

# **Varietal Trial of Traditional Upland Rice (*Oryza sativa* L.) Varieties Collected in the Province of Negros Occidental**

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## **ABSTRACT**

Thirteen traditional upland rice varieties (Kadidit Pilit, Red 64, Masipag 9, Masipag 15, Dinorado, Mindoro, Camuros, Masipag 22, Palawan, Suleg, Biday, Pilit, Pilit Talacdan) were evaluated in Randomized Complete Block Design (RCBD) in three replicates at the experimental area of Central Philippines State University (CPSU), Kabankalan City, Negros Occidental from November 2012 - April 2013. The parameters compared were their agronomic data on growth and yield, including grain characteristics. These data were processed using the one-way Analysis of Variance (ANOVA) with the Statistical Tool for Agricultural Research (STAR) (Version 2.0.1) while Duncan's Multiple Range Test (DMRT) were used to compare significant treatment means at 1% level. The upland rice varieties showed significant variation in growth, yield showed distinct grain characteristics. Biday variety was the tallest, produced longer and wider leaves, and bore the longest panicle. Mindoro and Masipag 22 produced the most number of tillers. Pilit talacdan had the biggest culm, produced the heaviest panicle, with the highest number of filled grains per panicle. Pilit variety gave the heaviest weight of 1,000 grains. The grain features were also found to be distinct in each variety. The yield significantly varied among the upland rice varieties. Pilit and Pilit Talacdan gave the highest yield among the varieties grown at CPSU condition. The performing varieties would be used for upland rice improvement and breeding program and for further verification in the farmer's field.

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## INTRODUCTION

Upland rice refers to rice grown on both flat and sloping fields sown directly under dry conditions and dependent on rainfall for moisture (De Datta, 1972). It is one of the three types of rice ecotypes based on surface hydrology (Prasad, 2011). About 30% of the total rice area is devoted to rainfed and upland rice which is likely one of the great contributor in attaining rice self-sufficiency in the country.

In the Philippines, the areas planted with upland rice included the provinces of Aurora, Benguet, Surigao and Agusan del Sur (PhilRice, 2012) and recently, landraces and traditional varieties were collected from the selected areas of Bukidnon (Jamago and Cortes 2012). In Negros Occidental, the existence of traditional varieties of upland rice is found in the remote areas which are hardly noticed for its economic importance. By itself, it is a rich natural resource considered as precious germplasm for upland rice which can be useful as starting material for plant improvement program and breeding new varieties (Rabara et al., 2014) as well as for production. Traditional upland rice varieties are considered as heirloom since they possess inherent characteristics potentially adaptable to a wide range of biotic and abiotic stresses which must be tapped to enhance livelihood opportunities in the upland rice farming communities. In low-input agriculture under minimal environments, traditional varieties or landraces have higher adaptation over time, thus their cultivation may subsidize to farm-level food security in the face of food production shortage (FAO, 1998; Ceccarelli & S. Grando, 2002 as cited in Govindaraj et al., 2014). It is a treasure that if given attention, can serve as an economic investment needed by the farmers of the area to increase food production and income.

Harnessing these resources for development purposes, research and development initiatives are imperative. To have a better knowledge of the potentials of these varieties, field trial is essential in determining the agronomic performance of any rice variety suited for local conditions. Understanding the potential of upland rice is deemed important in determining their variation which is the basis for improvement by selection, crop management and transfer of desirable traits to other plants (Varshney et al., 2008; Sasaki, 2005 as cited in Sohrabi et al., 2012). Upland rice possesses varied morphological

