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Original Research Article

Yield Gap Analysis and Strategy of Improving Wheat (*Triticum aestivum* L.) Productivity Under Late Sown Through Front Line Demonstrations in Eastern Uttar Pradesh

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A B S T R A C T

Front Line Demonstration is one of the most powerful tools for transfer of technology. The present study was undertaken to find out the yield gap through FLDs on wheat crop. Krishi Vigyan Kendra, Ballia, Uttar Pradesh conducted 10 front line demonstrations on wheat crop at farmers field of one adopted village with one blocks during 2013-14 to 2014-15. The objective of FLD was to demonstrate production potential and economic benefit of improved technologies consisting suitable variety (NW 1014), integrated nutrient management (100:60:40:25 kg NPKS/ha+ Azotobacter + PSB @ 5g/kg of seed), integrated pest management (deep ploughing + seed treatment with *Trichoderma viridae* @ 5 g/kg seed) at Ballia district of Uttar Pradesh under irrigated late sown conditions. The productivity of wheat from mean grain yield was 3.48 t/ha under improved practice on farmer's field as compared to farmer's practices mean of grain yield 2.61 t/ha. Yield increase was 33.33% over farmer's practices. It is evident from the results that the yield of improved wheat variety was found better than the check variety under same environment conditions. 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. 32,080/ha as compared to farmer practice of Rs. 20,172/ha. The average B:C ratio of improved technology was 2.18 over farmer practice 1.84.

Keywords

Wheat, NW 1014, yield, B C ratio and adaption

Introduction

Wheat is a very adaptable crop and is grown under the wide range of soil & climatic conditions. Wheat is consumed by human being in the form of flour for making Chapaties, Semolina and Pasta products. It is also used for preparation of bread, biscuits, cookies, cracks, noodles, dalia, maida, vermicelli, etc. Wheat contains about 70%

carbohydrates, 12% protein, 1.7% fat, 2.7% minerals, 2% fiber and 12% moisture. (Status paper on wheat ministry of agriculture)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. Current estimate indicates that in India around 13.5 million hectare of wheat is heat stressed (Joshi *et al.*, 2007). India is second largest producer of Wheat in the world after China with about 12% share in total world Wheat production. Now, India is surplus and in a position to export. Wheat is grown in India in an area of about 30 Million ha. with a production of 93 Million tonnes. The normal National productivity is about 2.98 tonnes/ha. The major Wheat producing States are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Maharashtra, Gujarat, Karnataka, West Bengal, Uttarakhand, Himachal Pradesh and Jammu & Kashmir. These States contribute about 99.5% of total Wheat production in the country. The requirement of wheat will be around 109 mt for feeding the 1.25 billion populations by 2020 AD (Singh, 2010). India's per capita production is 67 kg against per capita consumption of 73 kg/year. Thus, around 15 mt of wheat production has to be increased by adopting improved production practices. The climatic condition of this district is quite favorable for wheat cultivation due to prolong & cold winter. But lack of knowledge of improved varieties, sowing method, balance fertilizer, proper weed control and irrigation management etc., leads to very low productivity of wheat yield. There are several constraints of low productivity of wheat in India, out of which poor extension of improved agronomic practices is on the top. More than 50% area of wheat sowing gets delayed and goes up to last December to early January causing substantial loss due to late harvesting of preceding rice crop which resulted poor grain yield. Moreover, poor agronomic practices such as higher seed rate, unsuitable varieties, faulty nutrient management as well as weed control etc. are responsible for low productivity of wheat in India (Tiwari *et al.*, 2014). The choice of right varieties under Late sown condition is one of the crucial points determining the yield of wheat.

Materials and Methods

Participatory rural appraisal, group discussion and transect walk were followed to explore the detail information of study area. In between the technology intervention HRD components (Trainings/ Kisan gosthi/ Kisan mela/ field day etc.) were also included to excel the farmers understanding and skill about the demonstrated technology on wheat. A total 10 front line demonstrations were conducted during Rabi season of 2013-14 and 2014-2015 in Ballia District. The area under demonstration was 42.10 ha. in sandy clay-loam soil in texture with moderate water holding capacity, low in organic carbon, low in available nitrogen, low to medium in available phosphorus, low in available potassium. The treatment comprised of recommended practice (Improved variety for late sown NW 1014), integrated nutrient management-@ 100:60:40:25 kg NPK$ZnSO_4$/ha + Azotobacter + PSB @ 5 g/kg seed, integrated pest management- deep ploughing + seed treatment with Trichoderma viridae @ 5 g/kg seed etc. vs. farmers practice. Deep Summer ploughing was done during the April month. Crop was sown between 5 December to 20 December with a seed rate 100 kg/ha. An entire dose of P2O5, K2O and ZnSo4 through diammonium phosphate, K through muriate of potash and zink through ZnSO4 and 25% nitrogen was applied as basal before sowing; remaining quantity of nitrogen applied in three equal splits at 25, 40 and 60 days after sowing. The seeds were treated with *Trichoderma viridae*

@5 g/kg seeds then inoculated by Azotobacter and phospho-solubilizing bacteria biofertilizers each 5g/ kg of seeds. Application of sulfosulfuron + metsulfuronmethyle @32g a.i./ha at 25-30 DAS for effective weed management; used flat fan nozzle. Farmer's practice constituted with no deep ploughing was done during summer, old seed of variety PBW 343 was used, crop was sown on the same time of demonstration, broad casting method of sowing, higher seed rate (125 kg/ha) sown, imbalance dose of fertilizers applied (60:40:0 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 as of demonstration plots. To popularize the improved wheat production practices, constraints in wheat production were identified though participatory approach. Front line demonstrations (FLD) were planned and conducted at the farmer's fields with improved technologies selected for FLDs given in Table 1. Crop was harvested on the same time of harvesting of demonstration plots. Harvesting and threshing operations done manually and thresher, respectively, 50m^2 plot harvested in all farmers in demonstration and average grain weight taken. Similar procedure adopted on FP plots under each demonstration then grain weight converted into ton per hectare (t/ha). The gross 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 as per methods of (Samui, *et al.,* 2000 and Sagar *et al.,* 2004).

