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Impact assessment of improved wheat variety disseminated through farmer participatory research in Palwal district of Haryana

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ABSTRACT

In a study involving large-scale farmer participatory field trials for evaluating the performance of a recently released improved wheat variety, HD 3086 (Pusa Gautami) in 300 farmers' fields in three villages of Palwal district, significantly yielded higher grain and straw output compared to output of control group with the same existing resources. Adoption curves were generated to ascertain the rate of adoption and diffusion of HD 3086 among farmers of FFP villages and neighbouring villages. The rate of adoption of HD 3086 was more than 16 times on acreage basis in the span of three years.

Key words: Cost and returns, Grain, Straw, Wheat variety, Yield

North West Plains Zone (NWPZ) of India is the largest wheat growing zone of the country and comprises states of Punjab, Haryana, Delhi, Rajasthan, Uttar Pradesh and Uttarakhand (Singh *et al.* 2014). This zone demands improved wheat varieties to suit the irrigated timely sown crop conditions. In addition, improved wheat varieties in this area need to possess such qualities as resistance with yellow rust and tolerance to terminal heat stress. Hence, the search for higher yielding improved wheat varieties with special characters to adjust to severe climate change parameters will always remain the major agenda in wheat research. The introduction of new varieties with high yield potential and wide range of its adaptability is an important factor for enhancing wheat production (Alam *et al.* 2006).

A new bread wheat variety, HD 3086 (Pusa Gautami) has been released for commercial cultivation under timely sown irrigated conditions. HD 3086 has an average yield of 5.46 t/ha with yield potential of 7.1 t/ha and showed superiority over checks. It is resistant to yellow rust and brown rust. It has shown superior quality parameters with protein content (12.5 percent), a sedimentation value (45 ml), best Glu-1 Score (10/10) and good extraction rate (70.5 percent) meeting all the criteria for superior bread making qualities. This timely shown variety would contribute to increasing wheat production and alleviate the socio-economic poverty of farmers of north-western plains in India (Singh *et al.* 2014). In Haryana, wheat is cultivated in 2.56 m. ha with production of 11.55 mt average yield is 45.14 q/ha. (GoI 2018). Wheat variety, viz. HD 3086 (with mean yield of 54.6 q/ha and yield potential of 71.0 q/ha) as technology intervention was given to villages in Farmer FIRST Project (FFP) in order to enhance the wheat productivity in Haryana. The present study tried to evaluate the performance of HD 3086 among farmers and its adoption and diffusion.

MATERIALS AND METHODS

Palwal district of Haryana falls under NEPZ of irrigated timely sown wheat cultivation. The project villages were same in terms of resource availability and other financial constraints. All the farmers who grew new wheat variety HD 3086 were taken for the study as experimental group. Another group of farmers who grew other wheat varieties formed the control group for comparison. The total treatment-farmers were 150 and control-farmers were also of same number (with 50 farmers from each of the village). Descriptive statistics and inferential statistics like t test were used to analyse and compare the yield characteristics and economic variables between treated (adopters) and control (non-adopters) groups of farmers.

RESULTS AND DISCUSSION

The scientific staff of ICAR Farmer FIRST attempted to compare the performance of these two

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varieties on the differences in grain yield, straw yield, cost of cultivation, gross income from wheat crop, net returns and cost-benefit ratio. The results are presented in Tables 1, 2 and 3.

Grain yield

Perusal of Table 1 indicates the average grain yield of HD 3086 was 20.47q/acre while that of PBW 343 was only 17.60 q/acre. The grain yields of HD 3086 ranged from 18 to 23 q/acre while those of PBW 343 ranged from 16 to 19 q/acre. The mean difference was found to be 2.873 q/acre and found statistically significant. Looking through the lens of frequency distribution, the frequencies were the highest in middle category of grain yields. The frequencies of grain yields of HD 3086 fell into a near normal but slightly negatively skewed (as mode > mean) distribution with 56.67 percent with medium category of grain yields and 22.67 percent on lower side and 20.66 on higher side of grain yields. But the frequencies of grain yields of PBW 343 among 150 farmers' fields fell into a highly negatively skewed (as mode > mean) distribution with 41.33 percent frequencies in lower category, 46.00 percent in medium category and 12.67 percent in higher category of grain yields.