characteristics in terms of plant height, leaf length, and width, maturity date and yield as well as its grain quality. Zapico et al. (2010) observed a distinct set of morpho-agronomic values in each group based on cluster analysis from the 32 traditional rice varieties characterized in Kihan, Malapatan, Sarangani Province. The varieties showed variance on plant height, tillering ability, leaf length and width, and culm area while Mlikat samlaka cultivar appearing as the most distinct since it separates from the rest of the cultivars tested. Adeyemi et al. (2011) also noted significant differences among 25 upland rice cultivars evaluated based on their agro-morphological traits such as plant height, leaf and panicle length, number and weight of panicles, weight of 100 grains and total grain weight. Nascimento et al. (2011) also established high variability among 146 upland rice varieties from the germplasm collection based on agro-morphological characterization which indicates importance on breeding and genetic studies on this species. Meanwhile, Reibera et al. (2014) characterized the physical properties of grain and noted variations among the 21 selected traditional upland rice varieties in Sri Lanka.

This trial was conducted to evaluate the agronomic performance on growth and yield, qualitative traits and grain features of the collected traditional upland rice varieties. The information generated from this trial is useful for future endeavors on germplasm conservation and utilization in rice production as well as plant breeding and improvement program.

## **MATERIALS AND METHODS**

Thirteen varieties of upland rice were assessed some of which were collected and the others were given by upland rice farmers coming from the different cities and municipalities of the Province of Negros Occidental. The varietal trial was conducted according to Randomized Complete Block Design (Gomez & Gomez, 1984) in three replicates at the research area of Central Philippines State University in one cropping season (November 2012-April 2013). Each plot size was maintained at 20m<sup>2</sup> (4m x5m). Row to row distance was 30cm while plant to plant distance was 25cm where 3-5 seeds were planted in a drill-hill method and one plant per hill was maintained at latter stage after thinning the excess seedlings. The traditional varieties of upland rice included: Kadidit Pilit, Red 64, Masipag 09, Masipag 15, Dinorado, Mindoro, Camuros, Masipag 22, Palawan, Suleg, Biday, Pilit, and Pilit Talacdan.

Inorganic fertilizers were applied at the time of seed sowing at 80-60-30kg NPK per hectare. Data were recorded from ten (10) sample plants per

plot. Upland rice was harvested at 85% maturity when the grains from the tip of the panicle were golden yellow and panicles at the base were hard. The samples were harvested first and placed separately in sacks for data gathering and evaluation.

Agronomic data on growth and yield and other traits were determined based on the Standard Evaluation System for Rice (IRRI, 1988). Methods of evaluation are shown in Table 1 while other grain traits were visually characterized using the standard descriptor and descriptors states for rice (*Oryza sativa* L.) established by IBPGR-IRRI (1980). Data were processed using the Statistical Tool for Agricultural Research (STAR) (Version 2.0.1). Significant variation on upland rice was determined using the one-way Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) was used to further compare significant treatment means at 1% level.

Table 1. *Parameters evaluated.*

Parameters	Evaluation Methods
Plant Height	Measured from the base of the plant to the tip of the uppermost spikelet on the panicle, excluding awn
Culm length (cm)	Measured from ground level to the base of the panicle at maturity.
Culm diameter (cm)	Measured the outer diameter of the basal portion of the main culm at maturity.
Number of Tillers	Counted tillers at maturity stage
Leaf length (cm)	Measured length from the leaf base to the tip of the fully expanded leaves
Leaf width (cm)	Measured at the widest portion of the leaves
Panicle length (cm)	Measured from the panicle base to the tip excluding awn
Number of filled grains	Counted the number of filled grains from 10 random sampled panicles
Number of unfilled grains	Counted the number of unfilled grains from 10 random sample panicles
Weight of 1,000 grains (g)	Weighed random samples of 1000 well-developed, whole grains from 10 sample plants from each replicate, dried at 14% moisture content and weighed
Grain length (mm)	Measured from the lowermost glume to the tip excluding the awn using vernier caliper
Grain width (mm)	Measured the distance across the fertile lemma and palea at the widest point using vernier caliper

Grain thickness (mm)	Measured with caliper from 10 sample grains from each replicate
Grain yield (t ha <sup>-1</sup> )	Measured from the weight of grains from the yield sampling area per plot from each replicate calculated in t ha <sup>-1</sup>

