BIBLIOGRAPHY

MODESTO, JENNIFER M. APRIL 2010. Growth and Yield of Ten High Yielding Rice Varieties under Luna, Apayao Condition. Benguet State University, La Trinidad, Benguet.

Adviser: Danilo P. Padua, Ph. D.

ABSTRACT

Ten high yielding rice varieties were planted and evaluated to identify the best variety based on the growth, yield, and resistance to stemborer and rice blast and to determine the profitability of growing HYV's under Sta. Lina, Luna, Apayao condition.

The ten high yielding rice varieties used includes NSIC Rc 130, NSIC Rc 134, NSIC Rc 138, NSIC Rc 140, NSIC Rc 144, NSIC Rc 146, NSIC Rc 150, NSIC Rc 154, NSIC Rc 156 and PSB Rc 82 (check variety).

NSIC Rc 150 produced the highest number of productive tillers and obtained the highest grain yield of 7.8 kg/ 12 m^2 or 6.5 tons per hectare and also had the highest return on cash expenses. NSIC Rc 140 had the heaviest weight of 1000 grains and was resistant to stemborer.

TABLE OF CONTENTS

INTRODUCTION

Rice is a semi-aquatic plant scientifically known as *Oryza sativa* Linn. which belongs to the grass family. It is the staple food item of more than 90% of all Philippine households and takes up about a quarter of the total food budgets of Filipino families (Bruce, *et.al*, 2001).

For many years, rice production in the Philippines can hardly supply the needs of the rising population and the gap between the rice production and utilization is widening. Therefore, increase in rice production should be done to lessen the need for importation and move toward self-sufficiency (Yabes, 2008).

Annual rice production from 2000-2007 had an average growth rate of 3.68%, with an all time high of 7% in 2004. In 2007, production performance increased to 5.96%. However, these increases can hardly match the rising population's demand for rice (Sebastian, *et.al*, 2008).

According to Yabes (2008), there are two possible ways in which rice production levels could be increased. One is to increase yield ceiling through the development of new plant types (NPT) and hybrid rice under optimum crop management and favorable environment. The other is to narrow the yield gap through improved irrigation and crop management practices.

The increase of production per unit area is the best solution to meet the demand of the fast growing population. There is a very slim possibility of expanding the area of rice field because of the degradation of the environment and the conversion of areas to industrial and residential areas (Mateo, 2000).

At present, most rice farmers such as those in Luna, Apayao are looking for a variety which is high- yielding, have good eating quality and matures early to have more viable and profitable farms. To this end, the government is helping these rice farmers through subsidized certified seeds to improve their profit and supply the needs of their family and the hungry community.

Introducing other varieties especially the newly developed ones, would be a step towards the right direction. However, these new varieties have to be tested to find out whether they are adapted to local conditions and can meet the farmer's preferences.

The result of this study will guide the farmers on what variety is best adapted in the locality and accordingly help them increase the rice production in the locality. Farmers can go into planting high yielding varieties providing new income opportunities. It could also serve as a challenge to farmers already having high yields to attain even more, because the use of high yielding varieties permits two or three successive cropping. Increased yield means more income to farmers.

The study aimed to:

1. evaluate the growth and yield of ten high yielding rice varieties in Luna, Apayao condition;

2. determine the best variety adapted in terms of growth, yield and resistance to insect pest and diseases in Luna, Apayao condition; and

3. determine the Return on Cash Expense (ROCE) of growing high yielding rice varieties in Luna, Apayao.

The study was conducted from November 2009 to April 2010 at Barangay Sta. Lina, Luna, Apayao.

REVIEW OF LITERATURE

Varietal Evaluation

Varieties may be location- specific in accordance to prevailing environmental conditions (PhilRice, 2004). Modern varieties have greater yield potential than traditional varieties even under the best conditions (Vergara, 1992).

Previous variety evaluations have shown differing yield performance. Pablico (2002) stated that in the wet season test of cold tolerant varieties in La Trinidad, Benguet in 1995, PJ2 or NSIC Rc 104 was found to produce the highest yield (2.98 tons / hectare) while Pinidua- the traditional variety planted in Cordillera produced only 1 ton / hectare. In the succeeding dry season, PJ2 was one of the promising cold tolerant lines in the preliminary yield trials in Banaue and Benguet with highest yield of 6.59 tons/ hectare and 5.44 tons/ hectare respectively. In contrast, Gohang or PSB 44 produced only 3.7 tons/ hectare but found to perform well in the study conducted in Tocucan, Bontoc, Mt. Province in terms of growth and yield (Inchan, 2003).

In the dry season of 1996, PJ2 likewise proved much better than other varieties in the NCT in 4 sites. It also performed in a farmer's field which yielded 75% higher than Pinidua. On the average, the yield of PJ2 is 28.6% higher than that of Gohang in the dry season and 13.7% in wet season. It showed high yield potential in Benguet and Ifugao although its yield in Kalinga and Mt. Province is lower, it is much higher than the traditional varieties. Moreover, it showed better reaction to tungro under field condition of Kanlaon area in Negros Occidental (Pablico, 2002).

Based on the National Cooperative Test Evaluation, PSB Rc 26H or Magat bested PSB Rc 4 by 17% and IR 50 by 36% during the dry season. This is recommended primarily for Cagayan and Isabela, although it also performed well in Camarines Sur, Iloilo, Cotabato, Laguna, Bohol, Masbate, Palawan, Capiz, Pangasinan, Agusan del Sur and Zamboanga del Sur. Magat obtained an average yield of 5.7 tons/ hectare and its highest yield was recorded in Maligaya, Nueva Ecija at 11.8 tons/ hectare. It is also resistant to blast and has intermediate reaction to bacterial leaf blight, rice tungro virus, yellow stem borer green leafhopper and brown plant hoppers biotypes1, 2 and 3. Another variety tested was PSB Rc 72H or Mestizo which yielded an average of 6.3 tons/ hectare and the highest yield of 11.4 tons/ hectare was attained in Nueva Ecija, Laguna, Cotabato, Aurora and Palawan (DA-PhilRice, 1997).

Evaluating six varieties of rice at Cadtay, Kapangan, Benguet, Holanio (2001) found that PSB Rc 56 and PSB Rc 34 obtained the highest yield. In addition, PSB Rc 34 also performed well in a varietal research in Tagudtud, Bagulin, La Union with a mean yield of 4.3t/ha (Itong, 1997).

A variety trial was conducted in Tocucan, Bontoc, Mt. Province. Inchan (2003) found that among the varieties evaluated, SN-73 and Gohang performed well in terms of growth and yield. Another evaluation of six rice varieties was conducted in Gusaran, Kibungan, Benguet where Masegman (2005) found that SN-73, NCT 9 and NSIC 104 showed good performance particularly in terms of number of filled grains, yield and grains acceptability. On the other hand, the result of the evaluation of high yielding varieties conducted by Belino (2005) in Poblacion, Kibungan, Benguet showed that SN-73 and Rc 18 showed good performance in terms of grain yield and resistance to stem borer and rice blast.

According to Siteng (2005), seven high- yielding varieties were studied at Kadayakan, Maria Aurora. Results showed that all the entries performed well, particularly in grain yield in which all entries surpassed the National Average Yield of 3.5 tons/ hectare with SL 8H registering the highest yield of 5.3 tons/ hectare. However, a farmer observed in Solana, Cagayan that SL 8H is easily attack by diseases during wet season (Sosimo, 2006).

Among the varieties tested by Cawatig (2007) under Rizal, Kalinga condition, NSIC 112 and PSB Rc 18 were the best performing. Both had longer panicles, had greater number of filled grains, higher grain yield and more profitable to produce. NSIC 112 and PSB Rc 18 also showed good performance in Maria Aurora wherein NSIC 112 obtained 4.6 tons/ hectare and PSB Rc 18 yielded 4.8 tons/ hectare (Siteng, 2005).On the contrary PSB Rc 18 obtained the lowest harvest index and lowest yield with a mean of 0.43 and 1.83 tons/ hectare respectively, under Bugayong, Binalonan, Pangasinan (Urbano, 2008).

