Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 647-651
Received: 24-03-2020
Accepted: 28-04-2020

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On farm evaluation of alternative varieties of wheat suitable for Hathras District of Uttar Pradesh

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Abstract
An on farm research entitled "On Farm evaluation of alternative Varieties of Wheat suitable for Hathras District of Uttar Pradesh" was conducted during three consecutive Rabi seasons, at farmer's fields of District Hathras, to find out the best suitable variety of wheat for the area. The field experiment was laid out in three replications (at three locations) with four treatments in eight villages of four blocks. On Farm trials were conducted according to standard recommended practices of wheat at farmers' field with three new high yielding wheat varieties namely Pb W-550, WH-711 and Pb. W.-502 and compared with existing popular variety Pb W 343. The results revealed that all three tested varieties of wheat recorded higher grain yield than the locally popular variety Pb W 343. The averaged data of three years showed that the variety Pb W-550 recorded highest yield (45.30 q/ha) followed by WH-711 (43.43 q/ha) and Pb W-502 (42.93 q/ha) with yield increment of 12.88%, 8.22% and 6.97% respectively over the variety Pb W 343. The highest gross return was also recorded with variety Pb W-550 (Rs. 69100), net income Rs. 46800(17.06% higher than Pb W 343) with B:C ratio of 3.10. Also maximum additional income of Rs 7.92 for additional investment of one rupee recorded for Pb W 550. It was concluded that for obtaining higher grain yield, straw yield, gross and net income with higher B: C ratio from wheat, variety Pb W-550 may be adopted with recommended package of Practice under Hathras conditions of Uttar Pradesh.

Keywords: HYV, OFT, Pb W 550, gross return, cost of cultivation, net return, Hathras B:C ratio

Introduction
Wheat (*Triticum aestivum* L.) an important cereal crop is the staple food of more than one-third population of the earth. Its contribution is highest in acreage and production among all grain crops (including rice, maize, etc.) and is therefore, the most important cereal grain crop of the world. India ranks first in area (43.77 million ha) coverage followed by China, while in production China stands first and India ranks second (99.87 mt) during year 2017 (Anonymous 2019) [1]. Contribution of wheat in total food grains production is more than 35% in India. Uttar Pradesh is largest producer of wheat and contributes 32.04 percent of country's production with 32.75 mt (Anonymous 2019) [1]. India witnesses a record production (99.87 mt) during 2017-18 which was approximately eight times over the production level in 1964-65 (12.3 mt). This has been contributed by improved varieties and adoption of scientific package of practices. However, to meet the food requirement of our growing population, sustained research efforts are further needed to keep the upward trend in wheat production.
Under the Aligarh division of Uttar Pradesh, Hathras district is situated at 27.5^0 North latitude and 78.0^0 East longitudes. District enjoys moderate climate throughout the year. It is characterized by hot summer, cold winter and moderate rainy season. The annual rainfall is about 656 mm. The soil of the district Hathras is alluvial soils. In general the whole area is an Indo Gangetic Plain. The wheat is main crop of Hathras but mustard and potato, also cultivated at large scale in Rabi. Wheat is grown mainly in cropping Rice-Wheat, Bajra-Wheat and Pulse-Wheat sequences under irrigated condition. The area under wheat in Hathras is about 79000 ha with productivity of 39.99 q/ha. The package of practices followed by the farmers is not very scientific, like they use imbalance nutrients, faulty weedicide with wrong method and time. More than 90 percent farmers are growing the Pb W-343, a popular, high-yielding modern variety, developed in the 1990s based on CIMMYT materials. However, it is showing susceptibility to diseases and needs to be replaces with more recent, resistant varieties. It is well established that the high yielding varieties contributed maximum in increasing production and productivity as farmers gradually replaced their low yielding traditional varieties with high yielding (Prasai and Shrestha, 2015) [6]. A total of 448 wheat varieties have so far been notified for cultivation in different agro-ecological regions of the country (Gupta *et al.*, 2018) [3]. These varieties are instrumental in strengthening the food security of the country.

Joshi and Witcombe, (1996) [4, 8] and Witcombe *et al.* (1996) [4, 8] have suggested that the Participatory Variety Selection (PVS) can effectively be used to identify farmer-acceptable varieties and thereby overcome the constraints that cause farmers to grow old or obsolete varieties.