Straw yield

The mean straw yields of HD 3086 were 24.24 q/acre and that of PBW 343 was 21.53 q/acre. The straw yields ranged from 21 to 27 q/acre in HD 3086 and from 19 to 24 q/acre in PBW 343. The mean difference of straw yields of HD 3086 and PBW 343 was found to be 2.387 q/acre and statistically significant. A cursory look into the frequency distribution of the straw yields of 150 farmers' field trials revealed the frequencies of straw yields of HD 3086 as well as of PBW 343 fell into a normal distribution but slightly negatively skewed towards the higher side of straw yield. It could

Table 1 Performance of HD 3086 on grain yield and straw yield in farmers' fields

Particulars	Grain yield (q/acre) (n = 150)				Straw yield (q/acre) (n = 150)			
	HD 3086		PBW 343		HD 3086		PBW 343	
Mode	21.00		18.00		25.00		22.00	
Median	20.50		18.00		24.00		22.00	
Mean	20.47		17.60		24.24		21.85	
Standard deviation	1.097		0.85		1.46		1.14	
Min-max	18-23		16-19		21-27		19-24	
Mean difference	2.873				2.387			
t test value	25.339**				15.767**			
Categories	F	%	F	%	F	%	F	%
Low (< Mean-SD)	34	22.67	62	41.33	21	14	23	15.33
Medium (Between Mean ±SD)	85	56.67	69	46	99	66	77	51.33
High (> Mean +SD)	31	20.66	19	12.67	30	20	50	33.33
Total	150	100	150	100	150	100	150	100

Table 2 Performance of HD 3086 on cost of cultivation and gross income

Particulars	Cost of cultivation (₹) (n = 150)				Gross Income (₹) (n = 150)			
	HD 3086		PBW 343		HD 3086		PBW 343	
Mode	17500		18000		46900		42100	
Median	17725		17860		46920		40100	
Mean	17736		17789		46909		40092	
Standard deviation	414.69		501.60		2278.06		1936.30	
Min-max	16770-18570		16480-18760		42270-51400		34920-43608	
Mean difference	₹ 53.17				₹ 6817.83			
t test value	1.001^{NS}				27.929**			
Categories	F	%	F	%	F	%	F	%
Low (< Mean-SD)	24	16	25	16.67	27	18	27	18
Medium (Between Mean ±SD)	104	69.33	96	64	93	62	92	61.33
High (> Mean +SD)	22	14.67	29	19.33	30	20	31	20.67
Total	150	100	150	100	150	100	150	100

Table 3 Performance of HD 3086 on net return and cost benefit ratio

Particulars	Net return (₹ per acre)				Cost benefit ratio			
	HD 3086		PBW 343		HD 3086		PBW 343	
Mode	30000.00		18900.00		2.679		2.157	
Median	29123.00		22645.00		2.645		2.260	
Mean	29173.00		22302.00		2.646		2.255	
Standard deviation	2338.47		1993.27		0.145		0.126	
Min-max	24218 - 34265		16910 – 26930		2.326 - 3.006		1.910 - 2.631	
Mean difference	₹ 6871.00				0.391			
t test value	27.387**				24.888**			
Categories	F	%	F	%	F	%	F	%
Low (< Mean-SD)	25	16.67	26	17.33	22	14.67	21	14
Medium (Between Mean ±SD)	96	64	100	66.67	105	70	107	71.33
High (> Mean +SD)	29	19.33	24	16	23	15.33	22	14.67
Total	150	100	150	100	150	100	150	100

be inferred that PBW 343 yielded more straw compared to grain. Interestingly farmers' growing PBW 343 were getting more straw yield (valued at lesser prices) than the grain yields (valued at higher prices). Grain to straw ratio is better in case of HD 3086 compared to that of PBW 343.

Economic parameters of comparison

Four economic parameters, viz. cost of cultivation, gross income from wheat crop (Table 2), net returns and cost-benefit ratio (Table 3) were considered to evaluate the performance of improved wheat variety, HD 3086.

Cost of cultivation

The cost of cultivation of HD 3086 was ₹ 17736 per acre while that of PBW 343 was slightly higher at ₹ 17789 per acre. The costs of cultivation of HD 3086 ranged from ₹ 16770 to ₹ 18570 per acre while those of PBW 343 ranged from ₹ 16480 to ₹ 18760 per acre. The mean difference was found to be negligible. Here frequency distribution of the farmers' field trials of HD 3086 and PBW 343 on their cost of cultivation were both found to be falling into a near normal distribution. While the frequency distribution of farmers' field trials of HD 3086 was negatively skewed, the frequency distribution of farmers' field trials of PBW 343 was slightly positively skewed. Thus, it can be concluded that there is no difference in cost of cultivation in both treated and control field trials of farmers.

