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Impact of Technological Demonstrations on Yield of Rabi Pulses and Farmer's Adoption Behavior in Vindhyan Plateau of Madhya Pradesh

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A B S T R A C T

The important extension techniques to persuade the farmers about latest farm technologies are frontline demonstrations (FLDs). The present study was conducted continuously during three years from rabi 2015-16 to 2017-18 to assess the impact of 410 frontline demonstrations conducted on chickpea and lentil in 164 ha area across thirteen villages of Sagar district of Madhya Pradesh falls under Vindhyan Plateau Agro Climatic Zone. The results of demonstrations showed that farmers could increase the chickpea and lentil productivity remarkably by switching over to improved variety and adoption of improved production technology. It was observed from the FLDs that the improved chickpea variety JG 63 recorded the higher seed yield (1537 kg ha^{-1}) compared to the farmers' practices variety (992 kg ha^{-1}). The increase in the demonstration yield over farmer's practices was 55.27 percent. In case of lentil technology demonstrations, the average seed yield was recorded to be 1218 kg ha^{-1} using JL 3, PL 8 and IPL 316 varieties over farmer's practice (737 kg ha^{-1}) with the average increase of 64.45 percent. The overall impact of frontline demonstrations on adoption of chickpea and lentil production technology was 461 and 334 percent respectively. It was noticed from the front line demonstrations conducted on chickpea and lentil that the average technology gap values were 663 and 282 kg ha^{-1} respectively. The technology index was recorded to be 30.12 and 18.82 percent respectively in chickpea and lentil which reflect the superior performance of demonstrations.

Introduction

In India pulses are an integral part of the average human meal. A large proportion of the Indian population is vegetarian, and pulses form the main and affordable source of protein and minerals which play a key role in alleviating the protein calorie malnutrition, micronutrients deficiencies and other undernourishment related issues. These characteristics make pulses one of the cheapest sources of protein for human consumption. Protein malnutrition is prevalent among men, women and children in the country. Pulses contribute 11% of the total intake of proteins in India (Reddy, 2010).

Additionally, pulses are a vital source of livelihood generation for millions of resource. Based on a study, Singh *et al.,* (2018) reported that cultivation of pulses requires ten times less water than producing the same quantity of animal meat, moreover pulses not only fix atmospheric nitrogen to the extent of 70-210 kg ha^{-1} but also lower carbon footprint because of low carbon emission and higher carbon sequestration.

Mostly the agriculture is being practiced by the poor farmers in semi-arid and sub-tropical regions of the country. Pigeonpea, chickpea, greengram, blackgram and lentil are the major pulse crops grown in large areas. Shortfall of pulses production potential has been attributed to a number of factors, the major ones being the increasing population, inadequate transfer of appropriate technology, seed longevity, poor seed quality, geographical shift, abrupt climatic changes, complex diseases, pest and socioeconomic conditions (Ali and Gupta, 2012). India accounts for 33% of the world area and 22% of the world production of pulses. About 90% of the global pigeon pea, 65% of chickpea and 37% of lentil area falls in India, corresponding to 93%, 68% and 32% of the global production, respectively (FAO STAT, 2012). In India pulses were grown in 23.5 m ha area with production of 172 million tonne in the year 2015-16 and productivity was 728 kg ha^{-1} (Annual Report of Pulses, 2015-16). According to agriculture statistics 2014-15, chickpea, pigeonpea, greengram, blackgram and lentil was grown in 8.25, 3.55, 3.02, 3.24 and 1.47 million ha with the production of 7.33, 2.78, 1.5, 1.96 and 1.03 million tonne respectively in the country.

As a result of stagnant pulse production and continuous increase in population, the per capita availability of pulses has decreased considerably. The major constraints in pulse production are inadequate supply of quality seeds, low SRR, insufficient use of inputs, cultivation mostly under rainfed conditions as more than 87% of the area under pulses is presently rainfed which reported by Singh *et al.,* (2018), biotic and abiotic stress, technology gap, lack of attractive market price, lack of proper procurement and poor storage facilities of the farm produce. Drought stress alone may reduce seed yields by 50% in the tropics as reported by Saxena *et al.,* (2000). Keeping in view the shortfall in pulses production potential due to various factors listed above, Krishi Vigyan Kendra, Sagar (MP) conducted technology demonstrations on *rabi* pulses i.e. chickpea and lentil to enhance the production potentials and minimize the yield gap in the region.

