Research article

Evaluation and Preference Analysis of Improved Rice Genotypes in TharGaYa Village, Tharsi Township, Myanmar

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Abstract This study was conducted to identify high yielding improved rice genotypes which are adapted to the target location and accepted by local farmers. The experiment was conducted with a randomized complete block design with three replications, at TharGaYa village, Tharsi township, Myanmar. Sixteen improved rice lines and two check varieties were examined. Farmers voted for acceptance or rejection of individual varieties at the vegetative and pre-harvest stages and these votes were converted to a preference score. A significant difference among the genotypes tested occurred in yield per plant and its related characters. From the preference analysis, farmers and researchers showed highest preference for SM1/THY-DH-1-1 at the vegetative stage, followed by YAU-1214-183-3-1-2-1-1 and YAU-1201-90-2-4. At pre-harvest stage, farmers and researchers elected YAU-1201-90-2-4, followed by YAU-1214-183-35-1-1-1 and YAU-1214-183-3-1-1-1-1. According to the sensory evaluation test, the best line was YAU-1201-90-2-4, with second and third being YAU-1201-26-1-1 and YAU-1201-26-1-3. There was very strong agreement in preferences for the best performing lines shown by male and female farmers. However, a weak correlation between researchers and farmers preferences was identified. This seemingly indicates that farmers and researchers have different criteria in selecting good performing lines. Farmers have prioritized their own way of variety selection for their localities, using features such as uniformity, lodging, panicle length, effective tillering and earliness. Therefore, it is important to include farmers' preferences in any selection process to determine a suitable and acceptable variety.

Keywords correlation, preference score, sensory evaluation, variety selection

INTRODUCTION

Rice is one of the most important cereal crops around the world. Myanmar is an agricultural country, and agriculture is the backbone of its economy. The agriculture sector contributed 27.5% of GDP; 13.7% of total export earnings; and employed 61.2% of the labor force in 2010 (MOALI, 2010). One fourth of Myanmar's total area is cultivated land. In Myanmar, rice production accounted for the majority of cropping area and it is also the major food source. Rice ecosystems in Myanmar are generally classified into seven categories: 1) Irrigated rice land, 2) Regular rain-fed lowland, 3) Drought-prone rain-fed lowland, 4) Deep water rice 5) Submerged rice land, 6) Sea water affected rice land and 7) Upland rice (MOALI, 2010). Since it is a staple crop, having high yielding varieties that are adaptable for different agro-ecosystems is crucial.

Plant breeders develop varieties through conventional breeding and release varieties that are most productive under ideal conditions; often they are not suitable for marginal farm conditions (Singh et al., 2014). Therefore, participatory varietal selection, facilitates development of varieties optimal for marginal soils and acceptable to farmers. Farmers' preferences represent a part of the genotype selection and testing process, in order to ensure the large-scale adoption of the selected genotype.

Participatory Variety Selection (PVS) can be used to identify farmer-acceptable varieties effectively, and thereby overcome the constraints that cause farmers to grow old or obsolete varieties, or late maturing varieties which are susceptible to drought (Joshi and Witcombe, 1996; Witcombe et al., 1996). PVS trials were conducted on farm under the supervision of farmers, and identification of advanced promising lines from the breeding program occurred. It is crucial for plant breeders to identify which genotypes farmers prefer, and which they dislike, and the reasons for these opinions, adjusted to local conditions. PVS is a rapid and cost-effective way of identifying farmer-preferred cultivars and whether a suitable choice of cultivars exists (Witcombe et al., 2008). Hence, research costs can be reduced and adoption rates increased since farmers participate in variety testing and selection (Joshi et al., 1995).

OBJECTIVE

The experiment was conducted to identify high yielding and acceptable improved rice genotypes adapted to TharGaYa village, Tharsi Township, Myanmar through farmers' participation.

