BIBLIOGRAPHY

TOMIN, SORIEL HAZAN APRIL 2011. On Farm Trial of Glutinous Traditional Rice Varieties *(Oryza Sativa L.)* in Kapangan, Benguet. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The ten different varieties of glutinous rice varieties were evaluated to identify the best varieties with the highest yield and resistance to pest and to determine the profitability of growing the ten glutinous rice varieties under Belingbelis, Kapangan, Benguet.

Based on the results, Diket Red was the highest yielder and was the most profitable. All the varieties were resistant to stem borer and blast.

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INTRODUCTION

Rice (*Oryza sativa L.)* is one of the most important agricultural crops produced for human consumption. In fact, 95 percent of rice production in the world is found in Asia (Evenson *et al*., 1996).

In Benguet, most of the underutilized land have been converted to paddy or planted to perennial crops and only a few areas are continuously planted to upland traditional rice (CECAP and PhilRice, 2000). Production of traditional varieties of rice is beneficial due to the following characteristics namely: resistance to several insect pest and diseases, adapted to low temperature, low fertilizer requirements, good eating quality and market price (CECAP and PhilRice, 2002).

However, previous studies on traditional rice production observed that production of traditional rice is slow and decreasing due to the introduction of high yielding varieties to the highland farmers. The introduction of modern rice varieties may result in diversity loss of glutinous traditional rice. Furthermore, traditional rice is still preferred by some of the local consumers and used in some of their rituals.

The growing demand of glutinous rice in the US has also encouraged more farmers to propagate and go into commercial production of various native varieties of rice in the different provinces in the Cordillera region. Such a move not only helps in a bid to preserve the centuries old deteriorating rice terraces but it would bring forth a good source of income and livelihood to farmers in the region. With the increasing demand of the native rice varieties in the world market that fetches a buying price of $5 to $10 per kilo, it could be a substantial income for the farmers in augmenting their meager income (Cafe, 2010).

Due to the potential of glutinous rice in the region and its importance to the local economy as a source of income, a concerted drive should be done to evaluate the growth and yield of traditional rice varieties (Rottger, 1992).

The objectives of the study were to:

1. determine the growth and yield of the ten glutinous traditional rice varieties in Kapangan, Benguet;

2. identify the best glutinous rice varieties based on its performance and resistance to pests; and

3. determine the profitability of growing the different glutinous traditional rice variety

The experiment was conducted at BelingBelis, Kapangan, and Benguet from September to January 2011.

REVIEW OF LITERATURE

Importance to Rice to the Economy

Rice production and consumption are positively associated with low income and poverty of the 23 countries in the world that produce more than one million tons of rice. Almost half have a per capita income of less than 500 dollars. These are countries categorized by the World bank as the least developed. Rice is one of the cheapest sources food energy and their main source of protein. As income increases, people demand relatively by higher quality food, and resources are shifted from production of rice production of other food and non farm goods with high income elasticity demand. The importance of rice to national economy further dwindles as agriculture's shares in the national income decline with a faster growth in non farm incomes. Increasing productivity of rice sector however is an important means of raising the purchasing capacity of the poor and alleviation of poverty in low income countries (Evenson *et al*., 1996).

Rice has always been one of the most important foods in the world. It is estimated that 40 percent of the world population takes rice as a major sources of food; 1.6 Billion people in Asia takes rice as their mainstay food. Rice is produced in 111 countries in the world. The region with high population density and the most rapid population growth produce and consume the most rice. Furthermore, rice is the staple food for more than half of the world's population in Asia alone. Most of the consumers who depend on rice as their primary food live less developed countries. It is foreseen that the world's population may exceed 8 billion by 2025 and will need about 765 million tons of rice, 70 percent than what we consume today (Nanda, 2000).

Challenges in Rice Production

The Unites Nations recent population projected indicates that each year almost 80 Million people are likely to be added to the world's population during the next quarter century. The world population would increase by 35 percent from 35 billion 1995 to 7.67 billion by 2020. The population increase ill more than 45 percent in developing countries. Over the period, the absolute population increases will e at highest in Asia, but the relative increased will be greatest in sub-saharan dessert Africa, where population is expected to almost double (Evenson *et al*., 1996).

Currently, Asian rice production increase at an annual rate of only 1.4 percent, which is below the population growth rate. By the year 2025, we need to produce about 60 percent more rice than what we produced today to meet the growing demand. About 70 percent of the additional production will have to come from irrigated riceland and 20 percent from the favorable rain-fed lowland which was already extensively cultivated. Further, intensification of their riceland must be pursued against the backdrop of shrinking land area and decreasing availability and increasing cost of production input, water, fertilizer, chemical, labor and energy (Balasubramanian, 1999).

Importance of Grain Quality of Rice

It is very difficult to define with precision as preferences for quality vary from country to country. Few people realize its complexity and various quality components are involved. The concept of quality varies according to the preparation for which the grains are to be used. Although some of the desired quality characteristics by grower; millers and consumers may be the same yet each may place different emphasis on various quality characteristics. For instance, the miller's basis of quality is dependent upon total recovery and proportion of the head and broken rice on milling. Consumers based their concept of quality on the grain appearance, size and shape of the grains, the behavior upon cooking, the taste, tenderness, and flavor of the cook rice (Singh and Khush, 2000).

Temperature Requirement

Cool temperature, little sunshine condition prevailing in the Cordillera generally results in low rice yield. Average rice yield in the region is currently placed at 2.1 tons per hectare. Planting during wet season usually results to sterility of the spikelets (CECAP and PhilRice, 2000).

Pest Control Management

Integrated Pest Management (IPM) can make a contribution to environmental sensitive farming. Using GM or conventional crops with resistance to pest are an important part of IPM. Rotation of cultivars with different patterns of resistance is necessary to manage pest damage at the farm (Sheely *et al.*, 2000).

Importance of Varietal Evaluation

Varietal evaluation is important to observe performance characters which yield, earliness, vigor, maturity and quality because varieties has a wide range of differences of a plant in size and yield performance (Work and Carew, 1995). Furthermore, PRRI (1993) stated that varietal evaluation is an important in agro-ecology that stabilize the yield at a higher level that facilitates the production of efficient qualities of seed recommended varieties and encourage further seed increase for the farmer use.