Materials and Methods

The various technology components to be demonstrated for chickpea and lentil were identified based on group discussion. A cluster of similar farmers was identified based on their response and feedback received during the survey and group discussion. The technology demonstrations were conducted in Rehli, Jaisinagar, and Rahatgarh blocks of Sagar district during 2015-16 to 2017-18. A total of 410 farmers from 13 villages namely Channua, Parasia (Rehli block), Peepra, Kishanpura, Manak Chowk, Harbanshpura, Dhagrania, Maneshiya, Norza, Khajuria (Rahatgarh block), Hansrai, Masurhai and Semra Gopalman (Jaisinagar block). The farmer's practices were considered as control plot in all demonstrations. All inputs based on identified technology components *viz* seed, seed treatment materials i.e. fungicide (carboxin + thiram), biofertilizers - phosphate solubilizing bacteria (PSB) and Rhizobium, *Trichoderma viridae* for soil application @ 2.5 kg ha^{-1} and need based insecticides were provided to the beneficiaries. Soil test based fertilizer nutrients for NPKS @ 20:60:20:20 kg ha^{-1} in chickpea and NPKS @ 20:50:20:20

kg ha^{-1} in lentil was applied. The demonstration plots were supervised by the KVK scientists during the crop period. The data of the demonstrations was collected and used to assess the impact on yield, adoption and varietal replacement. The data regarding adoption was collected from the farmers with the help of interview schedule. The demonstrations were undertaken in cluster approach in the selected villages with the objective to demonstrate the better production potentials and benefits of the latest improved technologies; to enhance the productivity of pulses in the region and to make farmers self sufficient in production of quality seed. Data were subjected to suitable statistical methods suggested by Samui *et al.*, (2000) which is given below:

Technology gap = potential yield – demonstration yield

Extension gap = demonstration yield – farmer’s practices yield

Technology index (%) = potential yield – demo yield / potential yield x100

While impact on yield and impact on adoption was calculated by following formula-

Impact on yield (%) = yield of demo plot – yield of check plot / yield of check plot x 100

Impact on adoption (%) = number of adopters after demo – number of adopters before demo/ number of adopters before Demo x 100

Results and Discussion

Impact of frontline demonstrations on yield

The findings related to impact of FLDs on yield are presented in table 1 and 2. It is evident from table 1 that there was remarkable increase in yield of chickpea which was noted to be 43.34, 69.28 and 53.19 percent in the year 2015-16, 2016-17 and 2017-18 respectively with the mean value of 55.27 percent. The seed yield of chickpea in demonstrated plot was 1250 (2015-16), 1444 (2016-17) and 1918 kg ha^{-1} (2017-18) with the pooled yield of 1537 kg ha^{-1} over farmer's practice (992 kg ha^{-1}). This showed the significant increase in yield of chickpea over control. Yield enhancement in the different crops in frontline demonstration was reported by Tiwari *et al.*, (2003), Tomar *et al.*, (2003), Mishra *et al.*, (2009) and Naberia *et al.*, (2015). The trend was similar in case of lentil technological demonstrations (Table 2), revealed that the yield of demonstration plots of lentil was 948 (2015-16), 1401 (2016-17) and 1304 kg ha^{-1} (2017-18) with the average yield of 1218 kg ha^{-1} in comparison to farmer's practice (737 kg ha^{-1}). There was considerable increase in yield of lentil which recorded to be 39, 87.6 66.78 percent for the year 2015-16, 2016-17 and 2017-18 respectively with the average increase of 64.45 percent. This show the positive impact of frontline demonstrations conducted on lentil in the region. The yield level of check plot was threatened due to low yielding local / old variety degenerated seeds, imbalanced fertilizer application and improper plant populations. However, in case of demonstration plots, the factors led to enhance the yield of demonstrated crops were, use of recommended wilt resistant high yielding variety, balanced dose of fertilizer nutrients and soil application of *Trichoderma viridae* @ 2.5 kg ha^{-1} for management of soil born diseases especially wilt and dry root rot.

Impact on adoption

Impact of FLDs on adoption of chickpea and lentil production technology by the farmers is presented in Table 3 and 4 respectively. It was found that adoption of high yielding wilt resistant variety of chickpea by the farmers was less before demonstration which was increased by 829 percent after conducting demonstrations due to availability of the quality seed of the demonstrated variety. Seed treatment with carboxin+thiram, PSB and

Rhizobium was increased by 1589 percent due to technology interventions undertaken in the FLDs. Adopters in seed rate, fertilizer management and irrigation management were significantly increased by 1076 percent. Under lentil production technology the overall adoption level of various technology components was increased by 334 percent and 107 adopters were increased after conducting the technology demonstrations. Similar results were also reported by Chapke (2012) and Mahesh *et al.*, (2016) (Table 5).