MATERIALS AND METHODS

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications in farmers' fields in TharGaYa village, Tharsi Township, Myanmar. A total of 18 genotypes, including check varieties (Appendix 1), were raised in seedbeds and transplanted at 21 days after sowing, with a distance of 20 cm between rows and 20 cm within rows. All necessary precautions were taken to maintain uniform plant population in each treatment replication. The data recorded were 50 % flowering (DTF), plant height (PH), effective tiller per hill (ETPH), panicle length (PLen), spikelets per panicle (SPP), filled grain percent (FGP), 1000 grain weight (TGW) and yield per plant (YPP). These data were collected to know the farmer selected line(s) has short duration, medium or short plant height and high yield. These data were subjected to statistical analysis by using STAR software (STAR, 2014). Preference analysis through casting votes was conducted when most genotypes reached the active tillering and pre harvesting stages. In case of the selection of farmers, there were a lot of discussions and meetings with local staff from Department of Agriculture, key farmers and village authorities. After that, all the rice farmers who have different land access to grow rice for year-round cultivation were selected to participate. Additionally, voluntary farmers were asked to include to have a variety of preferences. In order to conduct the preference analysis, 61 farmers and 8 researchers were participated. In Myanmar, most of the farmers were males. Rahman et al., (2015) pointed that female farmer had different perceptions with males regards the selection process. In this case, the votes were separated from male and female farmers and identify whether their perceptions have somehow agree with each other.

A preference score was determined by using positive votes, negative votes and total votes cast (Paris, 2011). Firstly, the experimental plots were prepared with each line allocated with a bag for collection of ballots. Farmers were provided with four ballots to vote for two best and two worst lines. There were either positive or negative sign on one surface of each ballot and the possible reasons for their choice on one another. All the votes rooted from the quality of above-mentioned characters since the participants needed to mention the reason for their votes. To allow examination of farmer population' preferences, male farmers' ballots were blue, females' pink and researchers' green. It was

necessary to prepare separate ballot bags to collect the votes for each genotype. All the participants were asked to mention the reasons for their choices on the back of the ballots. Then preference scores for men and women were computed independently through counting positive and negative ballots collected in each ballot bag. The preference score was calculated as follows.

$$Preference\ score = \frac{Number\ of\ positive\ votes - Number\ of\ negative\ votes}{Total\ number\ of\ positive\ and\ negative\ votes}$$

Pearson's correlation was used to test the agreement of preferences between male and female farmers and between researchers and farmers.

RESULTS AND DISCUSSION

Yield and Yield Contributing Characters

Significant differences among the improved rice lines were observed in days to 50% flowering, effective tillers per hill, panicle length, spikelets per panicle, filled grain percent, 1000 grain weight and yield per plant (Table 1). Yield per plant of YAU-1215-183-3-4-1-1-1 line was highest among the tested lines, followed by YAU-1214-183-3-1-1-1-1 and YAU-1214-183-3-3-1-1-1. Yield per plant of the 9 improved rice lines were higher than those for the two local check varieties. However, effective tillers per hill was the highest in local check variety, ManawThuKha, followed by YAU-1215-183-3-4-1-1-1.

Table 1 Mean performance of improved rice lines in TharGaYa village, Tharsi Township

