Science and Technology Journal
Vol. VIII 2018 Issue ISSN: 2012 0060

PERFORMANCE OF TRADITIONAL UPLAND RICE (*Oryza sativa*) VARIETIES IN RAINFED LOWLAND AREAS OF BATAC, ILOCOS NORTE

Araceli J. Badar and Menisa A. Antonio*

ABSTRACT

The role of traditional upland rice (TUR) in meeting household rice sufficiency in many upland communities is indispensable. However, growing them using slash and burn farming is restricted by the government due to its destructive effects on the environment. Thus, a two-year (2013-2014 WS) growth and adaptability trial involving 49 accessions and one registered check variety for rainfed lowland was conducted in the rainfed lowland areas of MMSU, Batac, Ilocos Norte. The study aimed to identify high-yielding and adaptable accessions in such ecosystem.

Four TUR's consistently out-yielded the check variety with yields ranging from 3.3 to 4.17 t ha^{-1} in both the 2013 and 2014 wet season cropping. These were accessions TUR 53, 72, 74 and 77. These have fertile spikelets, medium sized panicles, medium tillering capacity, medium to big seed size. These accessions were recommended for rainfed lowland cultivation.

Keywords: *traditional upland rice, growth performance, rainfed lowland ecosystem, rice sufficiency*

INTRODUCTION

Upland rice is one of the most popular cereal crops and plays a very important role in mountain peoples' lives. Like maize and cassava, upland rice is a main source of food for people. The life of ethnic minorities is closely linked with upland farming in general and upland rice cultivation in particular.

TUR is known for its quality and aromatic flavor, which is highly demanded as source of carbohydrates specifically for the Filipinos. These varieties have high demands in the market, thus requiring higher prices than the modern rice varieties. However, with technological advances and introduction of high-yielding varieties, these TUR were almost displaced in the system and area of cultivation was reduced.

According to Philippine's National Statistical Center (2004), upland rice yields an average of 1.7 t ha^{-1} versus 3.6 t ha^{-1} for wet season lowland rice. Because of its low yield, upland rice is generally considered to be unsuitable for intensive management practices aimed at high yields. However, the low yield of upland rice is largely a consequence of its production being limited to infertile or drought-prone uplands and low harvest index (HI) of traditional cultivars (George *et al.*, 2001).

In Ilocos Norte and most parts of the country, TUR is usually cultivated through

**Corresponding Author Current Address: Research Directorate Mariano Marcos State University, City of Batac, Ilocos Norte 2906 Philippines; email: celybadar@yahoo.com*

slash-and-burn in high mountainous areas despite prohibitions set by the government. In order to reduce the ecological hazards to the upland agro-ecosystem and forest resources brought about by slash-and-burn practice, less risk-prone areas such as rainfed lowland areas have to be explored for traditional rice cultivation, therefore enhancing the sustainability of upland rice production and the environment.

Rainfed lowland ecosystems are unirrigated, leveled, and bunded fields that have shallow flooding with rainwater (Mackill *et al.*, 1996 as cited by Haefele, 2009). These are agro-ecosystems characterized by fields that are flooded for at least part of the growing season. As mentioned earlier, TURs are grown in upland areas which are infertile and droughty. Knowing this as resilient crop, there should be no reason why TUR cannot be productively grown in rainfed lowland ecosystem given the appropriate accessions. It was in this context that this research was conducted.

METHODOLOGY

Locale of the Study

The study was conducted for two consecutive years, in 2013 and 2014 wet season (WS), at the MMSU Experimental Farm, City of Batac, Ilocos Norte. The experimental site is a rainfed lowland area with an elevation of 17.9m above mean sea level (masl) and situated at 18° 3' N latitude, and 120° 53' E longitude. Weather data during the two-year trial were gathered from the MMSU-PAGASA, Agrometeorological Station, MMSU, City of Batac. These varied particularly on the amount of solar radiation, distribution of rain events and occurrence of typhoons. Total rainfall from June to September was 1863.8mm in 2013 WS while 1420.6mm in 2014 WS. However, despite the high total rainfall in 2013, a relatively long interspersed dry spell occurred during the vegetative stage of the crop. Further, high rainfall occurred during the late part of August 2013 which coincided with the booting stage, and at mid-September during the peak of the reproductive phase (Fig. 1). A good rainfall pattern was observed during the 2014 WS from vegetative to early reproductive stages of the crop. Cyclones in both years occurred sporadically during the growing season. There were more tropical cyclones in 2014 (12) than in 2013 (10), most of which occurred in September and October, coinciding with the reproductive and grain ripening phases of the crop.

