BIBLIOGRAPHY

BALAJO, MIRRIAM E. APRIL 2010. Growth and Yield of Ten High Yielding Rice Varieties Under General Tinio, Nueva Ecija Condition. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

Ten different high yielding varieties of rice were planted to identify the best adapted variety/ies in terms of yield, resistance to pests and diseases, and return on cash expenses; identify the acceptability of the farmers and consumers; and determine the return on cash expenses of growing high yielding rice varieties under Barangay Palale, General Tinio, Nueva Ecija condition from November 2009 to March 2010.

NSIC Rc 146 and NSIC Rc 138 had the highest grain yield of 5.33kg per 12 m^2 recorded the highest number of productive tillers, longest panicle at harvest, tallest plants and were found resistant to stemborer and blast. Both varieties also exhibit the highest return on cash expenses (7.52%).

NSIC Rc 140 and NSIC Rc 130, and PSB 28 (Control) may also be considered as good varieties as they recorded the highest grains per panicle, highest filled grains and unfilled grains and also exhibited a good return on cash expenses. .

The other varieties used were not well-adapted to the area as they were affected by moisture stress that prevailed in the area during the conduct of the experiment as shown by their low grain yield and shorter height.

It was observed that PSB 28 (Control), NSIC RC 134 and NSIC Rc 150 had soft grains just after cooking and even after it was stored overnight. Both were acceptable to the farmer and housewife respondents

NSIC Rc 138 and NSIC Rc 146, therefore, are highly recommended under Barangay Palale, General Tinio, Nueva Ecija.

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INTRODUCTION

Rice is the world's single most important food crop and a primary food for more than a third of the world's population (IRRI, 2006). Rice production and consumption are concentrated in Asia where more than 90% of all the rice is found. It is the only grain crop which can be grown under diverse climatic and soil topographical conditions (Pal and Dekas, 1996).

In the Philippines, 80% of the Filipino households devote at least half of their expenditure to food and about a quarter of it is used for rice (Virmani & Hardy, 2003). Thus, over the next 25 years, at least 65% more rice relative to year 2000 production volume would be needed to adequately feed the Philippine population.

Nueva Ecija Province, dubbed as the "rice bowl of the Philippines", is the largest and biggest rice producing province in Central Luzon. Approximately 3,080 hectares in the town are rice fields in which 954 hectares have proper irrigation while 2,126 hectares are rain-fed. In General Tinio, Nueva Ecija the average rice production in rain-fed areas is 80 cavans per hectare. Rice production in the irrigated area is 95,400 cavans or an average yield of 100 cavans per hectare (BAS, 2009).

However, majority of the people in Barangay Palale, General Tinio, Nueva Ecija, still depend on NFA (National Food Authority) rice. This problem is obviously due to shortage and low yield of rice varieties. The rice shortage is brought about by the growing population, decreasing production area and unpredictability of climate. In addition, there is apparent degeneration of the existing varieties planted in the area in terms of plant resistance to pest and disease. The continuous evaluation of new high yielding varieties of rice that will be suited in a certain location is one way to address such concern. Therefore it is important to introduce different high yielding rice varieties in order to identify varieties with better adaptability, greater resistance to pests and diseases and higher yield.

The result of this study could also serve as guide in selecting high yielding varieties for production. It may help convince local farmers to plant selected high yielding varieties and corresponding increase in their income. The study will be conducted to:

The study was conducted to:

1. evaluate the growth and yield of ten high yielding rice varieties under Barangay Palale, General Tinio, Nueva Ecija condition;

2. identify the best adapted variety/ies under Barangay Palale, General Tinio, Nueva Ecija condition in terms of yield, resistance to pests and diseases and return on cash expenses;

3. identify the acceptability of the farmers and consumers; and

4. determine the return on cash expenses of growing high yielding rice varieties in General Tinio, Nueva Ecija.

The study was conducted at a farmer’s field in Barangay Palale, General Tinio, Nueva Ecija from November 2009 to March 2010

REVIEW OF LITERATURE

Varietal Evaluation

Varietal evaluation is necessary for adaptability in a given location and it is also necessary to observe characters such as earliness, vigor maturity, yield and keeping quality because varieties have wide range of difference in size and yielding performance cited by Bawat (2004).

GMA Rice program stated that expansion of hybrid rice cultivation is one of their focus to achieve the goal two of DA which is enhancing productivity to reduce the price of wage, good's and increasing farmers income. At present hybrid rice is the only available genetic tool for increasing the yield potential of rice on the average farmer can get an additional 1,272kg rice/ ha using the hybrid ,as compared with yield obtain in PhilRice trial come from mestizo at 12t/ha in Cagayan and Bohol province (DA 2005-2006).

High grain of rice can be achieved only though a proper combination of variety, agronomic practices and environment. Of these three factors variety and agronomic practices can be manipulated.

Chagwasi (1996) stated that under Tabuk, Kalinga condition, PSB Rc18 produced the highest yield among 10 high yielding varieties studies. However Valera (2003), fund that planting PSB Rc18 in Nalbuan, Baay-Licuan Abra, was the earliest to mature although produce low grain yield.

Five inbred and hybrid varieties of rice evaluated in Nalbuan, Baay-Licuan Abra, PSB Rc46 produce the highest grain yield and hybrid mestizo had the highest weight of 1000 filled grains and its yield is comparable to inbred PSB Rc46 (Valera, 2003). Also in

Barangay Tukod, San Rafael Bulacan one farmer who tried planting mestizo reveled that hybrid mestizo gives a high yield and he harvested 150 cavan's /ha in his first trial (Samonte, 2009).

Batane (2004) stated that under Barangay Bilis Burgos, La Union, PSB Rc28 was the earliest to mature while PSB Rc96 has the highest grain yield/plot and per hectare among eight varieties studies. On white heads evaluation SL8 and PSB Rc96 were rated resistant. However (Siteng, 2005) fund that planting SL8 in Kadayakan, Maria Aurora showed that SL8 acquired the highest grain yield for both per plot and / ha (3.58 and 5332.32 kg) and SL8 were also resistant to white heads.

Seven varieties of rice were evaluated in Publacion Kibungan, Benguet. Result showed that PSB Rc 96 and PSB Rc28 were the earliest to mature. SN-73 had the highest grain yield (Belino, 2005).

Seven varieties of rice were planted and evaluated at Bugayong, Binalonan Pangasinan. Result showed that NSIC Rc138 recorded the highest number of productive tillers and gained the highest number of grain pert panicle. It obtained 3.31 to 2.06 tons per plot and per hectare. However it was the PSB Rc82 who is the earliest to mature (Urbano, 2008).

Water and fertilizer Requirement

Uptake of water is the first need for germination, irregular rainfall means slowed and uneven seedling growth. Severe drought will kill the seedling.

Water stress must be avoided while rice plant is still growing to prevent retards on the growth and reduced tillers, large amount of unfilled grains is due to lack of water. Also insufficient water result to wilting, that reduced the capacity of the plant to produced and transport its food (Urbano, 2008).

The use of proper doses of nutrients, nitrogen (N) in particular, is important to attain high yielding and efficient nutrients use in intensive rice ecosystem.