Table.1 Impact of frontline demonstration on yield of chickpea

Year	Variety	No. of Farmers	Area (ha)	Average yield (kg ha^{-1})		Impact (% change in yield)
				FP	RP	
2015-16	JG 63	75	30	872	1250	43.34
2016-17	JG 63	75	30	853	1444	69.28
2017-18	JG 63	75	30	1252	1918	53.19
Total		225	90	992	1537	55.27

Table.2 Impact of frontline demonstration on yield of lentil

Year	Variety	No. of Farmers	Area (ha)	Average yield (kg ha^{-1})		Impact (% change in yield)
				FP	RP	
2015-16	JL 3	60	24	682	948	39.0
2016-17	PL 8	75	30	747	1401	87.81
2017-18	IPL 316	50	20	782	1304	66.75
Total		185	74	737	1218	64.45

Table.3 Impact of frontline demonstrations on adoption of chickpea production technology

Technology	No. of adopter (225)		Change in No. of adopter	Impact (% change)
	Before Demonstration	After Demonstration		
Application of FYM	47	156	109	232
Recommended variety	21	195	174	829
Seed rate (75 kg)	18	179	161	894
Seed treatment (Fungicide, PSB, Rhizobium)	9	152	143	1589
Fertilizer management	7	161	154	2200
Irrigation management	86	201	115	134
Overall impact	31	174	143	461

Table.4 Impact of frontline demonstrations on adoption of lentil production technology

Technology	No. of adopter (185)		Change in No. of adopter	Impact (% change)
	Before Demonstration	After Demonstration		
Application of FYM	31	116	85	275
Recommended variety	17	153	136	802
Seed rate (40 kg)	19	142	123	649
Seed treatment (Fungicide, PSB, Rhizobium)	14	132	118	846
Fertilizer management	11	126	115	1042
Irrigation management	101	162	61	60
Overall impact	32	139	107	334

Table.5 Impact of frontline demonstrations on varietal replacement in cluster villages

Crop	Previously grown variety	New varieties introduced
Chickpea	Ujjain 21, JG 315, JG 322	JG 63
Lentil	Local unidentified mixed seed	JL 3, PL 8, IPL 316

Table.6 Seed yield, extension gap, technology gap and technology index of cluster frontline demonstrations on chickpea and lentil (pooled analysis of three year data from 2015-16 to 2017-18)

Crop	No. of FLDs	Potential yield (kg ha^{-1})	Average Demo Yield (kg ha^{-1})	Average FP yield (kg ha^{-1})	Extension gap (kg ha^{-1})	Technology gap (kg ha^{-1})	Technology index (%)
Chickpea	225	2200	1537	992	545	663	30.12
Lentil	185	1500	1218	737	481	282	18.82

Impact of FLDs on varietal replacement in adopted villages

The FLDs include a technology package for making change in existing farmer's practices. It was found that the local / old or unidentified variety degenerated seeds of lentil were replaced by JL 3, PL 8 and IPL 316 in FLD clusters. While in chickpea, old varieties such as Ujjain 21, JG 315 and JG 322 were replaced by JG 63 a high yielding wilt resistant variety. Replacement of local/ old or unidentified varieties with new varieties of maize, paddy and wheat due to laying out the FLDs was reported by Balai *et al.,* (2013). The data given in table 6 indicated that the technology index shows the feasibility of the evolved technology at farmer's field. Higher technology index reflected the insufficient extension services for transfer of technology. The lower value of technology index shows the efficacy and excellent performance of technological interventions. The average technology index in chickpea was observed to be 30.12 percent and in lentil it was 18.82 percent. Similar results were also reported by Singh *et al.*, (2012), Diwivedi *et al.,* (2014) and Tomar *et al.,* (2003).

On the basis of the above findings it may be concluded that the frontline demonstrations enhanced the yield of crops vertically and ensured rapid spread of technologies horizontally. The technological demonstrations made positive and significant impact on enhancement of chickpea seed yield by 55.27 percent and lentil by 64.45 percent. It was found that the demonstrations are proven extension interventions to demonstrate the production potential of various crops on farmer's field. This may help to raise the pulses productivity at regional as well as state and national level.

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