The temperature ranged from 23.94°C to 32.07°C (maximum) in 2013, and about 22.65°C to 31.92°C in 2014. These are within the maximum and minimum temperature requirements of rice (http://www.rice-trade.com/climatic-conditions-rice.html).

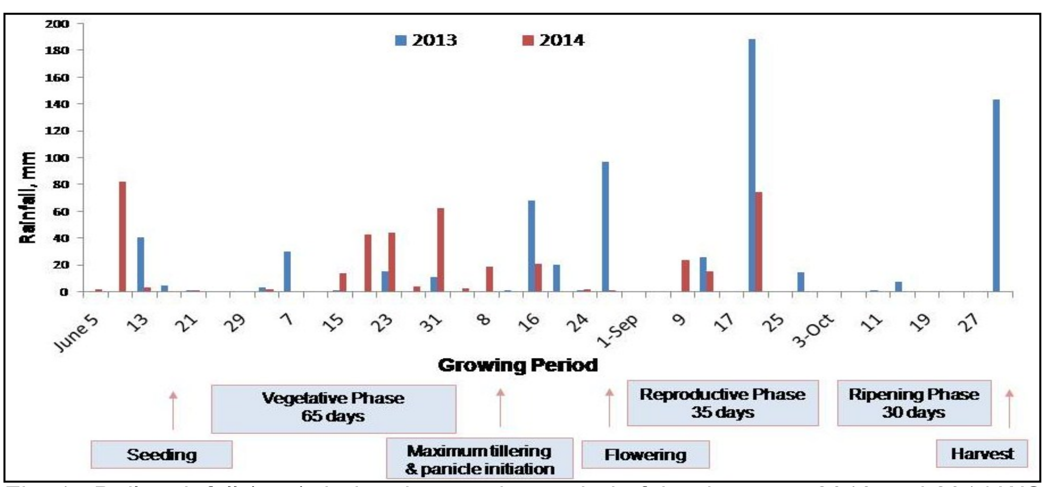

Fig. 1. Daily rainfall (mm) during the growing period of the rice crop, 2013 and 2014 WS

Experimental Design and Treatments

The research involved a field experiment of 49 TUR accessions and a registered variety for rainfed lowlands, NSIC Rc 146, as the check variety. It was laid out in Randomized Complete Block Design (RCBD) with 3 replications. Unit plot size was 9.0m^2 with 50cm distance between treatment plots. The accessions were numbered from 51 to 99 for identification.

Crop Establishment and Maintenance

Following the farmer's practice, about 3 to 5 seeds were dibbled per hill^{-1} with a distance of 20cm between hills and 30cm between rows. Resowing was done in hills with poor germination at 7 to 10 DAS. The recommended fertilizer of 90-60-60kg N-P2O5-K2O ha^{-1} was followed. All P and K and two-thirds of N were applied basally. The remaining N was top-dressed in 2 equal splits, during maximum tillering and at panicle initiation stages. Herbicide was sprayed before sowing. This was complemented with manual weeding during the crop's vegetative stage. The crop was not sprayed with any pesticide since pest infestation was not severe. The crop depended on rainfall except during long interspersed dry spells at critical growth stages especially during panicle initiation stage (50-60 DAS) where supplemental irrigation from a shallow tube well was applied twice a week.

Data Gathering Procedures

Agronomic data such as plant height, number of tillers hill^{-1}, panicle length and spikelets fertility were gathered using 10 sample plants per unit plot. Spikelet fertility was based on 10 sample panicles per plot while seed size was based on the weight of 1000 grains. The number of days to maturity was reckoned from date of planting to the date when 80% of the grains have turned straw brown while grain yield ha^{-1} was estimated on a 1-m^2 crop cut at the middle portion of each plot adjusting the weight to 14% moisture content.