High yielding and improve cultivars are known to play an important role in boosting production. Large number of indigenous and exotic accessories of various plants is evaluated and the number of cultivars are selected and recommended for mass growing (Bitaga, 2002).

MATERIALS AND METHODS

An area of 150 square meters was thoroughly cleaned and prepared (Figures 1 to 4). The area was divided into three blocks consisting of ten seedbeds each measuring 1m x 5m. The experiment was laid out using Randomized Complete Block Design (RCBD).

The varieties used in the study were selections from a previous experiment done in Kapangan Benguet. The following varieties were:

Variety	Source
Balatinaw	Kabayan
Balatangi	Sablan
Bayabas	Kapangan
Diket Red	Kabayan
Kinwoman	Kibungan
Lasbakan	Kibungan
Lablabi	Kibungan
Makabsog	Sablan
Muri	Kapangan
Luk-ab	Sablan

One cultivar was transplanted in each seed bed to avoid mixture of the different varieties. The seedlings were planted on the straight line spacing of 20 cm x 20 cm.

All recommended management practices for rice were uniformly followed in all treatments such as weeding and others.

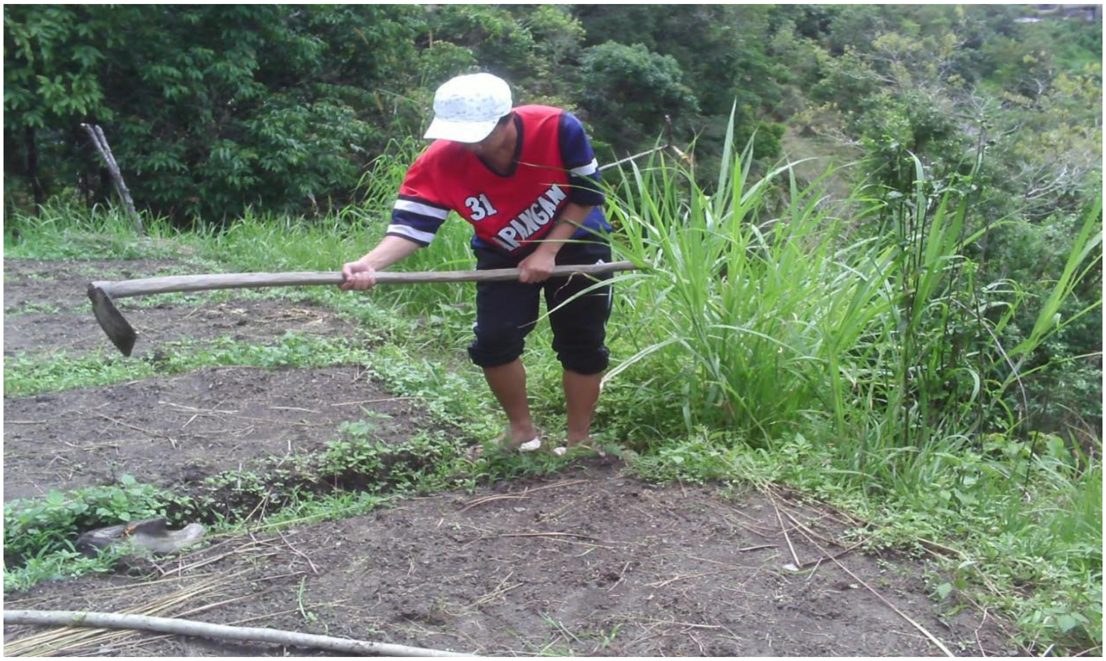

Figure 1. Land preparation and cleaning before sowing

Figure 2. Seeds broadcasted on beds

Figure 3. Rice seedlings before transplanting at the experimental area

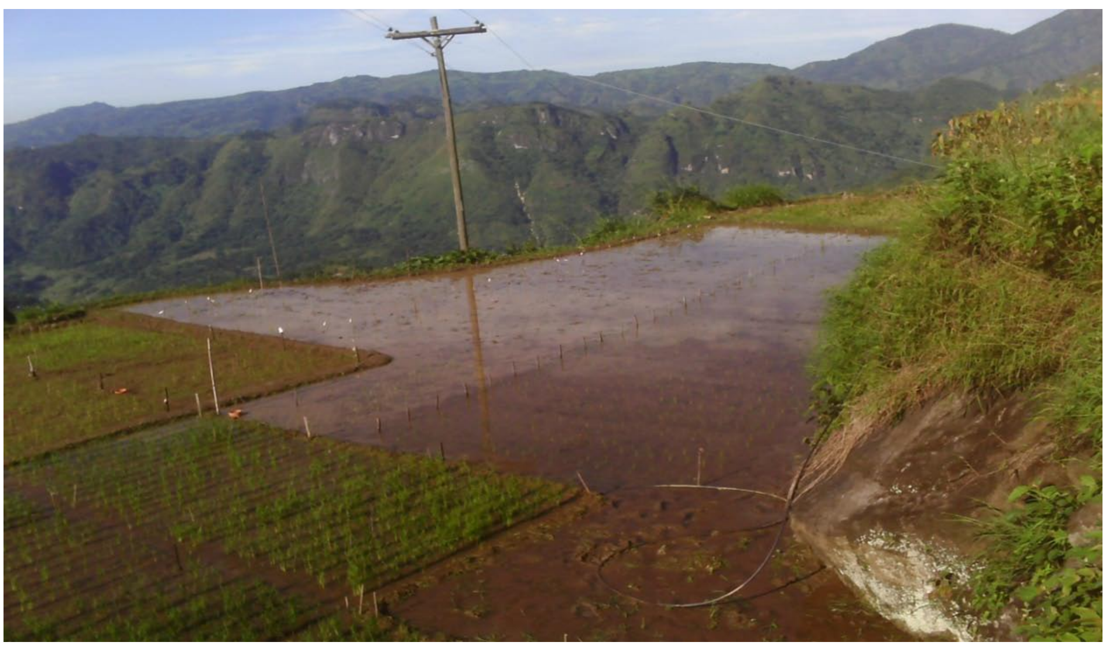

Figure 4. Overview of the experimental area at BelingBelis, Kapangan, Benguet

Data Gathered:

A. Meteorological data. The temperature and relative humidity were taken using a hygrometer. Rainfall was also taken by placing plastic containers within the field to collect water when precipitation occurred. The volume of water collected was measured using a graduated cylinder. Rainfall was recorded by getting the average volume of water from the plastic container. Light intensity was taken using a digital light meter.

