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Research Article

GAINING ECONOMIC BENEFITS FROM FRONT LINE DEMONSTRATIONS OF CEREAL CROPS IN JHALAWAR DISTRICT OF RAJASTHAN PROVINCE

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Abstract- Jhalawar is one high rainfall district falls under agro-climatic zone – V (South eastern Humid Plain zone) of Rajasthan. The average rainfall of the district is around about 950 to 1000 mm per year. Most of the area is irrigated. There are the two major cereal crops grown in the district i.e. *Maize (Zea mays)* during *kharif* and Wheat (*Triticum aestivum* L.*)* during *rabi* season. The Krishi Vigyan Kendra also known as Farm Science Centre of the district laid down Front Line Demonstrations on these cereal crops under Integrated Village Livelihood Development Project (IVLDP) and ICAR for introducing new varieties along with scientific practices in their cultivation. The productivity as well as the economic returns of cereals in improved technologies (FLDs) were calculated and compared with the corresponding farmer's practices (local checks). Both the cereal crops maize and wheat recorded average higher gross returns Rsha^{-1} 22833 and 41250, net return Rsha^{-1} 11400 and 9000 and benefit cost ratio 2.16 and 1.28, respectively in improved technologies (FLDs) as compared to the plots where farmers were using traditional practices in their cultivation.

Keywords- Cereal crops, Front line demonstrations, Technology and extension gaps, Technology index, Improved technologies

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Introduction

'Cereal' term is derived from latin word '*cerealis*' which means 'grain'. All the cereals are grass members of a monocot family Poaceae which is also known as Gramineae. They usually have long, thin stalks the examples are wheat, rice, maize, sorghum, millet, barley and rye, whose starchy grains are used as food. The cereal grains are sources for supplying high energy values, mainly from the starch fraction, but, also from the fat and protein portions. Cereal grain contains carbohydrates (mainly starches) 65 to 75% of their total weight as well as proteins 06 to 12% and fat 01 to 5% along with minutes of minerals and vitamins [15].

Krishi Vigyan Kendra (Farm Science Centre) is playing important role in enhancing the productivity of the cereals due to an innovative science–based institution the research scientists face to face with farmers. KVKs are grass root level agricultural institutions meant for application of technology through assessment, refinement and demonstration of proven technologies under different 'micro farming' situations in a district [5]. Front line demonstrations (FLDs) are one of the long term educational activities conducted in a systematic manner on farmers fields to worth of a new practice/technology. In India farmers are still producing crops based on their own knowledge transmitted to them by their forefathers which is unscientific agronomic, nutrient and pest management practices. Due to above, they couldn't achieve the desired potential yield of varieties of various crops. The Potential yield of a crop is influenced by the solar radiation, temperature, photoperiods, atmospheric concentration of carbon dioxide and genotype characteristics assuming water, nutrients, pests, and diseases are not limiting the crop growth. When the water supply for crop production is not under the control of the grower during rainy season, water-limiting yield may be considered as the maximum attainable yield for yield gap analysis assuming other factors are not limiting crop production. However, there may be season-to-season variability in potential yield caused by climatic variability, particularly rainfall. Water-limiting potential yield for a site could be determined by growing crops without any growth constraints, except water availability [16]. The baseline survey of the FLDs' villages was conducted by Krishi Vigyan Kendra, Jhalawar during 2007-08 to 2008-09 under Integrated Village Livelihood Development Project (IVLDP) for the rural people. The aim of the IVLDP project was to develop the livelihood security for the farmers at the village level for sustainability. Bouquets of improved technologies were tested in Khanpur and Asnawar cluster consisting of 10 villages and involving 213 households. It was observed by the baseline survey that the farmers were using seeds of the old varieties of cereal crops with improper use of chemical fertilizers, herbicides and pesticides. Keeping in view the above constraints, the Krishi Vigyan Kendra Jhalawar conducted front line demonstrations (FLDs) on major cereal crops (Maize and wheat) of the district which would ensure livelihood, nutritional security as well as economic empowerment of the farmers.