Data Analysis

Agronomic data of individual year were analyzed using Analysis of Variance (F-test) in RCBD. Where F-test showed significant result, each TUR accession was compared with the check variety using Least Significant Difference (LSD) test. Data on grain yield was analyzed across years. As part of the results and discussion, data on plant height, seed size, maturity, panicle length, spikelet fertility and tiller count were clustered into distinct descriptive groups based on Standard Evaluation System for Rice (IRRI 2014) as follows:

Rating Scale:

[1]Plant height

<90 cm	-	Semi-dwarf
90-125 cm	-	Intermediate
>125 cm	-	Tall

[2]Tiller count

20-25 tillers/ plant	-	Good
10-19 tillers/ plant	-	Medium
<9	-	Low
90-100 days	-	Early

[3]Maturity

101-120	-	Medium
>120 days	-	Late maturing

[4]Panicle length

21-30cm	-	Medium
31-40cm	-	Long

[5]Seed size

20-23g	-	Small
24-27g	-	Medium
>28g	-	Big

[6]Spikelet Fertility

>90%	-	Highly fertile
75-89%	-	Fertile
50-74%	-	Partly sterile
<50% to trace	-	Highly sterile

RESULTS AND DISCUSSION

Growth parameters

Plant Height

Significant differences (P<0.01) were observed on plant height in both years (Table 1). However, plants were generally taller in 2013 than in 2014. This height difference could be attributed to higher total rainfall in 2013 with majority of the rain events occurred during the most critical growth period.

In 2013 WS, plant height ranged from 87.22cm (check) to 150.53cm. All the accessions were significantly taller than the check variety except six accessions (54, 56, 66, 67, 76 and 89) with plant height values which did not differ from the former. In 2014, plant height ranged from 88.60cm to 142.60 with only 25 accessions taller than the check. Considering the mean height for the two-year period, the accessions can be grouped into tall (>125cm) and intermediate stature (90-125cm). A total of 15 accessions as well as the check variety belonged to the latter group. Such finding conforms to the findings of Ortuose 2014 that upland rice cultivars are taller than modern varieties reaching up to 150 cm in height.

Number of Tillers

Significant difference between the TUR and the check variety was also observed on the number of tillers in both cropping years (Table 1). In contrast to plant height, the number of tillers was generally higher in 2014 than in 2013. More and heavier rains occurred during the active vegetative phase of the crop in 2014 than in 2013 (Fig. 1). In 2013 WS, the number of tillers of 46 accessions did not differ from the check variety. The remaining three accessions produced more tillers than the check. In 2014 WS, 17 accessions produced less tillers than the check. However, based on IRRIs classification, all the accessions belongs to medium-tillering category (10-19 tillers $hill^{-1}$). The growth and development of tillers depend partially on environmental factors, especially on radiation, temperature, and nutritional conditions and partially on varietal characteristics (Hanada 1993, as cited by Mohammad Nuruzzaman, *et al.*, 2000). In a similar study conducted in the lower elevation upland of Payao and Lubbot, in the City Batac, Ilocos Norte, results showed that most of the TUR entries were low-tillering, a characteristic of upland varieties (Badar *et al.*, 2012).

Table 1. Growth performance of TUR accessions in comparison with the check variety

TUR Acc	PLANT HEIGHT[1] (cm)		NO. OF TILLERS[2]		MATURITY (DAYS)[3]	
	2013 WS	2014 WS	2013 WS	2014 WS	2013 WS	2014 WS
51	150.53 H	138.20 H	10 N	13 L	116.00 N	113.67 N
52	135.00 H	110.93 N	10 N	16 N	115.00 N	114.00 N
53	142.13 H	121.53 H	11 N	12 L	118.00 N	117.00 N
54	94.66 N	97.26 N	21 H	17 N	126.00 H	126.33 H
55	145.20 H	125.80 H	12 N	13 L	113.33 N	113.00 N
56	115.53 N	115.26 N	6 N	14 L	113.33 N	113.00 N
57	135.73 H	111.81 N	10 N	13 L	113.67 N	114.00 N
58	134.93 H	118.26 N	96 N	15 N	113.33 N	113.67 N
59	130.46 H	118.33 N	11 N	14 L	122.00 H	122.33 H
60	135.93 H	122.20 H	10 N	18 N	118.67 N	119.67 N
61	143.86 H	115.93 N	12 N	12 L	117.00 N	118.67 N
62	144.26 H	140.40 H	10 N	18 N	114.67 N	115.00 N
63	139.53 H	124.60 H	10 N	15 N	122.67 H	123.67 H
64	130.26 H	135.00 H	10 N	17 N	123.33 H	123.00 H
65	146.53 H	128.10 H	13 N	15 N	119.67 N	122.00 H