Among all the tests mentioned, PJ2 or NSIC Rc 104 was proven promising cold tolerant variety because of its good yielding ability in both dry and wet season under Benguet, Banaue and Mountain Province condition. Also, PSB Rc 26H is recommended for Cagayan and Isabela, although it performed well in Camarines Sur, Iloilo, Cotabato, Laguna, Bohol, Masbate, Palawan, Capiz, Pangasinan, Agusan del Sur and Zamboanga del Sur. PSB Rc 72H performed well in Nueva Ecija, Laguna, Cotabato, Aurora and Palawan while PSB Rc 34 showed good performance in Kapangan, Benguet and Bagulin, La Union. SN-73 also performed well under Bontoc, Mt. Province and Kibungan, Benguet. SL8H was found to be the highest yielder in Maria Aurora but was observed to be attacked easily by diseases during wet season in Solana, Cagayan. NSIC112 and PSB Rc 18 performed best in Rizal, Kalinga and also showed good performance in Maria Aurora. However, PSB Rc 18 obtained the lowest harvest index and lowest yield in Binalonan, Pangasinan.

Nutrient Management

The rice plant requires an adequate supply of nutrients from various sources of optimal growth. The nutrients are supplied by indigenous sources such as soil minerals, soil organic matter, rice straw, manure and water, but sometimes the amount supplied is usually inefficient to achieve high and sustainable yields (PhilRice, 2003).

Proper management of nutrients improves crop growth and yield. It means giving the right kind and amount of nutrients at the right time. Rice plants grow and respond better to fertilizer when there is more sunlight (PhilRice-FAO, 2007).

Sufficient nutrients from tillering to panicle initiation and flowering will ensure good tillering, panicle development and attainment of yield potential (Yabes, 2008).

Pest Management

The use of resistant varieties is the first line of defense in pest management. Significant pest damage occurs when one or more pests caused damage to the rice plant wherein it affects the growth and yield of the crop (PhilRice-FAO, 2007).

According to PhilRice-FAO (2007), pest management is an integral component of rice production. Knowledge of the interactions of the rice crop with the biotic factors, agro-ecosystem and crop management system provide an accurate understanding of the destructive potential of pests. Correct pest identification and application of integrated crop management technologies (resistant variety, land preparation, date and method of crop establishment and pesticides) during crop development are needed for successful pest management.

Temperature Requirement

Temperature is an important aspect in the production of rice. The critical temperature is normally below 20^{o}C and the high temperature is above 30^{o}C. They vary from one growth stage to another and differ according to variety, duration of critical temperature, diurnal changes and physiological status of the rice plant (Rebuelta, 1997).

Vergara (1992) stated that warm temperature is needed to increase the growth activities inside seeds while low temperature (10^{o}C) decreases activities inside seeds. Very high temperature (40^{o}C or higher) decreases germination percentage. Too much heat can kill sprouting seeds. In addition Rebuelta (1997) stated that at temperature range of 22^{o}C to 31^{o}C, growth rate just after germination increases.

Temperature slightly affects tillering and relative growth rate except at 22^{o}C. With adequate sunlight, high temperature increases tiller number while spikelet number per plant increases as temperature drops (Rebuelta, 1997).

Plants grow faster at warm temperatures than at cool temperatures. Cool temperatures can cause leaves to yellow; some seedlings may eventually die. (Vergara, 1992). A mean temperature above 21°C is an optimum temperature for the growth of rice (FAO, 2009).

Harvesting, Threshing and Drying

According to PCCARD (2001) harvesting and its related handling operations are significant points in post production sequence where losses can be incurred.

PhilRice-FAO (2007) stated that timely harvesting and threshing ensure good grain quality, high market value, and consumer acceptance. Harvesting too early results in a larger percentage of immature grains and in low milling recovery. Harvesting too late leads to increased grain shattering and excessive losses in terms of breakage during milling.

Harvesting the crop is done when 20% of the grains at the base of the panicle are at hard dough stage and most of the grains in the panicle are golden yellow. Threshing immediately after harvest (not later than one day in wet season or two days in dry season) avoid heat build up in the grain that leads to grain discoloration and lower quality of milled rice (Yabes, 2008). Drying is done gradually up to 14% moisture content (RAFID, undated).

MATERIALS AND METHODS

The study used ten different varieties of rice which served as treatments:

VARIETY	SOURCE
T_1- NSIC Rc 130 (Tubigan 3)	PHILRICE
T_2- NSIC Rc 134 (Tubigan 4)	PHILRICE
T_3- NSIC Rc 138 (Tubigan 5)	PHILRICE
T_4- NSIC Rc 140(Tubigan 6)	PHILRICE
T_5- NSIC Rc 144 (Tubigan 8)	PHILRICE
T_6- NSIC Rc 146 (PJ-7)	PHILRICE
T_7- NSIC Rc 150 (Tubigan 9)	PHILRICE
T_8- NSIC Rc 154 (Tubigan 11)	PHILRICE
T_9- NSIC Rc 156 (Tubigan 12)	PHILRICE
T_{10}- PSB Rc 82 (Peñaranda) (Check)	BPI-NSQCS

Ten seedbeds, each measuring 1m x 1m were thoroughly prepared for the sowing of the ten high yielding rice varieties at 0.3 kg per variety. Each variety was sown separately in beds with proper labels for easy identification and to avoid mixtures.

An experimental area of 360 m^2 was prepared and divided into 30 plots with a dimension of 2m x 6m each. The land was prepared thoroughly before transplanting; the soil was puddled and leveled for easy transplanting as shown in Figure 1.

The experimental area was flash-irrigated one week before plowing that allowed decomposition of rice stubbles and weeds, and allowed dropped seeds and weed seeds to germinate. Plowing and harrowing was done twice each at one week interval. Plots were leveled accordingly. The field was provided with 2-5 cm water depth before transplanting.

Lay-outing, Transplanting and Replanting

The experimental plots were laid out following the Randomized Complete Block Design (RCBD) in three replications and labeled accordingly.

Each of the ten varieties was transplanted 21 days after sowing (DAS) (Figure 2). The plant density was one seedling per hill at distances of 20 cm x 20 cm. Replanting was done 5-10 days after transplanting (DAT) to ensure that all hills have growing plants.

Fertilizer Application

The recommended rate of 67-21-21 kg/ha NPK was applied using 150 kg/ha of urea and 150 kg/ha of T-14.

The recommended amount of T-14 was broadcasted at 10-14 days after transplanting (DAT) at 2-3 cm water level during the first application, while the application of N fertilizer was applied following the leaf color chart (LCC) recommendation. LCC reading started at 21 days after transplanting (DAT) and every seven days thereafter until flowering.

Pest Management

Regular field monitoring was conducted to identify potential pests. Hand weeding was done when necessary after transplanting. Other recommended management practices were followed.