*\*All parameters evaluated under CPSU field condition.*

## RESULTS

The 13 upland rice varieties tested showed significant difference on their agronomic parameters on growth (Table 2). Almost all varieties reached a height of 1m and above wherein Biday variety was the tallest among the varieties. Camuros, Masipag 22 and Palawan showed the shortest height of below 1 m. The plant height of Biday variety was due to its culm (stem) length which showed the longest among the varieties. Mindoro and Masipag 22 varieties produced the maximum number of tillers with the difference of almost 20 tillers to the Suleg and Kadidit Pilit varieties which produced the lowest number of tillers. Suleg and Biday varieties produced the longest leaf with the latter producing the widest leaf.

Table 2. *Growth parameters of traditional upland rice varieties.*

Variety Code	Upland rice varieties	Plant Height (cm)	Culm length (cm)	Culm Diameter (cm)	Number of Tillers	Leaf Length (cm)	Leaf Width (cm)
V1	Kadidit Pilit	153.20cd	143.40b	0.39b	17.80g	46.47bc	2.62b
V2	Red 64	175.17b	126.63c	0.22h	22.67def	35.53e	1.52e
V3	Masipag 9	136.03ef	135.47bc	0.23g	23.67de	35.2ef	1.53e
V4	Masipag 15	142.7e	129.23c	0.23g	24.23d	37.68de	1.63de
V5	Dinorado	116.93f	108.55d	0.32cd	29.17c	33.02f	1.62de
V6	Mindoro	133.00f	125.00c	0.31e	35.73a	38.57d	1.63de
V7	Camuros	87.57h	72.55f	0.28f	32.13b	29.23h	2.05c
V8	Masipag 22	83.48h	73.67f	0.30e	37.30a	31.07g	1.68d
V9	Palawan	92.25gh	90.47e	0.25g	29.83c	37.75g	2.13c
V10	Suleg	157.93c	146.60b	0.29ef	17.77g	55.33a	2.3bc
V11	Biday	183.5a	168.08a	0.39b	19.13fg	54.77a	2.98a
V12	Pilit	101.82g	90.67e	0.32c	23.23de	33.37fg	2.08c
V13	Pilit Talacdan	151.53cd	139.63b	0.42a	21.77efg	49.47b	2.72b
F-test		**	**	**	**	**	**
CV%		14.45%	5.04%	6.34%	8.13%	16.23%	13.10%

\*\*p > 0.01

The yield of upland rice varieties was influenced by various yield components such as panicle length, number of filled and unfilled grains/panicle and weight of 1,000 grains (g). The yield components showed significant variation among the 13 varieties of upland rice tested (Table 3). Biday variety produced the longest panicle, followed by Pilit Talacdan and Kadidit Pilit wherein the latter varieties produced the highest number of filled grains. The least number of unfilled grains was produced by Maspag 9 variety. Pilit and Biday produced the highest weight of 1,000 grains. Pilit and Pilit Talacdan varieties were the highest yield (Figure 1) owing to their production of the most number of filled and heavier weight grains.

Table 3. *Yield components of upland rice varieties.*

Variety Code	Upland rice varieties	Panicle Length (cm)	No. of filled grains/panicle	No. of unfilled grains/panicle	Weight of 1,000 grains (g)
V1	Kadidit Pilit	30.08bc	194.20a	74.01b	27.37b
V2	Red 64	23.88de	88.74def	40.41d	22.37cd
V3	Masipag 9	25.57c	79.77g	58.28c	19.60f
V4	Masipag 15	23.67def	86.81ef	42.13e	19.43f
V5	Dinorado	23.48ef	64.75i	20.55b	23.87bcd
V6	Mindoro	27.50b	95.07c	37.45g	22.77cd
V7	Camuros	20.27f	71.23h	22.93gh	22.90cd
V8	Masipag 9	21.57ef	78.99g	18.83h	20.43de
V9	Palawan	21.7ef	58.03i	77.50b	20.77de
V10	Suleg	26.60c	138.24b	57.11c	22.30cde
V11	Biday	33.92a	133.84b	35.85f	32.50a
V12	Pilit	23.57d	91.00cd	36.38f	34.70a
V13	Pilit Talacdan	29.90b	197.59a	86.99a	26.13bc
F-test		**	**	**	**
CV%		3.11%	17.58%	4.34%	9.21%

