Farmers' Preference and Informal Seed Dissemination of First Ug99 Tolerant Wheat Variety in Bangladesh

D.B. PANDIT[1], M.S.N. MANDAL[1], M.A. HAKIM[1], N.C.D. BARMA[2], T.P. TIWARI[3] and A.K. JOSHI[4]

[1]Wheat Research Centre, Bangladesh Agricultural Research Institute, Nashipur, Dinajpur, Bangladesh; [2]Regional Wheat Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, Bangladesh; [3]International Maize and Wheat Improvement Center (CIMMYT), Bangladesh; [4]International Maize and Wheat Improvement Center (CIMMYT), South Asia Office, Kathmandu, Nepal; e-mail: dbpandit@yahoo.com

Abstract: Farmers' preference study and informal seed dissemination was carried out through farmer participatory variety selection (PVS) during 2006–2007 to 2008–2009 by the Wheat Research Centre (WRC), Bangladesh Agricultural Research Institute (BARI), Dinajpur, Bangladesh, in collaboration with CIMMYT. Four varieties including widely grown Shatabdi and four advance lines including Ug99 tolerant BAW 1064 were tested in mother-baby trial approach in 8 villages in each year. Mother trials were researcher designed but farmer managed. However, baby trials were designed and managed by farmers themselves. Preference scores of 30 farmers for varieties were recorded two times viz., pre and post-harvest stages. Farmers' preferred BAW 1064 owing to its 10% yield superiority over the widely grown Shatabdi variety, bolder white grains, larger grains/spike, non-lodging behaviour, earliness and resistance to diseases. This variety was found moderately resistant to Ug99 in Kenya. BAW 1064 was released as BARI Gom 26 in March 2010. After three years of PVS work, 19.4 t seeds reached informally to 969 farmers of 24 PVS villages from only 252 kg source seeds supplied for trials. In 2009–2010, seed production of this variety was done in 44 ha; 33.8 ha in 111 farmers' fields and 10.2 ha in research stations. Around 150 t seeds were produced that are being used for further testing and multiplication in 2010–2011. Seed dissemination through PVS was much faster than official approach of Bangladesh Agriculture Development Corporation (BADC). Hence, for selection and dissemination of CIMMYT developed Ug99 tolerant lines, farmer-participatory approach is being deployed.

Keywords: farmers' preference; participatory variety selection; seed dissemination; Ug99 tolerance; wheat

Wheat is the second important cereal crop in Bangladesh, but production is around 30% of the national requirement. On the other hand, its consumption is increasing day by day. Hence increasing wheat production is a priority in Bangladesh. Of many threats, stem rust race Ug99 is important. Although stem rust was never a serious problem in Bangladesh, there is no guarantee that it may not be a threat in future (Malaker & Reza 2010). Therefore, to increase stable wheat production it is very important to identify farmers' preferred varieties with tolerance to Ug99. Wheat Research Centre (WRC), Bangladesh Agricultural Research Institute (BARI) has so far released 26 improved wheat varieties but many of them were not adequately adopted by farmers. There can be a range of reasons including inadequate knowledge, lack of specifically adapted varieties and inadequate extension efforts.

Participatory variety selection (PVS) can be used to efficiently identify farmers-preferred varieties

and thereby overcome the constraints that cause farmers to grow land races, old or obsolete varieties (Joshi & Witcombe 1996; Witcombe *et al*. 1996). Moreover, participatory research increase the job efficiency of the scientists (Bellon 2001) and farmers' knowledge that enables seeds to be retained effectively from year to year (Grisley & Shamambo 1993). It also encourages resource poor farmers to preserve seeds each year (Spearling & Loevinsohn 1993). Research costs can be reduced along with increased adoption if farmers' participate in variety testing and selection (Joshi *et al*. 1995). In view of above, farmers' preference study and seed dissemination activities were conducted through PVS at WRC, BARI, Bangladesh during 2006–2007 to 2008–2009.

MATERIAL AND METHODS

The experiments were conducted in 8 different villages per year under Dinajpur, Jessore, Rajshahi and Jamalpur districts of Bangladesh during 2006–2007 to 2008–2009. Researches were conducted as mother trials (MTs) and baby trials (BTs). There were 2 MTs at 2 farmers' fields per village. Eight genotypes were used in MT of which four were popular cultivars – BARI Gom 20 (Sourav), BARI Gom 21 (Shatabdi), BARI Gom 23 (Bijoy) and BARI Gom 24 (Prodip). The other four were advance lines BAW 1051, BAW 1059, BAW 1064 and BAW 1104. Each MT (as a dispersed replication) was randomized differently. Plot size for each genotype was 20 m^2. The crop was grown under farmers' management. Mother trials were designed by the researchers and quantitative data were also taken by them. However, genotypes of each MT were evaluated by 30 farmers at physiological maturity and after harvest of the crop. Farmers' scored genotypes at both stages for different characters separately, as well as for overall performance. The highest score was 8, and was given for the best genotype for a particular character. The score reduced with the decrease of superiority of the character. Research and extension personnel assisted farmers during scoring.