B. Agronomic Characters

All ratings used were the rating scales by PhilRice (1996).

1. Plant vigor. This was taken before transplanting using the following scale:

Scale	Description	Remarks
1	Majority of the seedlings have 5 or more leaves with 2-3 tillers	Very vigorous
2	Majorities of the seedlings have 1-5 leaves with 1-2 tillers	Vigorous
3	Most of the seedlings have 4 leaves without tillers	Normal
4	Most of the seedlings have 3-4 leaves without tillers	Weak
5	Most of the seedlings turned yellow and thin	Very weak

2. Seedling height (cm). This was measured from the base of the shoot to the tip of the tallest leaf blade to the nearest cm. Average of ten seedlings was measured before transplanting.

Scale	Remarks
1	Short (<30 cm)
2	Intermediate (~45 cm)
3	Tall (>60 cm)

3. Number of days from planting to tillering. This was taken when 50% of the plants produced tillers.

4. Number of tillers produced. The number of tillers was counted just before booting using ten hills per treatment.

5. Number of productive tillers per hill. The number of productive tillers was counted using 10 hills per treatment selected randomly. Only the plants which produced panicles were considered productive.

6. Number of days from transplanting to booting. This was taken when 50% of the total plants in a plot booted as shown by the swelling of the upper flag leaf sheath.

7. Number of days from heading to ripening. This was taken when at least 80% of the panicles turn yellow.

8. Panicle exertion. This was observed as the extent to which the panicle is exerted above the flag sheath at near maturity. The following rating scale was used:

Scale	Description
1	Enclosed (panicle is partly or entirely enclosed within the leaf sheath of the flag leaf blade)
2	Partly exerted (panicle base is slightly beneath the collar of the flag leaf blade)
3	Just exerted (panicles base coincides with the collar of the flag leaf blade)

Scale	Description
4	Moderately well exerted (panicle base is above the collar of the flag leaf blade)
5	Well exerted (panicle base appears as well above the collar of the flag leaf blade)

9. Number of filled and unfilled grains per panicle. This was recorded from by counting the number of filled and unfilled grains at heading.

10. Height at maturity (cm). This was measured from the base of the plant to the tip at harvesting using 10 samples per plot selected randomly.

11. Harvest index. This was taken from 10 hill samples per treatment by using the formula:

$$\text{Harvest index} = \frac{\text{Weight of Dried Filled Grains}}{\text{Total Weight of Dried Plants with Grains}} \times 100$$

12. Percentage impurities. This was taken by segregating and weighing impurities from 20 grams rice samples. Impurities was counted using the formula:

$$\%\ \text{Impurities} = \frac{\text{Total Weight} - \text{Weight of Types}}{\text{Total Weight (20g)}} \times 100$$

C. Pest and disease incidence

1. Stem borer damage evaluation. Field rating was based on actual number of panicles affected using the three middle of the plot as sampling area. Ten sample hills were selected at random where white heads were counted ten days before harvest. The following standard scale was used (Phil Rice, 1996):

Scale	Description	Rating
1	1- 5 white heads	Resistant
2	6 – 10 white heads	Moderately resistant
3	11- 15 white heads	Intermediate
4	16 – 25 white heads	Moderately susceptible
5	26 and above white heads	Susceptible

2. Blast resistance (neck rot). Evaluation of the severity of rice blast was taken from the plant at the center rows per hill. Ten sample hills were taken randomly. Computation on percent infection was done using the formula (Phil Rice, 1996):

$$\text{\% Infection} = \frac{\text{No. of Panicle Infected}}{\text{Total Number of Panicle}} \times 100$$

Scale	Description	Rating
1	0-5% are affected by blast	Resistant
2	6-25% are affected by blast	Intermediate
3	26% and above are affected by blast	Susceptible

D. Yield and Yield Components

1. Yield per plot (kg). Grain yield per plot was taken after threshing and drying at 14% moisture content (MC) then weighed.

2. 1000 – grain weight (g). Random sample of 1000 well-developed, whole grains, dried to 13% moisture content was weighed on a sensitive balance.

3. Computed yield per hectare. This was taken by converting grain yield per treatment into yield per hectare using the following ratio and proportion:

$$\text{Yield/ha} = \frac{\text{Yield per Plot (kg)}}{\text{Plot size}} \times 10{,}000$$

E. Cost and Return Analysis

1. ROCE. This was the actual expenses during the conduct of the study and computed using the formula:

$$\text{Return on Cash Expense (ROCE):} \quad \frac{\text{Net Income}}{\text{Total Cost Production}} \times 100$$

F. Sensory evaluation. This was taken by distributing a sample of cooked rice which is sealed in small cellophane together with plastic spoon. Each person was given a sample with score sheet to indicate the following. The rating scales for each criteria were as follows:

a. Aroma

Scale	Description
1	Bland taste
2	Slightly perceptible
3	Moderate
4	Strong aroma
5	Very strong aroma

b. Taste

Scale	Description
1	Blunt taste
2	Slightly tasty
3	Moderate tasty
4	Strong perceptible
5	Very strong taste

c. Texture

Scale	Description
1	Very soft
2	Moderately soft
3	Slightly hard
4	Moderately hard
5	Very hard

d. General acceptability

Scale	Description
1	Like very extremely
2	Like very much
3	Like moderately
4	Dislike slightly
5	Neither like nor dislike

Data Analysis

All quantitative data were analyzed using Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD) with three replications. The significance of differences among the treatment means was tested using the Duncan's Multiple Range Test (DMRT).