IRRI (1986) stated that basal fertilizer application with a combined P and K level of 30 to 40 kg/ha each of P 20 and K 20 help early seedling vigor and stand establishment, rapid coverage of the field by ice foliage with consequent reduction of weed population.

Tillering ability

The number of tiller per plot increase as the distance between plant increases. However the number of tiller per square meter reduces when you do wide spacing of plants, also close spacing will result in mutual shading, less tiller and lanky plant which are susceptible to lodging (Arraedeau and Vergara, 1988).

A combination of high tillering ability and compact or nonspreading culm arrangement is desirable for all rice farmers. Compact culms that are moderately erect allow increased solar radiation to tillers and less mutual shading per unit of land area. In improved plant, heavy tillering is prepared over medium or low tillering, because dwarf does not have an optimum leaf area index and heavy tillering does not result in excessive plant size or mutual shading. Those leaf thicknesses have been related to high yielding ability through increased photosynthetic rate per unit of leaf area. However some highly productive varieties have relatively thin leaves when either transplanted or direct seeded. These suggest that the character does not have an important and direct relationship to yield potential.

Effect of Temperature

Rice can be grown most successfully in regions that have a mean temperature of about 23.89ºC or above during the entire growing season of 4-5 months. Rice yield are higher in warm temperature regions that have a low summer rainfall than in the humid tropics where rice disease and soil of low fertility are more prevalent (Martin & Stamp, 1976).

For paddy rice water temperature is a major determinant of growth and yield. In rice paddies water temperature and difference significantly affect production, especially in cool climates. However, there is no model to evaluate the effect of water temperature on rice yield.

Cultural management

Biag (2009) emphasizes that practice synchronizes planting after a fallow period will helps prevent pest build-up. Also it is a good start in rice production for it prevents the overlapping of population of insect and disease. Proper sanitation most be done by removing all straw piles in the paddies after harvest and minimizes size of levees to 15cm wide x 20cm high to avoid rat burrows and by removing seedling with stem borer egg masses before transplanting.

Preservation of beneficial insect, close monitoring, through land preparation, plant resistant varieties and avoid excessive nitrogen.

Harvesting and threshing

Harvest “palay” when 80% of the grains are mature, this is indicated by a yellow panicle or colored straw. Delay in harvesting may lead to grain shattering. On the other hand, early harvesting before maturing produce immature and chalky grains that breaks easily during milling (PHILRICE, 1997-1998).

Timely harvesting produce the best rice quality, increases rice marketability and consumer acceptability and increase rice production as a result of production of losses. Although adverse weather condition often times move the harvesting schedule either a little earlier or later than desired (PCARRD, BPRE and PARRFI, 2001).

Harvested "palay" must be threshed immediately to minimize field losses and grain quality problem. Rice should have 14% moisture content or lower to maintain grain quality during storage. Seeds and area should be cleaned and ensure well ventilated storage room to avoid rodent attack and have air circulation (PHILRICE, 1997-1998).

MATERIALS AND METHODS

The study tested ten high yielding varieties from Philippine Rice Research Institute (PhilRice) as follows:

CODE	VARIETY
T1	IR64
T2	NSIC Rc 144 (Tubigan 8)
T3	NSIC Rc 134 (Tubigan 4)
T4	NSIC Rc 138 (Tubigan 5)
T5	NSIC Rc 140 (Tubigan 6)
T6	NSIC Rc 150 (Tubigan 9)
T7	NSIC Rc 146 (PJ7)
T8	NSIC Rc 130 (Tubigan 3)
T9	NSIC Rc 154 (Tubigan 11)
T10	PSB Rc 28 (Agno, Control)

<u>Seedbed and land preparation</u>

Ten seedbeds measuring 1m x 1m each were prepared for the ten different varieties. One variety was sown in each seedbed to avoid mixture. Labels were placed on each seedbed for proper identification.

An experimental area of 360m² was prepared and was divided into 30 plots with a measurement of 2m x 6m each. Before transplanting, the soil was puddled and leveled using "Kuliglig".

Lay-outing and transplanting

After land preparation, the seedlings were transplanted in designated plots following the Randomized Complete Block Design (RCBD) with three replications. Each of the ten varieties was planted with two seedlings per hill on a straight row at a distance of 20cm x 20cm. Missing hills were replanted within ten days after transplanting.

Fertilizer Application

Two weeks after transplanting, application of fertilizer was done. A mixture of 7 kg of 14-14-14 and 7 kg of urea (42-0-0) was used.

Weeds and Insect Pest Control

Hand weeding was done to avoid competition for water and nutrients. Insect pests and diseases were controlled to reduce economic loss. Other recommended cultural practices were followed to ensure high yield.

Determination of Acceptability

Acceptability for cooked rice was determined by a panel of twenty farmers and consumers. The acceptability of cooked rice was based on tenderness and cohesiveness of the newly-cooked and left over rice.

Farm Location

Barangay Palale is located in the Northern part of General Tinio, Nueva Ecija. The distance of Barangay Palale from the city of General Tinio Nueva Ecija is 25 km from the National highway and it is about 35 km from Cabanatuan City (Fig 1).

The average daily temperature was 22˚C at minimum and 30˚C at maximum.

