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Research Article

Popularization of high yielding varieties of wheat (*Triticum aestivum* L.) in West Bengal state through Frontline Demonstrations

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ABSTRACT

Field trials were conducted in farmers' fields of Nadia, Murshidabad and Bardhaman district of West Bengal state under frontline demonstration to study the potential of high yield cultivar. Total 32 Frontline demonstrations (FLDs) at farmers field were laid out on wheat (*Triticum aestivum* L.) to demonstrate production potential and economic benefits of improved practices (IP) comprising high yielding varieties namely DBW 107 and HD 2967 during rabi seasons from 2014 - 16 in irrigated farming situation. Improved technology intervention revealed that, grain yield of DBW 107 (24.21 q/ha) and HD 2967 (31.35 q/ha) was quit high compared to farmer cultivar with UP 262 (21.06 q/ha) and Sonalika (22.98 q/ha). These varieties enhance 14.94 and 36.42 percent more grain yield over UP 262 and Sonalika. Straw yield was almost similar between DBW 107 (44.23 q/ha) and UP 262 (43.33 q/ha). However this was quite prominent in case of HD 2967 (59.65 q/ha) compared to tested farmer cultivar Sonalika (49.69 q/ha). Higher B:C ratio observed with HD 2967 (1.57) and was followed by DBW 107 (1.32). The productivity of wheat per unit area could be increased by adopting feasible scientific and sustainable management practices with a suitable variety.

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Key words: Cultivar, constraints, economics, wheat frontline demonstration.

INTRODUCTION

In dawn of new millennium, challenges in the agriculture sector are quite different from those met in previous decade. Wheat is the important winter season food crop of India and improvement in its productivity has played a key role in making the country self-sufficient in food grain. Crop occupies an area of about 28.5 million hectare with total production of 95.85 million tones and a productivity of 2.83 tones/ha and a shares 12.43% of total production of world [1]. However, in the past decade a general slowdown in increase in the productivity of wheat has been noticed, particularly under environments relatively unfavorable for growth and development of wheat [2]. Current estimate indicates that in India around 13.5 million hectare of wheat is heat stressed [3]. During past few years, more than 50% sowing of wheat after gets delayed till December or early January causing substantial loss in grain yield due to late harvesting of preceding *kharif* crop like rice, which ultimate results in poor seed yield. Late sown suffers due to sub-optimal temperature at sowing, which causes delayed germination, slow growth, lesser development and ultimately low yield. The delayed sowing further cause's supra-optimal thermal stress at reproductive phase which results enforced maturity. Moreover poor agronomic practice such as seed rate, selection of suitable variety, nutrient management, weed and irrigation are responsible for low productivity of wheat in India. Yield potential of wheat in Nadia and Bardhaman district of West Bengal is not being exploited fully due to many factors, among which low yielding varieties, poor nutrient and irrigation management are the most important ones. The productivity of wheat in most of the district is only1.68 t/ha, as compared to the national average of 2.7 t/ha [4]. This calls for special effort to manage natural resources of agriculture and the need for sustainable agriculture. Further, usually farmers were unaware about the suitable cultivar due to poor extension support system. As per our observation most of the farmers try to stick age old cultivar, and these leads to poor economic return to farming community. Hence, an effort made by ourselves by introducing new wheat cultivar with improved technologies for enhancing wheat production through front line demonstration.

MATERIALS AND METHODS

The present study is a part of the mandatory programme of AICPR on Wheat and Barley Improvement Project. 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 mela/ field day etc.) were also included to excel the farmers understanding and skill about the demonstrated technology on wheat. The Field demonstrations were conducted under close supervision of wheat project scientist of BCKV. Total 32 front line demonstrations under real farming situations were conducted during *rabi* season of 2014-16 at three different villages namely; Majherchar (Dist: Nadia), Golahat (District Bardhaman) and Mursidabad block, respectively. The soil of the experimental field was loamy in texture and almost neutral in reaction having pH 7.2, organic carbon 0.43%, available nitrogen 238 kg, available phosphorus 23.2 and available potassium 234 kg/ha. The area under each demonstration was 0.4 ha. The soil was sandy loamy in texture with moderate water holding capacity, low in organic carbon (0.26-0.41%), available nitrogen (146.8 242 kg/ha), phosphorus (16.5-21.2 kg/ha) and potassium