RESULT AND DISCUSSION

Meteorological Data

Table 1 shows the temperature, relative humidity, amount of rainfall and light intensity from the October to January 2011. It was observed that the temperature ranged from 29.5-31.0°C, relative humidity ranged from 59-79%, and rainfall from 119-683 ml.

The strongest light intensity recorded was on the month of November and followed by October.

In 1997, Rebuelta stated that normal light and high temperature increase the number of tillers while the number of spikelet per plot increases as temperature drops.

Plant Vigor

The plant vigor at seedling stage of the ten glutinous rice was normal and all of the seedling had 4 to 5 leaves with no tillers.

Table 1. Temperature, relative humidity, rainfall and light intensity from October 2010 to January 2011

MONTH	AVERAGE TEMPERATURE (°C)	RELATIVE HUMIDITY MINIMUM (%)	RELATIVE HUMIDITY MAXIMUM (%)	RAINFALL AMOUNT (ml)	LIGHT INTENSITY (Lux)
October	30.00	68.00	75.00	503.00	1315.00
November	30.50	71.00	79.00	683.00	1169.00
December	31.00	59.00	64.00	119.00	854.00
January	29.50	69.00	76.00	313.00	974.00
MEAN	30.25	66.75	73.00	404.50	1078.00

<u>Seedling Height</u>

Significant differences on the seedling height of the ten traditional varieties of rice are observed (Table 2). The seedling was measured from the base to the tip of the longest leaf using a ruler. It was observed that Lablabi significantly produced the tallest seedlings with a mean of 29.87 cm. On the other hand, the shortest seedling was noted from Luk-ab with a height of 19.98 cm. The significant differences among the treatments could be attributed to their varietal characteristics or adaptability to the environment.

Table 2. Seedling height of the ten glutinous rice varieties

VARIETY	SEEDLING HEIGHT (cm)
Balatinaw	26.12^{b}
Balatingi	22.00^{d}
Bayabas	20.62^{de}
Diket Red	23.86^{c}
Kintoman	22.22^{d}
Lasbakan	25.19^{bc}
Lablabi	29.87^{a}
Makabusog	20.98^{de}
Muri	25.11^{bc}
Luk-ab	19.98^{e}
CV (%)	4.05

Means followed by common letters are significantly different at 5 % level of DMRT

Number of Days from Transplanting
to Tillering

The number of days from transplanting to tillering of the ten rice varieties is shown in Table 3. It was observed that Lablabi and Makabsog were the earliest to tiller which is 22 days after transplanting. Tillering in rice is an important agronomic trait for grain production. Dominance of the early-tillers is encouraged to preclude the production of late-tillers (Yoshida, 1981).

Number of Days from
Transplanting to Booting

The number of days from transplanting to booting of the ten rice varieties is shown in Table 3. Kintoman, Lasbakan and Luk-ab booted earlier at 71 days as compared to other varieties that booted later. Muri was latest to boot at 92 days after transplanting. Rice varieties that boot later are more vulnerable to larval infestation of insect pest (Guang, 1980).

Number of Days from
Heading to Ripening

Bayabas, Muri and Luk-ab ripened early at 21days after heading (Table 3). The latest to ripen was Lasbakan and Lablabi at 36 days. The differences among the rice varieties could be attributed to their genetic make-up or adaptability to the environment. (Yoshida, 1981). Early ripening is an advantage to farmers who prefer to harvest their plant earlier also.

Table 3. Numbers of days from transplanting to tillering, transplanting to booting, and heading to ripening of the ten glutinous rice varieties

VARIETY	NUMBER OF DAYS FROM		
	TRANSPLANTNG TO TILLERING	TRANSPLANTING TO BOOTING	HEADING TO RIPENING
Balatinaw	29^{b}	78^{c}	22^{d}
Balatingi	29^{b}	78^{c}	22^{d}
Bayabas	29^{b}	85^{b}	21^{e}
Diket Red	36^{a}	85^{b}	26^{c}
Kintoman	22^{c}	71^{d}	26^{c}
Lasbakan	36^{a}	71^{d}	36^{a}
Lablabi	22^{c}	85^{b}	36^{a}
Makabusog	22^{c}	85^{b}	28^{b}
Muri	29^{b}	92^{a}	21^{e}
Luk-ab	29^{b}	71^{d}	21^{e}
CV (%)	0	0	0

Means followed by common letters are not significantly different at 5 % level of DMRT

Number of Total Tillers

As shown in Table 4, Muri had the highest number of tillers (20) while Balatinaw, Lablabi, and Lasbakan produced only 8 tillers. Not all tillers produced head, some tillers died while others remained at the vegetative stage. This often happens since there is competition among tillers for nutrients and light (UPLB, 1983).

TABLE 4. Number of total and productive tillers and panicle exertion of the ten glutinous rice varieties

VARIETY	NUMBER		PANICLE EXERTION
	TOTAL TILLERS	PRODUCTIVE TILLERS	
Balatinaw	8^{d}	4^{e}	Just exerted
Balatingi	15^{b}	10^{ab}	Moderately well exerted
Bayabas	14^{b}	11^{a}	Just exerted
Diket Red	14^{b}	6^{cde}	Just exerted
Kintoman	9^{d}	5^{cde}	Moderately well exerted
Lasbakan	8^{d}	5^{de}	Just exerted
Lablabi	8^{d}	6^{cde}	Just exerted
Makabsog	13^{b}	9^{abc}	Well exerted
Muri	19^{a}	7^{cde}	Just exerted
Luk-ab	14^{b}	7^{bed}	Moderately well exerted
CV (%)	17.70	23.78	

Means followed by common letters are not significantly different at 5 % level of DMRT

<u>Number of Productive Tillers</u>

Table 4 shows that the highest number of productive tillers was produced by Bayabas with a mean of 11. The production of tillers alone may not be a good gauge of the yield potential of rice (UPLB, 1983).

Panicle Exertion

Results show that among all the varieties evaluated only Makabsog had well exerted panicle which means the panicle base appears well above the collar of the flag leaf blade. The other varieties had just exerted to moderately well exerted panicles. Panicle exertion or the distance between flag leaf and panicle is one important morphological trait of rice that seriously affect the production of seeds in rice (Virmani, 1988).