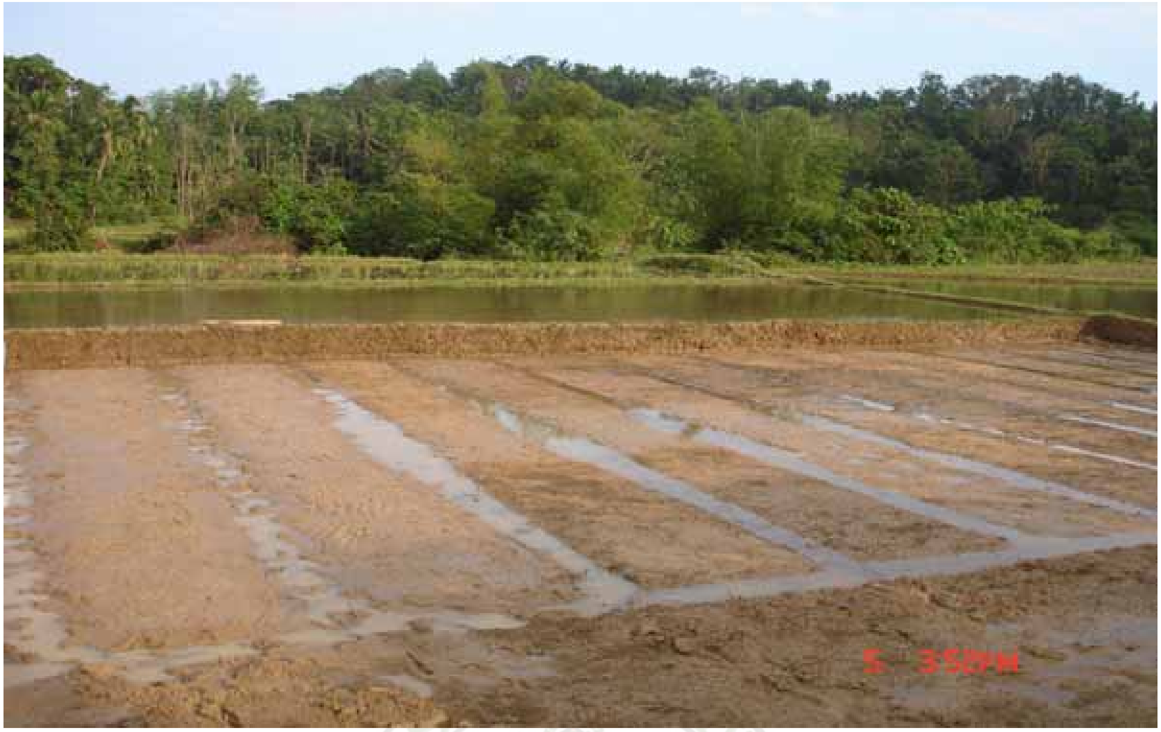

Figure 1. Overview of the experimental area after sowing in Sta. Lina, Luna, Apayao

Figure 2. Overview of the seedlings at 21 days after sowing

Data Gathered

1. Meteorological Data. The temperature, relative humidity, amount of rainfall and sunshine duration during the study were taken from Cagayan PAGASA station at Tuguegarao City.

2. Height of seedlings one week after transplanting (cm). The height of seedlings per variety was measured from the base to the tip of the longest leaf using 10 sample hills per plot, one week after transplanting.

3. Number of days from transplanting to tillering. This was taken when 50% of the total plants in a plot started producing tillers.

4. Number of tillers at maximum tillering stage. The number of tillers when the flag leaf of the rice plant had emerged was counted using 10 hills per plot.

5. Number of productive tillers per hill. The number of productive tillers was counted using 10 sample hills selected at random. Only rice plants which produced panicles were counted and considered.

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

7. Number of days from booting to heading. This was taken when at least 50% of the total plants produced panicles per treatment.

8. Number of days from heading to ripening. This was taken when 80% of the grains in the panicle have turned yellow.

9. Final height at harvest (cm). This was measured from the soil surface to the tip of the longest panicle taken at 86 DAT.

10. Insect Pest Evaluation (Stem borer). Field rating of rice stem borers was based on actual percentage of dead hearts and white heads. Dead hearts was counted 45 days after transplanting while white heads, 10 days before harvesting (DBH). For both dead heart and white heads, the following standard was used (PhilRice, 1996).

Scale	% Dead hearts	% Whiteheads	Remarks
1	1-10	1-5	Resistant
3	11-20	6-10	Moderately Resistant
5	21-30	11-15	Intermediate
7	31-60	16-25	Moderately Susceptible
9	60 and above	25 and above	Susceptible

11. Blast Disease Evaluation (Neck Rot). Evaluation of the severity of the rice blast (neck rot) was taken from the plants at the center rows. Ten hills taken at random were used. The following standard was used (PhilRice, 1996):

$$\% \text{ Infestation} = \frac{\text{Number of panicles infected}}{\text{Total number of panicles}} \times 100$$

Index	%Blast infection	Rating
1	0-5	Resistant
2	6-25	Intermediate
3	25 and above	Susceptible

12. Length of panicle at harvest (cm). This was measured from the panicle tip excluding the awn using 10 sample plants per plot taken at random.

13. Number of filled and unfilled grains per panicle. This was recorded by counting the number of filled and unfilled grains at ripening using ten sample panicles per treatment.

14. Weight of 1000 filled grains (g). One thousand seeds were selected at random after drying at 14% moisture content then weighed.

15. Yield per plot(kg). The grains were dried to approximately 14 % moisture content after harvest. The filled grains were separated from the unfilled grains by winnowing. Only the filled grains were used to obtain the grain weight or yield per plot.

16. Yield per hectare (tons/ha). This was taken by converting the grains per plot into hectare using ratio and proportion where:

$$\text{Yield per hectare (tons/ha)} = \frac{\text{Yield (kg/plot)}}{12\text{m}^2} \times \frac{10{,}000\text{m}^2}{1 \text{ hectare}} \times \frac{1 \text{ ton}}{1000 \text{ kg}}$$

17. Return on Cash Expense (ROCE). This was obtained by using the formula:

$$\text{ROCE} = \frac{\text{Gross sales- total expenses}}{\text{Total expenses}} \times 100$$

Data Analysis

All quantitative data were analyzed using the analysis of variance (ANOVA) for Randomized Complete Block Design (RCBD). The significance of difference among the treatment means was tested using the Duncan’s Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Agroclimatic Data

Shown in Table 1 is the agroclimatic information which includes the temperature, relative humidity, mean rainfall and sunshine duration during the conduct of the study. It was observed that the temperature was high and relative humidity was low during the month of March. Rainfall was high during the month of November and low during the month of March while mean sunshine duration was high during the month of February and low during the month of January.

Vergara (1992) stated that a favorable temperature for growing rice ranges from 30–35^{o}C. According to Rebuelta (1997), temperature slightly affects tillering and relative growth rate except at 22^{o}C. With adequate sunlight, high temperature increases tiller number while spikelet number per plant increases as temperature drops.

The temperature ranges during the study is favorable for the growth and development of rice.

Table 1. Agroclimatic data from November 2009 to March 2010

MONTH	TEMPERATURE (^{o}C)		RELATIVE HUMIDITY (%)	MEAN RAINFALL (mm)	SUNSHINE DURATION (min)
	MIN.	MAX.			
NOVEMBER 2009	20.60	30.20	82	4.88	170.50
DECEMBER 2009	17.00	28.30	82	1.16	162.10
JANUARY 2010	17.50	28.70	82	0.51	159.10
FEBRUARY 2010	18.90	33.10	79	0.40	230.70
MARCH 2010	19.50	34.00	74	0.20	211.10

Height of Seedlings One Week after Transplanting

The average height of seedlings one week after transplanting is shown in Table 2. Results showed that highly significant differences existed among the different varieties. NSIC Rc 146 was the tallest among the ten varieties with a mean of 25.44 cm followed by NSIC Rc 150 (24.64 cm.). The shortest seedling was observed in NSIC Rc 130 with a height of 21.55cm. The significant differences could be due to varietal characteristics.

Table 2. Height of seedlings one week after transplanting and final height of the ten high yielding rice varieties

VARIETY	SEEDLING HEIGHT AT 7 DAT (cm)	FINAL HEIGHT AT 86 DAT (cm)
NSIC Rc 130	21.55^{c}	94^{abcd}
NSIC Rc 134	23.57^{ab}	98^{a}
NSIC Rc 138	23.07^{bc}	96^{ab}
NSIC Rc 140	22.60^{bc}	95^{abc}
NSIC Rc 144	23.60^{bc}	97^{a}
NSIC Rc 146	25.44^{a}	97^{a}
NSIC Rc 150	24.64^{a}	91^{cd}
NSIC Rc 154	24.06^{ab}	92^{bcd}
NSIC Rc 156	23.02^{ab}	90^{cd}
PSB Rc 82(check)	22.72^{bc}	98^{a}
C.V. (%)	3.55	2.34

*Means with the same letters are not significantly different at 0.05 level of DMRT

Final Height at 86 DAT

Plant height at 86 DAT is shown in Table 2. It was observed that NSIC Rc 134 and PSB Rc 82 (check variety) were the tallest among the ten varieties with a mean of 98 cm followed by NSIC Rc 144 and NSIC Rc 146 with a mean of 97 cm. The shortest among the varieties evaluated was NSIC Rc 156 with a mean of 90 cm. Highly significant differences could be attributed to their genetic make-up.