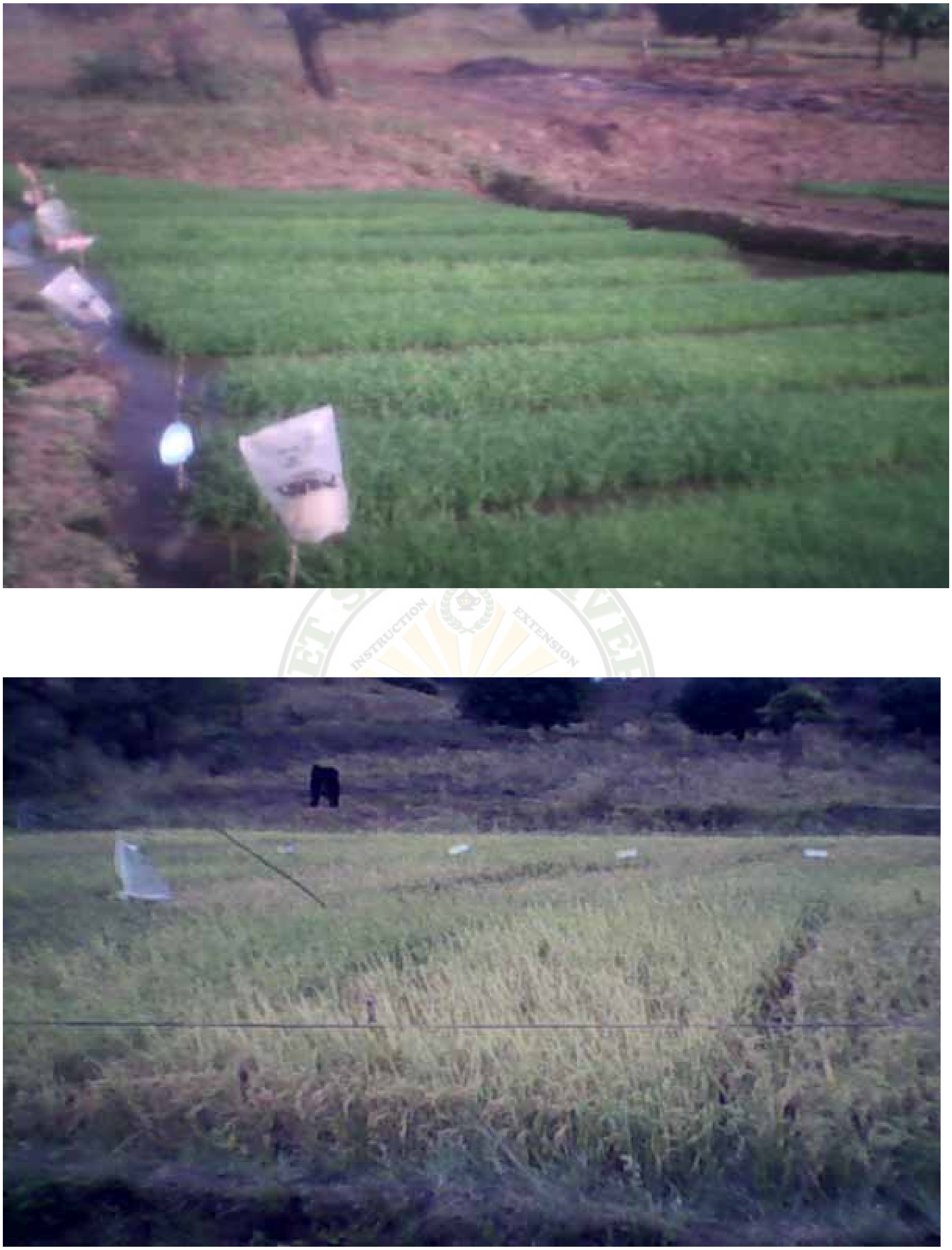

Figure 1. Overview of the experimental area

Barangay Palale has a sandy, loamy, clayey soil and characterized by flat lands to hilly and rough mountainous areas with a slope of 25 to 80 degree.

This condition of the location fall within the ranges that is suitable for rice production.

Data gathered:

1. Agroclimatic Data. Temperature, relative humidity, amount of rainfall during the conduct of the study were taken from Cabanatuan PAGASA office.

2. Number of days from transplanting to recovery. The number of days from transplanting to period of seedling recovery was recorded when the rice plants were almost dark green in color.

3. Number of days from transplanting to tillering. This was recorded when 50% of the total plant started producing tillers.

4. Number of days from transplanting to booting. This was recorded when 50% of the plants have booted, determined by visual observation when the flag leaf sheath swelled or showed enlargement.

5. Number of days from transplanting to heading. This was recorded when 50% of the plants produced panicle.

6. Number of days from transplanting to maturity. This was recorded when 80% of the grain in the panicle ripened or turned yellow.

7. 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 produce panicles were considered productive.

8. Plant height at maturity (cm). This was measured from the soil level to the tip of the panicle using ten samples selected at random.

9. Length of panicle at harvest (cm). This was measured from panicle base to panicle tip excluding the awn taken at random at harvest.

10. Number of grains per panicle. This was taken using randomly selected ten sample panicles per plot.

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

12. Reaction to blast resistance (neck rot). Evaluation of the severity of rice blast was taken from the plant at the center rows. Ten sample hills were selected 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

13. Stem borer incidence. This was determined based on the actual % dead hearts and white heads using the middle row of the plot as sampling area. Ten sample hills was selected at random where dead hearts were counted 45 days after transplanting while white heads, ten days before harvesting. The rating was based on the standard used by PhilRice (1996).

Rating	Description	%Dead heart	%White heads
1	Resistant	1-10	1-5
3	Moderate resistant	11-20	6-10
5	Intermediate	21-30	11-15
7	Moderate susceptible	31-60	16-25
9	Susceptible	60 and above	25 and above

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

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

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

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

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

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

18. Texture of cooked rice. This was the texture of the ten different varieties of rice just after cooking and after storing overnight the samples was put in plate together with spoon and place on the table. It was tested by twenty respondents (10 farmers and 10 housewives). The varieties were evaluated based on the following scale:

Scale	Description
1	Soft
2	Moderately soft
3	Hard
4	Moderately hard
5	Very hard

19. General acceptability. This was taken using the following scale:

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

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 were tested using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Agroclimatic Data

Table 1 presents the temperature, relative humidity and rainfall which were gathered from November 2009 to March 2010. March had the highest temperature with a minimum of 22.4 ºC and a maximum of 35 ºC while the lowest temperature was recorded in December with a minimum of 20.5 ºC and a maximum of 32.3 ºC. Relative humidity ranged from 81-88%. The highest relative humidity was noted in November (88%) while the lowest was noted in March (81%). November had the highest rainfall of 44.8 mm.

The temperature during the conduct of the study is still favorable to rice plant since temperature for cool and warm rice production ranges from 16-25 ºC and 25-35 ºC, respectively (Vergara, 1992).

Table 1. Agroclimatic data from November 2009 to March 2010

MONTH	TEMPERATURE (ºC)		RELATIVE HUMIDITY (%)	RAINFALL (mm)
	MIN	MAX		
November	22.6	33.4	88%	44.8
December	20.5	32.3	86	1.0
January	21.0	32.5	84	0.2
February	21.1	34.1	84	+/ Trace
March	22.4	35	81	6.0

Number of Days from Transplanting to Recovery

Table 2 shows the number of days from transplanting to recovery. It was noted that NSIC Rc 144 and 146 recovered in 6 days, followed by NSIC Rc 138, NSIC Rc 140 and NSIC Rc 130. The five remaining varieties recovered in 10 days.

PHILRICE (1997-1998) stated that transplanting 2-3 seedlings per hill at a depth of 2-3 cm into the soil is satisfactory. Too deep planting will delay recovery and reduce the number of tillers produced.

Number of Days from Transplanting to Tillering

Table 2 shows the number of days from transplanting to tillering. It was recorded that NSIC Rc 144 produced tillers in 18 days. It was closely followed by NSIC Rc 138, NSIC Rc 140, NSIC Rc 146 and NSIC Rc 130 which produced tillers in 19 days. IR64 and PSB 28 (control) were the last to produced tillers.

It was observed that early tillering varieties produced more tillers than late tillering varieties. Also early tillering varieties matured earlier under normal condition. Early tillering is a desirable trait since tillers tend to be more productive.

Number of Days from Transplanting to Booting

The average number of days from transplanting to booting is shown in Table 2. NSIC Rc 144, was the earliest to boot in 47 days, which was 1-3 days earlier than the other varieties. It was followed by NSIC Rc 138, NSIC Rc 140, NSIC Rc 146, NSIC Rc 130 that booted in 50 days or 3 days later than NSIC Rc 144. IR64 and PSB 28 (control) were late maturing compared to the other three varieties. Number of days from transplanting to booting may not always be due to varietal characteristic but also to

Table 2. Number of days from transplanting to recovery, to tillering, to booting, to heading and transplanting to maturity of ten high yielding rice varieties

VARIETY	NUMBER OF DAYS FROM TRANSPLANTING TO:				
	RECOVERY	TILLERING	BOOTING	HEADING	MATURIY
IR64	10	23	54	64	88
NSIC Rc 144	6	18	47	54	83
NSIC Rc 134	10	22	52	61	86
NSIC Rc 138	8	19	50	64	86
NSIC Rc 140	8	19	50	59	86
NSIC Rc 150	10	22	52	61	86
NSIC Rc 146	6	19	50	59	83
NSIC Rc 130	8	22	52	59	86
NSIC Rc 154	10	22	52	61	86
PSB 28 (control)	10	23	54	64	88

environmental influence such as temperature. Low temperature has been known to delay booting (Yoshida, 1981).