On Farm Trial, conducted under the close supervision of scientists, is a farmer participatory approach of research to asses and validate new technology where a systematic dialogue between farmers and scientists took place and physical and socioeconomic circumstances of the farmers are considered. The steps in on-farm research are generally defined as diagnosis, planning, experimentation, assessment, and recommendation (Byerlee *et al.*, 1982) [2]. Result of OFT helps in finding the appropriate substitute for the current technology. The productivity of wheat per unit area could be increased by adopting recommended scientific and sustainable management practices using a suitable high yielding cultivar. Taking into account the above considerations, On Farm trials (OFT) were carried out in a systematic manner on farmer's field to show the worth of new varieties, find out the best suitable variety of wheat for the area and convincing farmers to adopt improved wheat variety and production management for enhancing productivity of wheat.

Materials and Methods

On Farm Trials on varietal assessment of wheat were conducted as the mandatory work of K. V. K. during Rabi seasons of 2010-11, 2011-12 and 2012-13 at farmer's fields. The trials were laid out in eight villages of five blocks of Hathras District in Uttar Pradesh. On Farm Trials were conducted at three different locations every year in different blocks (Table: 1). Seed of every variety was sown in 0.4 ha area at all three locations of trial in order to have better representation of the district. The wheat growing farmers was selected in villages where crop covered a handsome area under wheat to achieve the better exposure to maximum farmers of the district. After selection of farmers a training programme on scientific cultivation of wheat was conducted to upgrade the knowledge and skill of farmers and ensuring correct usage and method. Each trial was conducted in a block of 1.60 ha area in order to have better impact of the technologies demonstrated against the local checks. Total nine trials in were conducted and a total area of 14.40 ha was put under on farm trials in three consecutive seasons.

Table 1: Three different locations of On Farm Trials.

Locations	2010-11	2011-12	2012-13
Location-I	Sri Netra Pal Singh Village- Mitanpur	Sri Devesh Chand Village- Nagla Ummed	Sri Harveer Singh Village- Barsai
Location-II	Sri Ravindra Kumar Village- Kateliya	Sri Ajay Kumar Village- Rahena	Sri Megh Singh Village- Barsai
Location-III	Sri Fateh Singh Village- Khitauli	Sri Ram Nivas Village- Dayanat Pur	Sri Indal Singh Village- Ruheri

As depicted in Table: 2 all standard package of practices were applied in trials plots. The farmers were provided with only 40 kg seed of each variety to asses every year to lay out the trials. Rest of the inputs and seed for famers practice treatment was arranged by farmers themselves during all the years. The soil of each trial plot was tested for pH, EC, O. C. and macro nutrients N, P and K. The soil of all demonstration plots was sandy loam and low in nitrogen and phosphorus and medium in potash. The pH was reported in the range of 7.2 to 8.5. The Recommended dose of fertilizer in every trial was applied on soil test basis. However, the Zinc Sulphate was applied @ of 25 kg/ha in all the treatments. The whole amount of phosphorus, potash and Zinc and half of the nitrogen was applied at sowing time as basal and rest half nitrogen was top dressed in two equal doses at after first irrigation at 35 DAS and after third irrigation at 65-70 DAS. Sowing was done on 5 November to 15 November during all the years. The 100 kg/ha treated seed was used in sowing with seed drill at inter-row spacing of 22.5 cm. Five irrigations at 20-25, 40-45, 70-75, 90-95 and 110-115 DAS were applied to trial plots. No disease and insect incidence occurred in crop.

Table 2: Package of practices of wheat applied to On Farm Trials.

Intervention	Demonstrated package
Year and season	Rabi 2010-11, 2011-12 and 2012-13
Farming situation	Irrigated
Variety	FP (Pb W 343), Pb W-550, WH-711, Pb W-502
Seed treatment	Seed treated with Bavistin @ 2.5 g/kg seed
Time of Sowing	05th to 15th November every year
Sowing Method	Line sowing at 22.5 cm with Ferti. cum seed drill
Seed rate	100 kg/ha
Fertilizer dose	120:60:50:25 (NPK&Zn kg/ha)
Irrigations	20-25, 40-45, 70-75, 90-95 and 110-115 DAS
Weed management	Sulfosulfuron 75% W.G.@ 33 g/ha+*Metsulfuron-methyl 20% WP @ 20* g/ha at 30-35 DAS
Harvesting and threshing	1-10 April every year

The crop was harvested manually at maturity (first week of April/130-140 DAS) and threshed with a power operated thresher during all the years. However, the plots of farmers practice were matured and harvested about one week before the demonstrations during all the years. Grain and straw yields of wheat were determined from a 20 m^2 area in each pre-demarcated plots. After three days sun-drying in the field, the total biomass (grain + straw) was weighed and threshed. Grain yield was reported at 14% moisture content. Straw yield was reported on a dry weight basis.

