BIBLIOGRAPHY

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ABSTRACT

Nine different landraces of non-glutinous rice were evaluated to identify the best landrace/s with the highest yield and resistance to stem borer and neck rot and to determine the profitability of growing the non-glutinous rice landraces under Bineng, La Trinidad, Benguet condition.

The different landraces of rice that were evaluated were Balisanga, FK, Bayag, Maltiha, Sapaw, Ba-ay, Makaneneng, Gulitan and Kayamsing.

The nine progenies were sown in a seedbed under the greenhouse and transplanted in the field. Differences among the landraces were noted in the seedling height and number of tillers produced. All of the landraces were observed to be normal and vigorous at seedling stage.

Rice landraces Sapaw and Ba-ay had the highest number of filled grains, weight of 1000 grains, total yield, computed yield, and realized a positive ROCE.

All of the rice landraces showed resistance to neckrot and blast but most were infested by rats except for Ba-ay and Sapaw.

TABLE OF CONTENTS

INTRODUCTION

Rice has been considered as the staple food for Filipinos. This is supported by the continuous growth of rice production in our country. The role of rice in our society has been considered as being the gift of life (Zaffaralla, 2004).

Rice (*Oryza sativa L.*), belonging to the Graminae family is cultivated in warm and cool climate, and is a semi – aquatic plant. PhilRice (2001) stated that most of Asia's population is highly dependent on rice, it is the main part of their meals especially Filipinos. Zaffaralla (2004) added that rice serves us so well in life and art and is a truly life giving grain.

The Central Cordillera Agricultural Program (CECAP and PhilRice, 2000) defines traditional rices as the varieties that have not undergone improvement in formal breeding and research institutions. At present, traditional rice varieties are grown in the higher elevation while the high yielding varieties are grown in the lower elevations. In the highland areas, rice grows in 6 -7 months, has low tillering, awned grains and tall stalk.

Traditional rice are mostly tall (160 -200cm) with droopy leaves, photoperiodic, low yielding, late maturing and less responsive to nitrogen fertilizer. These varieties have been bred through time to gain dependable yields under low management levels. These varieties are good sources of resistance and grain quality traits. These varieties also endure adverse environments such as submerged regions and in areas with low soil fertility (PhilRice, 2001).

At present, some municipalities of Benguet produce modern rice varieties which replaced the traditional varieties. These modern varieties are continuously produced and currently adapted in our locality. However, traditional rice is still preferred by tribal folks in the Cordillera Region as reflected by the continuous production of these varieties up to the present time. These varieties are not only produced for food but it is an important part of the culture of the Cordilleran.

In order to preserve these varieties, production of traditional rice must be done to increase the yield and widen adaptation. The results of the study can be used to determine the adaptability of rice landraces in La Trinidad and to restore the traditional rice varieties as one of the grandeur of the Cordillera Region. Findings can also serve as reference for future research.

The study was conducted to:

1. evaluate the nine rice landraces based on their growth and yield in Bineng, La Trinidad Benguet condition;

2. identify the best traditional rice landraces with the highest yield and resistance to stem borer and neck rot; and

3. determine the profitability of growing the non-glutinous rice landraces under Bineng, La Trinidad, Benguet condition.

The study was conducted at Bineng, La Trinidad, Benguet from August 2009 to March 2010.

REVIEW OF LITERATURE

Varietal Evaluation

Varietal evaluation is the process in plant breeding that has comparison to promising lines developed by breeders. It involves selection where plant breeder's choose the best performing variety among the developed lines in terms of yield, stress adaptability and resistance to pest and diseases (Sunil, 1990). In addition, Kang (2002) stated that the importance of conducting varietal evaluation of different crops is to determine and select a desirable variety that performs well and thus be recommended to farmers.

According to Hay and Porter (2006) plant breeders have sought to improve further the yield, reliable and quality of crops by improving adaptability to different climatic environments and to ensure that the life cycle of particular genotypes fit the constraints of the local environment.

Reiley and Shry (1991) reported that the variety must be adapted to the area in which it is grown. Different varieties which were grown under the same method of culture have a great variation in the yielding ability. A variety that yields well in one region is not a guarantee that it has the same performance in another region.

The variety to be selected should be high yielding, pest and diseases resistant, and early maturing so that the production would entail less expense, and ensure more profit. Selecting the right variety will minimize problems associated with water and fertilizer management activities (Bautista and Mabesa, 1997).

In addition, Lorenz and Maynard (1988), stated that selection of the variety to plant is one of the most important decisions the commercial vegetable grower must make each season. The variety should have the potential to produce crops at least equivalent to those already grown. The most economical and effective means of pest is through the use of varieties with genetic resistance to disease.