Number of Days from Transplanting to Heading

Table 2 also shows the number of days from transplanting to heading. NSIC Rc 144 was the earliest to produce heads with a mean of 54 days which was 1-7 days earlier than the other varieties. IR64 and PSB 28 (control) were the last to produce heads in 64 days after transplanting. This could mean that the varieties which produced heads earlier are also early maturing. Furthermore, early maturing varieties have lesser exposure to different pests and diseases and environmental stresses which gradually affect yield of the plant.

Number of Days from Transplanting to Maturity

Table 2 shows the number of days from transplanting to maturity. NSIC Rc 144 and NSIC Rc 146 were the earliest to mature in 83 days (Fig. 2). IR64 and PSB 28 (control) were the latest to mature in 88 days. This result could imply that early maturing varieties have lesser exposure to birds and rats especially during ripening stage.

Figure 2. The ten varieties at 80 DAT

Number of Productive Tillers per Hill

Table 3 shows the number of productive tillers per hill. NSIC Rc 150, NSIC Rc 146, NSIC Rc 140, NSIC Rc 130 produced the most numerous productive tillers with an average of 9.00. The rest of the varieties recorded the least productive tillers per hill with an average of 8.00.

Not all tillers produce heads since some tillers may die and others remain in their vegetative stage due to competition for water, nutrients and sunlight. Therefore production of tillers may not be a good basis for determining the yield potential of rice (UPLB, 1983).

Plant Height at Maturity

Plant height at maturity is shown in Table 3. It was recorded that NSIC Rc 146 was the tallest (72.59 cm) among the ten varieties of rice studied. It was followed by NSIC Rc 138 with an average height of 70.20 cm. IR64 was the smallest with a height of 61.44 cm. The differences are due to the varietal characteristic of the crop. The taller the plant the weaker they are and more susceptible to lodging or falling when their panicle turns heavy with grains (Arraedeau and Vergara, 1988).

Taller plants may have higher ability to compete with weeds but it may also cause spacing problems. Yield reductions due to weeds decreased with increasing plant height (Yoshida, 1981).

Table 3. Number of productive tillers per hill and plant height at maturity of ten high yielding rice varieties

VARIETY	PRODUCTIVE TILLER PER HILL	PLANT HEIGHT (cm) 80 DAT
IR64	8.00	61.44[c]
NSIC Rc 144	9.00	69.64[ab]
NSIC Rc 134	9.00	68.12[b]
NSIC Rc 138	9.00	70.20ab
NSIC Rc 140	9.00	67.94[b]
NSIC Rc 150	9.00	67.51[b]
NSIC Rc 146	9.00	72.59[a]
NSIC Rc 130	8.00	69.21[ab]
NSIC Rc 154	8.00	64.23[c]
PSB 28 (Control)	8.00	69.45[ab]
C.V. (%)	6.51	2.75

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

Length of Panicle at Harvest

The length of panicle at harvest was measured from the panicle base to the panicle tip excluding the awn. Table 4 shows that PSB 28 (control) had the longest panicle with a mean of 21.38 cm. It was closely followed by NSIC Rc 138 and NSIC Rc 146 with means of 21.57 cm and 21.37 cm, respectively. NSIC Rc 144 had the shortest panicle with a mean of 19.76 cm. It could mean that the longer the panicles could translate to more grains per panicle.

Number of Grains per Panicle

The number of grains per panicle is shown in Table 4. It was observed that NSIC Rc 140 gained the highest number of grains per panicle with a mean of 107, followed by NSIC Rc 130 with a mean of 98. NSIC Rc 144 had the lowest number of grains per panicle, which may indicate long spaces between the grains in the panicle. Significant differences can be attributed to the compactness of the grains in the panicle.

Table 4. Length of panicle at harvest and number of grains per panicle of ten high yielding rice varieties

VARIETY	LENGTH OF PANICLE AT HARVEST (cm)	NUMBER OF GRAINS PER PANICLE
IR64	19.77	89
NSIC Rc 144	19.76	81
NSIC Rc 134	19.77	89
NSIC Rc 138	21.57	91
NSIC Rc 140	20.63	107
NSIC Rc 150	19.97	93
NSIC Rc 146	21.37	93
NSIC Rc 130	20.39	98
NSIC Rc 154	19.81	92
PSB 28 (control)	21.38	84
C.V. (%)	4.67	8.37

According to Yoshida (1981) low solar or unfavorable condition during reproductive stage to post flowering reduces the number of grain yield.

Number of Filled and Unfilled Grains

The number of filled and unfilled grains is shown in Table 5. It was observed that NSIC Rc 140 had the highest number of filled grains with a mean of 93, followed by NSIC Rc 130 and PSB 28 (control) with a mean of 87 and 83, respectively. IR64 had the lowest number of filled grains with a mean of 75. On the other hand, NSIC Rc 130 had the highest number of unfilled grains with a mean of 15 and IR64 gained the lowest number of unfilled grains.

Table 5. Number of grains per panicle and number of filled and unfilled grains of ten high yielding rice varieties

VARIETY	NUMBER OF FILLED GRAINS	NUMBER OF UNFILLED GRAINS
IR64	75	9
NSIC Rc 144	78	5
NSIC Rc 134	77	12
NSIC Rc 138	79	9
NSIC Rc 140	93	14
NSIC Rc 150	82	9
NSIC Rc 146	81	9
NSIC Rc 130	87	15
NSIC Rc 154	83	12
PSB 28 (control)	83	9
C.V. (%)	7.33	23.64

PhilRice (2001) stated that while rice plant is still growing, water stress must be avoided to prevent retardation of growth and reduction of tillers. Large amount of unfilled grains is due to lack of water. Insufficient water result in wilting, therefore reducing the capacity of the plant to produce and transport its food. Thus, the high number of unfilled grains in some varieties may be due to insufficient water.

Yoshida (1981) further stated that low air and water temperature could cause injuries, such as failure of grains to germinate, delayed flowering, high spikelet sterility which results to higher unfilled grains per panicle and irregular maturity. High number of unfilled grains reduced yield.

Reaction to Blast Incidence (Neck Rot)

The reaction to blast incidence (neck rot) of the ten high yielding rice varieties was recorded. All the rice varieties were found resistant to blast (neck rot). The reaction was based only on natural condition because there is no inoculation or introduction of pest and disease in the area of the study. This could be altered if inoculums or pest are introduced.

Reaction to Stemborer Incidence

Evaluation of stemborer incidence was expressed as dead hearts and white heads. Dead heart was taken 45 days after transplanting and it was recorded that all of the varieties were field resistant to dead heart. On white heads evaluation, IR64 and NSIC Rc 150 were rated moderately resistant. Other varieties are resistant to the stemborer.