According to Vergara (1992) reduced plant height is the most important factor to increase the grain yield potential of rice. Shorter plants can take up more nitrogen fertilizer without lodging, resulting in higher grain yields.

Number of Tillers at Maximum Tillering Stage

The number of tillers at maximum tillering stage was recorded when the flag leaf of the rice plant came out. Table 3 shows that NSIC Rc 150 produced the highest number of tillers with a mean of 29 which could mean that it could have more panicles and could probably have higher yield. It was followed by NSIC Rc 156 with a mean of 28 tillers. NSIC Rc 140, NSIC Rc 144 and PSB Rc 82 (check variety) recorded the lowest number of tillers with a mean of 21. No other marked differences among the varieties were noted.

Vergara (1992) stated that varieties differ in tillering ability. Rice generally produces more tillers during wet season than during dry season. Enough water, right amount of fertilizer, proper spacing, and good weed control produce the most tillers. The number of tillers determines the number of panicles and is the most important factor in achieving high grain yield. Poor tillering or low tiller number can partially be compensated for by increasing spikelet fertility or the weight per grain. Pest or disease damage during early growth can reduce the number of panicles.

Table 3. Number of tillers at maximum tillering stage and number of productive tillers per hill of ten high yielding rice varieties

VARIETY	NUMBER OF		
	TILLERS AT MAXIMUM TILLERING STAGE	PRODUCTIVE TILLERS	
		PER HILL	% OF THE TOTAL
NSIC Rc 130	26	13	50
NSIC Rc 134	26	17	65
NSIC Rc 138	25	14	56
NSIC Rc 140	21	14	67
NSIC Rc 144	21	13	62
NSIC Rc 146	27	16	59
NSIC Rc 150	29	17	59
NSIC Rc 154	26	14	54
NSIC Rc 156	28	15	54
PSB Rc 82(check)	21	15	71
C.V. (%)	11.67	16.39	

Number of Productive Tillers per Hill

The number of productive tillers is shown in Table 3. NSIC Rc 134 and NSIC Rc 150 produced the highest productive tillers with a mean of 17 followed by NSIC Rc 146 with a mean of 16. On the other hand, NSIC Rc 130 and NSIC Rc 144 produced the lowest number of productive tillers with a mean of 13. More productive tillers mean higher yield potential. No other marked differences among the varieties were noted.

In terms of the ratio of the productive tillers over the total number of tillers, PSB Rc 82 was the highest (71%) followed by NSIC Rc 140 (67%) and NSIC Rc 134 (65%). This could mean that the foregoing three varieties could utilize resources such as water more efficiently.

According to Vergara (1992), modern varieties have more tillers than traditional varieties. Tillers formed during the late growth stages are usually non- productive. Either the tillers die or the panicles produced are too small and ripen late. Mutual shading, competition among tillers or lack of nutrients (especially nitrogen) may cause tiller loss.

In addition, the number of tillers determines the number of panicles and is the most important factor in achieving high grain yield. Poor tillering or low tiller number can partially be compensated for by increasing spikelet fertility or the weight per grain.

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

Table 4 shows the number of days from transplanting to tillering. Observations showed that NSIC Rc 134, NSIC Rc 140, NSIC Rc 146, NSIC Rc 150 and NSIC Rc 156 have the same number of days (7) from transplanting to tillering while PSB Rc 82 (check variety) had a longer period of 10 days from transplanting to tillering. Such significant differences could be due to the manner of planting and could be attributed by the adaptability of the different varieties to Sta. Lina, Luna, Apayao condition. Deep planting delays tillering (Vergara, 1992).

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

As gleaned from Table 4, NSIC Rc 144 significantly booted earlier in 49 days from the time of transplanting followed by NSIC Rc 140 and PSB Rc 82, the check variety with a mean of 52 days to booting. In contrast, NSIC Rc 134, NSIC Rc 146, NSIC Rc 150, NSIC Rc 154 and NSIC Rc 156 took 56 days to boot from the time it was transplanted.

Earlier booting could mean earlier maturity. Along this line, it appears that NSIC Rc 144, NSIC Rc 140 and PSB Rc 82 were early maturing varieties under Luna, Apayao condition.

Table 4. Number of days from transplanting to tillering, transplanting to booting, booting to heading, and heading to ripening of ten high yielding rice varieties

VARIETY	NUMBER OF DAYS FROM			
	TRANSPLANTING TO TILLERING	TRANSPLANTING TO BOOTING	BOOTING TO HEADING	HEADING TO RIPENING
NSIC Rc 130	8	54	9	26
NSIC Rc 134	7	56	9	27
NSIC Rc 138	9	55	10	26
NSIC Rc 140	7	52	11	27
NSIC Rc 144	8	49	10	25
NSIC Rc 146	7	56	9	26
NSIC Rc 150	7	56	9	27
NSIC Rc 154	9	56	9	28
NSIC Rc 156	7	56	9	29
PSB Rc 82(check)	10	52	8	25
C.V. (%)	13.35	2.52	12.84	3.91

Number of Days from Booting to Heading

The number of days from booting to heading is shown in Table 4. Observation shows that PSB Rc 82 (check variety) took 8 days from booting to heading followed by NSIC Rc 130, NSIC Rc 134, NSIC Rc 146, NSIC Rc 150 and NSIC Rc 156 which have the same number of days (9) from booting to heading. NSIC Rc 140 was the latest to produce heads which took 11 days.

The reaction of varieties from booting to heading may not always be due to genetic make-up but also influenced by temperature (Yoshida, 1981).

Number of Days from Heading to Ripening

Table 4 and Figure 3a and 3b show the number of days from heading to ripening. Highly significant differences among the varieties were observed. NSIC Rc 144 and PSB Rc 82 (check variety) ripened in 25 days which was 1-4 days earlier than the rest. It was followed by NSIC Rc 130, NSIC Rc 138 and NSIC Rc 146 with means of 26 days. NSIC Rc 156 ripened later in 29 days. This shows that varieties differ in their performance and adaptability to the locality.

Figure 3a. Overview of NSIC Rc 130, NSIC Rc 134, NSIC Rc 138, NSIC Rc 140 and NSIC Rc 144 at ripening stage

Figure 3b. Overview of NSIC Rc 146, NSIC Rc 150, NSIC Rc 154, NSIC Rc 156 and PSB Rc 82 at ripening stage

Reaction to Stemborer

Evaluation of stem borer expressed as deadhearts and whiteheads was done 45 days after transplanting and 10 days before harvesting. All the varieties were found to be resistant to deadhearts (Table 5). On whiteheads evaluation, most of the varieties were resistant but NSIC Rc 146 was moderately resistant.

Varieties differ in reactions to different insect pests (Vergara, 1992).

Table 5. Reaction to stemborer and rice blast of the ten high yielding rice varieties

VARIETY	DEAD-HEARTS	WHITE-HEADS	BLAST (NECK ROT)
NSIC Rc 130	Resistant	Resistant	Resistant
NSIC Rc 134	Resistant	Resistant	Intermediate
NSIC Rc 138	Resistant	Resistant	Intermediate
NSIC Rc 140	Resistant	Resistant	Resistant
NSIC Rc 144	Resistant	Resistant	Resistant
NSIC Rc 146	Resistant	Moderately Resistant	Intermediate
NSIC Rc 150	Resistant	Resistant	Resistant
NSIC Rc 154	Resistant	Resistant	Intermediate
NSIC Rc 156	Resistant	Resistant	Susceptible
PSB Rc 82(check)	Resistant	Resistant	Resistant

Reaction to Blast (Neck Rot)

Rice blast evaluation was taken before harvest. It was observed that NSIC Rc 130, NSIC Rc 140, NSIC Rc 144, NSIC Rc 150 and PSB Rc 82 (check variety) were resistant to the disease. On the contrary, NSIC Rc 156 was recorded to be susceptible and the rest of the varieties were found to be intermediate (Table 5). Varieties differ in reactions to different diseases (Vergara, 1992).