Furthermore, varietal evaluation is important in order to observe performance characters such as yield, earliness vigor, maturity and quality because varieties has a wide range of differences that affects the yield performance of the plant (Work and Carew, 1995).

Evaluation Trials

Roxas (1996) revealed that the evaluation for the yielding ability of the Ifugao rice varieties, both *Pinidua* and *Tinawon* types showed high yield potential. *Pinidua* of the Indica group were moderately susceptible to cold blast while the *Tinawon* of the Japonica group are highly tolerant. On rice blast reaction, both ecotypes possed moderate degrees of susceptibility, the *Tinawon* rice varieties, showed, moderate resistance to cold blast and to lodging and has a shorter growth duration. For grain quality, Ifugao rices has a brown caryopsis and high milling recovery.

CHARM (2002) reported that the PSB RC96 or *Ibulao,* the NSIC RC104 or *Balili* and the PR27137 CR153 were preferred by the farmer cooperators to be adapted and reproduced in Bakun Benguet.

Cultural Requirement and Management

Martin and Leonard (1970) stated that the best soil for rice is slightly acid to neutral, but it is best grown on soils that have a pH range of 4.5 – 7.5.

PhilRice (2001) emphasized that rice should be planted at two seedlings per hill at a distance of 20 cm x 20 cm. Empty hills must be replanted not later than 3-5 days after transplanting to avoid uneven maturity of the crop. Close space density results in mutual shading, less tillers, smaller panicles, and lanky and weak seedlings.

IRRI (1993) mentioned that irrigation should be done at a depth of 2-3 cm for wet and one cm for dapog method. At vegetative stage, water should increase from 1 to 10 cm while during the reproductive stage, the depth of 5 to 10 cm is maintained. The most critical water deficit is the period from 10 days before flowering, which caused high percentage of sterility, thereby reducing grain yield.

PhilRice (2001) stated that it is best to harvest rice when 80% of the grains are matured. This is indicated by a yellow panicle or straw. Delay of harvesting may lead to grain shattering. While too early harvesting may produce immature, chalky grains that break easily during milling.

MATERIALS AND METHODS

Seedbed and Land Preparation

Nine seedbeds were prepared for the nine landraces of non-glutinous rice under greenhouse condition. One variety was sown in one seedbed to avoid mixture of the different non-glutinous rice varieties and necessary labels were placed in each seedbed for easy identification. Before transplanting in the field an experimental area of 150 sq.m was prepared for the nine landraces which were replicated three times. Each plot measured 1m x 5 m.

Lay – out and Transplanting

After land preparation, the experiment was laid out following the Randomized Complete Block Design (RCBD) and was replicated three times. The thirty-day old seedlings were transplanted at once. One vigorous seedling per hill was transplanted at a distance of 20 cm x 20 cm between hills and rows as shown in Figure 1 and 2.

Hand weeding was done 20 days after transplanting for the plot to be kept weed free. Rats were observed during the conduct of the study. Thus, because of this, a net and screen was placed in the rice field to control the pest and birds. No fertilizers were applied to the rice plants.

Figure 1. Overview of the seeds sown under greenhouse condition

Figure 2. Overview of the experimental area at Bineng, La Trinidad, Benguet

The nine different non - glutinous rice varieties served as treatments:

Varieties	Place of collection
V_1 *Balisanga*	Palina, Kibungan
V_2 *Sapaw*	Sagpat, Kibungan
V_3 *Bayag*	Balluay, Sablan
V_4 *Kayamsing*	Sinacbat, Bakun
V_5 *Ba – ay*	Poblacion, Bakun
V_6 *Makaneneng*	Palina, Kibungan
V_7 *FK*	Banengbeng, Sablan
V_8 *Maltiha*	Sabdang Sablan
V_9 *Gulitan*	Bedbed, Mankayan

The data gathered were the following:

A. Meteorological data. Temperature, relative humidity, amount of rainfall and sunshine duration during the study were taken from PAGASA station, La Trinidad, Benguet

B. Soil chemical properties. Soil samples were taken from the experimental area before and right after harvest to determine the pH organic matter, nitrogen, phosphorous and potassium content of the soil.

C. Agronomic characters

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

Scale	Description	Remarks
1	Majority of the seedlings have 3 or more leaves with 2-3 tillers	Very Vigorous
2	Majority 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 tiller	Weak
5	Most of the seedlings turned yellow and thin	Very Weak

2. Number of days from transplanting to tillering. This was taken when 50% of the plants produced tillers as observed.

3. 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.