Materials and Methods

Geographically, District Jhalawar situated at 23^0 40' to 24^0 52' N - Latitude and 75^0 29' to 76^0 56' E-Longitude and an altitude of 312 m above mean sea level belonging to south eastern humid plain of Rajasthan. There are Baran and Kota districts in the Eastern and Northern borders, respectively. It adjoins the State of Madhya Pradesh in south, west and some eastern part. Jhalawar district is covering an area of 6.32 lac ha. Most of the parts of the district are covered by hills and platue of Malva. Agriculture is the main source of the livelihood in the Jhalawar district of Rajasthan with a gross cropped area of 4.63 Lac hectares. The district has a humid climate with average temperature of the district varies from 21.8-46⁰ C in summer and 04-26⁰C in winter and annual rainfall is about 952 mm. There are two major cereal crops being cultivated in Jhalawar, which includes maize during *Kharif* season (summer) and wheat during *Rabi* season (winter). The area, production and productivity of major crops cultivated in the district in 2012-13 depicted in the [Table-1][3].

Table-1 *Area, Production and Productivity of kharif and rabi seasons' crops cultivated in the district Jhalawar (2012-13).*

Crops	Area (ha)	Production (Tones)	Productivity (Kgha^{-1})
Kharif season			
Soybean	271071	381933	1409
Maize	28597	61913	2165
Urdbean	11092	8389	756
Paddy	1617	2864	1771
Sesame	1463	794	843
Jowar	1341	1862	1389
Groundnut	1167	1906	1633
Rabi season			
Wheat	86055	279018	3242
Rapeseed & Mustard	79561	118126	1485
Coriander	72186	68872	926
Chickpea	16993	18857	1110
Lentil	6838	7081	1036
Fenugreek	5013	7098	1180

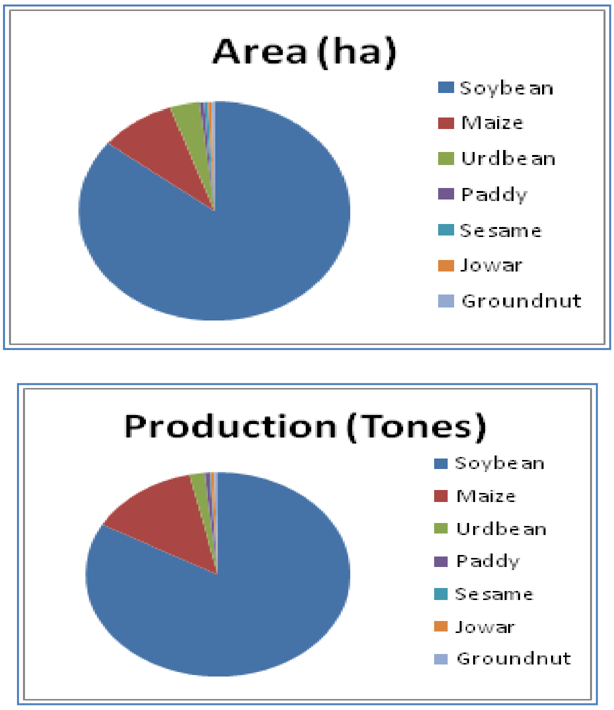
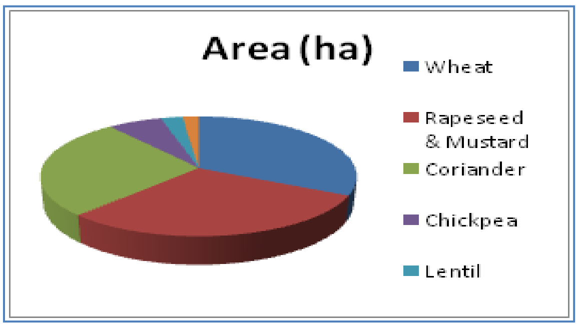


Fig-1 Area and Production of major *kharif* crops cultivated in Jhalawar district. (2012-13).



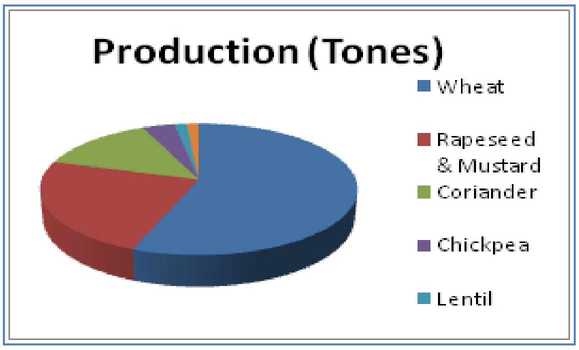


Fig-2 Area and Production of major *rabi* crops cultivated in Jhalawar district. (2012-13).