Length of Panicle at 86 DAT

The length of panicle at 86 days after transplanting is shown in Table 6. It was noted that NSIC Rc 138 and NSIC Rc 140 had the longest panicle (24cm) followed by NSIC Rc 146 and NSIC Rc 150 (23cm). NSIC Rc 134 and PSB Rc 82 (check variety) had the shortest panicle with a mean of 21 cm.

Modern varieties have many but small or short panicles. The length of the panicle is a fair gauge of the number of grain produced and probably also the yield (Vergara, 1992).

Number of Filled Grains per Panicle

Table 7 shows the number of filled grains per panicle. It was observed that NSIC Rc 130 had the highest number of filled grains per panicle with a mean of 140. It was followed by NSIC Rc 156 with a mean of 127, NSIC Rc 134 and NSIC Rc 154 with a mean of 120. NSIC Rc 138 had the lowest number of filled grains per panicle with a mean of 89. The difference between the number of filled grains per panicle is about 51.

Highly significant differences are attributed to the compactness of grains in the panicle. Vergara (1992) stated that enough leaves are necessary to ensure many spikelets

Table 6. Length of panicle at 86 DAT of the ten high yielding rice varieties

VARIETY	LENGTH (cm)
NSIC Rc 130	22
NSIC Rc 134	21
NSIC Rc 138	24
NSIC Rc 140	24
NSIC Rc 144	22
NSIC Rc 146	23
NSIC Rc 150	23
NSIC Rc 154	22
NSIC Rc 156	22
PSB Rc 82(check)	21
C.V. (%)	10.21

per panicle and also to fill these spikelets. A percentage of filled spikelets greatly depend on the environmental conditions.

Number of Unfilled Grains per Panicle

The number of unfilled grains is shown in Table 7. It was noted that NSIC Rc 144 had the lowest number of unfilled grains with a mean of 10 followed by PSB Rc 82 (check variety) with a mean of 13. NSIC Rc 130 had the highest number of unfilled grains with a mean of 36.

The significant differences could have been due to the high temperature during the conduct of the study (33.10- 34 ^{o}C). A low percentage of filled spikelets can result if temperature at flowering is too low (less than 20 ^{o}C) or too high (above 30^{o}C) (Vergara, 1992).

Table 7. Number of filled and unfilled grains and weight of 1000 filled grains of the ten high yielding rice varieties

VARIETY	NUMBER OF GRAINS		WEIGHT OF 1000 GRAINS (g)
	FILLED	UNFILLED	
NSIC Rc 130	140[a]	36[a]	23.88[bc]
NSIC Rc 134	120[abc]	20[bcde]	24.40[abc]
NSIC Rc 138	89[d]	28[abc]	25.88[a]
NSIC Rc 140	117[abc]	20[bcde]	25.87[a]
NSIC Rc 144	103[bcd]	10[e]	21.08[d]
NSIC Rc 146	94[cd]	23[bcd]	25.58[ab]
NSIC Rc 150	117[abc]	16[de]	23.75[bc]
NSIC Rc 154	120[abc]	18[cde]	22.78[c]
NSIC Rc 156	127[ab]	29[ab]	20.32[d]
PSB Rc 82(check)	103[bcd]	13[de]	24.19[abc]
C.V. (%)	12.22	26.66	4.23

*Means with the same letters are not significantly different at 0.05 level of DMRT

Weight of 1000 Filled Grains

The weight of 1000 filled grains is shown in Table 7. Results showed that NSIC Rc 138 had the heaviest weight of 1000 filled grains with a mean of 25.88 g followed by NSIC Rc 140 and NSIC Rc 146 with a mean of 25.87g and 25.88 g, respectively. The lowest weight was obtained from NSIC Rc 156 with a mean of 20.32 g. Highly significant differences could be due to grain characteristics.

Yield per 12 m^2 and per Hectare

Grain yield per 12 m^2 and per hectare is shown in Table 8 and Figure 4. Result showed that NSIC Rc 150 produced the highest yield with a mean of 7.80 kg/ 12m^2 or 6.50 tons/ha followed by NSIC Rc 140 and NSIC Rc 134 with a mean yield of 7.57 kg/12m^2 or 6.31 tons/ha and 7.30 kg/12m^2 or 6.09 tons/ha, respectively. NSIC Rc 144 produced the lowest yield with a mean of 5.62 kg/12m^2 or 4.68 tons/ha.

Highly significant differences could be attributed to the yielding ability of the different varieties. Yield is normally a function of genetic make-up and environmental conditions.

Modern varieties have greater yield potential than traditional varieties even under the best conditions. Improved farming practices will also increase grain yield in modern varieties (Vergara, 1992).

Table 8. Yield per 12m^2 and per hectare of the ten high yielding rice varieties

VARIETY	YIELD	
	PER 12m^2 (kg)	PER HECTARE (tons)
NSIC Rc 130	6.43^{ef}	5.35^{ef}
NSIC Rc 134	7.30^{abc}	6.09^{abc}
NSIC Rc 138	6.59^{def}	5.49^{def}
NSIC Rc 140	7.57^{ab}	6.31^{ab}
NSIC Rc 144	5.62^{g}	4.68^{g}
NSIC Rc 146	6.75^{cde}	5.63^{cde}
NSIC Rc 150	7.80^{a}	6.50^{a}
NSIC Rc 154	7.14^{bcd}	5.95^{bcd}
NSIC Rc 156	6.02^{fg}	5.01^{fg}
PSB Rc 82(check)	6.71^{cde}	5.59^{de}
C.V. (%)	4.85	4.87

*Means with the same letters are not significantly different at 0.05 level of DMRT

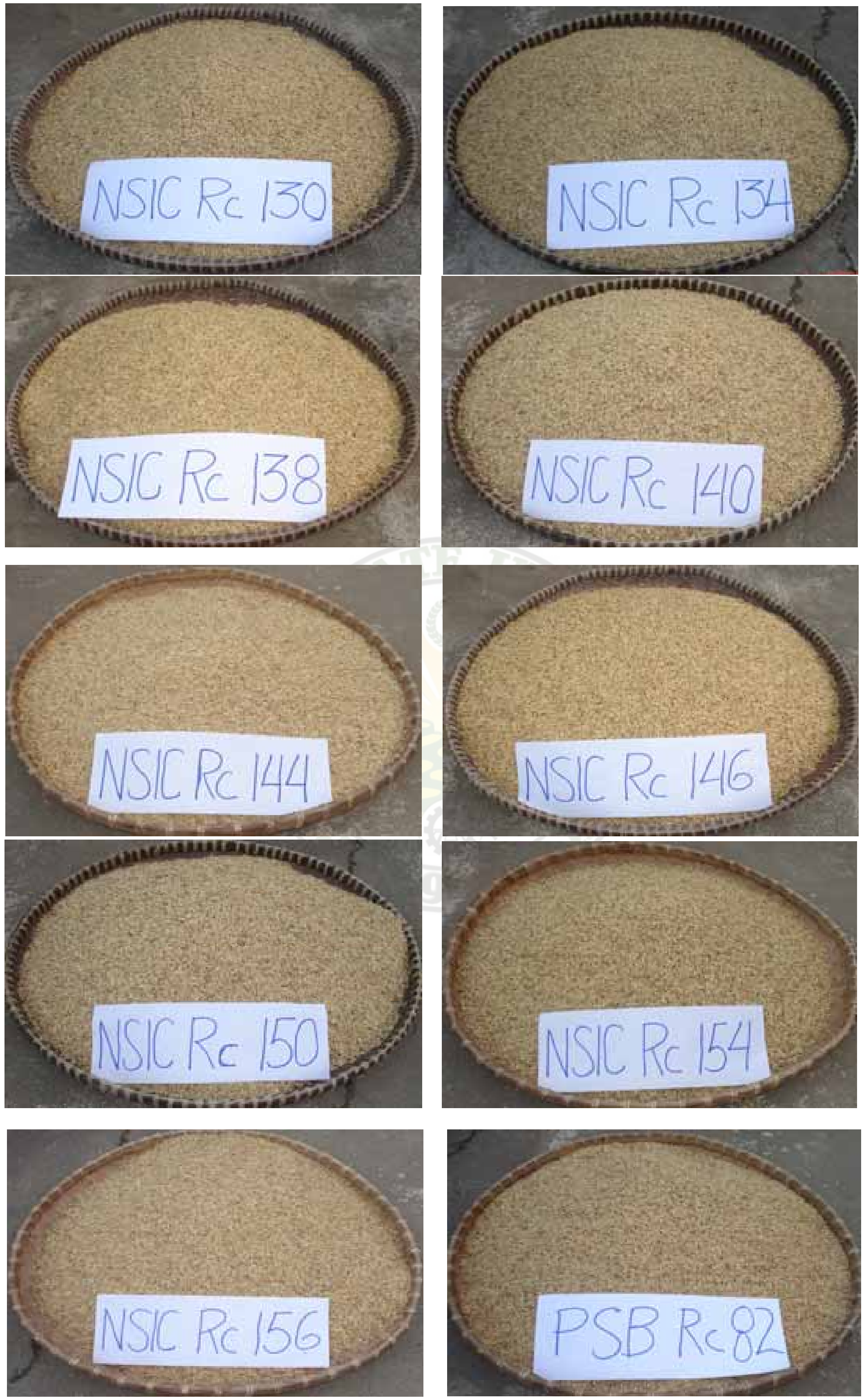
NSIC Rc 130
NSIC Rc 134
NSIC Rc 138
NSIC Rc 140
NSIC Rc 144
NSIC Rc 146
NSIC Rc 150
NSIC Rc 154
NSIC Rc 156
PSB Rc 82