(169.7-229.6 kg/ha) ranges from low to medium and soil pH was slightly acidic to neutral in reaction (6.8-7.2). The treatment comprised of improved wheat variety mainly DBW 107 and HD 2967. Farmer's practice constituted old seed variety UP 262 and Sonalika. Crop was sown on the same time of demonstration, broadcasting method of sowing, higher seed rate (125 kg/ha) sown, imbalance dose of fertilizers applied (100:50:20 kg NPK/ha), no seed treatment, no biofertilizers, no plant protection measures and one hand weeding at 30-35 DAS were adopted. Crop was harvested on the same time of harvesting of demonstration plots. Harvesting and threshing operations done manually and thresher, respectively; 5m × 3m plot harvested in 3 locations in each demonstration and average grain weight taken. Similar procedure adopted on FP plots under each demonstration then grain weight converted into quintal per hectare (q/ha). Before conduct the demonstration training to farmers of respective villages was imparted with respect to envisaged technological interventions. All other steps like site selection, farmers selection, layout of demonstration, farmers participation etc. were followed as suggested by Anonymous [5]. Visits of farmers and extension functionaries were organized at demonstration plots to disseminate the technology at large scale. Yield data was collected from farmers practice and demonstration plots. The grass returns, cost of cultivation, net returns and benefit cost ratio (B:C ratio) were calculated by using prevailing prices of inputs and outputs.

RESULT AND DISCUSSION

Wheat Frontline Demonstrations on an area of 10 hectares were organized very successfully by the All India Coordinated Wheat and Barley Improvement Project, Kalyani Centre, Bidhan Chandra Krishi Viswavidyalaya. Farmers who generally use the old varieties and don't follow proper irrigation schedule and don't apply the recommended dose of fertilizers were selected. Half of recommended dose of nitrogen i.e. 60 kg per hectare in the form of urea, full dose of P_2O_5 (60 kg / ha) and K_2O (40 kg/ha) in the form of SSP and MOP respectively were applied uniformly as basal dose. Remaining part of nitrogen i.e. 60 kg per hectare in the form of Urea was top-dressed at first irrigation i.e. 20-25 days after sowing. The crop was irrigated four to five times - first one at CRI stage, second one at jointing, third at flowering and fourth at soft dough stage of the crop. The farmers could not be motivated to sow the wheat seeds in lines. It is our experience that line sowing cannot be adopted by the farmers unless they have the facilities of seed drill. Usual farmer practice vary from demonstrated plot in term of date of sowing, fertilizer application and number of irrigation (Table 1). DBW 107 (7 days) was late sown cultivar and sowing was vary with timely sowing i.e. HD 2967 (9 days), that ultimately effect to certain extent yield of this cultivar. Improved technology intervention revealed that, grain yield of DBW 107 (24.21 q/ha) and HD 2967 (31.35 q/ha) was quit high compared to age old farmer cultivar with UP 262 (21.06 q/ha) and Sonalika (22.98 q/ha). Improved cultivar viz DBW 107 and HD 2967, could help to enhance 14.94 and 36.42 percent more grain yield over UP 262 and Sonalika (Table 2). Straw yield was almost similar between DBW 107 (44.23 q/ha) and UP 262 (43.33 q/ha). However this was quite prominent in case of HD 2967 (59.65 q/ha) compared to tested farmer cultivar Sonalika (49.69 q/ha) (Table 2). Economics reveled that farmer expense towards the cultivation of wheat was Rs. 36,635, compared to new cultivar in demonstration plot of Rs. 42,678. This high cost was mainly due to improved seed variety, cost of fertilizer, irrigation and better threshing and winnowing (Table 3). Higher B : C ratio observed with HD 2967 (1.57) and was followed by DBW 107 (1.32). Considering the above facts, Frontline demonstrations were carried out in a systematic and scientific manner on farmer's field to show the worth of a new variety and convincing farming community about

potentialities of improved production management technologies of wheat for further adoption. Response receives from different farmer's revealed that farmer were very much benefitted with the FLD and their response were quite good and positive (Table 4). The farmers became acquainted with new varieties of wheat and came to know more about wheat production technologies through these front line demonstrations. Framers were happy because improved varieties performed better and gave more yield than the check varieties. New varieties provided good returns to the farmers. As per agro-ecological constraints study revealed that few of serious disease and weeds were observed. Neighboring farmers' response was positive about the technologies demonstrated through FLDs. Wheat FLDs were perceived by the farmers as effective method of transfer of technology. No serious diseases were observed during FLD programme, neither in demonstration plot nor in check plot. Serious observation on termite infestation observed in few pockets. Lack of knowledge about appropriate dose and method of herbicide application among the farmers had been observed in most of the places. Serious problem of *Cyprus rotundus* (Motha), *Chenopodium album* (Bathua), *Avena ludoviciana* (Jangali Jai) and *Rumex dentatus* (Jangali Palak) observed (Table 5). Under abiotic stress, water scarcity and high temperature at maturity was become serious constraints. With discussion to the farming community, we knew that lack of knowledge among farmers about recent technologies and poor participation of farmer in exposure visits was most limiting factor for enhancing wheat production in this region. Problem in marketing of seed and straw along with bird damage was also a serious issue and take care of this parameter is very important for higher yield potential of wheat in this region.