Table 1. Continued

TUR Acc	PLANT HEIGHT[1] (cm) 2013 WS	PLANT HEIGHT[1] (cm) 2014 WS	NO. OF TILLERS[2] 2013WS	NO. OF TILLERS[2] 2014 WS	MATURITY (DAYS)[3] 2013 WS	MATURITY (DAYS)[3] 2014 WS
66	116.53 N	106.33 N	10 N	18 N	117.33 N	117.33 N
67	119.53 N	115.70 N	10 N	14 L	114.33 N	114.67 N
68	139.20 H	136.40 H	10 N	17 N	119.00 N	117.00 N
69	140.20 H	119.13 N	14 H	14 L	117.33 N	121.67 H
70	128.26 H	115.46 N	8 N	17 N	122.00 H	124.00 H
71	140.53 H	110.86 N	10 N	11 L	114.00 N	113.67 N
72	151.33 H	124.46 H	14 H	16 N	114.67 N	113.67 N
73	136.60 H	113.80 N	12 N	18 N	114.00 N	114.33 N
74	130.06 H	122.40 H	9 N	15 N	122.33 H	124.00 H
75	138.00 H	128.60 H	12 N	21 N	122.67 H	122.67 H
76	114.66 N	105.60 N	12 N	17 N	121.67 H	122.00 H
77	143.66 H	142.60 H	9 N	19 N	120.00 N	120.00 N
78	131.06 H	123.06 H	7 N	16 N	115.67 N	117.67 N
79	144.40 H	132.73 H	10 N	14 L	122.33 H	123.67 H
80	141.13 H	132.00 H	9 N	14 L	115.67 N	117.00 N
81	136.80 H	120.93 H	8 N	16 N	115.00 N	115.67 N
82	138.53 H	130.80 H	10 N	15 N	122.67 H	123.00 H
83	138.00 H	125.66 H	9 N	16 N	120.00 N	120.33 N
84	131.33 H	122.73 H	10 N	18 N	119.33 N	120.67 N
85	127.46 H	118.06 N	9 N	12 L	113.67 N	114.00 N
86	147.13 H	125.80 H	10 N	15 N	116.67 N	118.33 N
87	117.86 H	108.60 N	9 N	19 N	115.67 N	118.67 N
88	131.00 H	116.33 N	11N	12 L	113.67 N	114.33 N
89	102.70 N	88.60 L	12 N	20 N	121.67 H	123.67 H
90	138.20 H	117.13 N	10 N	16 N	117.67 N	118.00 N
91	123.40 H	116.33 N	9 N	13 L	114.67 N	116.67 N
92	126.26 H	117.00 N	11N	16 N	116.00 N	119.33 N
93	129.93 H	114.46 N	7 N	15 N	114.33 N	117.00 N
94	137.73 H	133.33 H	9 N	16 N	116.67 N	119.00 N
95	143.40 H	129.06 H	9 N	15 N	118.00 N	120.67 N
96	138.80 H	117.73 N	11 N	16 N	119.33 N	121.67 N
97	147.00 H	130.86 H	9 N	14 L	124.00 H	125.00 H
98	149.00 H	102.53 N	11 N	13 L	113.67 N	113.67 N
99	140.13 H	119.40 H	10 N	16 N	117.67 N	118.67 N
Check (NSIC Rc 146)	87.20	102.06	9	20	117.00	119.00
Sig	**	**	**	*	**	**
CV(%)	7.58	8.73	25.98	20.51	2.30	2.41

** - significant at 1% level
* - significant at 5% level
In a column, means marked with H, N and L are significantly higher, not different, and significantly lower, respectively, than the check variety at $LSD_{0.05}$.

