

Assessment of Unnat PBW 343 (Rust Resistant Wheat Variety) in Mohali, Punjab

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ABSTRACT

The present study was conducted to assess the productivity and profitability of new wheat variety Unnat PBW 343, released in 2017 by Punjab Agricultural University. It is a new rust resistant version of PBW 343, since earlier variety was widely popular among farmers, it was essential for the extension scientists to conduct frontline demonstration of this variety in order to assess its productivity and profitability in farmer's field of district S.A.S Nagar (Mohali), Punjab. The demonstrations were conducted at 10 farmers fields to demonstrate production potential and economic benefit of improved technologies under irrigated conditions during rabi season of 2017-18 and 2018-19. Its seed was also inoculated with new biofertilisers consortium and Azo-S produced by Punjab Agricultural University itself for wheat. Results revealed that due to increased yield, less lodging and decreased input cost of agrochemicals, frontline demonstration plots recorded 24.8 to 30.11 % higher net returns than check plots. Also, farmers were much satisfied with performance of this variety and biofertilisers.

Keywords: Unnat PBW 343, Frontline demonstrations, Biofertilisers, Yield, Profitability

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the largest cultivated food crop in the world and is the second most important cereal after rice in India. This golden grain Rabi cereal, is a major contributor to the food security system and Indian economy, occupies 29.55 million hectares (mha) land and produced 101.20 million tonnes (mt) of wheat in 2018-19 (ICAR-IIWBR, 2019). North western plains

zone is the most productive zone comprising states like Punjab, Haryana and parts of Uttar Pradesh. PBW-343, a variety based on the 'Veery' lines of wheat bred at the International Maize and Wheat Improvement Centre or CIMMYT in Mexico, was a household name among Indian farmers from the mid-nineties till the last decade. Its proneness to rust disease, causing significant yield losses, became apparent from around 2007.

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With the release of HD-2967 in 2011-12 and HD-3086 in 2013-14, both developed by the Indian Agricultural Research Institute at New Delhi, PBW-343 practically receded into the background. HD-2967 yields 21 quintals per acre, but it is also becoming susceptible to yellow and brown rust. HD-3086 also became slightly vulnerable to brown rust. Farmers liked to grow PBW-343 because of its medium plant height of 100 cm. We have other early-sown varieties such as PBW-725 and PBW-677, too, but their plant height of 105-107 cm makes them more prone to lodging. Classic wheat variety, PBW 343, after succumbing to yellow rust in 2004, gave way to *Unnat* PBW 343 and is the first variety in the country to be released through marker assisted backcross breeding. It has been developed by PAU, Ludhiana through marker assisted backcross breeding by pyramiding two leaf rust and two stripe rust resistance genes Lr76-Yr70/Lr37-Yr17. Lr37- Yr17 along with a linked stem rust resistance gene Sr38 have been introgressed from *Aegilops ventricosa* on wheat chromosome 2AL. Linked pair of genes Lr76-Yr70 were introgressed from *Aegilops umbellulata* on wheat chromosome 5DS in the wheat wide hybridization programme at Punjab Agricultural University, Ludhiana. It is an improved version of PBW 343 and has an average plant height of 100 cm. It is resistant to brown rust and moderately resistant to yellow rust. It claims average grain yield is 23.2 quintals per acre.

Yellow Rust disease appears as yellow stripes of powder or dust on leaves and leaf sheaths of the wheat crop. This yellow powder comes out on clothing or fingers when touched. The disease can spread rapidly under congenial conditions and affects crop development, and eventually the yield. Yield due to the disease can be reduced by 5 and 30 per cent. This occurs when the rust colonies in the leaves drain the carbohydrates from the plant and reduce the green leaf area. In India, it is a major disease in the Northern Hill Zone and the North-Western Plain Zone and spreads easily during the onset of cool weather and

when wind conditions are favourable. Rain, dew and fog favour the disease's development. More than 50% of area in District S.A.S Nagar (Mohali) falls under Sub-Mountainous Undulating Zone. This gave the idea of conducting frontline demonstrations of new rust resistant wheat variety in this district.

Frontline demonstration (FLD) is an adaptive research on the improved varieties and technologies, which is demonstrated by the National Agricultural Research System (NARS) at selected farmers' fields who will be the beneficiaries of the programme. Despite India being the second largest producer of wheat, there exists regional variation in production across states as well as agro-climatic zones. India is a leader in producing wheat but the level of yield realized at farmers' field is much lower than the genetic potential of the varieties, resulting in 'yield gaps'. *Inter alia*, FLD is a unique approach to bridge the yield gaps at farmers' field by demonstrating latest and improved technologies for popularizing among the farming community (Kumar et al., 2014a). In wheat, FLDs have been started since 1993-94. FLD on wheat has played a significant role in acreage expansion through variety percolation as well as yield enhancement. Farmers from the neighbouring villages are invited to interact with the FLD farmers. The programme not only aims at developing the individual but leadership qualities as well so that the users are also benefited. Finally, the findings/impact of the programme is given wide coverage through mass media. Therefore, the current study is generally intended to demonstrate *Unnat* PBW 343 variety in villages of district S.A.S Nagar, Punjab by frontline demonstration methods, to assess yield gap and to give feedback of farmers to researchers for improvement.