4. Panicle exertion. This was observed as the extent to which the panicle is exerted above the flag leaf sheath using the following scale:

Scale	Remarks	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 f the flag leaf blade
3	Just exerted	Panicle base coincides with the collar of the flag leaf blade
4	Moderately well exerted	Panicle base is above the collar of the flag leaf blade
5	Well exerted	Panicle base appears well above the collar of the flag leaf blade

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

6. Number of productive tillers per hill. The number of productive tillers was counted using ten hills per treatment selected randomly. Only the rice plants that produced panicles was considered productive.

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

8. Height at Maturity (cm). This was taken by measuring from the base of the plant to the panicle tip at harvest using ten hill samples per plot selected randomly.

D. Pest and diseases

1. Reaction to stem borer. Field rating was based on actual number of panicles affected using the three middle rows of the plots as sampling area. Ten sample hills were selected at random where white heads was counted ten days before harvesting. The following standard scale was used:

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

2. Reaction to blast (neck rot). Evaluation of the severity of rice blast was taken from the plant at the center rows. Ten sample hills were taken randomly. Computation of percent infection was done using the formula (PhilRice, 1996):

$$\% \text{ infection} = \frac{\text{No. of panicles infected}}{\text{Total no. of panicles}} \times 100$$

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

E. Yield and Yield Components

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

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

3. 1000-grain weight (g). Random sample of 1000 well-developed, whole grains, dried to 13% moisture content were weighed on a sensitive balance.

4. Computed yield per hectare (kg.). This was taken by converting grain yield per treatment into yield per hectare using ratio and proportion.

$$\text{Yield /ha} = \frac{\text{Yield per plot (kg)}}{\text{Plot size}} \times 10{,}000 \text{ m}^2$$

F. Return on Cash Expense. This was taken using the following formula:

$$\text{ROCE} = \frac{\text{Net Income}}{\text{Total Cost of Production}} \times 100$$

Data Analysis

All quantitative data was analyzed using the analysis of variance (ANOVA). The significance of difference among the treatment means was tested using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Meteorological Data

The monthly temperature, relative humidity, amount of rainfall, and light throughout the conduct of the study are shown in Table 1. It was observed that 24.7°C was the maximum temperature during the month of September, while the minimum temperature observed in December was 10.9°C. The relative humidity increased in the months of August to October then decreased during the month of November to January. The monthly rainfall ranged from 1.0 to 72.2 mm. Highest rainfall amount was gathered in October. The highest amount of sunlight was observed during the month of December which is 425.8 min. and the lowest amount of sunshine duration was obtained from November.

Vergara (1992) reported that the temperature favorable for cool and warm rice production ranges from 16-25°C and 25-35°C, respectively. De Datta (1983) added that low temperature causes low rice yield. Injury due to low temperature is a major constraint to rice production in hilly areas in the tropics and subtropics. Rice production is affected by not only soil fertility and water but also the temperature of the place of production (Yoshida, 1981).

Soil Chemical Properties

Soil pH. The soil pH of the soil before and after transplanting was 6.15 which favors the growth of rice since the pH range for rice is 4.5-7.5 (Martin and Leonard, 1970).

Soil organic matter (%). Table 2 shows that the percent soil organic matter before planting was 3.50 %. It was observed that the amount of organic matter in the soil before planting and after harvesting is the same because of the presence of azolla. Alam (2004) stated that azolla can be a potential source of green manure for tropical rice production due to the N that it can contribute to the rice crop. Thus, instead of utilizing the residual nutrients, the rice plants might have used the Nitrogen released by the azolla plant.

Nitrogen (%). No change in the amount of nitrogen content of the soil was observed. Although, nitrogen is crucial for several physiological and biochemical reactions during vegetative and reproductive phase of the plant (Krisma, 2002), the lack of change in soil Nitrogen implies that nitrogen from azolla is enough for the growing rice.

Table 1. Temperature, relative humidity, rainfall, and sunshine duration

MONTHS	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL (mm)	SUNSHINE DURATION (min)
	Max. ^{o}C	Min. ^{o}C			
July	23.6	16.5	90	20.3	180.5
August	23.3	16.3	89	30.2	180.5
September	24.7	17.6	91	18.2	125.0
October	23.2	15.4	90	72.2	238.62
November	23.5	13.8	84	T	39.76
December	22.7	10.9	81	1.0	425.8
January	23.3	12.5	86	T	

Source: BSU, La Trinidad Benguet, PAGASA office

Table 2. The initial and final analysis of the soil before planting and after harvest

	pH	OM (%)	N (%)	P (ppm)	K (ppm)
Before planting	5.63	3.50	0.175	140	72
After harvest	6.15	3.50	0.175	73	92

Source: Department of Agriculture, Soils Laboratory, Pacdal, Baguio City

Phosphorus (ppm). Phosphorus content of the soil decreased after harvest from 140 to 73 ppm. The decreased P could be attributed to the none application of fertilizer and the plant utilized the residual P in the soil.