BAW 1059 and BAW 1064 were tested in BT with BARI Gom 21 (Shatabdi) as check in all four locations. In a BT two test entries and one check variety were tested. Each trial was replicated 10 times in 10 different farmers' fields per village in all locations and years. Plot size of each genotype was 80 m^2. The crop was grown under farmers' management. Baby trials were evaluated by house hold level questionnaire (HLQ). Yield data were collected from farmers.

Existing seed act of Bangladesh allows seed distribution of unreleased varieties for research purpose only. Seeds of unreleased BAW 1964 was multiplied from research plot harvest and disseminated to other farmers by the farmers' themselves. To estimate seed dissemination, house-hold survey was conducted in 24 working villages using a survey format. The survey was conducted by a group of researches headed by an agricultural economist.

Yield and farmers' overall preference scores (FOPS) at post harvest stage were compiled and analyzed in one factor randomized complete block design (RCBD) combined over locations and years using MSTAT-C statistical package. The data of BT were analyzed by two tailed paired *t*-test. The mean data of BT were analyzed by Chi-square test. Seed dissemination data were computed in Excel sheet.

RESULTS AND DISCUSSION

The highest mean yield (3916 kg/ha) over years and locations was displayed by Ug99 tolerant BAW 1064 which was significantly higher than that of other tested genotypes (Table 1). The second highest yield (3797 kg/ha) was recorded for Prodip followed by BAW 1059 (3796 kg/ha), BAW 1051 (3754 kg/ha) and BAW 1104 (3740 kg/ha). The yields of these four genotypes were statistically similar. The lowest yield was recorded in Shatabdi (3606 kg/ha) followed by Soruav (3662 kg/ha) that were statistically at par.

Farmers' overall mean preference score (FOPS) was the highest (7.22) in Prodip followed by BAW 1059 (7.13), Bijoy (7.03) and BAW 1064 (7.00). During overall scoring, farmers considered multiple characters. The highest yielding BAW 1064 got the fourth highest score while the second highest yielding Prodip got highest score due to most visible traits (Pandit *et al.* 2007) such as larger seed size, attractive spikes and non-lodging type strong stem.

BAW 1059 was highest yielder at Dinajpur, Prodip at Jessore and BAW 1064 at Jamalpur and Rajshahi. Prodip was most preferred at Dinajpur and Jessore, BAW 1059 at Jamalpur and BAW 1104 at Rajshahi. Although genotype by environment interaction was present, yield and FOPS for BAW 1064 were

Table 1. Yield and farmers' overall preference scores for eight wheat genotypes over years and locations in Bangladesh during 2006–2007 to 2008–2009

Genotype	Yield (kg/ha)					Farmers' overall preference score (FOPS)				
	Dinajpur	Jessore	Jamalpur	Rajshahi	mean	Dinajpur	Jessore	Jamalpur	Rajshahi	mean
Sourav	4055	3542	3627	3424	3662	6.49	5.98	5.66	5.63	5.94
Shatabdi	3892	3666	3373	3491	3606	6.32	6.33	6.25	6.18	6.27
Bijoy	4040	3716	3644	3546	3737	7.25	7.16	7.04	6.65	7.03
Prodip	4064	3933	3732	3458	3797	7.59	7.49	6.83	6.98	7.22
BAW 1051	4035	3630	3634	3717	3754	6.80	6.63	6.24	6.45	6.53
BAW 1059	4243	3739	3660	3543	3796	7.33	7.15	7.15	6.90	7.13
BAW 1064	4208	3790	3879	3788	3916	7.44	7.00	6.89	6.66	7.00
BAW 1104	3978	3565	3738	3679	3740	6.83	6.88	7.13	7.08	6.98
Mean	4064[a]	3698[b]	3661[b]	3581[c]	3751	7.01[a]	6.83[b]	6.65[c]	6.57[c]	6.76
LSD (0.05)	205				103	0.41				0.21

Figure indicated by [a] is significantly higher than that of [b] and [c] and figure indicated by [b] is significantly higher than that of [c]

statistically at par to the highest yielder and scorers in all locations except for FOPS at Jessore. This revealed that the performance and preference to the highest yielding BAW 1064 was stable and this genotype perhaps would be widely adapted. Wide adaptation is an important factor and no evidence was found that selection for broad adaptation was a poor strategy when breeding for marginal environments (Virk *et al*. 1996). BAW 1064 was tested in Kenya against Ug99 stem rust races for two years and found tolerant. This genotype also produced 10% higher yield over Shatabdi in 16 farmers' fields of different regions of the country; therefore, it was approved as variety in March 2010 with the name of BARI Gom 26.