Number of Filled and Unfilled
Grains per Panicle

No significant differences were observed on the number of filled and unfilled grains of the ten glutinous rice varieties (Table 5). Among the different rice varieties evaluated, Diket Red had the highest number of filled grains (75) while Balatinaw had the lowest filled grains (45). Muri and Bayabas had the highest number of unfilled grains per panicle (25).

Reaction to Stem Borer, Blast
and Birds Infestation

All of the varieties were resistant to stem borer and blast. However, all of the varieties including those with awn were infested by birds.

Table 5. Number of filled grains and unfilled grains of the ten glutinous rice varieties

VARIETY	NUMBER	
	FILLED GRAINS	UNFILLED GRAINS
Balatinaw	45	24
Balatingi	59	23
Bayabas	70	25
Diket Red	75	21
Kintoman	66	15
Lasbakan	63	22
Lablabi	46	25
Makabsog	65	23
Muri	61	25
Luk-ab	72	18
CV (%)	20.10	31.28

Height at Maturity

The height of the ten glutinous rice was measured from the base of the plant to the panicle tip including the awn at harvest (Table 6). Makabsog was the tallest at 126.17 cm while Balatangi was the shortest (103.50 cm). Short varieties usually have high yield (Sachiko, 2010) and are preferred by farmers for ease in harvesting.

Table 6. Height at maturity of the ten glutinous rice varieties

VARIETY	HEIGHT AT MATURITY (cm)
Balatinaw	103.53[e]
Balatingi	103.50[e]
Bayabas	104.47[e]
Diket Red	113.70[c]
Kintoman	109.07[d]
Lasbakan	115.77[c]
Lablabi	109.10[d]
Makabsog	126.17[a]
Muri	113.80[c]
Luk-ab	119.50[b]
CV (%)	1.85

Means followed by common letters significantly different at 5 % level of DMRT

Weight of 1000 Filled Grains

The weight of 1000 filled grains of ten rice varieties is shown in Table 7. It was observed that Muri significantly had the highest weight of 32.48g of 1000 filled grains. The high grain weight of Muri may be attributed to the presence of awns.

Yield per Plot

Statistical analysis showed the highly significant differences on the yield of the ten varieties evaluated (Table 7). Diket Red obtained the highest yield per plot of 573.33g/5m^2. In the previous study done by Tay-eo from 2009-2010 at Kapangan, Bayabas had the highest yield.

Table 7. Weight of 1,000 filled grains, yield per plot, and computed yield per hectare of the ten glutinous rice varieties

VARIETY	WEIGHT OF 1000 FILLED GRAINS (g)	YIELD PER PLOT (g/5m^2)	COMPUTED YIELD PER HECTARE (t/ha)
Balatinaw	23.95^{d}	250.00^{de}	0.50e^{f}
Balatingi	29.45^{b}	312.67^{cd}	0.62^{cde}
Bayabas	20.63^{e}	423.33^{b}	0.85^{b}
Diket Red	26.30^{c}	573.33^{a}	1.15^{a}
Kintoman	25.25^{cd}	279.33^{cde}	0.56^{def}
Lasbakan	20.65^{e}	258.00^{cde}	0.51^{def}
Lablabi	24.38^{cd}	213.00^{e}	0.42^{f}
Makabsog	23.89^{d}	326.33^{cd}	0.65^{cde}
Muri	32.48^{a}	346.67^{bc}	0.69^{bcd}
Luk-ab	21.80^{e}	243.33^{de}	0.49^{bc}
CV (%)	4.58	15.77	15.86

Means followed by common letters are significantly different at 5 % level of DMRT

Computed Yield per Hectare

As shown in Table 7, Diket red produced the highest yield per hectare of 1.15 tons/. This value is still low compared to the 3.63tons/ha expected from traditional rice (PCARRD, 2011). The low yield of all the varieties tested may be attributed to infestation of birds during ripening stage and non- application of any fertilizer.

Return On Cash Expense

Diket red had the highest return on cash expenses (52.86%). Balatinaw, Balatangi, Kintoman, Lasbakan, Lablabi, Makabsog, Muri and Lak-ab had negative ROCE due to low yield and infestation of birds.

Table 8. Cost and return analysis of the ten glutinous rice varieties

VARIETY	YIELD $g/5m^2$	GROSS INCOME (Php)	COST OF PRODUCTION (Php)	NET INCOME (Php)	ROCE (%)
Balatinaw	250.00	20.00	30.00	-10	-33.33
Balatingi	312.67	25.01	30.00	-4.98	-16.6o
Bayabas	423.33	33.86	30.00	3.86	12.86
Diket Red	573.33	45.86	30.00	15.86	52.86
Kintoman	279.33	22.34	30.00	-7.65	-25.50
Lasbakan	258.00	20.64	30.00	-9.36	-31.20
Lablabi	213.00	17.04	30.00	-12.96	-43.20
Makabsog	326.33	26.10	30.00	-3.89	-12.96
Muri	346.67	27.73	30.00	-2.26	-7.53
Luk-ab	243.33	19.46	30.00	-10.53	-35.10

Sensory Evaluation

Aroma. Bayabas and Lablabi had slightly perceptive aroma while the rest of the varieties had moderate aroma. Aroma is the most important quality trait of traditional rice, which differentiates the highly valued aromatic rice from the other rice types (Subha, 2010).

Taste. Kintoman, Lablabi, and Muri had slightly tasty grains while the grains of the other varieties were bland. The taste of traditional rice is identified with the gourmet collection of fine rice meals and ethnically inspired recipes from around the globe (Subha, 2010).

