



Role of Participatory Varietal Selection (PVS) and Sensory Evaluation for Lowland Rice Improvement in Bihar

Shanti Bhushan¹; Amarendra Kumar²; Ajay Kumar³; V. N. Sahai³;
Hari Nath Singh⁴; R. B. Prasad³; Sanjay Kumar⁵

1. Veer Kunwar Singh College of Agriculture (BAU, Sabour), Dumraon-802 136, Buxar (Bihar)
2. Bihar Agricultural College, BAU, Sabour-813210, Bhagalpur (Bihar)
3. Rice Section, ARI, Mithapur (BAU, Sabour), Patna-800 001(Bihar)
4. Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263 145 (Uttarakhand)
5. Mandan Bharti Agricultural College (BAU, Sabour), Agwanpur, Saharsa-852 201(Bihar)

Corresponding Author- shantidixit@rediffmail.com

Abstract: Study on participatory varietal selection (PVS which provided opportunities for male and female farmers' to express their preference for rice varieties at the early stages of the breeding process and Sensory evaluation which provided opportunity to taste the cooked rice and show their preferences. were conducted at ARI, Mithapur, Patna. Forty three farmers participated in the preference analysis and selected RAU 759-5-41 followed by RAU 729-12-44 for having features like semi-tall plant, good tillers, long panicle medium bold grains, shinning of grains, white kernel, stiff stem, no lodging and suitable for low land and expecting good yield and good market price etc. The correlation between male and female farmers' preference scores were strong. The result of sensory evaluation where ninety six farmers participated showed Swarna Sub-1 as rank first followed by RAU 759-5-41 and Swarna.

Keywords: Participatory Varietal Selection (PVS), sensory evaluation, submergence tolerant rice, Sub-1 gene, mother trial.

Introduction

Rice, the most important cereal crop in the world is cultivated under diverse agro-ecosystems in India as well as in Bihar. Long duration rice varieties are mainly confined to lowland ecosystem, but, often these varieties face submergence or flash flooding due to sudden and excessive rainfall resulting in lower yield. Submergence is considered to be the third important damaging abiotic stress in rainfed lowland rice in the world (Widawski and O'Toole, 1990). Flash flood and submergence adversely affect more than 22 m ha of rainfed lowland rice area of the world (Khush, 1984). Flash flooding occurs mainly during vegetative stage and the period of flooding depends on the intensity and duration of rainfall. Tolerance to submergence in rice is governed by genetical, physiological and environmental factors. Thus there is a need to develop rice varieties which can recover from floods/submergence. For development of a suitable variety in order to ascertain food security, environmental sustainability, poverty alleviation, population and rural social development, it is necessary to identify farmers' criteria and perception in varietal selection. This will help rice breeders to breed good quality rice variety by incorporation of farmers' criteria as well as extension workers to develop the effective transferring strategies of quality rice (Chi *et al.*, 2007). To facilitate and accelerate adoption of these submergence tolerant varieties, it is necessary to identify men and women



farmers' criteria and preferences in selecting rice varieties in their specific rice environments (Borjas, 1997). Women can play key roles as change agents if they are provided with access to varieties suiting their needs, and they will disseminate improved quality seeds to other farmers. Based on this experience, farmer participatory approaches which involve 'learning by doing' and 'farmer to farmer' training or exchange of information are the best methods to accelerate farmer adoption of technologies (Paris *et al.*, 2008). The present investigation was attempted to study the best preferred lowland lines by the farmers following Participatory Varietal Selection (PVS) and eating and cooking quality following sensory evaluation of the preferred lines.

Materials and Methods

1 Site Selection

One mother trial (Researchers-managed trial) was laid out during *Kharif*, 2008-09 at Agricultural Research Institute (ARI), Mithapur, Patna, Bihar consisting of eighteen rice entries including IR-64 Sub-1, BPT 5204 Sub-1 and Swarna Sub-1 (Sub-1 version of Swarna) as checks with a plot size of 5X4 m² with a spacing of 30X10 cm² between and within the rows. 26 days old seedlings were transplanted. Recommended package of practices were followed for a healthy crop growth.

