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Strategy of Improving Wheat (*Triticum aestivum* L.) Productivity under New Alluvial Zone through Demonstration Programme

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ABSTRACT

The front line demonstrations of wheat were conducted during the *rabi* season of 2014-17 in seventeen farmers fields to demonstrate production potential and economic benefit of improved technologies consisting suitable variety (*viz.* HD 2967), improved nutrient (150:60:40 kg/ha NPK) and weed control measures under new alluvial zone of West Bengal, in irrigated conditions. The productivity of wheat ranged from 32.95 to 38.43 q/ha with mean grain yield of 36.13 q/ha under improved practice on farmers field as against a grain yield under farmers practice which ranged from 21.98 to 24.65 q/ha with a mean of 23.36 q/ha. It is evident from the results that the yield of improved wheat variety was found better than the local check under same environmental conditions. Farmers were motivated by results of demonstrated technologies applied in the FLDs and it is anticipated that they would adopt these technologies. Yield of the front line demonstration and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index. Cultivation of wheat under improved practices fetch higher net return of Rs. 19,519 to Rs. 23,247/ha compared to farmer practice of Rs. 7,847 to Rs.12,100/ha. The average B: C ratio of improved technology was 1.77 in comparison of farmer practice mean B: C ratio was 1.43.

Keywords*:* FLD, Improved practice, Variety, Wheat, Yield

INTRODUCTION

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. West Bengal is not a traditional wheat growing state in India. However, at present, wheat has become a staple food crop next to rice and its consumption is gradually increasing because of change in food habit and economic prosperity. In spite of a wide range of adoptability, little attention has been paid towards wheat production and maximization of yield potential of this crop in West Bengal and its share to national production is less than one per cent. Productivity of 2.8 t/ha is also far below the national average of 3.14 t/ha (Mukherjee, 2017). Since wheat is a major cereal crop and population is gradually increasing, increase in its production and acreage should be given top priority in order to achieve food and nutritional security in the state. However, success of any crop production depends on use of appropriate genotype/variety of high yield potential and improved nutrient and weed control measures.

Among the agronomic practices suitable cultivars plays a significant role in maximizing the crop yield and productivity. Weed control measures is very important for proper distribution of plants over cultivated area and for better utilization of available soil and natural resources. Most of the farmers in the new alluvial zone of West Bengal, avoid growing wheat due to improper knowledge of suitable cultivar and poor nutrient and weeding control measures. Hence, an effort made through AICRP on

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Wheat and Barley Improvement, by introducing the recommended technologies of wheat production with suitable cultivar through front line demonstration on farmers field during *rabi* season of 2014-17.

METHODOLOGY

Present study was conducted under the aegis of Bidhan Chandra Kristi Viswavidyalaya during winter season of 2014-15, 2015-16 and 2016-17 in the Nadia district of West Bengal. Participatory rural appraisal (PRA), group discussion and transect walk were followed to explore the detail information of study area. For easy understanding of the farming community of the region, training, field day and farmer awareness programme were conducted to excel the farmers understanding and skill about the demonstrated technology on wheat. Field demonstrations were conducted under close supervision of staff and scientist working under AICRP on Wheat and Barley. Total 17 front line demonstrations under real farming situations were conducted during *rabi* season of 2014-15, 2015-16 and 2016-17 at four different villages namely; Charjadubati, Majherchar, Golahat and Majhergram (Kachrapara), respectively. All the participating farmers were trained on various aspects of wheat production technologies. The area under each demonstration was kept 0.50 ha. A one fifth area was also devoted to grow local standard check (farmer's practices). Soil sample were analyzed for NPK as per standard laboratory procedures (Jackson, 1973). The soil was sandy clay loam in texture (sand 47.54 ± 0.6, silt 29.59 ± 0.4 and clay 22.87 ± 0.3), with moderate water holding capacity with low in organic carbon (0.28-0.47%) contents, slightly alkaline (7.1 ± 0.05), tested low in available N ($KMnO_4$-N, 291.3 ±5.1 kg/ha), medium in available P (Olsen's-P, 19.1 ± 0.9 kg/ha) and high in available K (NH_4OAC-K, 276.3 ± 8.1 kg/ha). The treatment comprised of recommended practice as established by AICRP on Wheat and Barley Improvement. Improved variety seed (HD 2967), with seed rate of 100 kg/ha along with recommended dose of fertilizer 150:60:40 kg of NPK/ha and weed control measures were used. Crop was sown between18th to 21st November in the demonstration field, with 20 cm row spacing. The crop received full dose of P_2O_5 and K_2O and half dose of nitrogen as basal dose and remaining nitrogen in 2 equal splits i.e. at tillering and at boot stage. The source of fertilizer was urea, single super phosphate and muriate of potash for N, P and K, respectively. Weed control measures mainly include, post emergence application of 2, 4 DEE @750 ml/ha was given at 23 DAS (days after sowing) followed by one hand weeding at 40 DAS for complete check of weed during critical period of crop-weed competition. Fields were irrigated at the critical stages of crop and the crop was harvested between 29th March to 9th April during all the years of demonstration. Farmer's practice constituted seed of age old variety of Sonalika. Crop was sown on the same time as demonstration, broadcasting method of sowing, higher seed rate (125 kg/ha), imbalance dose of fertilizers applied (100:40:0 kg NPK/ha), no seed treatment, no plant protection measures and one hoeing at 22 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 × 4m plot harvested in five different 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, farmer's selection, layout of demonstration, farmers participation *etc*. were followed as suggested by Choudhary (1999). Visits of