1- Technology gap = Potential yield – Demonstration yield

2- Extension gap = Demonstration yield – farmers yield

3- Technology index = [(Potential yield – Demonstration yield) /Potential yield] x 100

4- % increase over farmers practices = Improved practices – Farmers practices / farmers practices x 100

Results and Discussion

Yield and contributing characters

The yields contributing ear head (no. /m2) and number of tillers/m2 wheat obtained over the years under recommended practice as well as farmers practice are presented in table 2, revealed that, ear head numbers were high registered with FLD plots compare to farmer's practice. Ear head (no./m2) mean of 281 with improved practices on farmer's field as against a mean of 204 in farmer's practice. The number of tillers/m2 of wheat from mean of 303 under improved technology as against a mean value of 235 recorded under farmers practice. The productivity of wheat from mean grain yield of 3.48 t/ha under improved practice on farmer's field as compared to farmer's practices mean of grain yield 2.61 t/ha and grain yield increase 33.33% over farmer's practices. This corroborate with the finding of Mukherjee (2016).

Extension, technology gap and technology index

The extension gap 0.88t/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 1.52 t/ha reflected the farmer's cooperation in carrying out such demonstration with encouraging results during the period of study. Hence location specific recommendations are necessary to bridge the gap. These findings are similar to the findings of (Patel *et al.*, 2013) and (Mukherjee 2016). 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 30.4%, 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).

Table.1 Comparison between demonstration and farmers practices under FLD Wheat Crop

Particulars	Demonstration package	Farmers practice
Farming situation	Irrigated upland & midland	Irrigated upland & midland
Variety	NW 1014	PBW 343
Time of sowing	05 December to 15 December	Second fortnight of December
Method of sowing	Line Sowing	Broadcasting
Seed rate	100 kg ha	130 kg ha
Seed treatment	Azotobactor @ 5-10 gm per kg seed	Nil
Fertilizer Dose	100:60:40 kg/ ha, NPK	50:40:10 kg/ ha, NPK
Weed management	Isoproturon @ 1.0 kg ai /ha as pre emergence.	Nil
Water management	Irrigation at critical stages	Frequent Irrigation

Table.2 Impact of FLD on wheat under late sown condition Yield and contributing characters

Year	Area (ha)	Ear head no./m^2		Tiller no./m^2		Potential Yield	Grain Yield t/ha		Grain Yield increase over FP	Extension gap (t/ha)	Technology gap (t/ha)	Technology index
		IP	FP	IP	FP		IP	FP				
2013-14	44.20	266	199	293	229	5.00	3.37	2.58	30.62	0.79	1.63	32.6
2014-15	40.00	296	209	313	241	5.00	3.59	2.63	36.50	0.96	1.41	28.2
Mean	**42.10**	**281**	**204**	**303**	**235**	**5.00**	**3.48**	**2.61**	**33.33**	**0.88**	**1.52**	**30.4**

Table.3 Economics of FLD of wheat as recommended practices as well as farmer's practices under late sown conditions

Year	No of Demonstrations	Yield q/ha.		Sale price of grain (MSP) (Rs./qt)	Gross expenditure (Rs./ha)		Gross returns (Rs./ha)		Total returns (Rs./ha)		Extra returns	Incremental Benefit: Cost ratio	
		IP	FP		IP	FP	IP	FP	IP	FP		IP	FP
2013-14	10	33.70	25.80	1650	26910	23810	55605	42570	28695	18760	13035	2.07	1.79
2014-15	10	35.90	26.30	1750	27250	24417	62825	46025	35575	21608	16800	2.31	1.88
Mean	**10**	**34.80**	**26.05**	**1700**	**27080**	**24114**	**59160**	**44285**	**32080**	**20172**	**14875**	**2.18**	**1.84**

Economics

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 with a mean value of Rs. 27,080/ha against farmers practice where the variation in cost of production with mean value of Rs. 24,114/ha. Cultivation of wheat under improved practices fetch higher net return of mean value Rs. 32,080 compared to farmer practice to mean amount of Rs. 20172/ ha. The additional net return with mean value of Rs. 14,875/ ha over farmer practice. The B: C ratio of improved technology was 2.18. Moreover, farmer practice mean B: C ratio was 1.84. This figure may be due to higher yields obtained under improved practices compared to age old farmer practice.

The wheat variety NW 1014 led to higher adoption due to higher yield and higher cost benefit ratio in late sown condition. The wheat variety PBW-343 was replaced in district by this variety. The demand of quality seed of this variety is also increasing which has led to participatory seed production at farmer's field. This research is helpful for increasing income of the farmers as selection appropriate technology (variety) play a vital role to increase production and productivity.

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