Improved Rice Lines	DTF (days)	PH (cm)	ETPH (no.)	PLen (cm)	SPP (no.)	FGP (%)	TSW (g)	YPP (g)
YAU-1211-195-1-1	99.33	107.27	14.27	22.23	149.62	52.49	19.19	20.73
YAU-1211-82-1-1	91.00	108.20	14.93	21.82	142.51	70.08	24.75	35.42
YAU-1211-14-1-1	104.33	118.80	13.13	21.85	147.43	53.51	20.97	21.70
YAU-1201-26-1-1	94.00	105.33	12.00	23.34	96.66	69.84	28.53	22.74
YAU-1201-26-1-3	99.33	107.87	14.20	22.22	124.08	58.65	25.20	25.97
YAU-1201-90-2-4	91.67	115.93	16.20	22.60	83.49	80.62	29.16	31.13
YAU-1211-118-1-1	94.00	94.20	15.47	25.57	116.71	71.49	26.61	33.97
YAU-1214-183-3-1-1-1-1	90.00	102.47	15.07	24.05	115.72	89.54	27.53	42.12
YAU-1214-183-35-1-1-1-1	91.67	107.93	16.07	23.39	98.00	88.13	27.61	38.01
YAU-1214-183- 3-1- 2-1-1	92.67	96.53	16.93	22.90	90.54	82.25	26.86	33.83
YAU-1215-183-3-4-1-1-1	95.00	96.33	18.60	26.86	120.01	83.02	27.53	48.73
YAU-1214-183-3-3-1-1-1	89.00	105.40	13.93	24.47	121.92	84.94	27.34	39.44
Y8/THY-DH-4-1	91.33	104.6	13.40	23.63	100.95	75.92	26.7	26.90
Y8/THY-DH-5-1	84.67	107.13	14.40	21.24	72.18	88.83	27.32	25.06
Y8/THY-DH-9-2	88.33	104.00	14.20	20.45	68.04	85.1	26.98	22.05
SM1/THY-DH-1-1	84.67	119.13	17.07	19.90	86.53	74.69	23.02	25.11
MNTK	98.67	101.00	19.13	19.80	102.09	73.18	18.55	26.23
Yet 90	67.67	96.13	17.67	21.29	64.11	90.94	24.59	25.00
Mean	91.52	105.46	15.37	22.65	105.59	76.29	25.47	30.23
CV	3.01	11.45	15.13	10.08	17.80	8.04	4.85	16.14
Pr (>F)	**	ns	*	*	**	**	**	**
$LSD_{0.05}$	8.477	-	7.150	7.016	57.806	18.867	3.797	15.001

DTF = Days to 50% flowering, PH = Plant Height, ETPH = Effective tillers per hill, PLen = Panicle length, SPP = Spikelets per panicle, FGP = Filled grain percent, TSW = 1000 grain weight, YPP = Yield per plant

Preference Analysis

The preference score of different improved rice lines are shown in Fig. 1. At the vegetative stage, both male and female farmers show preference for SM1/THY-DH-1-1, followed by YAU-1214-183-3-1-2-1-1 and YAU-1201-90-2-4. However, researchers selected the most preferable three improved lines in the following order: Y8/THY DH-5-1, YAU-1201-90-2-4 and SM1/THY-DH-1-1. The reason why farmers and researchers selected these lines as the most preferable are based on the uniformity in plant growth, the high to medium tiller numbers per hill and no incidence of pest infestation or diseases. The least preferred genotypes selected by the farmers were ManawThuKha, Yet90 and YAU-1211-195-1-1. In combining farmers' and researchers' preferences, SM1/THY-DH-1-1, YAU-1214-183-3-1-2-1-1 and YAU-1201-90-2-4 were the most preferable lines at the vegetative stage.

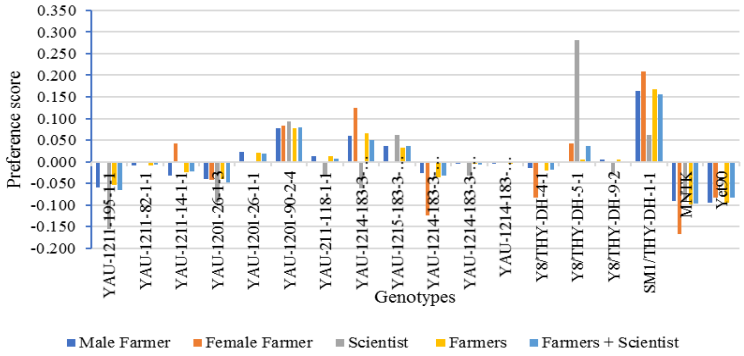

Fig. 1 Farmers' and researchers' preferences for improved rice lines at vegetative stage in TharGaYa village, Tharsi Township

At pre-harvest stage, the three most preferred lines selected by farmers were YAU-1201-90-2-4, YAU-1214-183-35-1-1-1-1 and YAU-1214-183-3-1-1-1-1 (Fig. 2). Farmers like these lines because they exhibit uniform growth, are lodging resistant, have long panicle length, have medium to highly effective tillers and display earliness. However, researchers selected YAU-1214-183-3-1-1-1-1, Y8/THY-DH-5-1 and YAU-1214-183-3-4-1-1-1 as the top three preferable lines. At the other extreme, YAU-1201-26-1-3, Yet90 and Y8/THY-DH-9-2 were the farmers' choice as the bottom three genotypes at pre-harvest stage. In all voting, YAU-1201-90-2-4, YAU-1214-183-35-1-1-1-1 and YAU-1214-183-3-1-1-1-1 were selected as the most preferable lines. Only one line; YAU-1201-90-2-4 was favored at the vegetative and pre-harvest stages. The other genotypes were preferred at only one of the stages considered in the selection process.