Potassium (ppm). As shown in Table 3, there was an increase in the potassium content of the soil at harvest. The initial and final potassium content of the soil was 72 and 92 ppm, respectively. This may be because K was not utilized by most of the plant during the grain development as it was eaten by the rats.

Plant Vigor

The plant vigor is shown in Table 3. Result showed that the plant vigor at seedling stage of the nine traditional non-glutinous rice were normal to vigorous, where majority of the seedlings have 4 to 5 leaves and some have 1 to 2 tillers.

Seedling Height

Significant differences on the seedling height of the nine traditional landraces of rice before transplanting is shown in Table 3. It was observed that *Sapaw* was significantly taller (33.65 cm) as compared to the other rice landraces. The significant differences among treatments could be attributed to their varietal characteristics or adaptability to the environment

Table 3. Plant vigor and seedling height of the nine traditional rice landraces

LANDRACE	PLANT VIGOR	SEEDLING HEIGHT (cm)
Balisanga	normal	21.50[c]
FK	normal	20.85[c]
Bayag	normal	17.50[de]
Maltiha	vigorous	15.90[e]
Sapaw	vigorous	33.65[a]
Ba-ay	vigorous	29.30[b]
Makaneneng	normal	19.70[cd]
Gulitan	normal	27.70[b]
Kayamsing	normal	22.75[c]
CV%		5.96

Transplanting to Tillering

The number of days from transplanting to tillering is shown in Table 4 where no significant differences among the landraces is observed. *Kayamsing* produced tillers earlier than the rest of the landraces at 64 days after transplanting followed by *FK* and *Gulitan* (68). The latest to produce tillers at 79 days was *Maltiha*.

The vegetative stage is characterized by active tillering, gradual increase in plant height and leaf emergence at regular intervals. Active tillering refers to a stage when tillering rate – the increase in tiller number per unit time- is high (Yoshida, 1981).

Table 4. Number of days from transplanting to tillering, booting, and heading to ripening of the nine rice landraces

LANDRACE	NUMBER OF DAYS FROM		
	TRANSPLANTNG TO TILLERING	TRANSPLANTING TO BOOTING	HEADING TO RIPENING
Balisanga	74	85	30
FK	68	78	30
Bayag	74	80	30
Maltiha	79	88	34
Sapaw	72	90	31
Ba-ay	79	86	34
Makaneneng	77	89	32
Gulitan	68	85	30
Kayamsing	64	83	30

<u>Number of Days from Transplanting to Booting</u>

The number of days from transplanting to booting is shown in Table 4. It was observed that among the landraces evaluated, *FK* booted earlier at 78 days as compared to the other Landraces that booted two to twelve days later. *Sapaw* was the last to boot with a mean of 90 days. This maybe attributed to their genetic make-up, varietal characteristics and adaptability in Bineng, La Trinidad, Benguet.

Number of Days from
Heading to Ripening

Number of days from heading to ripening of the nine landraces is shown in Table 4. Observations showed that *Balisanga, FK, Bayag, Gulitan, Kayamsing* ripened earlier at 30 days followed by *Sapaw* and *Makaneneng* at 31 and 32 days, respectively. *Maltiha* and *Ba-ay* was the latest to ripen at 34 days from heading to ripening.

Number of Tillers

Results revealed significant differences on the number of tillers as shown in Table 5. *Ba-ay* significantly produced the highest number of tillers with a mean of 33 followed by *Maltiha* (25) while the rest of the landraces produced 10 to 14 tillers.

Vergara (1992) mentioned that plants produced more tillers during the wet season compared to the number of tillers produced at dry season. Rice plants also grow faster at warm temperature than in cool temperature. Thus, the high number of tillers of *Ba-ay* may be due to the wet season from August to October and to varietal characteristics.

Number of Productive
Tiller per Hill

The number of productive tillers per hill showed significant differences among the landraces (Table 5). Most of the landraces have comparable number of productive tillers with means ranging from 6 to 10. Rice landrace *FK* produced the least number of productive tillers (3).

According to UPLB (1983), not all tillers produce heads, some tillers die while others remain at the vegetative stage since there is competition among the tillers for nutrient and light. Thus, the production of tillers alone may not be a good gauge of the yield potential of rice.