Table 9. Sensory evaluation of the ten glutinous rice varieties

VARIETY	AROMA	TASTE	TEXTURE	GENERAL ACCEPTABILITY
Balatinaw	Moderate	Bland	Very soft	Liked moderately
Balatingi	Moderate	Bland	Moderately soft	Liked moderately
Bayabas	Slightly perceptive	Bland	Very soft	Liked very much
Diket Red	Moderate	Bland	Very soft	Liked very much
Kintoman	Moderate	Slightly tasty	Very soft	Liked moderately
Lasbakan	Moderate	Bland	Moderately soft	Liked very much
Lablabi	Slightly perceptive	Slightly tasty	Very soft	Liked very much
Makabsog	Moderate	Bland	Very soft	Liked moderately
Muri	Moderate	Slightly tasty	Very soft	Liked very much
Luk-ab	Moderate	Bland	Very soft	Liked moderately

Texture. Only Balatangi and Lasbakan have moderately soft grains while the other varieties had very soft grains. Glutinous rice naturally has soft grains that are easily cooked (Subha, 2010).

General acceptability. Bayabas, Diket Red, Lasbakan, Lablabi, and Muri were liked very much by the panelists. These varieties had either very soft grains which were slightly tasty or had moderate aroma.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The plant vigor at seedling stage of the ten varieties was normal. Lablabi produced the tallest seedling while Luk-ab had the shortest. After transplanting, Lablabi and Makabsog were the earliest to tiller and Lasbakan and Diket red were the latest. Kintoman, Lasbakan and Luk-ab were the earliest to boot at 71 days whereas Muri was the latest. The earliest variety to ripen was Bayabas, Muri and Luk-ab at 21 days after heading while Lablabi and Lasbakan took 36 days.

Muri produced the highest number of tillers while Balatinaw and Lablabi produced only 8. But the highest number of productive tillers recorded was from Bayabas. No significant differences were observed on the number of filled and unfilled grains. Diket red had the highest number of filled grains while Balatinaw had the lowest filled grains. Furthermore, Makabsog was the tallest at 126.17 cm while Balatangi was the shortest. All the rice varieties were resistant to stem borer and blast but were infested by birds including those with awn.

Muri had the highest weight of 1000 filled grains followed by Balatangi and Diket Red. The highest total and computed yield was recorded from Balatangi and Diket Red. Diket Red also had the highest return on cash expenses (ROCE).

The cooked grains of the varieties had slightly perceptive to moderate aroma, were bland to slightly tasty, had moderately to very soft grains, and were liked moderately or liked much by panelists.

Conclusion

Based on the results, although Diket Red was the latest to produce tillers, boot, and ripen, it produced the highest yield and ROCE. All of the varieties were resistant to stem borer and blast but only Diket Red and Bayabas had positive ROCE.

Recommendation

Based on the results, Diket Red is recommended for production at Kapangan, Benguet.

Application of fertilizers is also recommended to enhance the yield of Diket Red.

LITERATURE CITED

BALASUBRAMANIAN V., HERDT R.W. and M. HOSSAIN. 1999. Management in Rice System. New York, USA: Kluwer Academic Publisher. P. 1.

BITAGA, J.E. 2002. Paddy Rice Post Harvest Industry in Developing Countries. Laguna: Philrice Research Institute P. 1.

CAFÉ, A. 2010. Native Rice to Save Deteriorating Ifugao Rice Terraces. Retrieved December 2011. From http://affleap.com/native-rice-to-save-deteriorating-ifugao-rice-terraces/.

CENTRAL CORDILLERA AGRICULTURAL PROGAMMED (CECAP) AND PHILPPINES RICE RESEARCH INSTITUTE (PHILRICE). 2000. Highland Rice production in the Philippines. Nueva Ecija: Agricultural program and Philrice research institute. Pp. 5-10.

CENTRAL CORDILLERA AGRICULTURAL PROGAMMED (CECAP) AND PHILPPINES RICE RESEARCH INSTITUE (PHILRICE). 2002. Highland Rice production in the Philippines. Nueva Ecija: Agricultural program and Philrice research institute. P. 44.

EVENSON, R.E 1996. Rice Research in Asia Progress and Priories. USA: Science Publisher Inc. Pp.1-25.

GUANG H.W 1980. Rice improvement in China and other Asian Countries. China: International Rice Research Institute and Chinese Academy of Agricultural Science. P. 37.

NANDA J.S 2000. Rice Breeding and genetic research priorities and challenges. USA: Science publisher Inc. Pp. 1-3.

PHILIPPINES RICE RESEACRH INSTITUTE. 1993. Philippine Rice R and D Highlights. Nueva Ecija: Philrice research institute. Pp 2-3.

PHILIPPINES RICE RESEACRH INSTITUTE. 1996. Philippine rice R and D Highlights. Nueva Ecija: Phil Rice. Pp. 1-13.

PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY and RESOURCE RESEARCH AND DEVELOPMENT. 2011. Short message service. Retrieved march 2011. from www.pcarrd. dost. gov. ph.

ROTTGER U. 1992. Paddy deterioration in the humid tropic. Germany: German agency for technical cooperation. P. 23.

REBUELTA, P.I. 1997. Rice Specialist Training Courch on IPM- Weather, Climate and Rice Production. March 12 1997 Nueva Ecija: PhilRice. Pp. 19-22.

SACHIKO J. 2010. Rice farming. Retrieved March 2011 from: http: //www.ricefarming.com/home /issues/2010-05/2010_MaySS.htmlLouisiana.

SHEELY, J.E., P.L. MITCHEL and J. HARDY, 2000.Redisigning rice photosynthesis to increase yield. Los Baños, Laguna: IRRI. Pp3-4.

SINGH, K. and KHUSH, G.S.2000.Aromatic rice. New Delhi: Oxford and IBH Publishing P 15.

SCHILLER, J.M., M.B.CHANGPENGXAY, B.LIAQUIST, and S.APPARAO.2006. Rice in Laos. Laguna: IRRI. P. 291.

SUBHA, R.S, 2010. Aroma association in Global popular Aromatic rice Cultivars in Tropical Environment. Malaysia: Institute of Biological Science. Pp.1 -14.

UNIVERSITY OF THE PHILIPPINES LOS BANOS. 1983. Rice Production Manual for NFAC-UPLB Country side Action Program.UPLB, Laguna, Philippines. Pp.7-16.

VIRMANI, R. 1988. Rice Research and Development. Laguna: IRRI. P. 11.

WORK and CAREW, J. 1995.Producing Vegetable Crops. The Interstate Printers and Publisher, Inc. Pp. 2, 238.