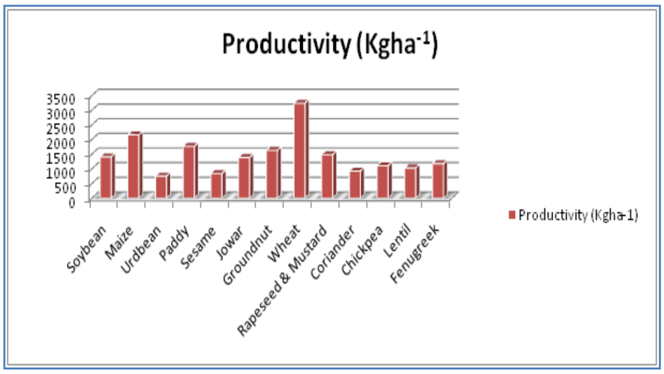


Fig-3 Productivity of major *kharif* and *rabi* crops cultivated in Jhalawar district. (2012-13).

This study was carried out in the adopted villages located in the operational area of Krishi Vigyan Kendra, Jhalawar with the objective, to identify the yield gaps as well as to work out the difference in input cost and monetary returns under front line demonstrations (improved cultivation) FLDs and farmers' practices (local checks). Soil of the study area is black cotton. The critical inputs were applied as per the scientific package of practices recommended by the Zonal Director Research, Agriculture Research Station, Ummedgamj, Kota and published by the Joint Director Agriculture Extension, Kota, Zone-Kota. [1, 2].

In [Table-2] the details of technology demonstrated by Krishi Vigyan Kendra, Jhalawar are mentioned. In each front line demonstration, the improved variety suitable to local condition was selected and the recommended package of practices was adopted.

Some of the major differences observed between the improved technologies adopted in front line demonstrations and farmers practices (local checks) adopted by farmers in different crops are summarized as below.

Maize: The technologies followed under improved technologies included improved varieties (PEHM-2 and Super-9681), integrated nutrient management (90:40 N P kg ha^{-1}) and integrated pest management (deep ploughing, Methyl Parathion 2% dust @ 25 kg ha^{-1} & Carbofuran 3G @ 7.5 kg ha^{-1}) were tested under demonstrations [Table-2]. Deep ploughing was done during the month of March 2007. Crop was sown by using seed @ 20 kg ha^{-1} with crop geometry 60x25 cm after receiving sufficient rainfall. The whole dose of phosphorus in the form of Di Ammonium Phosphorus (DAP) were applied as basal dose and nitrogen in the form of urea was top dressed in three equal splits at sowing, 25 DAS and at tasseling. The seeds were treated with thirum @ 3 gkg^{-1} seed and then inoculated with *Azotobector* + PSB @ 600 g ha^{-1}. Atrazin a. i. @ 0.5 kg ha^{-1}was applied pre emergence of maize for weed management. The Methyl Parathion 2% dust @ 25 kg ha^{-1} was top dressed at the time of incidence of grasshopper (*Hieroglyphus nigroripletus*) and carbofuran 3% G @ 7.5 kg ha^{-1} was applied in the shoots for the control of maize stem borer (*Chilo partillus*).

Wheat: In case of wheat [Table-2], farmers were using local or mixed seed retained by them over the years during *rabi* season. The farmers were using broadcast method of sowing without seed treatment and herbicides. Improved varieties (Raj 3077 and Raj 4037), Nutrient Management (120:40:30:05 N P K S kg ha^{-1}+ *Azotobector* + PSB @600 g ha^{-1}) and Weed Management (2, 4-D @ 500g/ha (Ester) and Isoproturon @ 1.25 Kg/ha *a.i.* after 1st irrigation for *phalaris minor*) were incorporated in FLDs (improved technologies). Wheat was sown from 1st week to 3rd week of November using seed @ 100 kg ha^{-1}. Whole of the Phosphorus along with Potash were applied in the form of DAP and MOP as basal dose and Nitrogen in the form of Urea was top dressed in two equal splits at CRI (1st irrigation) and 50-60 DAS (days after sowing). The seed was treated with Carbendazim @ 1 g/kg seed and then the seed was inoculated with *Azotobector* + PSB @600 g ha^{-1}. 2-4, D easter salt *a.i.* @ 500 g ha^{-1} and Isoproturon @ 1.25 Kg/ha *a.i.* after 1st irrigation for *phalaris minor* was applied 30-35 days after sowing the crop for the control of weeds. For the effective Pest Management Chloropyriphos 20 EC @ 4.0 liter/ha in standing crop and for Frost Management Spray of 0.1 % sulphuric acid before possibility of frost were applied.