\*\*p > 0.01

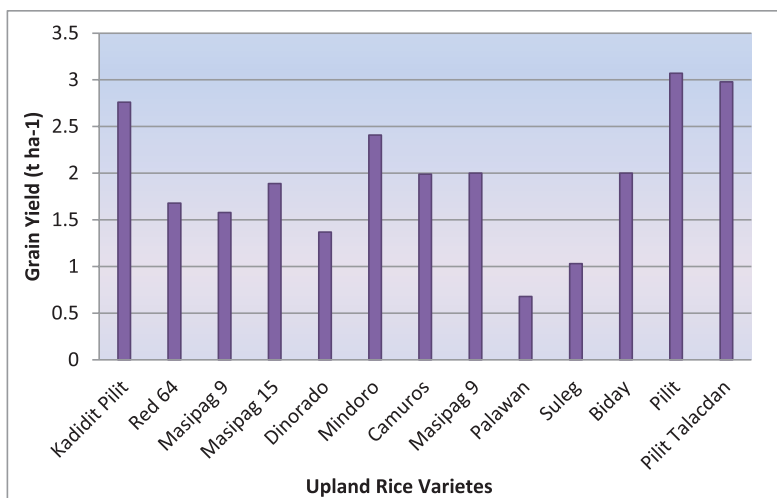


Figure 1. The Grain yield (t ha<sup>-1</sup>) of 13 upland rice varieties.

## DISCUSSION

### Growth Parameters of Upland Rice

Majority of the varieties were tall (>100cm) except for Camuros, Masipag 22 and Palawan that did not reach a height of 100 cm. Comparing the means among varieties, Biday upland rice was the tallest among the varieties with a maximum height of 183.5cm, followed by Red 64 with a height of 175. Taller height would allow the plant to receive more light; however, this would also cause the variety to be more prone to lodging. It was also noted that the varieties, Camuros and Masipag 22, incurred a plant height of 87.57cm and 83.48cm which was the shortest height recorded among the varieties of upland rice that were collected. Shorter height would allow the plant to escape lodging and it was suitable on areas which were always affected by heavy rains and typhoons.

Varieties of upland rice differed in terms of tillering ability (Table 1). Masipag 22 produced the most number of tillers of 37.30 which was comparable to the number of tillers of Mindoro with a mean number of 35.73. Camuros also produced a mean number of tillers of 32.13 which was statistically different from the number of Dinorado and Palawan varieties with a mean number of tillers of 29.17 and 29.83, respectively. The least number of

tillers was produced by upland rice varieties, Kadidit Pilit and Suleg. This result implied that varieties had a significant influence on the production of tillers which indicates the potential of each variety.

Culm length and diameter of upland rice was significantly different between varieties. Culm refers to the stem of the rice plant. Statistically, the biggest culm was produced by variety Pilit Talacdan, while Biday had longer culm eventually making this the taller variety. Likewise, the smallest culm was obtained by variety Red 64 while Masipag 22 and Camuros showed shortest culm height.

Data on the leaf length of upland rice showed a significant variation. Suleg and Biday produced the longest leaves with a mean length of 55.33cm and 54.77cm respectively wherein the tallest height was also observed on Biday variety (Table 1). Varieties Kadidit Pilit and Pilit Talacdan had also had identical length of leaves while the shortest leaves were produced by Camuros with a mean leaf length of 29.23cm.