Gross income from wheat crop

The average gross income from improved wheat variety, HD 3086 was ₹ 46909 per acre while that of PBW 343 was ₹ 40092 per acre. The gross income from HD 3086 ranged from Rs.42270.00 to ₹ 51400 per acre while those of PBW 343 ranged from ₹ 34920 to ₹ 43608 per acre. The mean difference was ₹ 6817.83 which was significant.Here frequency distribution of the farmers' field trials of HD 3086 and PBW 343 on their gross income from wheat crop were both found to be falling into a near normal distribution. The frequency distribution of farmers' field trials on the gross income from HD 3086 was symmetrical and not at all skewed (as mean=median=mode). But the frequency distribution of farmers' field trials on the gross income from PBW 343 was slightly negatively skewed (as mode > mean). Thus, it can be concluded that there is great difference in gross income from wheat crop in both treated and control field trials of farmers.

Net return and cost-benefit ratio

The results of two more key economic parameters, net returns and cost-benefit ratio are compared in Table 3 below.

Net return

The average net return of HD 3086 was ₹ 29173 per acre while that of PBW 343 was only ₹ 22302 per acre. The net returns of HD 3086 ranged from ₹ 24218 to ₹ 34265 per acre while those of PBW 343 ranged from ₹ 16910 to ₹ 26930 per acre. The mean difference was found to be ₹ 6871 per acre was statistically significant. The frequencies were the highest in middle category of net returns. The frequencies of net returns of HD 3086 fell into a near normal but slightly negatively skewed (as mode > mean) distribution with 64.00 percent with medium category of grain yields and 16.67 percent on lower side and 19.33 on higher side of net returns. But the frequencies of net returns of PBW 343 among 150 farmers' fields fell into a highly positively skewed (as mode < mean) distribution with 66.67% in medium category, 17.33% frequencies in lower category, and 16.00 percent in higher category of net returns. Thus, it can be concluded that the net returns from improved wheat variety HD 3086 were significantly higher than the net returns of popular local check variety, PBW 343.

Cost-benefit ratio

On per acre basis, the average cost-benefit ratio of

HD 3086 was 2.646 while that of PBW 343 was 2.255. The cost-benefit ratios of HD 3086 ranged from 2.326 to 3.006 while those of PBW 343 ranged from 1.910 to 2.631. The frequencies were the highest in middle category of cost-benefit ratios. The frequencies of cost-benefit ratios of HD 3086 fell into a near normal but negatively skewed (as mode > mean) distribution with 70% with medium category of cost-benefit ratios and 14.67% on lower side and 15.33 on higher side of cost-benefit ratios. But the frequencies of cost-benefit ratios of PBW 343 among 150 farmers' fields fell into a near normal but positively skewed (as mode < mean) distribution with 71.33% in medium category, 14% frequencies in lower category, and 14.67% in higher category of cost-benefit ratios. Thus, it can be concluded that the cost-benefit ratio from improved wheat variety HD 3086 were significantly higher than the cost-benefit ratio of popular local check variety, PBW 343.

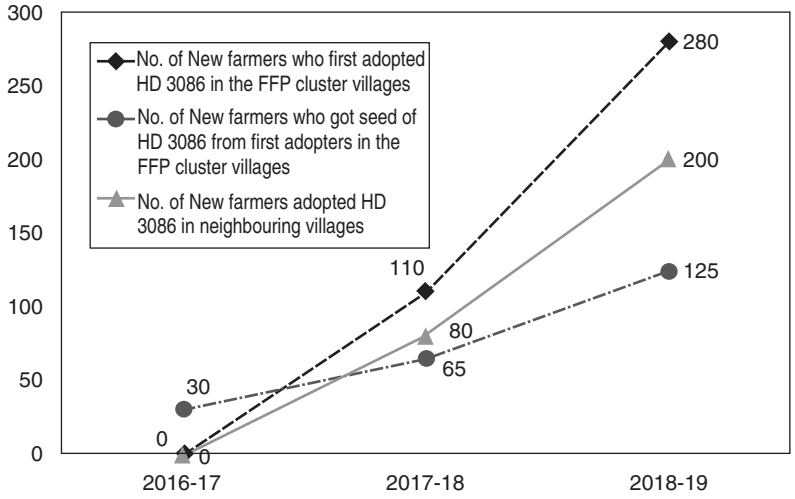

Fig. 1 Diffusion of HD 3086 among farmers of ICAR Farmer FIRST Project villages and in neighbouring villages.