Though, the mean yields of three genotypes in BT was statistically similar (χ^2 P = 0.058 between BAW 1064 and Shatabdi and χ^2 P = 0.771 between BAW 1064 and BAW 1059), the yields of BAW 1064 was numerically higher than the other two (Figure 1). The results of BT were in agreement with that of MT. So, both trials were equally important in selecting genotypes. However, BT is simpler and needs lesser cost to execute. Data of BT were taken by farmers. Though, farmers' possess the ability of selecting genotypes and species to suit their environments and resources and to meet quality and other consumer requirements (Hardon 1995), they might have some limitations in selecting for specific traits such as disease resistance and some other due to their inadequate scientific knowledge. Therefore it has been suggested that science based knowledge (researchers' knowledge) and local knowledge system (farmers'

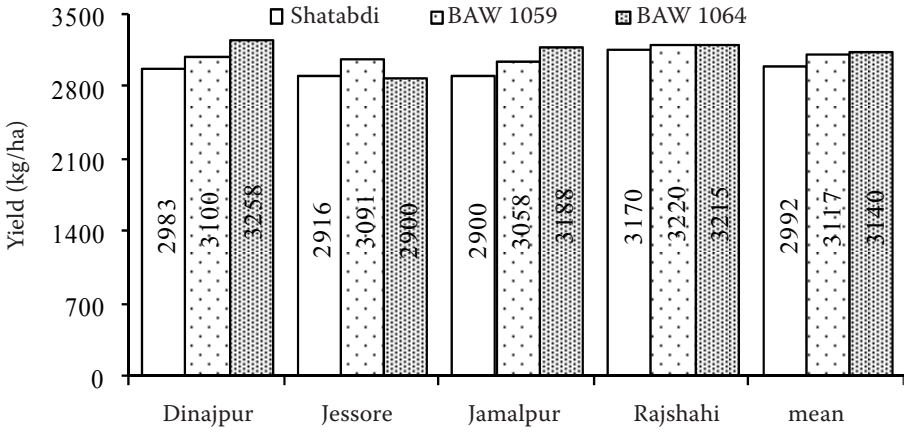

Figure 1. Yield of Ug99 tolerant wheat variety BAW 1064 in Bangladesh

knowledge) must be optimized in agricultural research and developmental process (Haverkort 1991). The PVS approach is a pragmatic example of this application.

Seed dissemination

Only 84 kg seed of Ug99 tolerant BAW 1064 was given to 96 farmers in eight working villages for conducting MT (4 kg to 16 farmers) and BT (80 kg to 80 farmers) with other genotypes in 2006–2007. From the produce, 96 farmers preserved 1416 kg seeds in 2007–2008 of which they kept 776 kg for their own use and sold 640 kg to 80 neighbouring farmers. Again 84 kg seed of these varieties were given to 96 farmers of other 8 villages in 2007–2008. This way, 1500 (1416 + 84) kg seed reached to 272 farmers (192 from WRC and 80 from farmers) for seeding in 2007–2008 (Figure 2). In 2008–2009, 272 farmers preserved 19 316 kg seed from their produce, of which 6010 kg was sold to 601 farmers and preserved 13 306 kg for their own use. In the same year, 84 kg seed was given from WRC for MT and BT to 96 new farmers of other villages. By three years of PVS research, when only 252 kg seed of BAW 1064 with other varieties (84 kg/year) was given to 288 farmers (96 farmers/year) for conducting mother and baby trials, 19.4 t (19.316 + 0.084 t) seed could reach to 969 farmers. Seed dissemination by farmer to farmer through PVS was much faster. One of the strength of participatory variety selection (PVS) is that, it involves both extension and research. Using this approach many farmers in the eastern Gangetic Plains of India have started their own seed businesses (Joshi *et al.* 2007). Varieties tested in PVS can rapidly spread to farmers (Joshi *et al.* 1995). In 2009–2010, seed production of BAW 1064 was done in 44 ha (33.8 ha with 111 farmers and 10.2 ha in research stations). Around 150 t seed was produced that was again deployed for seed production in current (2010–2011) cycle. Farmers had positive attitude about PVS and they desired its widespread adoption. This approach is much faster compared to current official approach of Bangladesh Agriculture Development Corporation (BADC) which takes at least four years to supply seeds to farmers after official release of a variety. By this time, many varieties start degenerating. Therefore, for selection and dissemination of CIMMYT developed Ug99 tolerant lines, farmer-participatory approach is being deployed in Bangladesh.

