

## Popularization of high yielding varieties of wheat (*Triticum aestivum* L.) in Jhalawar district of Rajasthan state through Frontline Demonstrations

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### Abstract

Total 487 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 Raj-3765 and Raj-4037 in Jhalawar district of humid zone V of Rajasthan state during *rabi* seasons from 2007-08 to 2010-11 in irrigated farming situation. The percent increased yield under improved practices ranged from 07.81 to 21.85 (Raj-4037) and 14.52 (Raj-3765) in respective years. The average extension gap, technology gap and technology index were 5.29 qha<sup>-1</sup>, 10.14 qha<sup>-1</sup> and 21.51 percent, respectively in different varieties of wheat. The improved practices gave higher benefit cost ratio ranging from 1.20 to 1.98 with a mean of 1.53 compared to farmers practices (1.25). The productivity of wheat per unit area could be increased by adopting feasible scientific and sustainable management practices with a suitable variety. 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.

**Keywords:** Frontline demonstrations, wheat, improved practices

### 1. Introduction

Wheat (*Triticum aestivum* L.) is the second most important winter cereal in India after rice contributing substantially to the national food security by providing more than 50% of the calories to the people who mainly depend on it. In historical perspective, India had made spectacular advancement in productivity and sustainability of wheat and wheat based cropping system. The scenario of the past ten years has clearly indicated that the wheat production in the country has soared ahead despite area remaining the same. The wheat programme has released 399 wheat varieties, comprising bread wheat (335), durum (54), dicoccum (5) and triticale (5), for cultivation under different production conditions in all the wheat growing zones.

The seven-fold increase in wheat production (12.57 million tonnes in 1965-66 to 84.27 million tonnes in 2010-11) during the last five decades has been a remarkable and unparalleled achievement (Anonymous, 2011). Wheat

production recorded a growth of about 21 per cent during the last decade with regular upward growth during the last five years. The increasing trend recorded in wheat production has been the outcome of concerted efforts made in crop improvement, crop protection, resource management and extension activities. In India, Uttar Pradesh has the largest area (9.67 mha) under wheat cultivation and it is the highest producer (27.52 mt) as well. In Rajasthan, it is grown on 3.06 m ha area with production 10.77 m ton and productivity of 3515 kg ha<sup>-1</sup> (Anonymous, 2012-13). The productivity of wheat in the Jhalawar district is around 33.0 qha<sup>-1</sup> as compared to average national productivity (28.35 qha<sup>-1</sup>).

Wheat production is governed by temperature regimes during sowing and harvest times, duration of the cold period, availability of irrigation water and input supply. The growing situations vary from harsh conditions in peninsular and central regions to the favourable conditions of northern India. Even in the IGP, growing conditions vary from less favourable eastern parts to the

more conducive western states. The rice-wheat cropping system, although one of the most productive wheat based cropping systems, has inherent problems which are not advantageous to wheat production at least in the eastern parts of the IGP. In addition to the climatic conditions, that may vary from year to year, the occurrence of diseases has a reducing effect on yield and total production. In case of the cultural practices under different wheat based cropping systems, particularly under the rice-wheat cropping system, injudicious use of fertilizers and water has led to numerous problems such as deteriorating soil health and receding water table. Wheat grown in rainfed/dryland areas is faced with water scarcity, temperature extremes and minimal use of nutrients that limit the yield potential and also result in irregular production.

The productivity of wheat per unit area could be increased by adopting recommended scientific and sustainable management production practices using suitable high yielding varieties namely Raj-4037 and Raj-3765 (Dhaka, *et al.* 2010 and Ranawat *et al.*, 2011). Frontline demonstration is the new concept of field demonstration evolved by the Indian Council of Agriculture Research (ICAR) with main objective to demonstrate newly released crop production and protection technologies and its management practices in the farmers fields under different agro-climatic regions of the country under different farming situations. While demonstrating the technologies in the farmers fields, the scientists are required to study the factors contributing higher crop production, field constraints of

production and thereby generate production data and feedback information. Taking into account the above considerations, Frontline demonstrations (FLD,s) were carried out in a systematic manner on farmer's field to show the worth of a new variety and convincing farmers to adopt improved production management practices of wheat for enhancing productivity of wheat (*Triticum aestivum* L.).