Maturity

The number of days to maturity varied significantly in both years with no apparent significant difference across year (113 to 126 days in 2013; and 113 to 125 in 2014). Most accessions were medium-maturing in both cropping years based on the classification scheme of *Oikeh et al.* (UD). In 2013, 12 accessions matured longer than the check while 14 accessions in 2014. TUR 54 which matured in 126 days was the latest to mature in both cropping years. This result was similar with the findings of Ortuose (2014) that maturity of the upland rice accessions in their study ranged from 122 to 126 days. None of the accessions was early maturing.

Yield and yield components

Panicle Length

Panicle length differed significantly in 2013 WS but not in 2014 WS (Table 2). In 2013, except TUR 63 with panicles classified as long, all the accessions as well as the check variety produced medium panicles as described in the Standard Evaluation System for Rice. There were only 5 accessions which are not significant to the check. In 2014, panicle length were not significant however, there were slightly more long-panicled than medium-panicled accessions. Panicle length ranged from 21.18cm to 35.51cm. This result could be partly attributed to the good rainfall pattern observed from vegetative to early reproductive stages of the crop during the 2014 WS. The significant variability in panicle length could be attributed to the genetic make-up of the accessions. The result obtained in 2013 was similar to the findings of Badar, *et al.* (2012) where the majority of the evaluated TURs in low-elevation upland produced medium panicles.

Seed Size

In 2013, two accessions, TUR 76 and TUR 89 were as small as the check entry while in 2014, 9 accessions were comparable to the check which is small (Table 2). This shows that majority of the TUR accessions had bigger seed size compared to the modern check, NSIC Rc 146. Differences in seed size might be attributed to the genetic make-up of the rice accessions. This conforms with the findings of Tahir *et al.* (2002) as cited by Khalil *et al.* (2009), who reported highly significant variation among different traits and observed that these traits are under the control of genotypic difference among the genotypes. Bharali *et al.* (1994) as cited by Khalil *et al.* (2009) reported the correlation and influence of 1000-grain weight by flag leaf area. Other factors like; adoptability, temperature, soil fertility, transplantation season and time might also be responsible for thousand grain weight. On the other hand, grain weight is determined by the supply of assimilates during the ripening period, and the capacity of the developing grain to accumulate the trans-located assimilates (Ntanos and Koutroubas, 2002). In addition, grain weight is a variable proportion of spikelet's sterility/ fertility regulated by moisture.

Therefore, one of the reasons behind grain yield loss with moisture stress may be the decrease in the number of filled grain per panicle (Atera, *et al.*, 2011).

Spikelet Fertility

Significant differences were observed in spikelet fertility of the different accessions evaluated (Table 2). TUR 84 was highly fertile in 2013, having 90.25%, followed by TUR 86, TUR 98, and TUR 72, which have 89.24%, 87.60% and 87.25% fertility, respectively. Meanwhile, in 2014, TUR 70 was highly fertile, having 91.28%, which was comparable to TUR 92, TUR 77, and TUR 78. Forty three and 44 accessions were as fertile as the check while six and 5 accessions had significantly lower spikelets fertility percentage than the check in 2013 and 2014 respectively.

Table 2. Yield components of the TUR accessions evaluated in the rainfed lowland of Batac, Ilocos Norte, 2013 and 2014 WS