Figure 4. Overview of the rice grains of the ten high yielding rice varieties

Return on Cash Expense

Table 9 shows that all the varieties had positive ROCE. NSIC Rc 150 and NSIC Rc 140 had the highest return on cash expenses of 39.12% and 35.02%, respectively. NSIC Rc 144 had the lowest return on cash expenses of 0.24%. These results indicate that the varieties used could be profitably grown in Barangay Sta. Lina, Luna, Apayao.

Table 9. Return on cash expense of rice production using ten high yielding rice varieties ($12m^2$)

VARIETIES	GRAIN YIELD PER $12m^2$ (kg)	GROSS INCOME (PhP)	COST OF PRODUCTION (PhP)	NET INCOME (PhP)	ROCE (%)
NSIC Rc 130	6.43	109.31	95.31	14.00	14.69
NSIC Rc 134	7.30	124.10	95.31	28.79	30.12
NSIC Rc 138	6.59	112.03	95.31	16.72	17.54
NSIC Rc 140	7.57	128.69	95.31	33.38	35.02
NSIC Rc 144	5.62	95.54	95.31	0.23	0.24
NSIC Rc 146	6.75	114.75	95.31	19.44	20.40
NSIC Rc 150	7.80	132.60	95.31	37.29	39.12
NSIC Rc 154	7.14	121.38	95.31	26.07	27.35
NSIC Rc 156	6.02	102.34	95.31	6.69	7.02
PSB Rc 82(check)	6.71	114.07	95.31	18.76	19.68

Note: The selling price of rice grains is based on 17 PhP / kilogram.

SUMMARY, CONCLUSIONS AND RECOMMENDATION

Summary

The study was conducted to evaluate the growth and yield of ten high yielding rice varieties in Luna, Apayao; determine the best variety adapted in terms of growth, yield and resistance to insect pest and diseases in Luna, Apayao condition; and to determine the Return on Cash Expense (ROCE) of growing high yielding rice varieties in Luna, Apayao.

Highly significant differences were observed among the varieties. NSIC Rc 134 and PSB Rc 82 were the tallest but had the shortest panicle. NSIC Rc 156 was the shortest in terms of height.

NSIC Rc 144 was the earliest to boot and PSB Rc 82 (check variety) was the first to produce heads. NSIC Rc 144 and PSB Rc 82 ripened first. NSIC Rc 140 was the latest to produce head but NSIC Rc 156 was the latest to ripen.

NSIC Rc 134 and NSIC Rc 150 produced the highest number of productive tillers. NSIC Rc 130 and NSIC Rc 144 produced the lowest number of productive tillers but NSIC Rc 130 produced the highest number of filled and unfilled grains. NSIC Rc 138 and NSIC Rc 140 had the longest panicle at harvest.

All the varieties were resistant to stemborer but NSIC Rc 144 was moderately resistant. On blast evaluation, NSIC Rc 156 was susceptible.

NSIC Rc 138 and NSIC Rc 140 had the heaviest weight of 1000 filled grains. NSIC Rc 150 obtained the highest grain yield and also highest return on cash expenses followed by NSIC Rc 140 and NSIC Rc 134.

Conclusions

Based on the results of the study, NSIC Rc 150 and NSIC Rc 140 were the shortest plants, produced the highest productive tillers per hill, and were the highest yielders.

Both varieties were also resistant to deadhearts, whiteheads and neck rot. In addition, they also had the highest return on cash expenses.

Recommendation

Based on the results and observations of the study, NSIC Rc 150 and NSIC Rc 140 are recommended at Sta. Lina, Luna, Apayao due to high yield and return on cash expenses as well as resistance to stemborer and rice blast.

LITERATURE CITED

BELINO, M. S. 2005. Evaluation of high yielding varieties of rice under Poblacion, Kibungan, Benguet condition. BS Thesis, Benguet State University, La Trinidad, Benguet. P.30

BRUCE, J. V., E. NOVENO, B. RAYCO, B. TOLENTINO and I. VILLAPANDO. 2001.101 Facts about rice in the Philippines. P.47

CAWATIG, J. K. 2007. Seed production of rice varieties applied with animal manures mixed with dolomite under Rizal, Kalinga condition. BS Thesis, Benguet State University, La Trinidad, Benguet. P.33

DA -PHILRICE. 1997. Questions and answers on hybrid rice. December 1997. P.6

FOOD AND AGRICULTURE ORGANIZATION. 2009. *Oryza sativa* L. FAO of the United Nations.Accessed at http://www.fao.org// on August 14,2009.

HOLANIO, M. S. 2001. Evaluation of high yielding varieties of rice under Cadtay, Kapangan, Benguet condition. BS Thesis, Benguet State University, La Trinidad, Benguet. P.4

INCHAN, E. P. 2003. Varietal evaluation of rice in Tocucan, Bontoc, Mt. Province. BS Thesis, Benguet State University, La Trinidad, Benguet. P.25

ITONG, E. G. 1997. Varietal evaluation of high yielding varieties under Tagudtud, Bagulin, La Union. BS Thesis, Benguet State University, La Trinidad, Benguet. P.6

MASEGMAN, H. B. 2005. Evaluation of rice varieties under Gusaran, Kabayan, Benguet condition. BS Thesis, Benguet State University, La Trinidad, Benguet. Pp.26-27

MATEO, J. M. 2000. Growth and yield performance of high yielding varieties of rice under Tubo, Abra Condition. BS Thesis, Benguet State University, La Trinidad, Benguet. P.1

PABLICO, S. M. 2002. PJ2 now a variety for the highlands. PhilRice Newsletter Special Issue.15:1. P.6

PHILIPPINE COUNCIL OF AGRICULTURE IN FORESTRY RESOURCE RESEARCH AND DEVELOPMENT. 2001. The Philippine recommends for rice production and post production operations. Los Baños, Laguna. P.7

PHILIPPINE RICE RESEARCH INSTITUTE- FOOD AND AGRICULTURE ORGANIZATION. 2007. Palay check system for irrigated lowland rice. Philippine Rice Research Institute. Maligaya, Science City of Muñoz, Nueva Ecija. Pp. 28, 42, 45, 52

PHILIPPINE RICE RESEARCH INSTITUTE. 2003. Philippine rice production training manual. Philippine Rice Research Institute. Maligaya, Science City of Muñoz, Nueva Ecija. P.77

PHILIPPINE RICE RESEARCH INSTITUTE. 2004. Rice production technoguide. Los Baños, Philippines. P. 22

REBUELTA, P. I. 1997. Rice specialist training course on IPM- Weather, climate and rice production. March 12, 1997. PhilRice, Maligaya, Muñoz, Nueva Ecija. P.1