Table 1: Mean weather data during the crop season

Year	Meteorological month	Rainfall (mm)	Rainy days	Temperature (°C)		Humidity (%)		Sunshine (hrs/day)
				Minimum	Maximum	Minimum	Maximum	
2014-15	October-March	4.56	3	15.31	35.80	44.56	82.05	5.16
2015-16	October-March	13.81	9	11.40	29.36	53.26	92.46	6.02
2016-17	October-March	0.21	1	12.42	33.65	47.98	84.65	7.54

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 and finally the extension gap, technology gap and technology index were worked out. Technology gap, extension gap and technology index were measured as per procedure given by Samui *et al.* (2000).

RESULT AND DISCUSSION

The weather data during the crop season are given in Table 1. There was scanty rainfall during the period of study. The minimum and maximum temperature ranged from 11.40 to 15.31 and 29.36 to 35.80, respectively during the years of demonstration. The relative humidity ranged from 44.56 to 53.26 for minimum and 82.05 to 92.46 per cent for maximum. The sunshine hrs/day varies from 5.16 to 7.54 during the FLD period.

The yields attributing parameters like ear head (no./m^2) and number of tillers/m^2 obtained over the years under recommended practice as well as farmers practice are presented in Table 2. Observation revealed that, ear head numbers were registered high with FLD plots compare to farmer's practice. Ear head (no./m^2) ranged from 236.63-311.23 with mean of 268.92 with improved practices on farmer's field as against a ranged from 156.33-201.29 with mean of 181.91 in farmer's practice. The number of tillers/ m2 of wheat ranged from 305.66 to 341.33 with mean of 322.77 under improved technology as against a ranged from 234.33-256.66 with a mean value of 252.16 recorded under farmers practice. This corroborate with the finding of Mukherjee (2016).

The grain yields of wheat obtained over the years under recommended practice as well as farmers practice are presented in Table 2. Grain yield is a function of various yield attributing factor and grain yield ranged from 32.95 to 38.43 q/ha with mean grain yield of 36.13 q/ha under improved practice on farmers field as against a grain yield ranged from 21.98 to 24.65 q/ha with a mean of 23.36 q/ha recorded under farmers practice. With comparisons to farmers practice there was an increase

Table 2: Impact of FLD programme on wheat productivity, yield attributes, yield and other variable

Year	Area (ha)	No. of farmers	Earhead (No. /m^2)		Tiller (No./m^2)		Grain yield (q/ha)			GY % increase over FP	Biological yield (q/ha)		BY % increase over FP	Harvest index (%)		Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
			IP*	FP**	IP	FP	Potential	IP	FP		IP	FP		IP	FP			
2014-15	4	26	236.63	156.33	305.66	265.66	45	32.95	23.45	40.51	79.65	50.32	58.28	41.36	46.60	12.05	9.50	26.77
2015-16	10	61	311.23	201.29	341.33	234.33	45	38.43	21.98	74.84	87.32	52.36	66.76	44.01	41.97	6.57	16.45	14.60
2016-17	10	53	258.92	188.12	321.33	256.66	45	37.01	24.65	50.14	71.91	56.39	27.52	51.46	43.71	7.99	12.36	17.75
Total/ Mean	24	140	268.92	181.91	322.77	252.16	45	36.13	23.36	55.16	79.62	53.02	50.85	45.61	44.09	8.87	12.77	19.70

*Improved practice; ** Farmer's practice.

of 40.51, 74.84 and 50.14 per cent higher yield, respectively during 2014-15, 2015-16 and 2016-17 following improved practices. The higher grain yield of wheat under improved practices was due to the use of latest high yielding variety, enhance rate of fertilizer application with proper weed control measures. Further analysis of Table 2 revealed that, biological yield also varies to the tune of 71.95 to 87.32 q/ha compared to farmer practice with range of 50.32 to 56.39 q/ha. Improved technology in the farmer's field, increase biological yield to the tune of 27.52 to 66.76 per cent over the age old farmers practice. The more grain yield and biomass production recorded with improved practices owing to better utilization of available resources, mainly because of more dry matter accumulation and yield attributing characters.