Moreover, the leaf width was also measured to further determine the functions of the growth components of the upland rice. It was inferred in Table 1 that Biday variety consistently produced the largest leaves with a mean leaf width which was statistically different in the leaf width of varieties Pilit Talacdan, and Kadiditi Pilit and Suleg. Likewise, varieties Mindoro, Masipag 15, Dinorado, Masipag 9 and Red 64 similarly produced smaller leaves compared to other varieties.

### **Yield Components of Traditional Upland Rice Varieties**

Variation in terms of panicle length was observed among the 13 upland rice varieties. Biday produced long grain-bearing panicles, while varieties Kadidit Pilit, Suleg, and Pilit Talacdan similarly produced the same panicle length. Likewise, Masipag 9 and Camuros produced similar culm length which was the shortest recorded among the 13 varieties that were planted. The result indicated that the longer the panicle the more number of grains was produced by the variety.

A composite of five (5) panicles from each variety was weighed and showed a significant difference in the panicle weight of upland rice. Generally, Pilit Talacdan and Biday varieties produced heavier panicles with a mean weight per panicle of 5.88g and 5.27g which was significantly different from Suleg variety. The lowest panicle weight was produced by varieties Camuros and Masipag 9.



The number of filled and unfilled grains/panicles showed a significant difference between varieties. Pilit Talacdan and Kadidit Pilit produced the highest number of filled grains. These two varieties were also noted to produce the most number of unfilled grains. The data also showed that Palawan variety which produced the least number of filled grains also produced the second most number of unfilled grains which was similar to Kadidit Pilit. The least number of unfilled grains was produced by Masipag 22.

The weight of 1,000 grains showed significant variation between the varieties of upland rice. Pilit and Biday varieties obtained the highest weight of 1,000 grains while Varieties Masipag 9 and Masipag 15 obtained the lowest weight of 1,000 grains.

### **Grain yield ( $\text{t ha}^{-1}$ ) of Upland Rice Varieties**

In terms of grain yield, Pilit and Pilit Talacdan consistently gave the highest yield with a mean of 3.07 and 2.98  $\text{t ha}^{-1}$ . Their yield was affected by their components wherein these two varieties together with Kadidit Pilit produced the most number of grains which was the significant attribute of grain yield. The lowest grain yield was obtained by Palawan variety with a mean yield of only 0.68  $\text{t ha}^{-1}$ . The yield was partly affected by the number of grains since this variety had the least number of filled grains.

### **Grain Characteristics**

Dinorado produced longer grains while Pilit variety bore bigger grains due to its diameter. Meanwhile, varieties Masipag 22, Suleg, Biday and Pilit had thicker grains since the grains of these varieties were well-filled. Most of the grain texture was smooth but rough grain texture was exhibited by Masipag 15 and Pilit varieties.

Distinct qualitative characteristics of each variety of upland rice from culm color to grain pubescence were noted. Common to each variety was having yellow-green culm color without culm pubescence while Kadidit Pilit variety was distinguished due to its violet culm color with the presence of pubescence on its stalk. Varieties Red 64, Masipag 9, Camuros and Masipag 22 were awnless while the rest of the varieties had varied length of awns.



Figure 2. Seed samples of 13 traditional upland rice varieties.

## CONCLUSION

Significant differences on growth, yield components and other grain traits were found from the traditional upland rice varieties tested. Biday variety was the tallest among the varieties, Mindoro and Masipag 22 produced the most number of tillers, Pilit Talacdan had the biggest culm, Biday and Suleg varieties had the longest leaves with Biday having wider leaves while Pilit and other qualitative characteristics were found among the varieties showing potential diversity.

## RECOMMENDATIONS

1. Conserve these varieties for future utilization on production and other future endeavors such as plant breeding and improvement program;
2. Further verification on the stability of these varieties on farmer's field condition may be conducted;
3. Further grain quality evaluation may be done in terms of aroma, phenolics, anti-oxidant content and other essential substances that promote good health; and
4. Export the prospects of heirloom rice (indigenous upland rice varieties).

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