Table 5. Number of tillers and productive tillers produced by the nine rice landraces

LANDRACE	NUMBER OF		PANICLE EXERTION
	TILLERS	PRODUCTIVE TILLER	
Balisanga	11[c]	8[a]	3
FK	11[c]	3[b]	5
Bayag	10[c]	6[a]	3
Maltiha	25[b]	8[a]	3
Sapaw	11[c]	8[a]	3
Ba-ay	33[a]	10[a]	5
Makaneneng	14[c]	9[a]	4
Gulitan	11[c]	8[a]	3
Kayamsing	10[c]	9[a]	3
CV%	12.84	21.70	

Means followed by common letters are not significantly different at 5 % level of DMRT
Rating scale for panicle exertion: 1-Enclosed, 2-Partly enclosed, 3-Just exerted, 4-Moderately just exerted, 5- Well exerted

Panicle Exertion

Table 5 also shows the panicle exertion of the nine rice landraces. Results showed that *FK* and *Ba-ay* had a well exerted panicle (scale 5). This means that the panicle base appears well above the colar of the flag leaf blade. On the other hand, *Makaneneng* was the only landrace which was moderately well exerted wherein the panicle base is above the collar of the flag leaf blade. Other landraces were just exerted (3) which means the panicle base coincides with the collar of the flag leaf blade.

The well exerted panicle of *FK* and *Ba-ay* implies that those landraces have longer panicles.

Height at 165 DAT

The height of rice the plants was measured from the base of the plant to the panicle tip excluding the awn at harvest. Table 6 shows the height of the nine rice landraces at maturity. Statistically, there were no significant differences noted among the rice landraces, though numerically, *Sapaw* was the tallest among the other landraces (119.48 cm). The shortest among the landraces evaluated was *FK* with a mean height of 88.39. These differences could be attributed to their varietal variability.

PhilRice (2001) stated that traditional rice are mostly tall with droopy leaves and are late maturing.

Table 6. Height at 165 DAT of the nine rice landraces

LANDRACE	HEIGHT AT 165 DAT (cm)
Balisanga	105.18
FK	88.39
Bayag	93.60
Maltiha	98.99
Sapaw	119.47
Ba-ay	105.00
Makaneneng	106.68
Gulitan	97.81
Kayamsing	92.10
CV%	10.51

Stem Borer, Blast (neck rot) and Rat Damage Evaluation

Evaluation of white heads was done accordingly based on the rate of infestation. For the white heads and blast, all entries were found to be resistant. All the entries were also resistant to stem borer damage as shown in Table 7.

Most of the landraces evaluated were infested by the rats because of their aromatic characteristics. *Sapaw* and *Ba-ay* are the only landraces which were not infested by rats. It was observed that as the rice matured, rats cut the tillers and eat portions of the developing head. As the rice heads mature, rats feed on the individual grains.

Table 7. Reaction to stemborer (whiteheads), blast (neck rot), and rat damage

LANDRACE	STEMBORER	BLAST	RAT DAMAGE
Balisanga	Resistant	Resistant	Infested
FK	Resistant	Resistant	Infested
Bayag	Resistant	Resistant	Infested
Maltiha	Resistant	Resistant	Infested
Sapaw	Resistant	Resistant	Resistant
Ba-ay	Resistant	Resistant	Resistant
Makaneneng	Resistant	Resistant	Infested
Gulitan	Resistant	Resistant	Infested
Kayamsing	Resistant	Resistant	Infested

De Datta (1981) reported that rodents, particularly rats, cause serious damage to the rice crop in all growth stages. They eat seeds (in-direct seeded rice) and seedlings, they grow off tillers, damage plants, and seed rice grains at various stages, they also destroy attached, stored, threshed and hulled rice.

Number of Filled Grains and Unfilled Grains

Statistically, results showed that no significant differences were observed on the number of filled and unfilled grains. Among the different rice landraces evaluated, *Sapaw* had the highest number of filled grains with a mean of 65 while *Gulitan* had the lowest filled grains (5).

Table 8. Number of filled grains and unfilled grains per panicle of the nine rice landraces

LANDRACE	NUMBER OF	
	FILLED GRAINS	UNFILLED GRAINS
Balisanga	19.00	24.50
FK	21.00	33.00
Bayag	33.50	45.50
Maltiha	22.50	33.50
Sapaw	65.00	62.50
Ba-ay	45.00	39.50
Makaneneng	21.00	65.00
Gulitan	4.50	29.00
Kayamsing	12.00	13.00
CV%	49.15	55.17

On the number of unfilled grains per panicle, *Makaneneng* had the highest number of unfilled grains per panicle with a mean of 65 followed by *Sapaw* (63) while *Kayamsing* had the lowest number of unfilled grains per panicle with a mean of 16. This is due to the damage of rats in most sample plants.