Table-2 *Particulars showing the details of cereal crops grown under Front Line Demonstrations and farmers practices.*

Particulars	Farmers Practice (Local Check)	Improved Practice (Front Line Demonstration)
A. Maize		
Variety	Mixed/local	PEHM-2 and Super-9681
Seed rate	30kgha^{-1}	20kgha^{-1}
Seed treatment	No seed treatment	Seed treatment with Thirum @ 3 gkg^{-1} seed+ *Azotobector* + PSB @ 600 g ha^{-1}
Sowing	Line sowing (30 x 15) cm	Line sowing crop geometry (60 x 25) cm
Weed Management	no use of herbicide, hoeing if weather permit	Atrazin a. i. @ 0.5 kg ha^{-1} at pre emergence
Nutrient Management	60:30 (N:P)	90:30 (N:P)
Pest Management	No use of plant protection measures	Methyl Parathion 2%dust @ 25 kg ha^{-1} & Carbofuran 3G @7.5 kg ha^{-1}
B. Wheat		
Variety	Lok-1	Raj-3765 and Raj – 4037
Seed rate	150 and more	100 Kg /ha
Seed treatment	No seed treatment	Carbendazim @ 1 g/kg seed + *Azotobector* + PSB @ 600 g ha^{-1}
Sowing type and time	Broad casting and 1st week of November to 3rd week of December	Line sowing and 1st to 4th week of November
Weed Management	No use of herbicides	2,4-D @ 500g/ha (Ester) at 30-35 DAS for BLW, Isoproturon @ 1.25 Kg/ha *a.i.* after 1st irrigation for *phalaris minor*
Nutrient Management	Imbalance use N:P:K:S (150:60:0:0)	N:P:K:S (120:40:30:05)
Irrigation Management	3-6 irrigations (As per availability of water without critical stages)	Four Irrigation (Due to heavy soils)- 1st (CRI-20-25 DAS), 2nd (Later stage of tillering-50-60 DAS), 3rd (Ear Formation-75-80 DAS) and 4th (Milking stage-95-100 DAS).
Pest Management	No use	Chloropyriphos 20 EC @ 4.0 liter/ha in standing crop
Frost Management	No use	Spray of 0.1 % sulphuric acid before possibility of frost

The data on yield, cost and monetary returns was collected for consecutive two years (2007-08 and 2008-09) from Front Line Demonstration plots as well as farmers practice to work out the economic feasibility of improved and scientific cultivation of cereals after successfully conduction. The technology gap, extension gaps and technology index were calculated by the formulae as given [14]:

Extension gap (qha^{-1}) = DY (qha^{-1}) – LY (qha^{-1}).
Technology gap (qha^{-1}) = PY (qha^{-1}) – DY (qha^{-1}).
Technology index (%) = [PY (qha^{-1}) – (DY (qha^{-1}) / PY (qha^{-1})] x 100

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

Results and Discussions

The data in the [Table–3] and [Fig-4] depicted that front line demonstration (FLD) of improved technologies increased productivity over respective local checks during the both year of study. If we see the results during *kharif* season the improved technologies recorded 28.42 qha^{-1} average higher, productivity of maize compared to farmers practices (local checks) 16.50 qha^{-1}. This increase in percent was 46.81 under average productivity of maize over local checks. The higher productivity of maize under improved technologies was due to the sowing of latest high yielding crop varieties and adoption of improved Nutrient and Pest Management techniques. The findings were similar to results reported earlier [4, 6, 7 and 9]. The year wise fluctuation in yields was observed mainly on the account of variations in soil fertility status and moisture availability due to untimely and erratic monsoon [Table-3] and [Fig-4]. Maize also recorded higher productivity in the year 2008, which might be due to rainfall received on the critical stages of crop growth.