## 2. Materials and methods

This study was conducted at farmers fields to demonstrate production potential and economic benefits of improved practices in Jhalawar district of humid Zone V of Rajasthan state during *rabi* season from 2007-08 to 2010-11 in irrigated farming situation. To popularize the improved wheat production practices, constraints in wheat production were identified through PRA. Based on top rank farmers problems identified, Frontline demonstrations were planned and conducted at the farmers fields under ICAR, ATMA and IVLDP. In all, total 487 full packages of practices Frontline demonstrations were conducted to convince them about potentialities of improved varieties of wheat *viz.*, Raj-4037 and Raj-3765 during *rabi* seasons from 2007-08 to 2010-11 under irrigated farming condition, in medium to heavy soils with low to medium fertility status under soybean-wheat cropping systems. Each demonstration was conducted in an area of 0.4 ha and adjacent to the farmers fields in which the crop was cultivated with farmers practice / local variety. Scientific interventions under FLDs were taken as mentioned in Table 1.

**Table 1.** Intervention points of low yield of wheat and their recommended potential solutions.

S. No.	Intervention points	Recommended potential Solutions
1	High yielding varieties	Raj – 4037, Raj-3765 and Raj-3077
2	Seed rate	100 Kg /ha
3	Seed treatment	Carbendazim @ 1 g/kg seed
4	Time of sowing	1 <sup>st</sup> to 4 <sup>th</sup> week of November
5	Manures & Fertilizers	10 t FYM, 120:40:30 (N:P:K) kg/ ha and 5 kg/ha Zinc sulphate
6	Hoeing & Weeding	Hoeing after 1 <sup>st</sup> irrigation, 2,4-D @ 500g/ha (Ester) at 30-35 DAS for BLW, Sulfosulfuron @ 25g/ha after 1 <sup>st</sup> irrigation for grassy weeds, Isoproturon / Metaxiron / Manzobenzathiozuron @ 1.25 kg/ha in heavy soil at 30-35 DAS.
7	Irrigation Management	Four Irrigation (Due to heavy soils)- 1 <sup>st</sup> (CRI-20-25 DAS), 2 <sup>nd</sup> (Later stage of tillering-50-60 DAS), 3 <sup>rd</sup> (Ear Formation-75-80 DAS) and 4 <sup>th</sup> (Milking stage-95-100 DAS).
8.	Termite	Chloropyriphos 20 EC @ 4.0 liter in standing crop
9.	Frost Management	Spray of 0.1 % sulphuric acid before possibility of frost occurrence

All the participating farmers were trained on all aspects of wheat production management before implementing the FLDs at their field. To study the impact of Frontline demonstrations, data from FLDs and local practices were collected and analyzed. The Extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al.* (2000).

$$\text{Extension gap (qha}^{-1}\text{)} = \text{DY (qha}^{-1}\text{)} - \text{LY (qha}^{-1}\text{)}.$$

$$\text{Technology gap (qha}^{-1}\text{)} = \text{PY (qha}^{-1}\text{)} - \text{DY (qha}^{-1}\text{)}.$$

$$\text{Technology index (\%)} = \frac{\text{PY (qha}^{-1}\text{)} - \{\text{DY (qha}^{-1}\text{)} / \text{PY (qha}^{-1}\text{)}\}}{\text{PY (qha}^{-1}\text{)}} \times 100$$

Where, DY- Demonstration yield, LY:- Local Check Yield, PY:- Potential Yield of variety.

The respondents were interviewed personally with the help of a pre-tested and well structured interview schedule. Client Satisfaction Index was calculated as developed by Kumaran and Vijayaragavan (2005). The individual obtained scores were calculated by the formula as:

Client Satisfaction Index = (the individual obtained score / Maximum score possible)