Table 6. Reaction to stemborer incidence of ten high yielding rice varieties

VARIETY	DEAD HEARTS	WHITE HEADS
IR64	Resistant	Moderately Resistant
NSIC Rc 144	Resistant	Resistant
NSIC Rc 134	Resistant	Resistant
NSIC Rc 138	Resistant	Resistant
NSIC Rc 140	Resistant	Resistant
NSIC Rc 150	Resistant	Moderately Resistant
NSIC Rc 146	Resistant	Resistant
NSIC Rc 130	Resistant	Resistant
NSIC Rc 154	Resistant	Resistant
PSB 28 (control)	Resistant	Resistant

Weight of 1000 Filled Grains

Table 7 shows the weight of 1000 filled grains. Among the ten varieties evaluated, it was observed that NSIC Rc 146 gave the highest weight with a mean of 26g compared to PSB Rc 28 (control) with a mean of 24g. It was followed by NSIC Rc 140 with a mean of 25g. NSIC RC 154 had the lowest weight of 21g. This can be attributed to the size, shape and fullness of the grains.

Yield per 12 m^2 and per Hectare

Table 7 shows yield per 12 sm^2 and per hectare of ten high yielding rice varieties. NSIC Rc 138 and NSIC Rc 146 had gained the highest yield both per plot and per hectare (5.33 kg/plot and 4.4 tons/ha) compared to PSB 28 (control) with a mean of 4.23 kg/plot and 4.11 tons/ ha. NSIC Rc 144 has the lowest grain yield. The highly significant difference could be due to number of grains per panicle produced and length of panicle which could translate into more grains per panicle.

The low yield of the ten rice varieties may be due to the onset of El Niño phenomena during the growth of the plants. According to PCCARD (1983), rice has three critical stages wherein moisture deficit reduce grain yield substantially. These are (1) transplanting period (or seedling establishment), (2) tillering stage and (3) the period

Table 7. Weight of 1000 filled grains and yield per $12m^2$ and per hectare of ten high yielding rice varieties

VARIETY	WEIGHT OF 1000 FILLED GRAINS (g)	YIELD PER $12m^2$ (kg)	YIELD PER HECTARE (tons/ha)
IR64	23^{bcd}	4.25^{abcd}	3.54^{bcd}
NSIC Rc 144	23^{bcd}	3.8^{d}	2.96^{dc}
NSIC Rc 134	22^{cd}	4.25^{abcd}	3.54^{e}
NSIC Rc 138	25^{ab}	5.33^{a}	4.44^{a}
NSIC Rc 140	25^{ab}	4.93^{abc}	4.11^{ab}
NSIC Rc 150	23^{bcd}	4.00^{cd}	3.33^{bcde}
NSIC Rc 146	26^{a}	5.33^{a}	4.44^{a}
NSIC Rc 130	22^{cd}	4.67^{abc}	3.89^{abc}
NSIC Rc 154	21^{d}	3.77^{cd}	3.14^{cde}
PSB 28 (control)	24^{abc}	4.93^{ab}	4.11^{ab}
C.V. (%)	6.35	12.66	12.63

*Means with the same letter are not significantly different at 0.05 level by DMRT from about 14 days before to a week after panicle initiation. Yield reduction due to moisture stress during heading or flowering is largely caused by unfertilized flowers.

Return on Cash Expenses (ROCE)

The return on cash expenses (ROCE) of ten high yielding rice varieties is shown in Table 8. NSIC Rc 138 and NSIC Rc 146 had the highest ROCE (17.52) compared to PSB 28 (control) (8.71 %). NSIC Rc 154 had the highest negative ROCE (-16.86). These results indicate that not all the varieties are suitable in Barangay Palale, General Tinio, Nueva Ecija. It also shows that NSIC Rc 136 and NSIC Rc 146 are the best varieties among the ten varieties evaluated since both had the same positive ROCE. The onset of El Niño during the conduct of the study had somehow resulted to insufficient water supply that affected the performance of the varieties studied. It is possible that given the right amount of water, these ten varieties might perform better and give positive ROCE. Moreover, those varieties with positive ROCE could have performed better and have higher ROCE.

Table 8. Return on cash expenses (ROCE) of ten high yielding rice varieties

VARIETY	GRAIN YIELD PER PLOT ($kg/12m^2$)	GROSS INCOME (Php)	COST OF PRODUCTION (Php)	NET INCOME (Php)	ROCE (%)
IR64	4.25	72.25	77.09	-4.84	-6.00
NSIC Rc 144	3.80	65.00	77.09	-12.49	-16.20
NSIC Rc 134	4.25	72.25	77.09	-4.84	-6.00
NSIC Rc 138	5.33	90.61	77.09	13.52	17.52
NSIC Rc 140	4.93	83.81	77.09	6.72	8.71
NSIC Rc 150	4.00	68.00	77.09	-9.09	-11.79
NSIC Rc 146	5.33	90.61	77.09	13.52	17.52
NSIC Rc 130	4.67	79.39	77.09	2.30	2.98
NSIC Rc 154	3.77	64.09	77.09	-13.00	-16.86
PSB 28 (control)	4.93	83.81	77.09	6.72	8.71

Note: the selling price of rice grains is based on Php 17.00/kilo.

Texture of Cooked Rice

Table 9 shows the texture of cooked rice of the different varieties. Ten farmers and ten housewives were used as testing panel for both newly cooked and cooked rice that was stored overnight. PSB 28 (control), NSIC Rc 138, NSIC Rc 134, NSIC Rc 150 NSIC Rc 130 and IR64 had soft grains, while NSIC Rc 144 had hard grains. The other varieties produced moderately soft grains that were newly cooked. Likewise for rice left overnight, PSB 28 (control), NSIC Rc 134 and NSIC Rc 150 maintained their soft quality. The rest of the varieties were moderately soft except for NSIC Rc 146 and NSIC Rc 138 which were moderately hard. NSIC Rc 154 easily spoiled after storing overnight.

Mackill, *et al*., (2010) further stated that rice with intermediate amylose content approaches the ideal for many consumers; they are fluffy when cooked and remain soft when cool. Intermediate amylose is preferred in most rainfed lowland of Asia particularly in Indonesia, Malaysia and Philippines. Thus, the varieties which maintained soft grains even after storing overnight may have intermediate amylase content and may be preferred by Filipino consumers.

Table 9. Texture of cooked rice of ten high yielding rice varieties

VARIETY	EATING QUALITY	
	NEWLY COOKED RICE	RICE STORED OVERNIGHT
IR64	Soft	Moderately hard
NSIC Rc 144	Moderately hard	Moderately hard
NSIC Rc 134	Soft	Soft
NSIC Rc 138	Soft	Moderately hard
NSIC Rc 140	Moderately soft	Moderately soft
NSIC Rc 150	Soft	Soft
NSIC Rc 146	Moderately soft	Moderately hard
NSIC Rc 130	Soft	Moderately soft
NSIC Rc 154	Moderately soft	Spoiled
PSB 28 (control)	Soft	Soft

Rating Scale: 1- Soft, 2- Moderately soft, 3-Hard, 4- Moderately hard, 5- Very hard

<u>General Acceptability</u>

Table 10 shows the general acceptability of cooked rice of the different varieties. Ten farmers and ten housewives were used as testing panel for both newly cooked and cooked rice that was stored overnight. PSB 28 (control), NSIC Rc 138, NSIC Rc 134, NSIC Rc 150 NSIC Rc 130 and IR64 liked very extremely while NSIC Rc 144 was disliked slightly. The newly cooked rice of the other varieties were liked very much. Likewise for cooked rice left overnight, PSB 28 (control), NSIC Rc 134 and NSIC Rc 150 were liked very extremely. The rest of the varieties were liked very much, except for NSIC Rc 154 which was neither liked nor disliked by the panelists.