YOSHIDA, S. 1981. Fundamentals of Rice crop science. Laguna: IRRI. Pp. 30-32, 67-70.

APPENDICES

Appendix Table 1. Plant vigor

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	3	3	3	9	3
Balatingi	3	3	3	9	3
Bayabas	3	3	3	9	3
Diket Red	3	3	3	9	3
Kintoman	3	3	3	9	3
Lasbakan	3	3	3	9	3
Lablabi	3	3	3	9	3
Makabsog	3	3	3	9	3
Muri	3	3	3	9	3
Luk-ab	3	3	3	9	3

Appendix Table 2. Panicle Exertion

	REPLICATION				
VARIETY	I	II	III	TOTAL	MEAN
Balatinaw	3	3	3	9	3
Balatingi	4	4	4	12	4
Bayabas	3	3	3	9	3
Diket Red	3	3	3	9	3
Kintoman	4	4	4	12	4
Lasbakan	3	3	3	9	3
Lablabi	3	3	3	9	3
Makabsog	5	5	5	15	5
Muri	3	3	3	9	3
Luk-ab	4	4	4	12	4

Appendix Table 3. Seedling height (cm)

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	26.10	26.55	25.71	78.36	26.12 [b]
Balatingi	21.37	24.04	20.61	66.02	22.00 [d]
Bayabas	19.76	20.34	21.75	61.85	20.62 [de]
Diket Red	24.92	23.12	23.54	71.58	23.86 [c]
Kintoman	22.11	22.78	21.77	66.66	22.22 [d]
Lasbakan	26.24	24.88	24.46	75.58	25.19 [bc]
Lablabi	30.25	29.33	30.04	89.62	29.87 [a]
Makabsog	21.15	21.46	20.33	62.94	20.98 [de]
Muri	26.10	24.04	25.18	75.32	25.11 [bc]
Luk-ab	21.10	19.19	19.66	59.95	19.98 [e]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	1.836	0.919			
Treatment	9	251.576	27.953	30.62**	2.43	3.52
Error	18	16.433	0.913			
TOTAL	29	269.846				

** Highly significant CV (%) = 4.05

Appendix Table 4. Number of days from transplanting to tillering

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	29	29	29	87	29 [b]
Balatingi	29	29	29	87	29 [b]
Bayabas	29	29	29	87	29 [b]
Diket Red	36	36	36	108	36 [a]
Kintoman	22	22	22	66	22 [c]
Lasbakan	36	36	36	108	36 [a]
Lablabi	22	22	22	66	22 [c]
Makabsog	22	22	22	66	22 [c]
Muri	29	29	29	87	29 [b]
Luk-ab	29	29	29	87	29 [b]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Replication	2	0.001	0.000			
Treatment	9	720.443	80.049	240145.8**	2.46	3.60
Error	18	0.006	0.000			
TOTAL	29					

**-highly significant CV (%) = 0.00%

Appendix Table 5. Number of days from transplanting to booting

	REPLICATION				
VARIETY	I	II	III	TOTAL	MEAN
Balatinaw	78	78	78	234	78 [c]
Balatingi	78	78	78	234	78 [c]
Bayabas	85	85	85	255	85 [b]
Diket Red	85	85	85	255	85 [b]
Kintoman	71	71	71	213	71 [d]
Lasbakan	71	71	71	213	71 [d]
Lablabi	85	85	85	255	85 [b]
Makabsog	85	85	85	255	85 [b]
Muri	92	92	92	276	92 [a]
Luk ab	71	71	71	213	71 [d]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.001	0.000			
Treatment	9	1484.283	164.920	494776.1**	2.46	3.60
Error	18	0.006	0.000			
TOTAL	29					

**-highly significant CV (%) = 0.00%

Appendix Table 6. Number of tillers produced

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	8	10	7	25	8.33 [d]
Balatingi	13	15	18	46	15.33 [b]
Bayabas	12	14	17	43	14.33 [b]
Diket Red	15	11	16	42	14.00 [b]
Kintoman	8	12	8	28	9.33 [cd]
Lasbakan	8	8	7	23	7.67 [d]
Lablabi	9	8	8	25	8.33 [d]
Makabsog	10	15	13	38	12.67 [bc]
Muri	10	11	8	29	19.67 [a]
Luk-ab	14	16	12	42	14.00 [b]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	8.467	4.233			
Treatment	9	237.633	26.404	6.52**	2.43	3.52
Error	18	72.867	4.048			
TOTAL	29	318.967				

**- Highly significant CV (%) = 17.70

Appendix Table 7. Number of productive tillers

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	4	5	3	12	4.00^{e}
Balatingi	10	9	11	30	10.00^{ab}
Bayabas	10	13	9	32	10.67^{a}
Diket Red	4	8	5	17	5.67^{cde}
Kintoman	6	6	4	16	5.33^{cde}
Lasbakan	6	5	4	15	5.00^{de}
Lablabi	5	5	7	17	5.67^{cde}
Makabsog	8	10	8	26	8.67^{abc}
Muri	5	5	10	20	6.67^{cde}
Luk-ab	6	7	9	22	7.33^{bed}

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	4.200	2.100			
Treatment	9	134.033	14.893	5.53**	2.43	3.52
Error	18	48.467	2.693			
TOTAL	29	186.700				

**-highly significant CV (%) = 23.78

Appendix Table 8. Number of filled grains at heading per panicle

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	44	34	57	135	45.00
Balatingi	67	63	46	176	58.66
Bayabas	76	57	78	211	70.33
Diket Red	67	80	77	224	74.66
Kintoman	56	67	75	198	66.00
Lasbakan	68	75	45	188	62.66
Lablabi	65	46	36	147	46.00
Makabsog	54	65	77	196	65.33
Muri	64	67	51	182	60.66
Luk-ab	56	87	74	217	72.33