The cost of cultivation was calculated on the basis of local market rate of inputs and other operation prevailing at that time, similarly the local rate of straw and minimum support price of wheat was considered for calculation of gross and net income. The net returns were calculated by subtracting cost of cultivation from the gross income. The variable costs include all the costs involved in inputs and all farm operations. The B: C (Benefit: Cost) ratio was calculated by dividing gross income with cost of cultivation. Frequent visit of all trials was made by scientists of Krishi Vigyan Kendra, Hathras. Field

day was also conducted at trials plot at maturity stage of the crop.

Results and Discussion

Grain and Straw Yield

The data pertaining to performance of all new tested and farmers practice wheat varieties is given in table 3. It is evident from the data that the highest average grain yield (45.30 q/ha) with 12.88% higher than farmers practice (40.13 q/ha) was recorded in variety Pb W 550 at all the locations (Figure 1). The similar trend was recorded for straw yield and increase in yield over farmers practice (Table 4). The maximum grain yield (41.5, 46.8 and47.6 q/ha) was obtained from variety Pb W 550 which was 13.38%, 13.04% and 12.26% higher during 2010-11, 2011-12 and 2012-13, respectively than the yield of farmers practice (Pb W343). This was followed by WH-711(43.43 q/ha) which gave 39.3, 44.8 and 46.2 q/ha with an increment of 7.37, 8.21 and 8.96% during 2010-11, 2011-12 and 2012-13 respectively, over farmers practice. Moreover the variety Pb W-502 also produced higher grain yield (42.93 q/ha) than the yield of farmers practice (PbW343) which was recorded 38.8, 44.4 and 49.7 q/ha with an increment of 6.01, 7.24 and 7.54% during 2010-11, 2011-12 and 2012-13 respectively. The grain yield superiority of Pb W 550 over Pb W 343 and DBW 17 have also been reported earlier by Ram *et al.* (2013) [7] at different locations in North western India. Pandey *et al.* (2018) [5] reported higher grain yield of variety Pb W 502 than Pb W 343 under irrigated condition at Faizabad. The varietal vigour and adoptability of variety in a particular ecosystem/climate collectively determined the vegetative growth and yield attributes which reflected in term of productivity. Better vegetative growth coupled with higher yield attributes resulted in higher grain and straw yields.