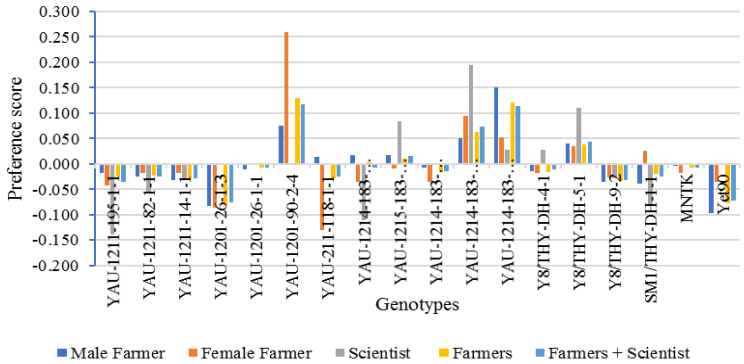

Fig. 2 Farmers' and researchers' preferences for improved rice lines at pre-harvest stage in TharGaYa village, Tharsi Township

According to Pearson's correlations, the results show significant and moderate positive correlation between male and female farmers' preference scores (Table 2). This means that, with r = 0.5861 (at 5% level of significance), male and female farmers 'somewhat agree' in their preferences for the best performing genotypes. When farmers' preferences (both male and female) are compared with breeders' preferences, the correlation analysis shows a non-significant and slightly positive correlation (r = 0.311). The results indicate that there is weak agreement between the farmers' preferences and the researchers' in selecting good performing genotypes.

Table 2 Correlation analysis of preference scores between farmers (male and female) and researcher in TharGaYa village, Tharsi Township

	Male farmer	Female farmer	Farmer	Researcher
Male Farmer	1	0.586*	0.930**	0.293
Female Farmer	0.586*	1	0.843**	0.256
Farmer	0.930**	0.843**	1	0.311
Researcher	0.293	0.256	0.311	1

**, ** = significant at 5% and 1% level, respectively*

The farmers' perception of good-performing varieties, as indicated by the preference score, is weakly associated with the researcher-calculated yields for the improved rice lines, with r = 0.345 and non-significant (Table 3). This means that there is a somewhat weak agreement between the predicted yields and the resulting choices of the farmers based on their own set of criteria.

Table 3 Correlation analysis of preference scores and yield in TharGaYa village, Tharsi Township

	Yield per plant	Farmer
Yield per plant	1	0.345
Farmer	0.345	1

Table 4 Sensory evaluation frequencies of rice varietal lines tested in TharGaYa village, Tharsi Township

Improved Rice Lines	Bad	Fair	Good	Bad (%)	Fair (%)	Good (%)
YAU-1211-195-1-1	14	30	16	1.30	2.78	1.48
YAU-1211-82-1-1	20	27	13	1.85	2.50	1.20
YAU-1211-14-1-1	27	26	7	2.50	2.41	0.65
YAU-1201-26-1-1	12	31	17	1.11	2.87	1.57
YAU-1201-26-1-3	10	26	24	0.93	2.41	2.22
YAU-1201-90-2-4	7	19	34	0.65	1.76	3.15
YAU-1211-118-1-1	20	32	8	1.85	2.96	0.74
YAU-1214-183-3-1-1-1-1	21	24	15	1.94	2.22	1.39
YAU-1214-183-35-1-1-1-1	26	29	5	2.41	2.69	0.46
YAU-1214-183- 3-1- 2-1-1	21	29	10	1.94	2.69	0.93
YAU-1215-183-3-4-1-1-1	27	27	6	2.50	2.50	0.56
YAU-1214-183-3-3-1-1-1	19	26	15	1.76	2.41	1.39
Y8/THY-DH-4-1	35	19	6	3.24	1.76	0.56
Y8/THY-DH-5-1	35	21	4	3.24	1.94	0.37
Y8/THY-DH-9-2	31	25	4	2.87	2.31	0.37
SM1/THY-DH-1-1	18	28	14	1.67	2.59	1.30
MNTK	26	23	11	2.41	2.13	1.02
Yet 90	28	25	7	2.59	2.31	0.65