Table 10. General acceptability of ten high yielding rice varieties

VARIETY	GENERAL ACCEPTABILITY	
	NEWLY COOKED RICE	RICE STORED OVERNIGHT
IR64	Liked very extremely	Liked very much
NSIC Rc 144	Disliked slightly	Disliked slightly
NSIC Rc 134	Liked very extremely	Liked very extremely
NSIC Rc 138	Liked very extremely	Liked moderate
NSIC Rc 140	Liked very much	Liked very much
NSIC Rc 150	Liked very extremely	Liked very extremely
NSIC Rc 146	Liked very much	Liked moderate
NSIC Rc 130	Liked very extremely	Liked very much
NSIC Rc 154	Liked very much	Neither liked nor disliked
PSB 28 (control)	Liked very extremely	Liked very extremely

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to evaluate the growth and yield of ten high yielding rice varieties; identify the best adapted variety/ies in terms of yield, resistance to pests and diseases, acceptability of the farmers and consumers; and determine the return on cash expenses of growing high yielding rice varieties under Barangay Palale, Nueva Ecija condition.

No significant differences were observed among the varieties in terms of number of days from transplanting to plant recovery, tillering, booting, heading and maturity, number of productive tillers per hill, and number of grains per panicle. NSIC Rc 146 and NSIC Rc 138 produced tillers in 19 days and had the highest plant height at maturity with means of 72.59 cm and 70.20 cm, respectively. It was also recorded that these varieties gained the greatest number of productive tillers and gained the highest yield per plot.

NSIC Rc 144 was the earliest to produce tillers in 18 days and was the earliest to boot, to form heads and mature in about 80 days after transplanting. IR64 and PSB 28 (control) were the latest to reach maturity.

Highly significant differences in plant height at maturity were observed among the varieties. NSIC Rc 146 was the tallest followed by NSIC Rc 138, NSIC Rc 144, PSB 28 (control) while IR64 was the shortest. NSIC Rc 138 had the longest panicle, followed by PSB 28 (control), NSIC Rc 146 and NSIC Rc 130, while NSIC Rc 144 had the shortest panicle.

NSIC Rc 138 and NSIC Rc 146 obtained the highest grain yield per plot and per hectare (5.33 kg/plot and 4.44 tons/ha) compared to PSB 28 (control) (4.93 kg /plot and 4.11tons/ha).

All varieties were found resistant to stemborer except for IR64 and NSIC Rc 154 which were moderately resistant. On blast (neck rot) evaluation, all varieties were resistant.

PSB 28 (control), NSIC RC 134 and NSIC Rc 150, were liked very extremely by the panelist.

Conclusion

Based on the result of the study, NSIC Rc 146 and NSIC Rc 138 had the highest grain yield of 5.33 kg per 12 m^2, recorded the highest number of productive tillers, longest panicle at harvest, tallest plants and were found resistant to stemborer and blast. Both varieties also exhibited the highest return on cash expenses (7.52%).

PSB 28 (Control), NSIC RC 134 and NSIC Rc 150 had soft grains just after cooking and even after it was stored overnight. Both were acceptable to the farmer and housewife respondents.

Recommendation

Based on the result of the study, NSIC Rc 138 and NSIC Rc 146 are recommended at Barangay Palale, General Tinio, Nueva Ecija, for higher yield and return on cash expenses.

PSB 28 (Control), NSIC RC 134 and NSIC Rc 150 are recommended for processing due to soft grains and acceptability by farmers and housewives.

LITERATURE CITED

ARRAEDEAU, M. A. and B. S. VERGARA. 1988. A farmer primer on growing upland rice. IRRI and IRAT. Los Baños, Laguna, Philppines. P. 81-82.

BATANE, E. A. 2004. Evaluation of high yielding varieties of rice under Bilis, Burgos, La Union condition. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet. Pp. 30-31.

BUREAU OF AGRICULTURE STATISTICS. Undated. General Tinio takes pride in the number of professionals working in Manila and abroad and is one of the most literate towns in the province. Thanks to the "ikmo" industry and good attitude of most parents for believing that education is the best legacy that can be imparted to their children. Accessed at http://www.generaltinio.gov.ph/index.php?option =com_ content&task=category&sectionid=1&id=1&Itemid=4

BAWAT, E. 2004. Evaluation of high yielding varieties of rice in Dalingoan Sinacbat, Bakun Benguet. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet. P. 3.

BELINO, M. 2005. Evaluation of high yielding varieties of rice under Bilis, Burgos, La Union condition. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet. P. 30.

.

BIAG, H. H. June, 2009. Rice farmer urge to use certified seed despite reduced subsidy. Agricultural Magazine, Manila Bulletine.Vol.xii, no.7. P. 44.

CHAGWASI, M. Y. 1996. Yield evaluation of rice HYV's under Tabuk, Kalinga condition. Upublished BS Thesis. Benguet State University, La Trinidad, Benguet. P. 29.

DEPARTMENT OF AGRICULTURE. 2005-2006. Rice program 2005-2006. Department of Agriculture. P. 4.

IRRI. 1986. Tropical climates and its influence on rice. IRRI Los Baños, Laguna, Philippines. Pp. 7-8.

IRRI. 2006. International Rice Research Institute News. 31.2 (7).

MACKILL, D. J, COFFMAN, W. R. and GARRITY, D. P. Undated. Rainfed lowland rice improvement. http://books.google.com.ph/books?id=B5aDOlwvFesC&pg= PA162 &lpg=PA162&dq=describe+amylose+content&source=bl&ots=ckpCd_ALe6&sig=opfBmpdufai7BqqTFiXm_3w8DEY&hl=en&ei=F5VdS_yYLsGLkAX10JGeAg&sa=X&oi=book_result&ct=result&resnum=8&ved=0CDAQ6AEwBw#v=onepage&q=describe%20amylose%20content&f=false

MARTIN, J. H. W. H., LEONARD, and D. STAMP, 1976. Principle of field crop production (3rd ed). Macmillan Company INC. New York. Pp. 497- 498.

PAL, M. and J. DEKAS. 1996. Fundamental of cereal crops production. RK Raitata. McGraw-Hill. New Delhi. P. 1.

PCARRD, BPRE and PARRFI. 2001. The Philippines recommends for rice post production operations (2nd ed). Phil agriculture and resources research foundation, INC. Los Baños, Laguna. Pp. 9-10.

PCARRD. 1983. The Philippines recommends for irrigation water management. Philippine council for agriculture, forestry and natural resources research development. Los Baños, Laguna. 1 (34). Pp. 28-29.

PHILRICE. 2001. Phil Rice Newsletter. October 2001. Munoz, Nueva Ecija. Pp. 3.

PHILRICE. 2000. PhilRice R&D highlights 1999. PhilRice Maligaya, Munoz, Nueva Ecija. P. 90.