CONCLUSION

The result of front line demonstration convincingly brought out that the yield of wheat could be increased higher with the intervention on varietal replacement *i.e.* HD 2967 and DBW 107, appropriate nutrient and weed management and proper irrigation in wheat production in the west bengal district. To safeguard and sustain the food security in India, it is quite important to increase the productivity of wheat under limited resources. Favorable benefit cost ratio is self explanatory of economic viability of the demonstration and convinced the farmers for adoption of improved technology of wheat production. The technology suitable for enhancing the productivity of wheat and calls for conduct of such demonstration under the transfer of technology programme by university.

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LIST OF TABLES:

Table no. 1: Particulars of the FLD and Check plots

PARTICULARS	**FLD PLOT** (CULTIVARS)		**CHECK PLOT**
	DBW 107	HD 2967	
Date of sowing	30.11.14 to 10.12.14 03.12.15 to 12.12.15	10.11.14 to 22.11.14 16.11.15 to 25.11.15	20.11.14 to 30.11.14 24.11.15 to 07.12.15
Seed Rate used (kg/ha)	100	100	125
Sowing method	Broadcast	Broadcast	Broadcast
Duration of the variety (in days)	111-115	114-118	110-114 days
Name of previous crop	Rice	Rice	Rice
Type of soil	Clay loam	Clay loam	Clay loam
Fertility status	Medium	Medium	Medium
Fertilizer used (N:P:K in kg/ha)	120: 60:40	120: 60:40	100: 50:20
Irrigation type	Tube well	Tube well	Tube well
Number of irrigations	Four to five	Four to five	Three
Number of weeding	Two	Two	One
Harvesting method used	Manual	Manual	Manual
Threshing method	Thresher	Thresher	Manual
Price of grain (Rs./quintal)	Rs. 1975 /q	Rs. 2000 /q	Rs. 1900 /q
Price of straw (Rs./quintal)	Rs. 81 / q	Rs. 76 / q	Rs. 76 / q

Table no. 2: Varieties in FLD and check plot, area covered under each variety and yield (Pooled of two years).

FLD plot				Economics			Check plot				Economics			% increase grain yield over check plot
Name of variety	Area sown (ha)	Grain Yield (q/ha)	Straw Yield (q/ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	B: C ratio	Name of variety	Area sown (ha)	Grain Yield (q/ha)	Straw Yield (q/ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	B: C ratio	
DBW 107	4.48	24.21	44.23	42,678	15,472	1.32	UP 262	1.12	21.06	43.33	36,635	6,672	1.18	14.94
HD 2967	5.52	31.35	59.65	42,678	24,555	1.57	Sonalika	2.50	22.98	49.69	36,635	10,803	1.29	36.42

Table no. 3: Cost of cultivation (Rupees / hectare).

Sl. No.	Operations	FLD plot	Check plot
1.	Land preparation	3,000	3,000
2.	Seed cost + Seed Treatment cost + Sowing cost	3,800	3,200
3.	Manures cost + Application of manures	1,000	1,000
4.	Fertilizer cost + Application of fertilizer	1,650	1,250
5.	Bio-Fertilizer cost + Application cost		
6.	Plant protection chemicals		
7.	a. Weedicides + Application cost	480	480
	b. Insecticides + Application cost	500	-
	c. Fungicides + Application cost		
8.	Irrigation + Labour cost	11,587	9,147
9.	Manual weeding	2,359	1,056
10.	Harvesting		
	a. Manual harvesting	5,100	5,100
	b. Combine harvester		
11.	Watch & ward	5,000	5,000
12.	Threshing & winnowing	4800	4,000
13.	Drying, Weighing, Bagging	1,200	1,200
14.	Transport to house / Mandi	1,002	1,002
15.	Any other (Miscellaneous expense)	12,00	1,200
	Total Expenses	42,678	36,635

Table no. 4: Feedback receive from the farmer.