### 3. Results and discussion

**3.1 Constraints in wheat production :** Farmer's wheat production problems were documented in this study. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in wheat production. The ranking given by the different farmers are given in Table 2. A perusal of table indicates that effect of heat at maturity (77.41%) was given the top most rank followed by less technical knowledge (71.66%) and no seed treatment (68.38%). Based on the ranks given by the respondent farmers for the different constraints revealed that no irrigation at critical stages, untimely sowing, termite problem, improper use of manures & fertilizers and less attention on hoeing & weeding (40.86%). Other constraints such use of more Seed rate, frost management were found to reduce wheat production. Among all the constraints, low soil fertility got least concerns. Other studies (Hassan *et al.*, 1998; Ouma *et al.*, 2002; Joshi *et al.*, 2005; Dhaka *et al.*, 2010; Ranawat *et al.* 2011; Dhruw *et al.*, 2012; Sreelakshmi *et al.*, 2012) have reported similar problems in wheat production.

**Table 2.** Ranks given by farmers for different constraints (n=487).

S. No.	Constraints	Percentage	Ranks
1.	Effect of heat at maturity	77.41	I
2.	Lack of high yielding varieties	71.66	II
3.	No seed treatment	68.38	III
4.	No irrigation at critical stages	63.24	IV
5.	Untimely sowing	59.96	V
6.	Termite problem	52.36	VI
7.	Improper use of manures & fertilizers	49.69	VII
8.	Less attention on hoeing & weeding	40.86	VII
9.	Use of more Seed rate	32.44	IX
10.	Frost Management	27.10	X

**3.2 Performance of FLD:** The data presented in the Table-3 of demonstrated varieties and local checks, showed that the productivity of wheat in Jhalawar district under improved

production technologies ranged between 30.79 to 42.32 qha<sup>-1</sup> with a mean yield of 37.00 qha<sup>-1</sup>. The productivity under improved practices (IP) varied from 27.50 to 48.50 and 28.00 to 40.75 qha<sup>-1</sup> for the varieties Raj-4037 and Raj-3765, respectively as against the yield range between 29.50 to 36.00 with a mean of 31.71 qha<sup>-1</sup> under farmers practices (FP) and varieties during study period. The percent increase yield under improved practices ranged from 07.81 to 21.85 (Raj-4037) and 14.52 (Raj-3765) in respective years of FLDs. This increment in grain yield with improved practices was mainly because of high yielding varieties. The variation in the productivity was also caused unusual delay in sowing in some of the farmer's fields. Similar yield enhancement in different crops in Frontline demonstration has amply been documented by Haque (2000), Tiwari and Saxena (2001), Tiwari *et al.* (2003), Nazrul Islam *et al.* (2004), Hiremath *et al.* (2007), Mishra *et al.* (2009), Tomar *et al.* (2009), Dhaka *et al.* (2010), Kumar *et al.* (2010) and Sreelakshmi *et al.* (2012). From these results it is evident that performance of improved varieties was found better than the local check under local conditions. Farmers were motivated by results of Agro technologies applied in the FLDs trials and it is expected that they would adopt these technologies in the coming years also.

Yield of the Frontline demonstration trials and potential yield of the different varieties of crop was compared to estimate the yield gaps which were the extension gap was calculated *i. e.* 5.29 qha<sup>-1</sup>. The technology gap shows the gap in the demonstration yield over potential yield and it was 10.14 qha<sup>-1</sup>. The observed technology gap may be attributed to dissimilarities in soil fertility, salinity and erratic rainfall and other vagaries of weather conditions in the area. Hence, to narrow down the gap between the yields of different varieties, location specific recommendation appears to be necessary. Technology index shows the feasibility of the variety at the farmer's field. The lower the value of technology index (21.51%) more is the feasibility (Table 3). The finding of the present study is in line with the findings of Sawardekar *et al.* (2003), Hiremath and Nagaraju (2009) and Dhaka *et al.* (2010).