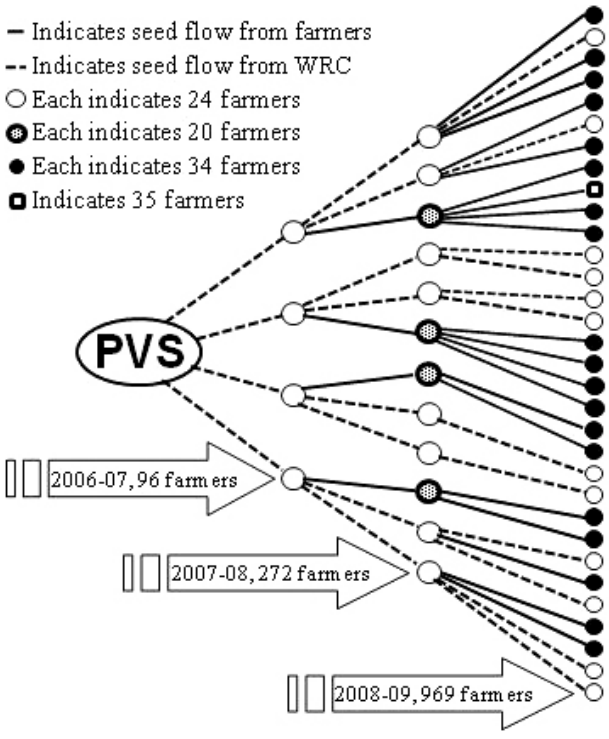

Figure 2. Seed dissemination of Ug99 tolerant wheat variety Bari Gom 26 in Bangladesh

References

Bellon M.R. (2001): Participatory Research Methods for Technology Evaluation. A Manual for Scientist Working with Farmers. CIMMYT, Mexico, D.F.

Grisley W., Shamambo M. (1993): An analysis of adoption and diffusion of Carioca beans in Zambia resulting from an experimental distribution of seed. Experimental Agriculture, **29**: 379–386.

Hardon J. (1995): Participatory plant breeding. The outcome of a workshop on participatory plant breeding. Issues in Genetic Resources No. 3. October 1995. Rome, Italy, International Plant Genetic Resources Institute.

Haverkort B. (1991): Farmers' experiments and participatory technology development. In: Haverkort B., Vander Kamp J., Waters-Bayer A. (eds): Joining Farmers Experiments: Experience in Technology Development. Intermediate Technology Publications, London.

Joshi A., Witcombe J.R. (1996): Farmer participatory crop improvement. II. Participatory Varietal Selection: a case study in India. Experimental Agriculture, **32**: 461–477.

Joshi K.D., Rana R.B., Subedi M., Kadayat K.B., Sthapit B.R. (1995): Effectiveness of participatory testing and dissemination programme: a case study of Chaite Rice in the western hills of Nepal. LARC Working Paper No. 95/49. Lumble Agricultural Research Centre, Pokhara.

Joshi A.K., Mishra B., Chatrath R., Ortiz Ferrara G., Singh R.P. (2007): Wheat improvement in India: present status, emerging challenges and future prospects. Euphytica, **157**: 431–446.

Malaker P.K., Reza M.A. (2010): Resistance to rusts in Bangladesh wheat. In: BGRI Technical Workshop. Abstracts of Oral and Poster Presentations. May 30–31, 2010, St. Petersburg, Russia.

Pandit D.B., Islam M.M., Rashid M.H., Sufian M.A. (2007): Participatory variety selection on wheat and its' impact on scaling-up seed dissemination and varietal diversity. Bangladesh Journal of Agricultural Research, **32**: 473–486.

Spearling L., Loevinsohn M.E. (1993): The dynamics of adoption, distribution and mortality of bean varieties among small farmers in Rwanda. Agricultural Systems, **41**: 441–453.

Virk D.S., Packwood A.J.P., Witcombe J.R. (1996): Plant breeding, varietal testing and popularization and research linkage. In: ODA/ICAR Workshop on Recognizing Research for Rain Fed Farming. September 11–15, 1995, CRIDA, Hyderabad.

Witcombe J.R., Joshi A.K., Joshi K.D., Sthapit B.R. (1996): Farmers participatory crop improvement. I. varietal selection and breeding methods and their impacts on biodiversity. Experimental Agriculture, **32**: 445–460.