MATERIALS AND METHODS

The study was carried out in operational area of Krishi Vigyan Kendra, S.A.S. Nagar (Mohali) of Punjab falling under sub mountainous zone (30.69°N latitude, 76.72°E longitude having an average altitude of 316 m

from the sea level). Participatory rural appraisal (PRA), group discussion and transect walk were followed to explore the detail information of study area. In between the technology intervention HRD components (Trainings/ Kisan sangosthi/ field day etc.) were also included to excel the farmers understanding and skill about the demonstrated technology on wheat. Field demonstrations were conducted under close supervision of krishi vigyan Kendra and constraint analysis was done at beginning. High cost of inputs, non availability of seeds of newly released varieties, high custom hiring rate, Phalaris minor, yellow rust problem, declining water table and lack of knowledge among farmers about recent technologies and were perceived and high input cost of agrochemicals were major constraints in wheat production in this region. Since submontaneous area of district is vulnerable spot for yellow rust hence it was decided to conduct 10 demonstrations in during 2017-18 and 2018-19. The variety Unnat PBW 343 was used under the demonstration plots. The basic purpose was to educate the farmers about other options in place of Propiconazole to manage this disease. They were also educated to grow newly released yellow rust resistant/tolerant varieties to manage this disease. Total twenty front line demonstrations were conducted during 2017-18 and 2018-19 covering an area of 8.0 hectare. Farmers were selected from Majri and kharar blocks of S.A.S. Nagar district through survey, group meetings and conducting discussions with them. Selected farmers were guided about improved production technology recommended by Punjab Agricultural University, Ludhiana through training programmes, farm literature and personal contact method for conducting frontline demonstrations at their fields.

Wheat variety 'Unnat PBW 343' was sown in rows, 23 cm apart, using a seed rate of 100 kg ha⁻¹ during first fortnight of November in both the years. Fourty kg seed for one acre was inoculated with 500 g consortium during 2017-18 and 250 g each of Azotobacter and Streptomyces (Azo-S) biofertilizer during

2018-19 and one litre of water on pucca floor. It was dried in shade and sown immediately. Under the demonstration plots, bio-fertilizers were applied along with inorganic fertilizers, whereas, in check plots only inorganic fertilizers were applied. About 100 kg N, 60 kg P₂ O₅ and 40 kg K₂O were applied to the crop. Out of which, 1/3rd N and full dose of P₂ O₅ and K₂ O were applied as basal dose at the time of sowing by broadcasting method. The remaining 2/3rd dose of N was applied in two splits at first and second irrigation. Seed was treated with Gaucho (imidaclopid) @ 6.0 ml per kg seed before planting for protection against attack of termite with Bavistin (carbendazim) @ 3g per kg seed for protection against various fungal diseases. To control broad leaf weeds, 2, 4-D sodium salt @ 625g ha⁻¹ and to control grass weeds, Total 75 WG (sulfosulfuran + metsulfuron) herbicide @ 40 g ha⁻¹ were applied after 35 days of sowing. Wheat was sprayed with Rogor (Dimethoate 30 EC) @ 375 ml ha⁻¹ for control of aphid at spike head stage of wheat. Harvesting was done. The crops were harvested at perfect maturity and yield data was collected. Further, information on actual yield obtained by the farmers on their farms under their own management practices was collected. All the important farm operations were performed under the supervision of KVK scientist by regular visits. At front line demonstration site off campus trainings were organized to extent the technology to other farmers of the area. Opinion of the farmers about technologies used under demonstration was collected for further improvement in research and extension activities. The extension activities like group meetings and field days were also organized at the demonstration sites as to provide opportunities for other farmers of the area to interact and to seek benefits from these demonstrations.

Yield gap analysis was generally done to quantify the additional yield that can be produced with the given level of resources and improved technologies. Yield gap arises due to the difference in region efficiency (Surendra et al., 2017) and management practices.

However, the present study makes use of the following hybrid approach as outlined in Sendhil et al. (2014). In this case, FLD yield is considered as the potential yield under farmer's management practice. Potential yield at experimental farm was intentionally ignored owing to different management practice (not by farmers) and being carried out at a small scale by the researchers (generally in small experimental plots). Yield under FLD, check plot, state and national average yield were taken into consideration and the existing yield gaps were computed.

Yield Gap I (YG I) = FLD yield – Check plot yield

Yield Gap II (YG II) = FLD yield – State average yield

Yield Gap III (YG III) = FLD yield – National average yield

Economic analysis

In present study, only operational or variable costs were considered to know the profitability of technology adoption. Operational costs include expenses on labour employed to perform different cultural operations and expenses incurred on material inputs *viz.*, seeds, FYM, fertilizers, plant protection chemicals *etc.* The returns over operational costs give the idea of margin accrued to the farmer after meeting all the working expenses. The economic gain is the difference between gross returns and operational costs in FLD and check plots. Benefit: cost ratio were also worked out for both FLDs and check varieties to know the profitability in cultivating wheat.