2 Preference Analysis

In order to select two best and two least preferred lines among the entries, the PA was conducted on 2nd December, 2008 at ARI, Patna with the involvement of males, females and researchers at ripening stage of the crop. Farmers' preferences were gathered through voting process and by assigning codes as V₁ to V₁₂ for each line/variety. This was done to remove the biasness from selecting lines/varieties. These farmers were allowed to "vote" for their preferred varieties during a field day by depositing paper ballots in a bag or envelope placed in front of the plot. Ballots with 'Y' (most preferred) and ballots with 'X' (least preferred) were prepared with three colors: blue, red and green. Blue ballots were given to male farmer-participants; red ballots to female participants and green for breeders/researchers. Two ballots with 'Y' letters and two ballots with 'X' letters were given to 2 rice varieties that they like best (designed positive votes) and 2 rice varieties that they most dislike (designed as negative votes). These were the raw data collected to know total positive and negative votes for a rice variety.

Preference scores- It generates two kinds of data: (a) quantitative preference score for each variety, expressed as the number of votes it received divided by the total number of votes cast, and (b) qualitative opinions of male and female farmers on why they like and dislike new lines/varieties. Farmers' opinions were discussed immediately after tallying the votes during the field visits. The preference score (PS) for each variety was calculated as follows:

$$PS = (\text{Number of positive votes} - \text{negative votes}) / \text{Total number of positive and negative votes}$$

The preference scores for males and females were presented. However, identification of the "most" and "least" preferred varieties or selection was based on the combined male and female farmers' preference scores. Pearson Correlation (PC) was used to investigate the relationships



between two variables (x and y). This technique was used to test whether preference scores between male and female farmers as well as between researchers and farmers were significant correlation or not. The level of correlation was classified based on 'r' as following:

- 0.00 - no correlation
- 0.01-0.20 - very weak correlation
- 0.21-0.40 – weak correlation
- 0.41-0.60 – moderate correlation
- 0.61-0.80 – strong correlation
- 0.81-0.99 – very strong correlation
- 1.00 – perfect correlation

3 Sensory Evaluations

It was done following Bhushan *et al.* (2010a). After selection of visually best performing entries through Preference Analysis (PA) involving male and female farmers and breeders, the entries along with the local checks were tested for their eating and cooking quality. The selected entries with the check were coded to avoid biasness and were cooked simultaneously and separately. Male and female farmers were asked to assess the eating and cooking qualities of the lines/varieties included in the farmer-managed trials. Each farmer was given to eat cooked rice one by one with drinking water in between two events of eating so as to nullify the taste, aroma etc of the previously eaten cooked rice and finally ranked based on specific weights for a given criteria. Sensory evaluation was done at ARI, Patna for the selected lines through PVS out of mother trail.

Result and Discussion

The result of preference analysis has been shown in **Table-1**. Forty three farmers participated in the preference analysis and selected RAU 759-5-41 followed by RAU 729-12-44 for having features like semi-tall plant, good tillers, long panicle medium bold grains, shinning of grains, white kernel, stiff stem, no lodging and suitable for low land and expecting good yield and good market price etc. On the other hand, farmers showed least preference for RAU 670 followed by IR 64 Sub-1 as these lines showed poor plant population, lodging, poor number of tillers, unfertile grains, poor grain color, un-synchronized panicle emergence, susceptible to diseases expecting very low yield.

The preference analysis (**Table-2**) represents the correlation in preferences of male, female farmers and breeders for their likes and dislikes. The correlation between male and female farmers' preference scores were strong indicating that with $r= 0.86$ (at 1% level of significance), male and female farmers strongly agree on their preferences for the best performing varieties tested in the researcher-managed trials. Similarly, the correlation analysis between farmers (both male and female combined) and researchers also showed strong correlation with $r= 0.62$ at 1% level of significance resulting in strong agreement of the choice of farmers and breeders. A weak correlation between the preference scores of farmers and yield ($r = 0.28$) was recorded though their relationship was not significant. Similar results were reported by Bhushan *et al.* (2010b) whereas, Chi *et al.* (2011) reported correlation between male and female farmers' preference scores as moderate and significant and the correlation analysis between farmers and researchers as significant moderate. The results show that there is strong agreement between the farmers' preferences, given their own reasons and set of criteria



for selection, and the researchers' own criteria in selecting good performing varieties. Participation of both men and women in the early evaluation of the performance of the rice lines/genotypes on their own farms led to the development of varieties that are suited to their fragile environments (Paris *et al.* 2008).