PHILRICE. 1996. Rice production technoguide. Los Baños, Laguna, Philippines. Pp. 32-43.

PHILRICE. 1997-1998. PhilRice technoguide-calendar. Phil Rice research institute. Maligaya, Munoz, Nueva Ecija. Pp. 7, 10, 12.

SAMONTE, P. May 2009. Successful hybrid rice production in unfavorable rainfed area. Agricultural Magazine, Manila Bulletine, 13 (5): 18.

SITENG, B. T. 2005. Performance of high yielding varieties of rice under Kadayakan, Maria Aurora condition. Unpublished BS Thesis.Benguet State University, La Trinidad, Benguet. P. 25.

UPLB. 1983. Rice production manual for NFAC-UPLB Countryside Action Program UPLB, Laguna, Philippines. Pp. 7-8

URBANO, M. 2008. Evaluation of high yielding varieties of rice under Bugayong, Binalonan Pangasinan condition. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet. P. 30.

VALERA, D. G. 2003. Evaluation of hybrid rice in Nalbuan, Baay-licuan, Abra. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet. P. 26.

VERGARA, B. S. 1992. A farmers primer on growing rice. IRRI. Los Baños, Laguna, Philippines. Pp. 3-10.

VIRMANI, S. S., C. X. MAO, and B. HARDY, 2003. Hybrid rice for food security, poverty alleviation and environmental production. IRRI. P. 381.

YOSHIDA, S. 1981. Fundamental of rice crop science. IRRI. Los Baños, Laguna, Philippines. Pp. 30-32.

APPENDICES

Appendix Table 1. Number of days from transplanting to recovery

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	10	10	10	30	10
NSIC Rc 144	6	6	6	18	6
NSIC Rc 134	10	10	10	30	10
NSIC Rc 138	8	8	8	24	8
NSIC Rc 140	8	8	8	24	8
NSIC Rc 150	10	10	10	30	10
NSIC Rc 146	6	6	6	18	6
NSIC Rc 130	8	8	8	24	8
NSIC Rc 154	10	10	10	30	10
PSB 28 (control)	10	10	10	30	10
TOTAL	86	86	86	258	8.6

Appendix Table 2. Number of days from transplanting to tillering

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	23	23	23	69	23
NSIC Rc 144	18	18	18	54	18
NSIC Rc 134	22	22	22	66	22
NSIC Rc 138	19	19	19	57	19
NSIC Rc 140	19	19	19	57	19
NSIC Rc 150	22	22	22	66	22
NSIC Rc 146	19	19	19	57	19
NSIC Rc 130	22	22	22	66	22
NSIC Rc 154	22	22	22	66	22
PSB 28 (control)	23	23	23	69	23
TOTAL	209	209	209	627	20.9

Appendix Table 3. Number of days from transplanting to booting

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	54	54	54	162	54
NSIC Rc 144	47	47	47	141	47
NSIC Rc 134	52	52	52	156	52
NSIC Rc 138	50	50	50	150	50
NSIC Rc 140	50	50	50	150	50
NSIC Rc 150	52	52	52	156	52
NSIC Rc 146	50	50	50	150	50
NSIC Rc 130	52	52	52	156	52
NSIC Rc 154	52	52	52	156	52
PSB 28 (control)	54	54	54	162	54
TOTAL	513	513	513	1539	51.3

Appendix Table 4. Number of days from transplanting to heading

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	64	64	64	192	64
NSIC Rc 144	54	54	54	162	54
NSIC Rc 134	61	61	61	183	61
NSIC Rc 138	64	64	64	192	64
NSIC Rc 140	59	59	59	177	59
NSIC Rc 150	61	61	61	183	61
NSIC Rc 146	59	59	59	177	59
NSIC Rc 130	59	59	59	177	59
NSIC Rc 154	61	61	61	183	61
PSB 28 (control)	64	64	64	192	64
TOTAL	606	606	606	1818	60.6

Appendix Table 5. Number of days from transplanting to maturity

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	88	88	88	264	88
NSIC Rc 144	83	83	83	249	83
NSIC Rc 134	86	86	86	258	86
NSIC Rc 138	86	86	86	258	86
NSIC Rc 140	86	86	86	258	86
NSIC Rc 150	86	86	86	258	86
NSIC Rc 146	83	83	83	249	83
NSIC Rc 130	86	86	86	258	86
NSIC Rc 154	86	86	86	258	86
PSB 28 (control)	88	88	88	264	88
TOTAL	858	858	858	2574	85.8

Appendix Table 6. Number of productive tillers per hill

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	8	8	8	24	8
NSIC Rc 144	9	8	9	26	9
NSIC Rc 134	8	9	9	26	9
NSIC Rc 138	9	9	9	27	9
NSIC Rc 140	10	9	8	27	9
NSIC Rc 150	9	9	9	27	9
NSIC Rc 146	9	10	9	28	9
NSIC Rc 130	9	8	9	26	8
NSIC Rc 154	8	9	8	25	8
PSB 28 (control)	8	9	8	25	8
TOTAL	87	88	86	261	9

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	1%
Replication	2	0.267	0.133	1.63^{ns}	2.46	3.60
Treatment	9	4.667	0.519			
Error	18	5.733	0.319			
TOTAL	29	10.667				

ns= not significant

Coefficient of variation (CV) = 6.51%

Appendix Table 7. Plant height at maturity

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	63.85	64.42	56.05	184.32	61.44
NSIC Rc 144	68.91	68.83	71.18	208.92	69.64
NSIC Rc 134	69.54	65.85	68.97	204.36	68.12
NSIC Rc 138	69.93	70.87	69.81	210.61	70.20
NSIC Rc 140	68.24	67.81	67.76	203.81	67.94
NSIC Rc 150	67.07	67.71	67.76	202.54	67.51
NSIC Rc 146	71.99	72.16	73.64	217.79	72.59
NSIC Rc 130	68.07	69.60	69.97	207.64	69.21
NSIC Rc 154	63.19	63.87	65.63	192.69	64.23
PSB 28 (control)	69.29	69.42	69.65	208.36	69.45
TOTAL	680.08	680.54	680.42	2041.06	68.04

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	1%
Replication	2	0.011	0.006	8.52**	2.46	3.60
Treatment	9	269.243	29.916			
Error	18	63.205	3.511			
TOTAL	29	332.460				

** = highly significant

Coefficient of variation (CV) = 2.75%

Appendix Table 8. Length of panicle at harvest

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	19.55	20.07	19.68	59.3	19.77
NSIC Rc 144	19.71	19.63	19.94	59.28	19.76
NSIC Rc 134	20.59	19.11	19.6	59.3	19.77
NSIC Rc 138	22.23	21.74	20.73	64.7	21.57
NSIC Rc 140	20.64	20.63	20.62	61.89	20.63
NSIC Rc 150	19.81	19.28	20.82	59.91	19.97
NSIC Rc 146	20.87	21.79	21.46	64.12	21.37
NSIC Rc 130	19.42	19.94	21.82	61.18	20.39
NSIC Rc 154	19.18	19.5	20.74	59.42	19.81
PSB 28 (control)	23.74	20.4	20	64.14	21.38
TOTAL	205.74	202.09	205.41	613.24	20.44