<u>Weight of 1000
Filled Grains</u>

Statistically, results showed no significant varietal differences on the weight of 1000 filled grains produced (Table 9). The weight of 1000 filled grains of the different landraces ranged from 8.89 to 25.13 g. *Sapaw* obtained the heaviest weight with a mean of 25.14g while the lowest weight was obtained from *Gulitan* with a mean of 8.89g. This is due to the grain characteristics such as the size of grains and the damage caused by rats.

Yield per $5m^2$

The yield per $5m^2$ is shown in Table 9. It was observed that among the nine landraces evaluated, *Ba-ay* produced the highest total yield with a mean of 1,310 g followed by *Sapaw* weighing 1,181 g. The lowest yield was obtained from *Gulitan* with a mean of 251 g. This is attributed to the differences in the number of grains, weight of 1000 filled grains and rat damage.

Computed Yield per Hectare

The computed yield per hectare showed that *Ba-ay* had the highest yield per hectare with a mean of 2,621 kg which was not significantly different but numerically higher than *Sapaw* with a mean of 2,362 kg per hectare. *Gulitan* obtained the lowest yield per hectare with a mean of 431 kg. Such differences follow the same pattern in the weight of filled grains and yield per $5m^2$ except *Sapaw* and *Ba-ay* landraces.

Table 9. Weight of 1000 filled grains, yield per $5m^2$ and computed yield per hectare of the nine rice landraces

LANDRACE	WEIGHT OF 1000 FILLED GRAINS (g)	YIELD PER $5m^2$ (g)	COMPUTED YIELD PER HECTARE (kg)
Balisanga	12.87	230	460
FK	12.53	486	970
Bayag	23.94	730	1460
Maltiha	11.47	453	910
Sapaw	25.13	1181	2362
Ba-ay	23.05	1310	2621
Makaneneng	21.98	539	1169
Gulitan	8.89	216	431
Kayamsing	11.05	346	691
CV%	41.6	9.10	9.16

Return on Cash Expense (ROCE)

The return on cash expense (ROCE) of the nine landraces is shown in Table 10. *Sapaw* and *Ba-ay* had the highest ROCE compared to the other landraces evaluated, which had negative ROCE. These results indicate that not all the rice landraces are profitable to be produced under Barangay Bineng, La Trinidad, Benguet condition.

Table 10. Cost and return analysis of the nine rice landraces

LANDRACE	YIELD PER 5m^2	GROSS INCOME (Php)	COST OF PRODUCTION (Php)	NET INCOME (Php)	ROCE (%)
Balisanga	230	16.10	56	-39.90	-71.25
FK	486	34.02	56	-21.98	-39.25
Bayag	730	51.10	56	-4.90	-8.75
Maltiha	453	31.71	56	-24.29	-43.38
Sapaw	1181	82.67	56	26.67	47.63
Ba-ay	1310	91.70	56	35.70	63.75
Makaneneng	539	41.09	56	-14.91	-26.63
Gulitan	216	15.05	56	-40.95	-73.13
Kayamsing	346	24.22	56	-31.78	-56.75

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted from September 2009 to March 2010. Nine landraces of rice were evaluated to identify the best rice landraces with the highest yield and resistance to pests and to determine the profitability of growing the non-glutinous rice landraces under Bineng, La Trinidad, Benguet condition.

The performance of the nine rice landraces during the seedling stage showed normal and vigorous seedlings. *Sapaw* had significantly taller seedlings before transplanting.

Among the landraces evaluated, *Sapaw* and *Ba-ay* produced the highest number of filled grains and unfilled grains, heaviest weight of 1000 grains, and total yield per hectare.

In terms of the vegetative data, *Sapaw* was the tallest during seedling and maturity stages but was the latest to boot from transplanting.

Kayamsing was the earliest to produce tillers and produced the lowest number of unfilled grains.

In terms of resistance to stem borer and blast, all of the rice landraces were resistant while most of the landraces were damaged by rats except for *Sapaw* and *Ba-ay*.

Conclusion

Based on the results, *Ba-ay* and *Sapaw* are the best performing landraces and considered to be adapted at Bineng, La Trinidad, Benguet because both produced the highest yield, positive ROCE and showed resistance to neckrot, blast and rat damage.

Recommendation

Based on the results and observations of the study, *Ba-ay* and *Sapaw* are the landraces recommended for rice growers of Bineng, La Trinidad, Benguet. *Makaneneng* and *Bayag* yielded slightly lower than *Ba-ay* landrace but both maybe considered by farmers as alternative landraces due to their neckrot and blast resistance.