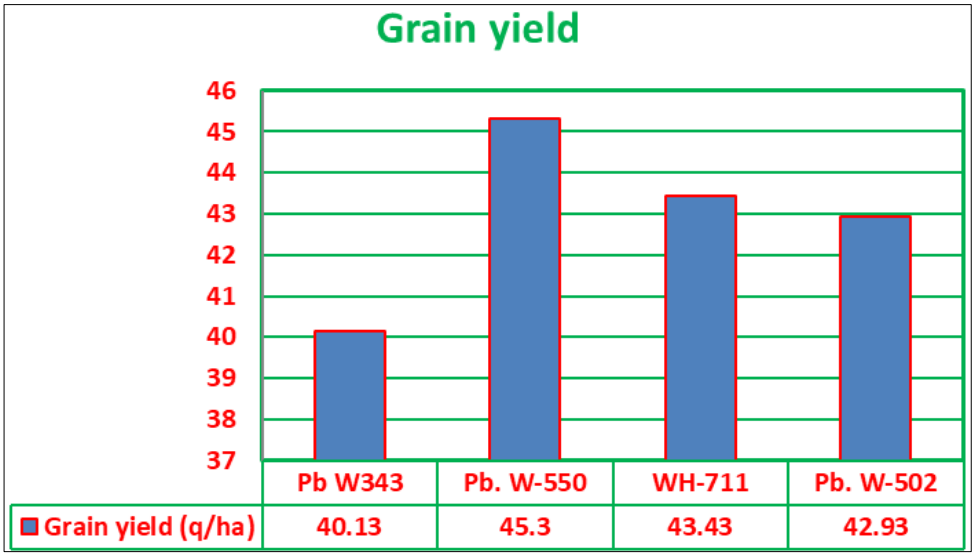

Fig 1: Mean of Grain Yield in various Wheat Cultivars at farmers field

Harvest Index

For grain crops, harvest index (HI) is the ratio of harvested grain to total biomass, and this can be used as a measure of reproductive efficiency. However, in present study the data of mean comparison suggested that the highest harvest index (0.524) was from the variety of WH-711, although it did not show much difference with other cultivars of Pb W-550 (0.523) Pb W 343 (0.522) and Pb W-502 (0.522) and they were in one level (Table 3). Also, the cultivar of PbW343 and Pb W-502 with a mean of 0.522 had the lowest harvest index. Varieties WH-711, Pb. W-550 and Pb W343 gave maximum HI values during years 2010-11, 2011-12 and 2012-13, respectively. This might be due to temperature variations during crop maturity in different years (Figure 2).

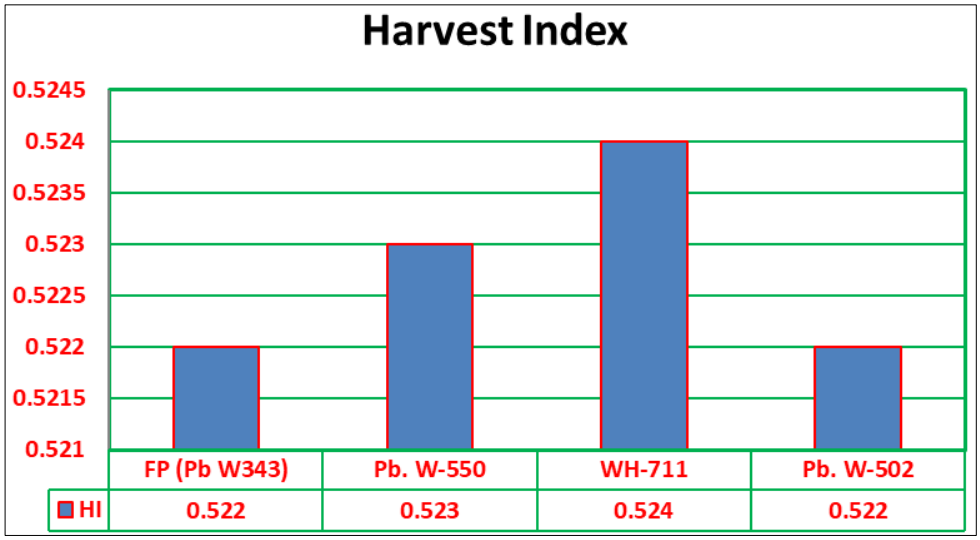

Fig 2: Mean of Harvest Index in various Wheat Cultivars at farmers field

Economic Returns

It is evident from the data of the average of three years that the highest net income of Rs. 50563/- with B: C ratio of 3.25 was recorded with variety Pb. W-550 which was closely followed by other tested varieties. Lowest net return of Rs. 43099/- with B: C ratio of 3.00 was obtained with farmers practice (Pb W 343) (Table 5a&b). The data of economic analysis clearly indicated that the variety Pb W-550 recorded the highest gross returns (Rs. 69100), net returns (Rs. 46800) and B: C ratio (3.10), which was closely followed by other tested varieties. It might be due to higher grain yield recorded in variety Pb. W-550 during all the years. The results are in line with the results of Ram *et al*. (2013) [7] who reported the significantly higher gross, net returns and B:C ratio in variety Pb W 550 than Pb W 343. It was also interesting that the cost of cultivation of new varieties was also higher as compared to the farmers practice, but added cost of seed was less as compared to the yield enhancement in all the tested varieties. Marginal profit analysis showed that every additional Rupee invested on seed of new variety gave return of Rupees 3.02 (Pb W-502) to 8.46 (Pb W-550 during 2011-12). Irrespective of the locations variety Pb. W-550 recorded highest benefit: cost ratio (2.71, 3.25, 3.34) among all the varieties and during all the years. It can be inferred that the use of new varieties will help the farmers in increasing the farm income. The net returns under the variety Pb W-550 (Rs. 46800/ha) increased by 17.06 per cent over the farmer's practice variety Pb W 343 (Rs. 39979/ha). This average increment in net income over the farmer's practice variety Pb W 343 due to WH-711 and Pb W-502 was recorded 10.08 and 7.95 percent, respectively.