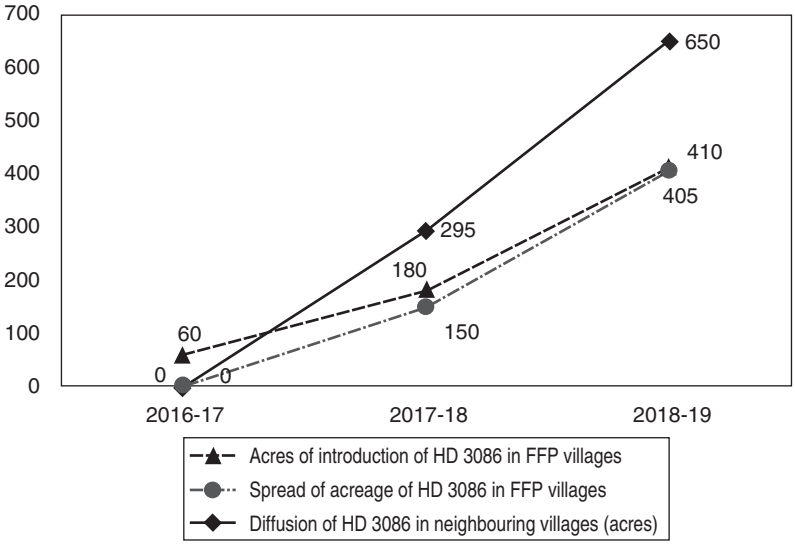

Fig 2 Diffusion of HD 3086 in acreage of ICAR Farmer FIRST Project villages and in neighbouring villages.

Diffusion of Improved Wheat Variety HD 3086 in the FFP villages and the neighbourhood

As the net returns and the cost-benefit ratio of HD 3086 were found to be relatively better, other farmers started adopting this new wheat variety in a big way. So, an attempt was made to present the results of spread of adopters of HD 3086 in the FFP villages and the neighbourhood villages over a period of three years through graphical representation. The rate of adoption of HD 3086 over time is presented in adoption curves in Fig 1 and Fig 2.

In the year 2016-17, the seeds of improved wheat variety HD 3086 were introduced as an innovation by IARI in FFP villages of Palwal, Haryana in about 60 acres among 30 farmers. In the next year, IARI seed of HD 3086 was introduced again in about 180 acres cultivated by 65 farmers of FFP villages. Yet in 2018-19, the acreage spread to 410 acres benefitting 180 farmers. Thus HD 3086 spread to 180 farmers who have got the benefit of IARI seed of HD 3086 among three FFP villages.

In the year 2017-18, after witnessing the relative advantage of HD 3086 in their own villages, started procuring seed of HD 3086 and about 110 farmers adopted cultivation of HD 3086 in 295 acres. In the next year 2018-19 the acreage under HD 3086 further spread to 650 acres in the FFP villages thereby benefitting 280 farmers.

In the year 2017-18, one year after the introduction of HD 3086 in FFP villages, many farmers in the neighbourhood villages evinced interest in this new variety. So about 80 farmers have adopted HD 3086 cultivation by procuring seed from the farmers of FFP villages and started cultivating HD 3086 in 150 acres. In the next year 2018-19, HD 3086 what variety further diffused among 200 farmers who cultivated in 405 acres in neighbouring villages. Thus, it can be concluded that the new wheat variety HD 3086 has diffused among 480 farmers who cultivated in about 1055 acres in three years of 2016-19 in the villages of the project.

Conclusion

The large-scale farmers' field trials HD 3086 conducted in villages in Haryana under ICAR Farmer FIRST project and registered significant higher per acre grain yields, per acre straw yields, gross income from wheat crop per acre, net returns per acre and higher cost-benefit ratios in comparison to control group. However, the cost of cultivation remained the same with no significant changes in both wheat varieties. Thus, it can be concluded that the performance of HD 3086 has proved to be a significantly higher yielder and highly profitable for farmers. The rate

of adoption of HD 3086 has escalated from as low as 60 acres in first year to 1055 acres in the third year, 2017-18.

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