RESULTS AND DISCUSSIONS

Grain yield and yield gap analysis

The perusal of data presented in Table 1 revealed that during 2017-18, the average yield in demonstration plots was 62.40 q/ha, whereas, the average yield of check variety for the same period was 58.2 q/ha (Table 1). It means, the yield advantage of improved varieties over check varieties was 7.4 q/ha i.e. 13.45 per cent. During 2018-19, similar trend was followed but the yield increase was 12.35% over farmers plot. This yield increase was due to seed inoculation with effective

biofertilisers and use of new rust resistant varieties. It is a fact that seed is the most critical input and a valuable factor contributing in overall yield of a particular field. Seed contributes 30-40% of crop yield and this variety resulted in better photosynthetic activity due to negligible incidence of yellow rust, thus resulting in better translocation of carbohydrates from source to sink, resulting in higher yield. Similar results have been reported earlier by Singh et al. (2019) and Sharma et al. (2016). Dileep and Ravinder, 2006 also reported that *Azotobacter* + *Azospirillum* in 1:1 ratio was found to be effective in increasing the growth, yield attributes and yield of wheat crop to significant levels. High tillering and undisturbed nutrient uptake by the plants due to *Azospirillum* inoculation was attributed to higher yield. Afzal and Asghari, 2008, revealed that single and dual inoculation of *Rhizobium* and P solubilizer with P fertilizer has resulted in an increase of 30 – 40% in grain yield of wheat as compared to alone application of P fertilizer.

During 2017-18 yield gap II was 11.6 q/ha, during 2018-19 it was 9.3 q/ha (Table 2). Yield gap II was recorded 28.69 q/ha and 22.87 q/ha during 2017-18 and 2018-19, respectively. This yield gap emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap. The new agro-techniques will eventually lead to the farmers to replace old varieties with the new one. The results are corroborating with the findings of Hiremath and Nagaraju (2009) and Dhaka et al. (2010).

Economic analysis

The economics of wheat production under frontline demonstration have been presented in Table 2. During the two year period higher average gross return was recorded with demonstration plots (Rs 85947/ha) as compared to farmers practice plots (Rs 67499

/ha). During 2017-18 improved technology produced higher gross return (Rs 87864/ha) compared to farmers practice (Rs 70415/ha). Similar results were obtained during 2018-19 also where demonstration gave higher gross return in comparison to farmers practice plot due to higher grain yield obtained. However, the increase in net return of demonstration plots was 24.8% and 30.11% over check plot

during 2017-18 and 2018-19, respectively. Higher net returns among demonstration was due to higher grain yield obtained as compared to farmers practice plots. Favorable benefit cost ratio is self explanatory of economic viability of the demonstration. Similar results have been reported earlier on wheat by Tiwari et al., 2015, Sreelakshmi et al. (2012) and Joshi et al. (2014).

Table 1: Productivity and yield gap analysis of wheat (Unnat PBW 343) as affected by improved agronomic practices in District S.AS Nagar, Mohali

Year	Average Demonstration Yield (q / ha)	Local Check Yield (q / ha)	Increase in Yield (%)	State yield (q / ha)	National yield (q / ha)	Yield Gap I (q / ha)	Yield Gap II (q / ha)	Yield Gap III
2017-18	62.4	55.0	13.45	50.77	33.71	7.4	11.6	28.69
2018-19	58.2	51.8	12.35	48.9	35.33	6.4	9.3	22.87
Mean	60.3	53.4	12.9	49.835	34.52	6.9	8.35	25.78

Table 2: Economics of the Front Line Demonstrations on Summer moong in District S.AS Nagar

Year	Farmers' Practice Plots (farmers practiceP/Local Check)				Demonstration Plots				
	Gross Cost (Rs./ ha)	Gross Return (Rs./ ha)	Net Return (Rs./ ha)	B:C Ratio	Gross Cost (Rs./ ha)	Gross Return (Rs./ ha)	Net Return (Rs./ ha)	B:C Ratio	Net returns increase (%) over farmers practiceP
2017 - 18	43010	113425	70415	1.64	42000	129,864	87864	2.09	24.78
2018-19	47830	112412	64582	1.35	46170	130,200	84030	1.82	30.11
Mean	45420	112919	67499	1.50	44085	130320	85947	1.96	27.45

CONCLUSION

The findings of front line demonstrations showed that wheat yield can be enhanced by 24.8 to 30.11 % with the use of improved technologies in Mohali district by using rust resistant variety Unnat PBW 343 and inoculation with consortia of beneficial microorganisms. The FLDs conducted on improved technologies during the present study resulted in enhancement of yield, net returns and also increased the knowledge of the farmers. Thus, productivity of wheat could be increased by adopting recommended improved management practices with a suitable rust resistant high yielding variety like Unnat PBW 343 under submountaneous conditions. The present study resulted in convincing the farming community about

potentialities of improved production management technologies of wheat in productivity enhancement and for further adoption by the farming community.

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