Table 3: Grain yield, Straw yield and HI as affected by varieties.

Cultivar	2010-11				2011-12				2012-13				Mean of Three Years			
	Grain Yield (q/ha)	Straw Yield (q/ha)	Increase in Yield (%)	HI	Grain Yield (q/ha)	Straw Yield (q/ha)	Increase in Yield (%)	HI	Grain Yield (q/ha)	Straw Yield (q/ha)	Increase in Yield (%)	HI	Grain Yield (q/ha)	Straw Yield (q/ha)	Increase in Yield (%)	HI
FP(PbW343)	36.6	39.9	-	0.522	41.4	45.6	-	0.524	42.4	46.7	-	0.524	40.13	43.8	-	0.522
Pb. W-550	41.5	45.5	13.38	0.523	46.8	51.7	13.04	0.525	47.6	51.5	12.26	0.520	45.30	49.6	12.88	0.523
WH-711	39.3	43.4	7.37	0.525	44.8	48.9	8.21	0.522	46.2	50.4	8.96	0.522	43.43	47.8	8.22	0.524
Pb. W-502	38.8	42.7	6.01	0.524	44.4	48.6	7.24	0.523	45.6	49.7	7.54	0.522	42.93	46.9	6.97	0.522

Table 4: Income from Grain yield, Straw yield and Gross Income (Rs./ha) as affected by varieties.

Cultivar	2010-11			2011-12			2012-13			Mean of Three Years		
	Grain Income	Straw Income	Gross Income	Grain Income	Straw Income	Gross Income	Grain Income	Straw Income	Gross Income	Grain Income	Straw Income	Gross Income
FP(Pb W 343)	40992	7980	48972	53199	11400	64599	57240	14010	71250	50229	10950	61179
Pb W-550	46480	9100	55580	60138	12925	73063	64260	15450	79710	56700	12400	69100
WH-711	44016	8680	52696	57568	12225	69793	62370	15120	77490	54360	11950	66310
Pb W-502	43456	8540	51996	57054	12150	69204	61560	14910	76470	53734	11725	65459
Price (Rs/q)	1120	200	-	1285	250	-	1350	Rs.300	-	1251	250	-

Table 5a: Comparative economics of different varieties.

Cultivar	2010-11					2011-12				
	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	B:C Ratio	Additional income (Rs/Rs.)	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	B:C Ratio	Additional income (Rs/Rs.)
FP(Pb W 343)	19500	48972	29472	2.51	-	21500	64599	43099	3.00	-
Pb W-550	20500	55580	35080	2.71	6.61	22500	73063	50563	3.25	8.46
WH-711	20500	52696	32196	2.57	3.72	22500	69793	47293	3.10	5.19
Pb W-502	20500	51996	31496	2.54	3.02	22500	69204	46704	3.08	4.61

Table 5b: Comparative economics of different varieties.

Cultivar	2012-13					Mean of Three Years					
	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	B:C Ratio	Additional income (Rs/Rs.)	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	Increase in Net Income (%)	B:C Ratio	Additional income (Rs/Rs.)
FP(Pb W 343)	22600	71250	48650	3.15	-	21200	61179	39979	-	2.89	-
Pb W-550	23900	79710	55810	3.34	6.51	22300	69100	46800	17.06	3.10	7.92
WH-711	23900	77490	53590	3.24	4.80	22300	66310	44010	10.08	2.97	5.13
Pb W-502	23900	76470	52570	3.20	4.02	22300	65459	43159	7.95	2.94	4.28

Conclusion

On Farm trials are playing important role in assessment refinement of technologies and motivating the farmers for adoption of these improved agriculture technology resulting in increasing their yield and profits. On the basis of results of OFT conducted during three consecutive years, It was concluded that for obtaining higher grain yield, straw yield, gross and net income with higher B: C ratio from wheat, variety Pb W-550 may be adopted with recommended package of Practice under Hathras conditions of Uttar Pradesh.

Acknowledgement

The author is thankful to Director of Extension, C. S. A. University of Agriculture and Technology Kanpur, Uttar Pradesh and Director ICAR-ATARI, Kanpur for giving me opportunity to conduct the On Farm trials and providing fund during the course of investigation.

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