According to the result of sensory evaluation, the improved rice line with good eating quality was YAU-1201-90-2-4 (Table 4). Lines with fair eating quality were YAU-1211-118-1-1, YAU-1201-26-1-1 and YAU-1211-195-1-1. Lines with bad eating quality were identified as Y8/THY-DH-4-1, Y8/THY-DH-5-1 and Y8/THY-DH-9-2. Among the selected line at pre-harvest stage, only YAU-1201-90-2-4 had a good eating quality. The YAU-1214-183-3-1-2-1-1 line selected at vegetative stage and YAU-1214-183-35-1-1-1-1 line selected at pre-harvest stage both had a moderate eating quality. Therefore, the YAU-1201-90-2-4 line stands as the farmers' prefer improved rice line and needs to undergo further field testing.

CONCLUSION

Significant differences exist among the tested genotypes and were found in yield per plant and its component characters. From the preference analysis, farmers and researchers selected SM1/THY-DH-1-1 as the best line at the vegetative stage followed by YAU-1214-183-3-1-2-1-1 and YAU-1201-90-2-4. The reason of selection of these lines are the uniformity in plant growth, the high and medium tillers number per hill and no incidence of pest and diseases. At the pre-harvest stage, farmers and researchers selected YAU-1201-90-2-4 as the best followed by YAU-1214-183-35-1-1-1 and YAU-1214-183-3-1-1-1-1. Farmers like these lines because they have growth uniformity, are lodging resistant, have long panicle length, have medium to highly effective tillers and display earliness. According to the sensory evaluation test, the best line is YAU-1201-90-2-4. This line is selected as the preferred line of farmers at the vegetative and pre-harvest stages. Therefore, YAU-1201-90-2-4 line ranks as the farmers' preferred improved rice line and needs to be tested again in field trials. There was a very strong agreement between male and female farmers' in their preference for the best performing lines at pre-harvest stage. However, only a weak correlation between researchers' and farmers' preferences has been identified. This indicates that farmers and researchers have different criteria in selecting what is a good performing line. Therefore, it is vitally important to include farmers' preferences in any variety selection process.

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Appendix 1 Rice genotypes included in PVS

Pedigree source	Varietal code	Remarks
YAU-1211-195-1-1	G1	Pre-released, Salt Tolerance
YAU-1211-82-1-1	G2	Pre-released, Salt Tolerance
YAU-1211-14-1-1	G3	Pre-released, Salt Tolerance
YAU-1201-26-1-1	G4	Pre-released, Salt Tolerance
YAU-1201-26-1-3	G5	Pre-released, Salt Tolerance
YAU-1201-90-2-4	G6	Pre-released, Salt Tolerance
YAU-1211-118-1-1	G7	Pre-released, Salt Tolerance
YAU-1214-183-3-1-1-1-1	G8	Pre-released, High yield
YAU-1214-183-35-1-1-1-1	G9	Pre-released, High yield
YAU-1214-183- 3-1- 2-1-1	G10	Pre-released, High yield
YAU-1215-183-3-4-1-1-1	G11	Pre-released, High yield
YAU-1214-183-3-3-1-1-1	G12	Pre-released, High yield
Y8/THY-DH-4-1	G13	Pre-released, High yield
Y8/THY-DH-5-1	G14	Pre-released, High yield
Y8/THY-DH-9-2	G15	Pre-released, High yield
SM1/THY-DH-1-1	G16	Pre-released, High yield
MNTK	G17	Local Check, High yield
Yet 90	G18	Local Check, Short growth duration