Sl.No.	Particulars	Feedback
1.	Benefits of the demonstrated improved/new variety in comparison to old/check variety	√Beneficial / Not beneficial / Can't say
2.	Benefits of the other demonstrated technologies (Please mention the technology)	√Beneficial / Not beneficial / Can't say
3.	Response of neighboring farmers to the demonstrated technology	√Positive / Negative / No response
4.	Level of satisfaction with yield record.	Low / √ Medium / High
5.	Will the farmer adopt the demonstrated technologies if input support is discontinued	√Yes / No
6.	Level of satisfaction with the support provided under the FLD programme.	√Satisfactory / Not satisfactory / Can't say

Table no. 5: Critical analysis of agro-economical constraints for limiting wheat yields.

S.No.	Constraint/Problem	MS	S	NS	S.No.	Constraint/Problem	MS	S	NS
	I. Diseases	-	-	-		***VI. Inputs***			
i.	Yellow Rust	-	-	-	I	High cost of inputs	-	√	-
Ii	Loose smut	-	-	-	ii	Poor quality seeds	√	-	-
Iii	Powdery Mildew	-	-	-	iii	Non-availability of seed of newly released variety	√	-	
Iv	Karnal Bunt	-	-	-	iv	Poor quality fertilizers	-	-	√
	II. Insects-Pests				v	Non-availability of Nitrogen/ Phosphorus fertilizer at desired time	-	-	√
I	Aphid	-	-	-	vi	Poor quality herbicides/pesticides	-	√	-
Ii	Termite	-	√	-	vii	Lack of irrigation facilities	-	-	-
Iii	Stem borer	-	-	√	viii	Non-availability of diesel	-	-	√
Iv	Leaf folder	-	-	-		**VII. Technological**			
					I	Late sowing	√	-	-
	III. Weed Infestation				ii	Poor/Low plant population	-	√	-
I	Resistance against herbicide	-	-	-	iii	Zn deficiency	-	-	-
Ii	Lack of knowledge about appropriate dose and method of herbicide application among the farmers	√	-	-	iv	Poor soil fertility (NPK)	-	-	√
Iii	*Phalaris minor* (Kanki/Mandusi/Gehoon ka mama)	-	-	√	v	Low organic matter	√	-	
Iv	*Cyprus rotundus* (Motha)	-	√	-	vi	Low micro-nutrients	√	-	-
V	*Chenopodium album* (Bathua)	-	√	-	vii	Lodging	-	√	-
Vi	*Avena ludoviciana* (Jangali Jai)	-	√	-	viii	Lack of land leveling	√	-	-
vii	*Malva parviflora* (Chughra)	-	-	-	ix	Imbalanced use of fertilizer	-	-	-
viii	*Convolvulus arvensis* (Hirankhuri)	-	-	-	X	Faulty irrigation methods	-	-	√
Ix	*Rumex dentatus* (Jangali Palak)	-	√	-	Xi	Lack of facility of canal irrigation water	-	-	-
X	*Anagalis arvensis* (Krishnanil)	-	-	√	xii	Poor drainage facilities	-	-	-
Xi	*Argemone maxicana* (Satyanashi)	-	-	√	xiii	Faulty tillage methods	-	-	-
					xiv	Non availability of farm machinery	-	√	-
	IV. Abiotic Stress					**VIII. Extension**			
I	*Water stress*	-	√	-	I	Lack of knowledge among farmers about recent technologies	√	-	-

ii	Poor quality irrigation water	-	-	-	Ii	Poor information delivery by state extension machinery	-	√	-
Iii	Water logging	-	-	-	Iii	Poor participation in exposure visits arranged by various departments	-	√	-
Iv	Untimely rain/ Erratic rainfall/ Weather vagaries	-	-	√	Iv	Poor participation in kisan melas/ field day/kisan goshthi/ training	-	√	-
V	High Temperature at maturity	√	-	-	V	Lack of extension literature	-	√	-
Vi	Declining water table	-	√	-	Vi	Lack of training facility	-	√	-
vii	Temperature fluctuation during crop growth	√	-	-	Ix	Others			
					i	Non-availability of electricity		-	√
	V. Socio-economic				ii	Erratic power supply	-	--	√
I	Non availability of labour	√	-	-	iii	Low price of wheat / barley	-	√	-
Ii	Non availability of crop loan	-	-	√	iv	Problem in marketing of seed and straw.	√	-	-
Iii	Higher custom hiring rate of land leveling, field preparation, sowing & harvesting	-	-	√	v	Birds	√	-	-
Iv	Small land holdings	√	-	-	vi	Rodents	√	-	-

MS :Most Serious; S: Serious; NS: Not Serious