The economic feasibility of improved practices (IP) over traditional farmer's practices (FP) was calculated depending on the prevailing prices of inputs and output costs (Table 4). It was found that cost of production of wheat under improved practices (IP) varied from Rs. 22500 to 33500 ha<sup>-1</sup> in case of Raj-4037 and Rs. 32500 ha<sup>-1</sup> in case of Raj-3765 with an average of Rs. 29857.14 ha<sup>-1</sup> and an average of Rs. 28514.29 ha<sup>-1</sup> in farmers practice. The additional cost incurred in the improved practices (IP) was mainly due to more costs involved in the cost of improved seed only. Frontline demonstrations recorded higher mean gross returns (Rs. 44785.71 ha<sup>-1</sup>) and mean net return (Rs. 14928.57 ha<sup>-1</sup>) with higher benefit cost ratio (1.53) under improved practices of different improved varieties of wheat as compared to local checks. These results are in line with the findings of Gurumukhi and Mishra (2003), Sawardekar *et al.* (2003), Sharma (2003),

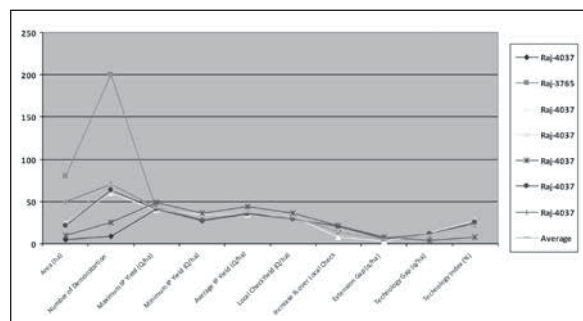
Hiremath *et al.* (2007), Hiremath and Nagaraju (2009) and Sreelakshmi *et al.* (2012). Further, average additional cost of Rs. 1342.86 ha<sup>-1</sup> in demonstration has yielded additional net returns of Rs. 8675.71 ha<sup>-1</sup> with incremental benefit cost ratio 6.46 suggesting its higher profitability and economic viability of the demonstration. Similar results were also reported by (Hiremath and Nagaraju 2009, Dhaka *et al.*, 2010 and Meena *et al.*, 2014) in maize crops. The results from the present study clearly brought out the potential of improved production technologies in enhancing wheat production and economic gains in rainfed farming situations conditions of this region of Rajasthan. Hence, wheat production technologies have broad scope for increasing the area and productivity at each and every level.

**Farmers satisfaction:** The extent of satisfaction level of respondent farmers over extension services and performance of demonstrated variety was measured by Client Satisfaction Index (CSI) and results presented in (Table 5). The data depicted in the (Table 4) showed that majority of the respondent farmers expressed medium (49.69%) to the high (36.35%) level of satisfaction for extension services and performance of technology

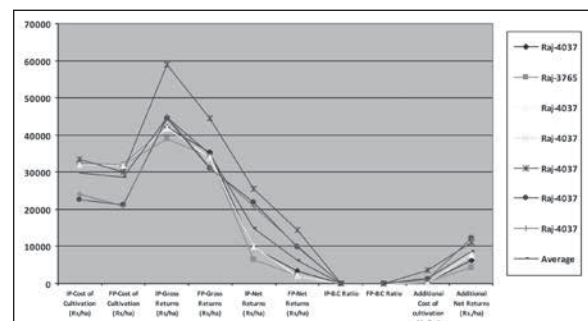
under demonstrations whereas, very few (13.96) percent of respondents expressed lower level of satisfaction. The results are in close conformity with the results of Narayanaswamy and Eshwarappa (1998) on pulses crops, Kumaran and Vijayaragavan (2005) on mustard & gram crops, Dhaka *et al.* (2010) and Meena *et al.* (2014) on maize crop. The medium to higher level of satisfaction with respect to services rendered, linkage with farmer's and technologies demonstrated etc. indicate stronger conviction, physical and mental involvement in the Frontline demonstration which in turn would lead to higher adoption. This shows the relevance of Frontline demonstration. It indicates that maize grown with low yields are identified by low knowledge, unfavorable attitude towards high yielding varieties, low risk bearers with negative perception of maize production technology. In other words, it may also due to socio-economic status, lower holdings and unavailability of inputs, credit facilities and to some extent supply and marketing problems. This is a point of concern for research and extension functioning to disseminate improved maize production technologies for raising the productivity of maize at all the levels.

**Table 3.** Yield of wheat as influenced by improved production technologies and high yielding varieties over local practices in farmer's fields (2007-08 to 2010-11).