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Replication	2	40.067	20.033			
Treatment	9	2498.800	277.644	1.76 ns	2.43	3.52
Error	18	2838.600	157,700			
TOTAL	29	5377.467				

ns- not significant CV (%) = 20.10

Appendix Table 9. Number of unfilled grains per panicle

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	32	25	16	73	24.33
Balatingi	24	19	26	69	23.00
Bayabas	20	26	28	74	24.67
Diket Red	20	24	19	63	21.00
Kintoman	19	15	12	46	15.33
Lasbakan	16	22	27	65	21.67
Lablabi	34	17	24	75	25.00
Makabsog	16	34	18	68	22.67
Muri	15	35	24	74	24.67
Luk-ab	23	14	16	53	17.67

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	22.200	11.100			
Treatment	9	283.33	31.481	0.66	2.43	3.52
Error	18	852.467	47.359			
TOTAL	29	1158.000				

ns- not significant CV(%) = 31.28

Appendix Table 10. Number of day from heading to ripening

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	22	22	22	66	22
Balatingi	22	22	22	66	22
Bayabas	21	21	21	63	21
Diket Red	26	26	26	78	26
Kintoman	26	26	26	78	26
Lasbakan	36	36	36	108	36
Lablabi	36	36	36	108	36
Makabsog	28	28	28	84	28
Muri	21	21	21	63	21
Luk-ab	21	21	21	63	21

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Replication	2	0.001	0.000			
Treatment	9	931.923	103.547	310638.6**	2.46	3.60
Error	18	0.006	0.000			
TOTAL	29					

**-highly significant CV (%) = 0.00%

Appendix Table 11. Height at maturity

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	100.9	105.8	103.9	310.6	103.53 [e]
Balatingi	103.5	102.8	104.2	310.5	103.5 [e]
Bayabas	104.3	104.6	104.5	313.4	104.47 [e]
Diket Red	111.3	117.7	112.1	341.1	113.7 [c]
Kintoman	107.8	109.3	110.1	327.2	109.07 [d]
Lasbakan	117.3	114.8	115.2	347.3	115.77 [c]
Lablabi	107.9	109.3	110.1	327.3	109.10 [d]
Makabsog	124.0	126.9	127.6	378.5	126.17 [a]
Muri	111.0	118.8	111.6	341.4	113.80 [c]
Luk-ab	121.3	118.9	118.3	358.5	119.50 [b]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	19.358	9.679			
Treatment	9	1484.299	164.922	38.55**	2.43	3.52
Error	18	77.815	4.279			
TOTAL	29	1580.672				

**highly significant CV (%) = 1.85

Appendix Table 12. Stem borer evaluation (white heads)

	REPLICATION				
VARIETY	I	II	III	TOTAL	MEAN
Balatinaw	1	1	1	3	1
Balatingi	1	1	1	3	1
Bayabas	1	1	1	3	1
Diket Red	1	1	1	3	1
Kintoman	1	1	1	3	1
Lasbakan	1	1	1	3	1
Lablabi	1	1	1	3	1
Makabsog	1	1	1	3	1
Muri	1	1	1	3	1
Luk-ab	1	1	1	3	1

Appendix Table 13. Blast Evaluation (neck rot)

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	1	1	1	3	1
Balatingi	1	1	1	3	1
Bayabas	1	1	1	3	1
Diket Red	1	1	1	3	1
Kintoman	1	1	1	3	1
Lasbakan	1	1	1	3	1
Lablabi	1	1	1	3	1
Makabsog	1	1	1	3	1
Muri	1	1	1	3	1
Luk-ab	1	1	1	3	1

Appendix Table 14. Weight of 1000 filled grains

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	26.94	22.71	22.19	71.84	23.95 [d]
Balatingi	28.59	30.12	29.64	88.35	29.45 [b]
Bayabas	19.52	20.19	22.19	61.90	20.63 [e]
Diket Red	26.94	25.83	26.13	79.90	26.30 [c]
Kintoman	25.38	26.06	24.32	75.76	25.25 [cd]
Lasbakan	20.66	21.03	20.26	61.95	20.65 [e]
Lablabi	24.24	24.97	23.92	73.19	24.38 [cd]
Makabsog	23.53	23.92	24.22	71.67	23.89 [d]
Muri	33.13	33.17	31.13	97.43	32.48 [a]
Luk-ab	21.65	21.92	21.83	65.40	21.80 [e]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	1.324	0.662			
Treatment	9	384.804	42.756	32.88**	2.43	3.52
Error	18	23.406	1.300			
TOTAL	29	409.535				

** highly significant CV (%) = 4.58

Appendix Table 15. Yield per plot

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	237	293	220	750	250.00 [de]
Balatingi	320	354	264	938	312.67 [cd]
Bayabas	420	450	400	1270	423.33 [b]
Diket Red	580	550	590	1720	573.33 [a]
Kintoman	213	300	325	838	279.33 [cde]
Lasbakan	265	319	190	774	258.00 [cde]
Lablabi	260	215	164	639	213.00 [e]
Makabsog	334	390	255	979	326.33 [cd]
Muri	410	330	300	1040	346.67 [bc]
Luk-ab	210	200	320	730	243.33 [de]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Replication	2	7035.800	3,517.900			
Treatment	9	309,952.533	34439.170	13.20	2.43	3.52
Error	18	46,600.867	2588.937			
TOTAL	29	363,589.200				

** Highly significant CV (%) = 15.77

Appendix Table 16. Computed yield per hectare (Kg)

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
Balatinaw	.47	.58	.44	1.49	.50 [ef]
Balatingi	.64	.70	.52	1.86	.62 [cde]
Bayabas	.84	.90	.80	2.54	.85 [b]
Diket Red	1.16	1.10	1.18	3.44	1.15 [a]
Kintoman	.42	.60	.65	1.67	.56 [def]
Lasbakan	.53	.63	.38	1.54	.51 [def]
Lablabi	.52	.43	.32	1.27	.42 [f]
Makabusog	.66	.78	.51	1.95	.65 [cde]
Muri	.82	.66	.60	2.08	.69 [bcd]
Luk-ab	.42	.40	.64	1.46	.49 [bc]

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Replication	2	0.028	0.014			
Treatment	9	1.250	0.139	13.34**	2.43	3.52
Error	18	0.187	0.010			
TOTAL	29	1.465				

**-Highly significant CV%=15.86