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APPENDICES

Appendix Table 1. Plant vigor

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	3	3	6	3
FK	3	3	6	3
Bayag	3	3	6	3
Maltiha	2	2	4	2
Sapaw	2	2	4	2
Ba-ay	2	2	4	2
Makaneneng	3	3	6	2
Gulitan	3	3	6	3
Kayamsing	3	3	6	3

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	1	4	4			
Treatment	8	0	0	ns	3.44	6.05
Error	8	0	0			
TOTAL	17	4				

^{ns}- not significant

CV (%) =0

Appendix Table 2. Seedling height

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	21.9	21.1	43	21.5
FK	21	20.7	41.7	20.85
Bayag	17.2	17.8	35	17.50
Maltiha	15.8	16	31.8	15.90
Sapaw	35.8	31.5	67.3	33.65
Ba-ay	29.2	29.4	58.6	29.30
Makaneneng	19.5	19.9	39.4	19.70
Gulitan	28.8	26.6	55.4	27.70
Kayamsing	21.4	24.1	45.5	22.75
TOTAL	228.7	225.3	454	227

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	1	0.681	0.681			
Treatment	8	546.614	68.327	35.74**	3.44	6.05
Error	8	15.294	1.912			
TOTAL	17	562.589				

**- highly significant

CV (%) = 5.96

Appendix Table 3. Number of days from transplanting to tillering

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	74	74	148	74
FK	68	68	136	68
Bayag	74	74	148	74
Maltiha	79	79	158	79
Sapaw	72	72	144	72
Ba-ay	79	79	158	79
Makaneneng	77	77	154	77
Gulitan	68	68	136	68
Kayamsing	64	64	128	64
TOTAL	655	655	1310	655

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	1	433.11	433.11			
Treatment	8	0		ns	3.44	6.05
Error	8	0				
TOTAL	17	433.1				

^{ns}- not significant

CV (%) = 0

Appendix Table 4. Number of tillers

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	10	12	22	11
FK	12	11	21	11
Bayag	16	13	19	10
Maltiha	25	24	49	25
Sapaw	12	9	21	11
Ba-ay	36	29	65	33
Makaneneng	14	14	28	14
Gulitan	10	11	21	11
Kayamsing	8310	9	19	10
TOTAL	153	145	278	143

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	1	6.722	6.722			
Treatment	8	1008.111	126.014	32.75**	3.44	6.03
Error	8	30.78	3.847			
TOTAL	17	1045.611				

**- highly significant

CV% = 12.84

Appendix Table 5. Number of days from transplanting to booting

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	85	85	170	85
FK	78	78	156	78
Bayag	80	80	160	80
Maltiha	88	88	176	88
Sapaw	90	90	180	90
Ba-ay	86	86	172	86
Makaneneng	89	89	178	89
Gulitan	85	85	170	85
Kayamsing	83	83	166	83
TOTAL				

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	1	257.78	257.78			
Treatment	8	0		ns	3.44	0.65
Error	8	0				
TOTAL	17	257.78				

^{ns}-not significanrt

CV (%) = 0

Appendix Table 6. Number of productive tiller per hill

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	5	10	15	8
FK	3	3	6	3
Bayag	7	5	12	7
Maltiha	8	8	16	8
Sapaw	8	8	16	8
Ba-ay	15	14	29	10
Makaneneng	7	11	18	9
Gulitan	8	6	14	8
Kayamsing	9	9	18	9
TOTAL	76	84	160	

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	1	0.889	0.889			
Treatment	8	149.000	18.625	6.18**	3.44	6,05
Error	8	42.111	3.014			
TOTAL	17	174.000				

**- highly significant

CV% = 21.70

Appendix Table 7. Number of days from heading to ripening

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	30	30	60	30
FK	30	30	60	30
Bayag	30	30	60	30
Maltiha	34	34	68	34
Sapaw	31	31	62	31
Ba-ay	34	34	68	34
Makaneneng	32	32	64	32
Gulitan	30	30	60	30
Kayamsing	30	30	60	30
TOTAL				

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	1	47.11	47.11			
Treatment	8	0		ns	3.44	6.05
Error	8	0				
TOTAL	17	47.11				

^{ns}- not significant

CV (%) = 0

Appendix Table 8. Height at 165 DAT

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	109.37	101	210.37	105.18
FK	77.12	99.67	176.79	88.39
Bayag	99.71	87.6	187.31	93.65
Maltiha	99.14	98.67	197.98	98.65
Sapaw	117.28	121.67	238.95	119.47
Ba-ay	107	103	210	105
Makaneneng	108.8	104.57	213.37	106.68
Gulitan	115	80.62	195.62	97.81
Kayamsing	95.2	89	184.2	92.1
TOTAL	1036.05	990.97	2027.02	