TUR Acc	PANICLE LENGTH[4] (cm)		SEED SIZE[5] (g/1000 seeds)		SPIKELET FERTILITY[6] (%)	
	2013	2014	2013	2014	2013	2014
51	27.37 H	35.51	28.73 H	29.80 H	75.39 N	73.25 L
52	26.03 H	31.48	27.53 H	24.63 H	74.24 N	80.78 N
53	26.69 H	30.19	32.33 H	29.90 H	83.76 N	86.88 N
54	21.96 N	27.37	26.93 H	24.13 H	77.53 N	76.26 N
55	25.18 H	29.77	24.70 H	23.33 H	83.81 N	77.83 N
56	26.39 H	30.37	25.96 H	24,66 H	84.35 N	87.14 N
57	26.15 H	31.30	34.23 H	31.56 H	75.79 N	73.59 L
58	26.10 H	30.30	26.96 H	27.76 H	82.21 N	66.15 L
59	27.04 H	31.14	29.90 H	26.73 H	72.23 L	88.33 N
60	29.32 H	32.47	28.30 H	26.53 H	79.00 N	77.75 N
61	30.47 H	32.32	34.06 H	33.93 H	83.58 N	84.08 N
62	29.05 H	33.82	31.13 H	30.03 H	76.70 N	88.79 N
63	30.62 H	34.51	29.20 H	25.73 H	81.92 N	86.38 N
64	28.85 H	32.44	29.36 H	27.53 H	77.43 N	76.27 N
65	29.17 H	31.77	31.03 H	28.13 H	82.55 N	81.07 N
66	23.73 N	27.05	27.60 H	21.63 N	74.61 N	61.99 L
67	26.46 H	27.81	28.00 H	26.06 H	80.86 N	86.42 N
68	28.29 H	30.92	34.40 H	30.10 H	76.68 N	83.07 N
69	26.58 H	28.74	30.16 H	28.70 N	69.83 L	78.51 N
70	25.19 H	31,68	28.93 H	25.06 H	75.01 N	91.28 N
71	28.33 H	28.58	33.80 H	31.13 H	84.78 N	86.96 N
72	28.55 H	29.85	31.30 H	28.96 H	87.25 N	84.64 N
73	27.29 H	32.24	28.90 H	26.50 H	71.21 L	78.61 N
74	29.33 H	31.21	27.13 H	25.16 H	79.62 N	79.89 N
75	29.04 H	31.78	28.20 H	26.73 H	71.98 L	80.72 N
76	23.56 N	28.07	21.86 N	17.70 N	87.04 N	79.60 N
77	29.12 H	30.09	26.66 H	22.36 N	82.83 N	89.19 N
78	26.38 H	29.76	26.36 H	24.56 H	86.29 N	89.08 N
79	28.83 H	30.80	30.56 H	30.36 H	83.20 N	86.34 N
80	29.10 H	31.94	30.66 H	27.63 H	86.21 N	84.34 N
81	27.22 H	29.16	27.33 H	26.63 H	76.63 N	88.82 N
82	26.09 H	31.14	25.36 H	22.16 N	81.40 N	75.55 N
83	26.93 H	31.36	29.36 H	28.76 H	75.64 N	88.83 N
84	28.41 H	31.02	31.96 H	28.40 H	90.25 N	85.99 N
85	26.64 H	28.84	27.46 H	24.16 H	82.14 N	84.61 N
86	28.46 H	30.89	28.43 H	21.96 N	89.24 N	78.92 N
87	23.54 N	28.53	24.10 H	22.83 N	78.18 N	82.60 N
88	25.56 H	29.65	32.00 H	28.86 H	68.46 L	77.32 N
89	22.28 N	27.66	22.93 N	20.86 N	70.91 L	56.67 L
90	24.41 H	30.04	27.33 H	23.80 H	83.06 N	84.50 N
91	27.94 H	30.03	29.73 H	27.50 H	87.10 N	86.76 N
92	25.57 H	32.79	31.50 H	27.46 H	86.92 N	89.72 N
93	27.03 H	31.45	26.16 H	29.30 H	82.20 N	88.13 N
94	26.99 H	21.18	32.50 H	22.36 N	79.70 N	81.92 N
95	28.89 H	34.08	27.80 H	26.50 H	79.84 N	83.57 N