REGIONAL AGRICULTURE AND FISHERIES INFORMATION DIVISION (RAFID). Undated. Hybrid rice technology. Department of Agriculture Regional Field Unit I. Sevilla, San Fernando City,La Union. P.21

SEBASTIAN, L. S., C. T. BRIONES, M. C. CASIMERO, A. C. CASTANEDA, S. R. FRANCISCO, L. C. JAVIER, M. J. MARIANO, J. J. RABARA. 2008. Philippine rice self-sufficiency master plan 2009-2010. August 8, 2008. Philippine Rice Research Institute. Maligaya, Science City of Muñoz, Nueva Ecija. P.11

SITENG, B. T. 2005. Performance of high yielding varieties of rice under Kadayakan, Maria Aurora condition. BS Thesis, Benguet State University, La Trinidad, Benguet. P.26

SOSIMO, M. D. 2006. Manila Bulletin Agriculture Magazine- New and upcoming varieties from PhilRice. This engineer is a successful rice farmer. April 2006. P.29

URBANO, R. R. 2008. Evaluation of high yielding varieties of rice under Bugayong, Binalonan, Pangasinan condition. BS Thesis. Benguet State University, La Trinidad,Benguet. P.32

VERGARA, B. S. 1992. A farmer’s primer on growing rice. International Rice Research Institute. Pp. 7,15,23,94,96,125,164,165,208

YABES, S. I. 2008. Palay check- Field Operations Manual. July 2008. Philippine Rice Research Institute. Maligaya, Science City of Muňoz, Nueva Ecija. Pp.1,13,14,15

YOSHIDA, S. 1981.Fundamentals of rice crop science. International Rice Research Institute. Los Baňos, Laguna, Philippines. Pp. 3-4

APPENDICES

Appendix Table 1. Height of seedlings one week after transplanting (cm)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	21.10	22.00	22.00	64.66	21.55
NSIC Rc 134	22.40	24.70	24.00	70.72	23.57
NSIC Rc 138	21.90	24.00	23.00	69.22	23.07
NSIC Rc 140	23.80	22.90	21.00	67.81	22.60
NSIC Rc 144	23.60	23.00	22.00	69.08	23.03
NSIC Rc 146	25.70	26.00	25.00	76.33	25.44
NSIC Rc 150	25.60	24.70	24.00	73.93	24.64
NSIC Rc 154	24.90	24.20	23.00	72.19	24.06
NSIC Rc 156	24.50	23.50	23.00	70.86	23.62
PSB Rc 82 (check variety)	23.50	22.40	22.00	68.17	22.723
TOTAL	237	237	229	703	234

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	4.49	2.25			
Treatment	9	35.24	3.92	5.66**	2.46	3.60
Error	18	12.46	0.69			
TOTAL	29	52.20				

Higly significant Coefficient of Variation (%) = 3.55

Appendix Table 2. Number of days from transplanting to tillering

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	7	7	10	24	8
NSIC Rc 134	8	7	7	22	7
NSIC Rc 138	10	10	8	28	9
NSIC Rc 140	7	7	7	21	7
NSIC Rc 144	8	7	10	25	8
NSIC Rc 146	7	7	7	21	7
NSIC Rc 150	7	7	8	22	7
NSIC Rc 154	10	10	7	27	9
NSIC Rc 156	8	7	7	22	7
PSB Rc 82 (check variety)	10	10	10	30	10
TOTAL	82	79	81	242	81

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.47	0.23			
Treatment	9	30.53	3.39	2.93**	2.46	3.60
Error	18	20.87	1.16			
TOTAL	29	51.87				

Highly significant Coefficient of Variation (%) = 13.35

Appendix Table 3. Number of tillers at maximum tillering stage

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	20	26	27	72.5	24
NSIC Rc 134	23	27	27	77.1	26
NSIC Rc 138	23	26	25	74.4	25
NSIC Rc 140	23	20	20	63.3	21
NSIC Rc 144	19	22	21	62.3	21
NSIC Rc 146	29	25	26	79.5	27
NSIC Rc 150	34	26	26	86.0	29
NSIC Rc 154	27	26	25	77.1	26
NSIC Rc 156	28	28	28	83.6	28
PSB Rc 82 (check variety)	22	20	21	62.6	29
TOTAL	248	245	245	738	246

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	15.00	7.50			
Treatment	9	153.37	17.04	1.99^{ns}	2.46	3.60
Error	18	154.33	8.57			
TOTAL	29	322.70				

Non- significant   Coefficient of Variation (%) = 11.67

Appendix Table 4. Number of productive tillers

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	12	13	13	38	13
NSIC Rc 134	19	13	19	51	17
NSIC Rc 138	12	16	14	42	14
NSIC Rc 140	13	14	16	43	14
NSIC Rc 144	13	14	12	39	13
NSIC Rc 146	16	14	17	47	16
NSIC Rc 150	23	15	14	52	17
NSIC Rc 154	14	14	14	42	14
NSIC Rc 156	14	18	14	46	15
PSB Rc 82 (check variety)	14	15	17	46	15
TOTAL	150	146	150	446	148

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.07	0.53			
Treatment	9	65.47	7.27	1.22^{ns}	2.46	3.60
Error	18	106.93	5.94			
TOTAL	29	173.47				

Non- significant

Coefficient of Variation (%) = 16.39

Appendix Table 5. Number of days from transplanting to booting

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
NSIC Rc 130	54	54	54	162	54
NSIC Rc 134	57	56	54	167	57
NSIC Rc 138	57	56	53	166	55
NSIC Rc 140	54	49	54	157	52
NSIC Rc 144	50	48	50	148	49
NSIC Rc 146	56	55	56	167	56
NSIC Rc 150	57	56	56	169	56
NSIC Rc 154	56	56	56	168	56
NSIC Rc 156	56	57	56	169	56
PSB Rc 82 (check variety)	51	53	53	157	52
TOTAL	548	540	542	1630	534

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	2	3.47	1.73			
Treatment	9	145.33	16.15	8.58**	2.46	3.60
Error	18	33.87	1.88			
TOTAL	29	182.67				

Highly significant

Coefficient of Variation (%) = 2.52

Appendix Table 6. Number of days booting to heading

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	8	10	9	27	9
NSIC Rc 134	9	8	11	28	9
NSIC Rc 138	8	11	12	31	10
NSIC Rc 140	10	13	11	34	11
NSIC Rc 144	9	11	9	29	10
NSIC Rc 146	9	10	9	28	9
NSIC Rc 150	10	9	9	28	9
NSIC Rc 154	10	8	9	27	9
NSIC Rc 156	9	10	9	28	9
PSB Rc 82 (check variety)	9	7	8	24	8
TOTAL	91	97	96	284	95

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	2.07	1.03			
Treatment	9	20.80	2.31	1.56^{ns}	2.46	3.60
Error	18	26.60	1.48			
TOTAL	29	49.47				

Non- significant

Coefficient of Variation (%) = 12.84

Appendix Table 7. Number of days from heading to ripening

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	27	25	26	78	26
NSIC Rc 134	26	28	27	81	27
NSIC Rc 138	25	27	26	78	26
NSIC Rc 140	26	29	27	82	27
NSIC Rc 144	25	24	26	75	25
NSIC Rc 146	27	25	26	78	26
NSIC Rc 150	27	26	27	80	27
NSIC Rc 154	29	28	27	84	28
NSIC Rc 156	29	30	28	87	29
PSB Rc 82 (check variety)	25	26	25	76	25
TOTAL	266	268	265	799	266

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.47	0.23			
Treatment	9	40.97	4.55	4.19**	2.46	3.60
Error	18	19.53	1.09			
TOTAL	29	60.97				

Highly significant

Coefficient of Variation (%) = 3.91

Appendix Table 8. Final height at 86 DAT (cm)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	93	95	93	281	94
NSIC Rc 134	94	98	102	294	98
NSIC Rc 138	95	98	96	289	96
NSIC Rc 140	94	94	98	286	95
NSIC Rc 144	97	97	96	290	97
NSIC Rc 146	97	99	96	292	97
NSIC Rc 150	92	93	88	273	91
NSIC Rc 154	92	93	90	275	92
NSIC Rc 156	92	87	92	271	90
PSB Rc 82 (check variety)	98	97	98	293	98
TOTAL	944	951	949	2844	948