Similarly, if we see the data of the *rabi* season mentioned in the [Table-3] and [Fig-4] shows that Wheat crop recorded average higher productivity of 40.75 qha^{-1} in improved technologies compared to local check (31.69 qha^{-1}). The average percent increase in the productivity of wheat over local check was 13.23. The yield increment in wheat might be due to the overall effect of high yielding, moderate disease resistant varieties & adoption of improved Weed and Nutritional Management. The similar yield enhancement in different crops under front line demonstration has amply been documented [4, 7, 10, 11 and 17].

It is also pointed out from the data of [Table-3] and [Fig-4] that Yield of the front line demonstration trials and potential yield of the crop was compared for estimating the yield gaps which were further categorized into technology and extension gaps [8]. The highest technology gap in the demonstration yield over potential yield was 11.00 qha^{-1} in wheat as compare to maize (07.39 qha^{-1}). This technology gap was mainly attributed to rain fed conditions prevailing in the district during *kharif*. The other reasons include dissimilarity in soil fertility status and marginal land holdings. Further the higher extension gap of 07.78 qha^{-1} was recorded in maize followed wheat (04.19 qha^{-1}). This gap indicates that the need of the emphasizing on to educate the farming community through various extension activities for creation awareness programmes about the adoption of scientific practices in cultivation of the cereal crops. It was also opined that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity [13]. The data presented in [Table-4] also revealed that, the technology index was lower for maize (16.21%) compared to wheat (23.44%). Technology index shows the feasibility of evolved technology at the farmer's field and lower the value of technology index more is the feasibility of the technology. These results are conformed [9].

Economic impact of Front Line Demonstrations

For calculating cost of cultivation, net return and benefit cost ratio of crops, the inputs and outputs prices of commodities prevailed during both year of demonstrations were taken [Table-4] and [Fig-5]. On the basis of economic analysis of the data over two years it is revealed that maize under front line demonstrations recorded higher gross return (Rs. 22833 ha^{-1}) net return (Rs. 11400 ha^{-1}) and B:C. ratio (2.16) as compared to the local checks where farmers gross return, net returns and B:C ratio of Rs. 16091 ha^{-1}, Rs. 6800 ha^{-1} and 1.90, respectively.

Table-3 *Yield of Cereals as influenced by improved production technologies and high yielding varieties over local practices in farmer's fields (2007-08 to 2008-2009).*

Year	Crop & Variety	Area (ha)	Demo. Nos.	Yield (qha-1)				Percent Increase over local check	Extension gap (qha-1)	Technology gap (qha-1)	Technology Index (%)
				Improved Practice (FLD)			Farmers' practice (Local Check)				
				Max.	Min.	Avg.					
A) Kharif	Maize										
2007	PEHM-2	05.00	21	17.00	11.84	13.33	09.50	40.32	03.83	16.67	37.04
2007	PEHM-2	05.00	12	33.00	22.00	26.00	21.00	23.81	05.00	04.00	08.42
2008	Super-9681	03.50	08	35.25	31.25	33.50	19.00	76.32	14.50	01.50	03.16
	Total	13.50	41	85.25	65.09	72.83	49.50	140.44	23.33	22.17	48.62
	Average	04.50	13.67	28.42	21.70	24.28	16.50	46.81	07.78	07.39	16.21
B) Rabi	Wheat										
2007-08	Raj-4037	05.00	09	41.25	27.5	36.5	31.75	14.96	04.75	11.00	23.16
	Raj-3765	80.00	200	40.75	28	35.5	31.00	14.52	04.50	09.50	21.11
2008-09	Raj-4037	24.00	60.00	40.00	34.00	34.50	32.00	07.81	02.50	13.00	27.37
	Raj-4037	24.00	60.00	41.00	33.50	37.00	32.00	15.63	05.00	10.50	22.11
	Total	133.00	329	163.00	123.00	143.50	126.75	52.91	16.75	44.00	93.74
	Average	33.25	82.25	40.75	30.75	35.88	31.69	13.23	4.19	11.00	23.44