Table 2. Continued

TUR Acc	PANICLE LENGTH[4] (cm)		SEED SIZE[5] (g/1000 seeds)		SPIKELET FERTILITY[6] (%)	
	2013	2014	2013	2014	2013	2014
96	27.26 H	32.76	26.53 H	23.83 H	80.24 N	78.72 N
97	28.33 H	32.55	32.66 H	31.13 H	81.65 N	83.21 N
98	27.58 H	30.13	30.66 H	27.63 H	87.60 N	83.13 N
99	26.96 H	32.14	23.66 H	20.93 N	87.57 N	81.03 N
Check (NSIC Rc 146)	21.15	30.28	20.63	18.16	78.94	83.59
Sig	**	ns	*	**	**	**
CV(%)	7.10	10.76	3.48	4.88	8.94	28.37

** - significant at 1% level
* - significant at 5% level
ns - not significant
In a column, means marked with H, N and L are significantly higher, not different, and significantly lower, respectively, than the check variety at $LSD_{0.05}$.

Table 3. Main yield (t ha^{-1}) of the TUR accessions evaluated in the rainfed lowland of Batac, Ilocos Norte, 2013 and 2014 WS

TREATMENT	YIELD (kg ha^{-1})	YIELD ADVANTAGE OVER THE CHECK (%)
Year (Y)	ns	
Year 1 (2013)	2511.11	
Year 2 (2014)	2543.70	
Accessions (V)	*	
51	1605.03 L	-25.46
52	2209.23 N	8.59
53	3287.23 H	38.78
54	3105.58 H	34.88
55	2668.83 H	24.34
56	2015.27 N	0
57	1763.36 L	-14.77
58	2560.00 H	21.09
59	1659.99 L	-21.69
60	2706.06 H	25.46
61	2729.32 H	26.00
62	1849.28 L	-9.18
63	2810.81 H	28.11
64	2869.85 H	29.61
65	2289.52 N	11.77
66	2194.46 N	7.76
67	3069.41 H	34.20
68	1946.87 N	-3.58
69	1865.87 L	-8.02
70	2213.54 N	8.59
71	2934.88 H	31.05

Table 3. Continued

TREATMENT	YIELD (kg ha^{-1})	YIELD ADVANTAGE OVER THE CHECK (%)
72	3562.10 H	43.25
73	1867.44 L	-8.02
74	4167.84 H	51.55
75	2223.17 N	9.00
76	1973.35 N	-2.53
77	3301.46 H	38.78
78	3013.12 H	32.89
79	2821.69 H	28.36
80	2236.54 N	9.82
81	3004.25 H	32.67
82	2842.44 H	28.87
83	3001.32 H	32.67
84	3112.32 H	35.04
85	2641.26 H	23.48
86	1788.59 L	-12.84
87	1387.28 L	-45.32
88	2370.39 N	14.76
89	1618.58 L	-24.69
90	3118.30 H	35.25
91	2588.63 H	22.00
92	2332.87 N	13.30
93	3271.55 H	38.22
94	2685.98 H	24.90
95	2725.87 H	26.00
96	2267.78 N	11.01
97	2975.30 H	32.22
98	2942.48 H	31.29
99	2127.93 N	5.16
Check (NSIC Rc 146)	2021.19	-
Y x V	ns	
CV(%)	46.60	

** - significant at 1% level
* - significant at 5% level
ns - not significant
In a column, means marked with H, N and L are significantly higher, not different, and significantly lower, respectively, than the check variety at $LSD_{0.05}$.

Grain Yield

Combined analysis across years showed significant differences on the varieties/accessions but not on year, and variety x year (Table 3). Twenty seven accessions produced significantly higher grain yield than the check and 9 accessions produced significantly lower yield than the check. A yield advantage of 5.07% to 51.53% over the check was likewise obtained.

Four entries, TUR 53, 74, 72 and 77, are within the yield range of 3.3t ha^{-1} to 4.17t ha^{-1} obtained from the six promising accessions evaluated in low elevation upland (Badar *et al.*, 2012). The high yield obtained from them could be attributed to their high spikelet fertility in combination with bigger seed size (in TUR 53), many productive tillers (in TUR 72), long panicles (in both TUR 74 and 77) and also on the varietal yielding capabilities of the accessions as described by Ortuose 2014. The same variability were reported by Zahid *et al.* (2005), who studied twelve genotypes of coarse rice to check their yield performance in Kallar tract and reported highly significant variation for different traits. This variation in the grain yield might be due to the environment (Mahpattra, 1993 as cited by Khalil, 2009) or the correlation of grain yield plant^{-1} with various yield contributing characteristics like: fertility of soil, flag leaf area, grains panicle^{-1}, number of grains panicle^{-1} and grain weight and correlation with these traits.