Year	Variety	Area (ha)	Demo. Nos.	Yield (qha <sup>-1</sup> )			Local Check	Percent Increase in over local check	Extension gap (qha <sup>-1</sup> )	Technology gap (qha <sup>-1</sup> )	Technology Index (%)
				Improved Practice							
				Max.	Min.	Avg.					
2007-08	Raj-4037	05.00	09	41.25	27.50	36.50	31.75	14.96	4.75	11.00	23.16
	Raj-3765	80.00	200	40.75	28.00	35.50	31.00	14.52	4.50	9.50	21.11
2008-09	Raj-4037	24.00	60	40.00	34.00	34.50	32.00	07.81	2.50	13.00	27.37
	Raj-4037	24.00	60	41.00	33.50	37.00	32.00	15.63	5.00	10.50	22.11
2009-10	Raj-4037	10.00	25	48.50	36.50	43.75	36.00	21.53	7.75	03.75	07.89
2010-11	Raj-4037	21.00	63	41.50	27.50	35.50	29.50	20.34	6.00	12.00	25.26
	Raj-4037	50.00	70	43.25	28.50	36.25	29.75	21.85	6.50	11.25	23.68
	Total	214.00	487	296.25	215.50	259.00	222.00	116.63	37.00	71.00	150.58
	Average	30.57	69.57	42.32	30.79	37.00	31.71	16.66	5.29	10.14	21.51



**Fig. 1** Yield of wheat as influenced by improved production technologies and high yielding varieties over local practices in farmer's fields.



**Fig. 2** Cost of cultivation (Rs.ha<sup>-1</sup>), net returns (Rs.ha<sup>-1</sup>) and Benefit: Cost ratio of wheat as affected by improved production technologies over local practices.

**Table 4.** Cost of cultivation (Rs.ha<sup>-1</sup>), net returns (Rs.ha<sup>-1</sup>) and Benefit: Cost ratio of wheat as affected by improved production technologies over local practices (2007-08 to 2010-11).

Year	Variety	Total cost of cultivation (Rs.ha <sup>-1</sup> )		Gross return (Rs.ha <sup>-1</sup> )		Net return (Rs.ha <sup>-1</sup> )		Benefit : Cost ratio		Add. Cost (Rs.ha <sup>-1</sup> )	Add. Net (Rs.ha <sup>-1</sup> )
		IP*	FP**	IP*	FP**	IP*	FP**	IP*	FP**		
2007-08	Raj-4037	32500	31900	42150	35350	9650	3450	1.30	1.11	600	6200
	Raj-3765	32500	31900	39050	34100	6550	2200	1.20	1.07	600	4350
2008-09	Raj-4037	32000	31800	41800	34000	9800	2200	1.31	1.07	200	7600
	Raj-4037	32000	31800	42000	33500	10000	1700	1.31	1.05	200	8300
2009-10	Raj-4037	33500	30000	59000	44500	25500	14500	1.76	1.48	3500	11000
2010-11	Raj-4037	22500	21200	44500	31000	22000	9800	1.98	1.46	1300	12200
	Raj-4037	24000	21000	45000	31200	21000	10200	1.88	1.49	1300	12200
	Total	209000	199600	313500	243650	104500	44050	10.73	8.73	9400	60450
	Average	29857.14	28514.29	44785.71	34807.14	14928.57	6292.86	1.53	1.25	1342.86	8675.71

\*IP- Improved Practice, \*\*- FP- Farmer Practice.

**Table 5.** Extent of farmers satisfaction of extension services rendered (n=487).

Satisfaction level	Number of respondents	Percent
Low	68	13.96
Medium	242	49.69
High	177	36.35

## Conclusion

It can be concluded that the yield gap between farmers practices and improved practices was perceptibly higher on the basis of the result obtained in present study; there is urgent need to make stronger extension services for educating the cultivators in the implementation of improved practices. However, the yield level under FLDs was better than the local varieties and performance of these varieties could be further improved by adopting recommended packages of practices. Hence, it can be also observed that increment in yield was because of adoption of high yielding varieties and Frontline demonstration of proven technologies. Yield potentials of crop can be increased to greater extent. This will subsequently increase the income as well as the livelihood of the farming community of the district. From the above research findings it can be also concluded that the maximum number of the respondents had medium level of knowledge and extent of adoption regarding recommended wheat production technology.

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