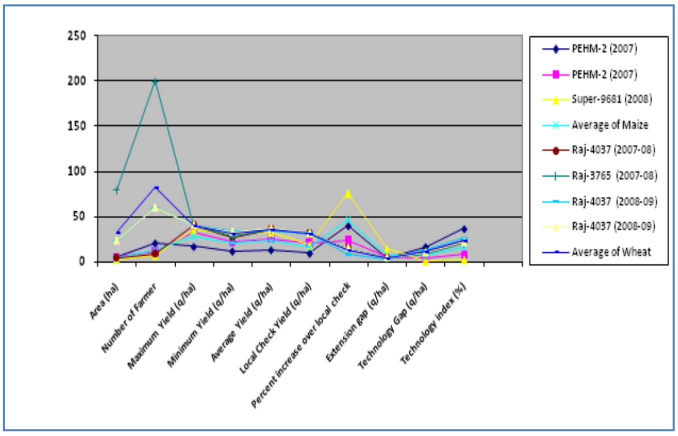


Fig-4 Yield of Cereals as influenced by improved production technologies and high yielding varieties over local practices in farmer's fields

The crop wheat also recorded higher gross returns of Rs. 41250 ha^{-1}, net return of Rs. 9000 ha^{-1} and B:C ratio of 1.28 in improved technologies as compared to the local check where farmers got gross returns, net returns and B:C ratio of Rs. 34237 ha^{-1}, Rs. 2387 ha^{-1} & 1.07, respectively. These are in corroboration with the finding [12, 18].

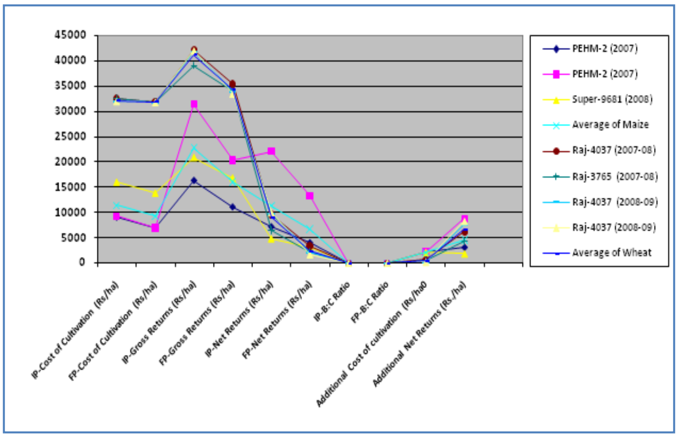


Fig -5 Cost of cultivation (Rs.ha-1), net returns (Rs.ha-1) and Benefit : Cost ratio of Wheat as affected by improved production technologies over local practices

Table-4 *Economic attributes of cereals as influenced by improved production technologies and high yielding varieties over local practices in farmer's fields (2007-08 to 2008-2009).*

Year	Crop & Variety	Total cost of cultivation (Rs.ha-1)		Gross return (Rs.ha-1)		Net return (Rs.ha-1)		Benefit : Cost ratio		Add. Cost (Rs.ha-1)	Add. Net (Rs.ha-1)
		IP*	FP**	IP*	FP**	IP*	FP**	IP*	FP**		
A) Kharif	Maize										
2007	PEHM-2	9125	7050	16350	11125	7225	4075	1.79	1.58	2075	3150
2007	PEHM-2	9225	7025	31350	20350	22125	13325	3.40	2.90	2200	8800
2008	Super-9681	15950	13800	20800	16800	4850	3000	1.30	1.22	2150	1850
	Total	34300.00	27875.00	68500.00	48275.00	34200.00	20400.00	6.49	5.69	6425.00	13800.00
	Average	11433.33	9291.67	22833.33	16091.67	11400.00	6800.00	2.16	1.90	2141.67	4600.00
B) Rabi	Wheat										
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
	Total	129000.00	127400.00	165000.00	136950.00	36000.00	9550.00	5.12	4.30	1600.00	26450.00
	Average	32250.00	31850.00	41250.00	34237.50	9000.00	2387.50	1.28	1.07	400.00	6612.50

* Improved Practice, ** Farmer Practice

Conclusion

It may be concluded on the basis of above findings that the inclusion of improved technologies along with improved varieties, weed management, nutrients and pest management for cultivation of cereal crops has been found more productive & economic. The grain yield in both cereals maize and wheat was increased up to 46.81 and 13.23 per cent, respectively over local checks. The existing gap in technology and extension can be bridged by giving more attention on the making popularizing package of practices of cereals. So, keeping in the view of above results it is concluded that there may be increase in the number of FLDs for effective and rapid transmission of technology among farming community.

Conflict of Interest: None declared

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