The result of sensory evaluation has been shown in **Table-3**. Ninety six farmers participated in the evaluation and Swarna Sub-1 ranked first followed by RAU 759-5-41 followed by Swarna. Swarna Sub-1 was the most preferred variety because of the taste, tenderness, small grain, flavour, aroma, sweetness, softness and colour of cooked rice. RAU 759-5-41 and Swarna were least preferred because they were not sweet and soft as Swarna Sub-1 confirming the results of Bhushan *et al.* (2010a). The choice of male farmers matched with the female farmers in ranking sensorial evaluation (**Table-4**) which is against the findings of Bhushan *et al.* (2010a).

It is concluded that the better performing selected lines can be put into baby trials and can further be assessed with the participating farmers and more for its wider adaptability and release. At the same time the likes and dislikes of farmers can be put into considerations for further breeding programmes. A difference between visual choice during preference analysis and selection based on sensory evaluation. Thus, the breeders should consider eating and cooking qualities of the new lines/varieties in the development of future stress tolerant varieties considering the likes and dislikes of the farmers (Bhushan *et al.*, 2010a and 2010b).

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Table 1. Preference analysis of rice genotypes of Mother trial at ARI, Patna

Entry		Male (n=34)		Female (n=21)		Scientist (n=4)		Total (n=55)		Preference Score
Code	Name	+VE	-VE	+VE	-VE	+VE	-VE	+VE	-VE	
V1	RAU 731-2-201	7	1	0	1	0	0	7	2	0.029
V2	RAU 730-20-178	2	2	0	0	0	0	2	2	0.000
V3	RAU 732-106-3	7	0	0	0	0	0	7	0	0.041
V4	RAU 751-176-9	0	0	1	0	0	0	1	0	0.006
V5	RAU 670	1	29	0	5	0	2	1	34	-0.192
V6	RAU 759-5-41	24	0	8	0	7	0	32	0	0.186
V7	RAU 748-18-6	1	0	1	1	0	0	2	1	0.006
V8	RAU 637-99-55	1	0	3	0	0	0	4	0	0.023
V9	RAU 639-200-55	1	1	3	1	0	0	4	2	0.012
V10	RAU 735-17-2	0	2	0	3	0	0	0	5	-0.029
V11	RAU 678-82-4	0	1	1	1	0	0	1	2	-0.006
V12	RAU 729-12-44	20	0	4	0	6	0	24	0	0.140
V13	RAU 724	0	0	1	0	0	6	1	0	0.006
V14	RAU 708	0	5	0	1	0	5	0	6	-0.035
V15	RAU 649	0	5	0	1	3	0	0	6	-0.035
V16	BPT 5204 Sub1	0	2	0	1	0	0	0	3	-0.017
V17	IR 64 Sub1	0	13	0	5	0	0	0	18	-0.105
V18	Swarna Sub1	0	3	0	2	0	3	0	5	-0.029
	Total	64	64	22	22	16	16	86	86	

Table 2. Correlation in preferences of Male, Female Farmers and Breeders of PVS Mother Trial 2008 at ARI, Patna

Site	Station	Stress	Entries (n)	Male vs. Female	Farmer vs. Breeder	Farmers vs Yield
RAU- Pusa	ARI, Patna	Submergence	18	0.86***	0.62***	0.28

* significant at 10%, ** significant at 5%, *** significant at 1%

Table 3. Sensory evaluation summary by the farmers of best chosen lines from Mother trial at Agricultural Research Institute, Patna

Code/Variety	Count		Relative Weight		Combined Weight	Rank
	Acceptable	Not Acceptable	Ranking	Rating		
345 Swarna Sub-1	32	0	41.15	40.28	40.71	1
934 Swarna	32	0	26.04	28.47	27.26	3
Total	96	0	1000	100	100	



Table 4. Sensory evaluation summary report for male and female of best chosen lines from Mother trial at Agricultural Research Institute, Patna

Code/Variety	Count				Relative Weight				Combined Weight		Rank	
	Acceptable		Not Acceptable		Ranking		Rating		Female	Male	Female	Male
	Female	Male	Female	Male	Female	Male	Female	Male				
568 RAU 759-5-41	5	27	0	0	36.67	32.10	38.00	30.00	37.33	31.05	2	2
345 Swarna Sub-1	5	27	0	0	40.00	41.36	35.80	41.11	37.90	41.23	1	1
934 Swarna	5	27	0	0	23.33	26.54	26.20	28.89	24.77	27.72	3	3
Total	15	81	0	0	100	100	100	100	100	100		