The average yield obtained from these evaluation of TUR is also higher in the upland (2.14t ha^{-1} to 4.67t ha^{-1}), (Badar *et al.*, 2012) than in the rainfed lowland (1.39t ha^{-1} to 4.17t ha^{-1}). A similar result was reported by Alibuyog *et al.* (2015), who obtained higher yield from traditional varieties in the upland (1.49kg ha^{-1} to 6.99kg ha^{-1}) than in the rainfed lowland (0.96t ha^{-1} to 5.30t ha^{-1}). This implies that these traditional varieties are more adaptable in upland agro-ecosystems.

CONCLUSIONS

The TUR accessions showed variability in their agronomic performance. Characteristics such as tiller count, panicle length and spikelets fertility were the directly determinants of the grain yield of the evaluated accessions. Among the accessions, TUR 53, 72, 74, and 77 were the most promising based on grain yield with yield potential of 3.3. to 4.17t ha^{-1}. These have fertile spikelets, medium-sized panicles, medium tillering capacity, and medium to big seeds.

A confirmatory trial (farmer managed) using the identified high-yielding accessions in farmers' fields is recommended to validate the agronomic performance of the identified accessions. Purification, seed production and re-introduction of good/promising accessions to the upland rice farmers should be initiated next.

LITERATURE CITED

Alibuyog, A.Y., Solero, J.M., Rosales, R.J.G., and Bartolome, M.A.B. (2015). Abstracts of Paper Presentations. 28th National Rice R&D Conference. PhilRice, Central Experiment Station, Maligaya, City of Munoz, Nueva Ecija, September 9-10, 2015.

Atera, E.A, Onyango, J.C., Azuma, T., Asanuma, S. and Itoh, K. (2010). Afr. J. Agric Res. pp 4-5.

Badar, A.J., Antonio, M.A., Bucao, D.S., Agustin, E.O. and Gorospe, M.B. (2012). Promising Traditional Upland Rices Adaptable to Low Elevation Upland Areas (Unpublished). 24th Regional Symposium, Teatro Ilocandia, Mariano Marcos State University, City of Batac, October 31, 2012.

George, T., Magbanua, R., Roder, W., Van Keer, K., Trebuil, G., and Reoma, V. (2001). Upland rice response to phosphorus fertilization in Asia. Agron*,* 93, 1362-1370.

Hossain, M.B., Islam, M.O., Hasanuzzaman M. (2008). Influence of different nitrogen levels on the performance of four aromatic rice varieties. International Journal of Agriculture and Biology. 2008;10(6):693–696.

Hussain, S., Ramzan, M., Aslam, M., Manzoor, Z. and Ehsan Safdar, M. (2005). Effect of Various Stand Establishment Method on Yield and Yield Components of Rice. Proceedings of the International Seminar on Rice Crop. October 2-3. Rice Research Institute, Kala Shah Kau, Pakistan. pp. 212-220.

Khalil, I., Abdul Bari, H.I., Khan, S. and Zada, I. (2009). Genetic Variation for Yield and Yield Components in Rice. ARPN Journal of Agricultural and Biological Science. Vol. 4, No. 6, November 2009. ISSN 1990-6145.

IRRI (2014). Standard Evaluation System for Rice. 5th ed. June 2014. ISBN 978-971-22-0304-6.

Nuruzzaman, M., Yamamoto, Y., Youji, N., Yoshida, T. and Miyazaki, A. (2000). Varietal differences in tillering ability of fourteen Japonica and Indica rice varieties. Soil Science and Plant Nutrition. 46:2, 381 -391.

National Statistical Center. (2004). Statistical Yearbook 2003. National Statistical Center Venttiane, 144 pp.

Ntanos, D.A., and Koutroubas, S.D. (2002). Dry matter and N accumulation and translocation for Indica and Japonica rice under Mediterranean conditions. Field Crops Res. 74:93-101.