_3GM_0	94.3	88.6	86.4	269.3	89.77
GM_1	95.3	94.0	94.2	283.5	94.5
GM_2	98.0	97.6	95.1	290.7	96.9
GM_3	96.2	94.4	97.8	288.4	96.13
TOTAL	1072.0	1040.9	1051.9	3164.8	1055.03

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	76.00	84.33	89.53	87.90	337.76	84.44
IR34	80.20	82.97	89.00	87.80	339.97	85.00
PSB Rc 82	89.77	94.5	96.90	96.13	377.30	94.33

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F 5%	TABULAR F 1%
Block	2	41.4506	29.7253			
V	2	742.4672	371.2336	59.06^{ns}	3.44	5.72
GM	3	522.2889	174.0963	27.70**	3.05	4.82
V x GM	6	50.4461	8.4077	1.34^{ns}	2.55	3.76
Error	22	138.2828	6.2856			
Total	35					

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 2.85%

APPENDIX Table 11.Yield per plot (kg) of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	2.0	2.15	1.90	6.05	2.02
GM_1	2.50	2.65	2.50	7.65	2.55
GM_2	2.75	2.80	2.80	8.35	2.78
GM_3	2.45	2.40	2.10	6.95	2.32
V_2GM_0	1.95	2.0	1.90	5.85	1.95
GM_1	2.65	2.50	2.60	7.75	2.58
GM_2	2.80	2.65	2.65	8.10	2.70
GM_3	2.40	2.35	2.10	6.85	2.28
V_3GM_0	1.75	1.80	1.65	5.20	1.73
GM_1	2.05	2.05	2.15	6.25	2.08
GM_2	2.45	2.50	2.50	7.45	2.48
GM_3	2.15	2.05	2.15	6.35	2.12
TOTAL	27.9	27.9	27.0	82.9	27.59

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	2.02	2.55	2.78	2.32	9.67	2.42
IR34	1.95	2.58	2.70	2.28	9.51	2.38
PSB Rc 82	1.73	2.08	2.48	2.12	8.41	2.10

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	0.0450	0.0225			
V	2	0.6988	0.3494	41.55**	3.44	5.72
GM	3	2.7117	0.9039	107.49**	3.05	4.82
V x GM	6	0.1146	0.0191	2.27^{ns}	2.55	3.76
Error	22	0.1850	0.0084			
Total	35					

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 3.99%

APPENDIX Table 12. Computed grains yield per hectare (t) of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	1.33	1.43	1.27	4.03	1.34
GM_1	1.67	1.77	1.67	5.11	1.70
GM_2	1.83	1.87	1.87	5.57	1.86
GM_3	1.63	1.60	1.40	4.63	1.54
V_2GM_0	1.30	1.33	1.27	3.90	1.30
GM_1	1.77	1.67	1.73	5.17	1.72
GM_2	1.87	1.77	1.77	5.41	1.80
GM_3	1.60	1.57	1.40	4.57	1.52
V_3GM_0	1.17	1.20	1.10	3.47	1.16
GM_1	1.37	1.37	1.43	4.17	1.39
GM_2	1.63	1.67	1.67	4.97	1.66
GM_3	1.43	1.37	1.43	4.23	1.41
TOTAL	18.60	18.62	18.01	55.23	18.40

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	1.34	1.70	1.86	1.54	6.44	1.61
IR34	1.30	1.72	1.80	1.52	6.34	1.59
PSB Rc 82	1.16	1.39	1.66	1.41	5.62	1.41

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	0.0200	0.0100			
V	2	0.3116	0.1558	42.86**	3.44	5.72
GM	3	1.2157	0.4052	111.47**	3.05	4.82
V x GM	6	0.0507	0.0885	2.32^{ns}	2.55	3.76
Error	22	0.0800	0.0036			
Total	35					

** - highly significant Coefficient of Variance (CV)= 3.93%

APPENDIX Table 13. Reaction to stemborer of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	1	2	3	6	2.0
GM_1	1	2	1	4	1.33
GM_2	2	1	2	5	1.67
GM_3	3	1	2	6	2.0
V_2GM_0	2	2	1	5	1.67
GM_1	1	3	2	6	2.0
GM_2	2	1	2	5	1.67
GM_3	1	2	2	5	1.67
V_3GM_0	2	2	1	5	1.67
GM_1	1	2	3	6	2.0
GM_2	2	3	2	7	2.33
GM_3	1	3	2	6	2.0
TOTAL	19	24	23	67	22.33

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	2.0	1.33	1.67	2.0	7.0	1.75
IR34	1.67	2.0	1.67	1.67	7.01	1.75
PSB Rc 82	1.67	2.0	2.33	2.0	8.0	2.0

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	1.1667	0.5833			
V	2	0.5000	0.2500	0.41^{ns}	3.44	5.72
GM	3	0.1111	0.0370	0.06^{ns}	3.05	4.82
V x GM	6	1.7222	0.2870	0.47^{ns}	2.55	3.76
Error	22	13.5000	0.6136			
Total	35					

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 42.73%

APPENDIX Table 14. Reaction to rice blast of rice varieties applied with different green manures

TREATMENT	BLOCK(S)			TOTAL	MEAN
	I	II	III		
V_1GM_0	3	2	1	6	2.0
GM_1	2	1	2	5	1.67
GM_2	1	2	3	6	2.0
GM_3	2	1	1	4	1.33
V_2GM_0	3	1	2	6	2.0
GM_1	2	1	2	5	1.67
GM_2	1	1	2	4	1.33
GM_3	1	2	1	4	1.33
V_3GM_0	1	2	1	4	1.33
GM_1	3	1	2	6	2.0
GM_2	1	1	2	4	1.33
GM_3	2	1	1	4	1.33
TOTAL	22	16	20	58	19.33

TWO - WAY TABLE

TREATMENT	CONTROL	SUNFLOWER	MADRE DE CACAO	IPIL-IPIL	TOTAL	MEAN
IR 64	2.0	1.67	2.0	1.33	7.0	1.75
IR34	2.0	1.67	1.33	1.33	6.33	1.58
PSB Rc 82	1.33	2.0	1.33	1.33	6.0	1.50

ANALYSIS OF VARIANCE

SOURCES OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Block	2	1.5556	0.7778			
V	2	0.3889	0.1944	0.36^{ns}	3.44	5.72
GM	3	1.2222	0.4074	0.76^{ns}	3.05	4.82
V x GM	6	1.6111	0.2685	0.50^{ns}	2.55	3.76
Error	22	11.7778	0.5354			
Total	35					

** - highly significant
ns- not significant

Coefficient of Variance (CV) = 45.41%