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	2.60	1.30			
Treatment	9	229.47	25.50	5.17**	2.46	3.60
Error	18	88.73	4.93			
TOTAL	29	320.80				

Highly significant Coefficient of Variation (%) = 2.34

Appendix Table 9. Reaction to stemborer (Dead hearts)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	1	1	1	3	1
NSIC Rc 134	1	1	1	3	1
NSIC Rc 138	1	1	1	3	1
NSIC Rc 140	1	1	1	3	1
NSIC Rc 144	1	1	1	3	1
NSIC Rc 146	1	1	1	3	1
NSIC Rc 150	1	1	1	3	1
NSIC Rc 154	1	1	1	3	1
NSIC Rc 156	1	1	1	3	1
PSB Rc 82 (check variety)	1	1	1	3	1
TOTAL	10	10	10	30	10

Appendix Table 10. Reaction to stemborer (Whiteheads)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	1	1	1	3	1
NSIC Rc 134	1	1	1	3	1
NSIC Rc 138	1	1	1	3	1
NSIC Rc 140	1	1	1	3	1
NSIC Rc 144	1	1	1	3	1
NSIC Rc 146	7	1	1	9	3
NSIC Rc 150	1	1	1	3	1
NSIC Rc 154	1	1	1	3	1
NSIC Rc 156	1	1	1	3	1
PSB Rc 82 (check variety)	1	1	1	3	1
TOTAL	16	10	10	36	12

Appendix Table 11. Rice blast evaluation (Neck Rot)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	2	1	1	4	1.33
NSIC Rc 134	1	2	2	5	1.67
NSIC Rc 138	1	2	2	5	1.67
NSIC Rc 140	1	1	1	3	1.00
NSIC Rc 144	1	1	1	3	1.00
NSIC Rc 146	1	2	2	5	1.67
NSIC Rc 150	1	1	1	3	1.00
NSIC Rc 154	2	2	2	6	2.00
NSIC Rc 156	2	3	3	8	2.67
PSB Rc 82 (check variety)	1	1	1	3	1.00
TOTAL	13	16	16	45	15.38

Appendix Table 12. Length of panicle at 86 DAT (cm)

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
NSIC Rc 130	20	23	24	67	22
NSIC Rc 134	13	25	24	62	21
NSIC Rc 138	24	24	24	72	24
NSIC Rc 140	25	23	24	72	24
NSIC Rc 144	22	22	22	66	22
NSIC Rc 146	22	24	24	70	23
NSIC Rc 150	22	23	23	68	23
NSIC Rc 154	19	24	23	66	22
NSIC Rc 156	17	24	24	65	22
PSB Rc 82 (check variety)	16	23	23	62	21
TOTAL	200	235	235	670	223

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	2	54.20	27.10			
Treatment	9	31.20	3.47	0.65^{ns}	2.46	3.60
Error	18	95.80	5.32			
TOTAL	29	181.20				

Non- significant Coefficient of Variation (%) = 10.21

Appendix Table 13. Number of filled grains per panicle

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	142	137	142	421	140
NSIC Rc 134	123	130	106	359	120
NSIC Rc 138	87	84	97	268	89
NSIC Rc 140	143	87	121	351	117
NSIC Rc 144	105	101	103	309	103
NSIC Rc 146	79	91	111	281	94
NSIC Rc 150	105	121	124	350	117
NSIC Rc 154	114	134	111	359	120
NSIC Rc 156	138	111	131	380	127
PSB Rc 82 (check variety)	113	99	97	309	103
TOTAL	1149	1095	1143	3387	1129

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	175.20	87.60			
Treatment	9	6558.03	728.67	3.83**	2.46	3.60
Error	18	3427.47	190.42			
TOTAL	29	10160.70				

Highly significant

Coefficient of Variation (%) = 12.22

Appendix Table 14. Number of unfilled grains per panicle

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	48	35	25	108	36
NSIC Rc 134	28	15	18	61	20
NSIC Rc 138	27	32	26	85	28
NSIC Rc 140	22	17	20	59	20
NSIC Rc 144	9	9	11	29	10
NSIC Rc 146	27	24	17	68	23
NSIC Rc 150	13	17	17	47	16
NSIC Rc 154	26	13	16	55	18
NSIC Rc 156	23	35	28	86	29
PSB Rc 82 (check variety)	9	14	16	39	13
TOTAL	232	211	194	637	212

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	72.47	36.23			
Treatment	9	1710.03	190.00	5.93**	2.46	3.60
Error	18	576.87	32.05			
TOTAL	29	2359.37				

Highly significant Coefficient of Variation (%) = 26.66

Appendix Table 15. Weight of 1000 filled grains (g)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	25.25	22.85	23.53	71.63	23.88
NSIC Rc 134	24.46	25.05	23.68	73.19	24.40
NSIC Rc 138	26.67	25.88	25.10	77.65	25.88
NSIC Rc 140	27.85	25.46	24.29	77.60	25.87
NSIC Rc 144	22.22	19.10	21.92	63.24	21.08
NSIC Rc 146	25.27	26.30	25.16	76.73	25.58
NSIC Rc 150	23.44	23.79	24.02	71.25	23.75
NSIC Rc 154	22.74	24.16	21.45	68.35	22.78
NSIC Rc 156	21.12	20.66	19.17	60.95	20.32
PSB Rc 82 (check variety)	24.74	23.92	23.92	72.58	24.19
TOTAL	243.76	237.17	232.24	713.17	237.73

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	6.68	3.34			
Treatment	9	98.54	10.95	10.81**	2.46	3.60
Error	18	18.23	1.01			
TOTAL	29	123.45				

Highly significant

Coefficient of Variation (%) = 4.23

Appendix Table 16. Yield per $12m^2$ (kg)

VARIETY	REPLICATION I	II	III	TOTAL	MEAN
NSIC Rc 130	6.60	6.45	6.25	19.30	6.43
NSIC Rc 134	7.45	7.51	6.95	21.91	7.30
NSIC Rc 138	6.87	6.50	6.40	19.77	6.59
NSIC Rc 140	7.20	7.45	8.05	22.70	7.57
NSIC Rc 144	5.90	5.45	5.50	16.85	5.62
NSIC Rc 146	7.10	7.05	6.10	20.25	6.75
NSIC Rc 150	8.35	7.75	7.30	23.40	7.80
NSIC Rc 154	7.20	7.30	6.93	21.43	7.14
NSIC Rc 156	6.55	5.50	6.00	18.05	6.02
PSB Rc 82 (check variety)	7.10	6.67	6.35	20.12	6.71
TOTAL	70.32	67.63	65.83	203.78	67.93

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	2	1.02	0.51			
Treatment	9	12.49	1.39	12.78**	2.46	3.60
Error	18	1.95	0.11			
TOTAL	29	15.46				

Highly significant Coefficient of Variation (%) = 4.85

Appendix Table 17. Yield per hectare (tons)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
NSIC Rc 130	5.50	5.34	5.21	16.05	5.35
NSIC Rc 134	6.21	6.26	5.79	18.26	6.09
NSIC Rc 138	5.73	5.42	5.33	16.48	5.49
NSIC Rc 140	6.00	6.21	6.71	18.92	6.31
NSIC Rc 144	4.92	4.54	4.58	14.04	4.68
NSIC Rc 146	5.92	5.88	5.08	16.88	5.63
NSIC Rc 150	6.96	6.46	6.08	19.50	6.50
NSIC Rc 154	6.00	6.08	5.78	17.86	5.95
NSIC Rc 156	5.46	4.58	5.00	15.04	5.01
PSB Rc 82 (check variety)	5.92	5.56	5.29	16.77	5.59
TOTAL	58.62	56.33	54.85	169.80	56.60

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.02	0.51			
Treatment	9	12.49	1.39	12.78**	2.46	3.60
Error	18	1.95	0.11			
TOTAL	29	15.46				

Highly significant

Coefficient of Variation (%) = 4.87