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	1%
Replication	2	0.839	0.419	1.86^{ns}	2.46	3.60
Treatment	9	15.208	1.690			
Error	18	16.377	0.910			
TOTAL	29	32.424				

ns= not significant

Coefficient of variation (CV) = 4.67%

Appendix Table 9. Number of grains per panicle

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	85	99	82	266	89
NSIC Rc 144	79	83	81	244	81
NSIC Rc 134	106	74	88	267	89
NSIC Rc 138	90	91	92	273	91
NSIC Rc 140	12	101	110	322	107
NSIC Rc 150	100	88	92	280	93
NSIC Rc 146	85	104	91	279	93
NSIC Rc 130	101	94	100	295	98
NSIC Rc 154	93	95	88	277	92
PSB 28 (control)	85	81	85	51	84
TOTAL	835	910	908	2653	88

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	TABULAR F 1%
Replication	2	70.067	35.033	2.33^{ns}	2.46	3.60
Treatment	9	1272.533	141.393			
Error	18	1091.267	60.626			
TOTAL	29	2433.867				

Ns= not significant

Coefficient of variation (CV) = 8.37

Appendix Table 10. Number of filled grains per panicle

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	72	74	78	224	75
NSIC Rc 144	74	80	81	235	78
NSIC Rc 134	84	70	78	232	77
NSIC Rc 138	73	81	84	238	79
NSIC Rc 140	94	88	97	279	93
NSIC Rc 150	91	76	80	247	82
NSIC Rc 146	78	84	82	244	81
NSIC Rc 130	90	85	85	260	87
NSIC Rc 154	84	89	74	248	83
PSB 28 (control)	93	80	76	249	83
TOTAL	835	804	816	2455	82

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	1%
Replication	2	35.467	17.733	2.22^{ns}	2.46	3.60
Treatment	9	720.833	80.093			
Error	18	647.867	35.993			
TOTAL	29	1404.167				

Ns = not significant

Coefficient of variation (CV) = 7.33%

Appendix Table 11. Number of unfilled grains per panicle

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	12	7	7	26	9
NSIC Rc 144	5	6	3	14	5
NSIC Rc 134	22	6	89	37	12
NSIC Rc 138	9	10	8	26	9
NSIC Rc 140	16	13	12	43	14
NSIC Rc 150	11	13	12	26	9
NSIC Rc 146	4	16	8	28	9
NSIC Rc 130	15	9	20	44	15
NSIC Rc 154	11	6	19	36	12
PSB 28 (control)	7	8	13	28	9
TOTAL	112	94	111	317	11

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	TABULAR F 1%
Replication	2	23.267	11.633	1.20^{ns}	2.46	3.60
Treatment	9	246.300	27.367			
Error	18	409.400	22.744			
TOTAL	29	1404.167				

Ns = not significant

12.66 %23.64%

Appendix Table 12a. Reaction to stemborer incidence (Dead hearts)

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
IR64	1	3	2	6	2.00
NSIC Rc 144	0	0	0	0	0.00
NSIC Rc 134	1	0	1	2	0.67
NSIC Rc 138	0	1	0	0	0.33
NSIC Rc 140	1	2	1	4	2.00
NSIC Rc 150	1	1	1	3	1.00
NSIC Rc 146	0	0	0	0	0.00
NSIC Rc 130	1	1	0	2	0.70
NSIC Rc 154	2	1	2	5	1.67
PSB 28 (control)	1	1	2	4	2.00
TOTAL	8	10	9	27	0.90

Appendix Table 12b. Reaction to stemborer incidence. (White heads)

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	1	3	2	6	2.00
NSIC Rc 144	0	1	0	1	0.30
NSIC Rc 134	1	0	1	2	0.70
NSIC Rc 138	0	0	0	0	0.00
NSIC Rc 140	0	0	1	1	0.30
NSIC Rc 150	1	4	1	6	2.00
NSIC Rc 146	1	0	0	1	0.30
NSIC Rc 130	0	1	1	2	0.70
NSIC Rc 154	1	1	0	2	0.70
PSB 28 (control)	0	0	0	0	0.00
TOTAL	5	10	6	21	0.70

Appendix Table 13. Weight of 1000 filled grains

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	21	23	24	68	23^{bcd}
NSIC Rc 144	24	22	22	68	23^{bcd}
NSIC Rc 134	23	20	22	65	22^{cd}
NSIC Rc 138	23	25	26	74	25^{ab}
NSIC Rc 140	25	26	25	76	25^{ab}
NSIC Rc 150	25	24	22	71	23^{bcd}
NSIC Rc 146	26	26	27	79	26^{a}
NSIC Rc 130	20	23	23	66	22^{cd}
NSIC Rc 154	22	20	21	63	21^{d}
PSB 28 (control)	25	24	24	73	24^{abc}
TOTAL	23	23	24	23.4	7.8

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	TABULAR F 1%
Replication	2	0.067	0.033	3.19*	2.46	3.60
Treatment	9	62.533	6.948			
Error	18	39.267	2.181			
TOTAL	29	101.867				

*= significant

Coefficient of variation (CV) = 6.35 %

Appendix Table 14. Yield per $12m^2$

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	3.50	5.50	3.75	12.75	4.25
NSIC Rc 144	3.40	3.50	3.75	10.65	3.8
NSIC Rc 134	4.75	3.50	4.50	12.75	4.25
NSIC Rc 138	5.75	4.75	5.50	16.0	5.33
NSIC Rc 140	5.55	4.50	4.75	14.80	4.93
NSIC Rc 150	4.0	3.50	4.50	12.0	4.00
NSIC Rc 146	5.50	4.75	5.75	16.0	5.33
NSIC Rc 130	4.50	4.75	4.75	14.0	4.67
NSIC Rc 154	3.5	4.30	3.50	11.3	3.77
PSB 28 (control)	4.80	5	5	14.80	4.93
TOTAL	45.25	44.05	45.75	135.05	4.50

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	1%
Replication	2	0.153	0.076	3.70**	2.46	3.60
Treatment	9	10.822	1.202			
Error	18	5.842	0.325			
TOTAL	29	16.817				

**= highly significant

Coefficient of variation (CV) = 12.66 %

Appendix Table 15. Computed yield per hectare

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
IR64	2.92	4.58	3.13	10.62	3.54
NSIC Rc 144	2.83	2.92	3.13	8.88	2.96
NSIC Rc 134	3.96	2.92	3.75	10.62	3.54
NSIC Rc 138	4.79	3.96	4.59	13.33	4.44
NSIC Rc 140	4.63	3.75	3.96	12.33	4.11
NSIC Rc 150	3.33	2.92	3.75	10.00	3.33
NSIC Rc 146	4.58	3.96	4.79	13.33	4.44
NSIC Rc 130	3.75	3.96	3.96	11.67	3.89
NSIC Rc 154	2.92	3.58	2.92	94.17	3.14
PSB 28 (control)	4.00	4.16	4.16	12.33	4.11
TOTAL	37.71	36.71	38.14	112.56	3.75

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	OBSERVED F	TABULAR F 5%	1%
Replication	2	0.106	0.053	3.71**	2.46	3.60
Treatment	9	7.488	0.832			
Error	18	4.041	0.224			
TOTAL	29	11.635				

**= highly significant

Coefficient of variation (CV) = 12.63 %