Similarly, higher harvest index was recorded under improved technology (41.36 to 51.46% mean value of 45.61%) as compared to farmers practice (ranged between 41.97 to 46.60%, mean of 44.90). The higher values of yield attributing character, yield and harvest index following improved practice was due to the use of right kind of crop genotype with suitable technology interventions during the study years of demonstration. Similarly, Nain *et al.* (2012) reported spike length, number of grains/spike, grain yield, and total dry matter produced as significantly higher in the tested technologies as compared to farmers' practices.

The extension gap ranging between 9.50-16.45 q/ha during the period of study emphasized the need to educate the farmers through various means for the adoption of improved agricultural production to reverse the trend of wide extension gap (Table 2). The technology gap is the difference or gap between the demonstration yield and potential yield and it was varies during the year of observation. The trend of technology gap ranging between 6.57-12.05 q/ha reflected the farmer's cooperation in carrying out such demonstration with encouraging results during the period of study. This gap existed due to variation in the soil fertility and climatic or weather conditions (Table 1). Hence location specific recommendations are necessary to bridge the gap. These findings are similar to the findings of Patel *et al.* (2013) and Mukherjee (2016a). The technology index showed the feasibility of the evolved technology at the farmer's field. The lower the value of technology index, the more is the feasibility of the technology. As such, the reduction in technology index from 26.67, 14.60 and 17.75 per cent, respectively during 2014-15, 2015-16 and 2016-17 exhibited the feasibility of the demonstrated technology in this region. The results of the present study are in recurrence with the findings of Bar and Das (2015).

The inputs and outputs price of commodities prevailed during the FLD period were taken for calculating cost of cultivation, net returns and B:C ratio. (Table 3). The investment on production by adopting improved technology ranged from Rs. 26,893 to Rs. 28,695 with a mean value of Rs. 27,859/ha against farmers' practice where the variation in cost of production ranges was Rs. 22,654 to Rs. 23,965 with mean value of Rs. 23,480/ha. Cultivation of wheat under improved practices fetched

Table 3: Economics of FLD of wheat as affected by recommended practices as well as farmer's practices under irrigated conditions

Year	No. of demons-tration	Yield (q/ha)		Economics								
				Gross expenditure (Rs./ha)		Gross returns (Rs./ha)		Net return (Rs./ha)		Additional net return (Rs./ha)	B:C ratio	
		IP*	FP**	IP	FP	IP	FP	IP	FP		IP	FP
2014-15	4	32.95	23.45	26,893	22,654	46,412	33,636	19,519	10,982	8,537	1.72	1.48
2015-16	7	38.43	21.98	27,989	23,821	51,236	31,668	23,247	7,847	15,400	1.83	1.32
2016-17	6	37.01	24.65	28,695	23,965	50,365	36,065	21,670	12,100	9,570	1.75	1.50
Total/Mean	17	36.13	23.36	27,859	23,480	49,337	33,789	21,479	10,310	11,169	1.77	1.43

*Improved practice; ** Farmer's practice

higher net return of Rs. 19,519 to Rs. 23,247 with mean value of Rs. 21,479 compared to farmer practice to Rs. 7847 to Rs. 12,100 with mean amount of Rs. 10,310/ha. The additional net return of Rs. 8,537 to Rs. 15,400/ha with a mean value of Rs. 11,169/ha over farmer practice was received. The average B: C ratio of improved technology was 1.77, varying from 1.72 to 1.83, whereas, in farmers' practice means B: C ratio was 1.43 with range of 1.32 to 1.50. This figure may be due to higher yields obtained under improved practices compared to age old farmer practice.

CONCLUSION

The result of front line demonstration convincingly brought out that the yield of wheat could be increased with the intervention on varietal replacement *i.e.* HD 2967 with improved cultivation practices for new alluvial zone of West Bengal. 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 demonstrated technology 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.

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