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	1	101.057	101.057			
Treatment	8	1426.195	178.274	1.59^{ns}	3.44	6.05
Error	8	898.388	112.299			
TOTAL						

^{ns}- Not significant

CV (%) = 10.51

Appendix Table 9. White heads evaluation

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	1	1	2	1
FK	1	1	2	1
Bayag	1	1	2	1
Maltiha	1	1	2	1
Sapaw	1	1	2	1
Ba-ay	1	1	2	1
Makaneneng	1	1	2	1
Gulitan	1	1	2	1
Kayamsing	1	1	2	1
TOTAL				

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	1	18	18			
Treatment	8	0		ns	3.44	6.05
Error	8	0				
TOTAL	17	18				

ns - not significant

CV (%) = 0

Appendix Table 10. Neck rot evaluation

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	1	1	2	1
FK	1	1	2	1
Bayag	1	1	2	1
Maltiha	1	1	2	1
Sapaw	1	1	2	1
Ba-ay	1	1	2	1
Makaneneng	1	1	2	1
Gulitan	1	1	2	1
Kayamsing	1	1	2	1
TOTAL				

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	1	18	18			
Treatment	8	0		ns	3.44	6.05
Error	8	0				
TOTAL	17	18				

ns- not significant

CV (%) = 0

Appendix Table 11. Number of filled grains

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	0	38	38	19
FK	35	7	42	21
Bayag	26	41	67	34
Maltiha	45	0	45	22.5
Sapaw	50	80	130	65
Ba-ay	20	70	90	45
Makaneneng	30	12	42	21
Gulitan	0	9	9	4.5
Kayamsing	0	24	24	12
TOTAL				

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	1	312.500	312.500			
Treatment	8	5395.444	674.431	1.31^{ns}	3.44	6.05
Error	8	4117.000	514.625			
TOTAL	17	9824.944				

$^{ns-}$ not significant

CV (%) = 49. 15

Appendix Table 12. Number of unfilled grains

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	0	49	49	24.5
FK	26	40	66	33
Bayag	43	46	89	45
Maltiha	67	0	67	33.5
Sapaw	60	63	123	62
Ba-ay	42	37	79	40
Makaneneng	67	63	130	65
Gulitan	0	58	58	29
Kayamsing	0	26	26	13
TOTAL				

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	1	329.389	329.389			
Treatment	8	4639.778	579.972	0.88^{ns}	3.44	6.05
Error	8	5267.111	658.389			
TOTAL	17	10236.278				

$^{ns-}$ not significant

CV (%) = 55.17

Appendix Table 13. Weight of 1000 filled grains

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	0	25.75	25.75	12.88
FK	21.93	12.14	34.07	17.04
Bayag	26.49	21.39	47.88	23.94
Maltiha	22.94	0	22.94	11.47
Sapaw	26.1	24.17	50.27	25.14
Ba-ay	19.23	26.86	45.07	23. 05
Makaneneng	22.33	21.64	43.97	21.94
Gulitan	0	17.78	17.78	8.89
Kayamsing	0	22.10	22.10	11.05
TOTAL	139	171.83		

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	1	12.517	12.517			
Treatment	8	497.973	62.247	0.37^{ns}	3.44	6.05
Error	8	1340.142	167.518			
TOTAL	17					

^{Ns}- not significant

CV% = 41.6

Appendix Table 14. Computed yield per plot

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	0	459	459	229
FK	519	453	972	486
Bayag	730	730	1460	730
Maltiha	906	0	906	453
Sapaw	1218	1144	2362	1181
Ba-ay	1329	1292	2621	1310
Makaneneng	633	536	1169	589
Gulitan	0	431	431	215
Kayamsing	0	691	691	345
TOTAL				

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	1	27300.05	27300.05			
Treatment	8	2505581.1	31397.639	2.96^{ns}	3.44	6.03
Error	8	846284.40	105785.56			
TOTAL	17					

^{ns} – not significant

CV%=6.16

Appendix Table 15. Computed yield per hectare

LANDRACES	REPLICATION		TOTAL	MEAN
	I	II		
Balisanga	0	920	920	460
FK	1040	900	1940	970
Bayag	1460	1460	2920	1460
Maltiha	1820	0	1820	910
Sapaw	2436	2288	4724	2362
Ba-ay	2658	2584	5242	2621
Makaneneng	1266	1072	2338	1169
Gulitan	0	862	862	431
Kayamsing	0	1382	1382	691
TOTAL				

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	1	107030.22	107030.22			
Treatment	8	10015759.1	1251969.9	2.94^{ns}	3.44	6.05
Error	8	3404761.78	425595.22			
TOTAL	17					

^{ns}- not significant

CV%=6.16