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IMPACT OF FRONT-LINE DEMONSTRATIONS ON YIELD AND ECONOMICS OF CHICKPEA IN DAUSA DISTRICT OF RAJASTHAN, INDIA

Akshay Chittora[1*], Sunita Kumari[2], B.L. Jat[3], J.K. Gupta[4] and R.L. Meena[5]

[1]Subject Matter Specialist (Horticulture), Krishi Vigyan Kendra, Dausa, SKN Agriculture University, Jobner (Rajasthan), India

[2]Subject Matter Specialist (Extension Eucation), Krishi Vigyan Kendra, Dausa, SKN Agriculture University, Jobner (Rajasthan), India

[3]Senior Scientist and Head, Krishi Vigyan Kendra, Dausa, SKN Agriculture University, Jobner (Rajasthan), India

[4]Assistant Professor (Entomology), College of Agriculture, Lalsot, SKN Agriculture University, Jobner (Rajasthan)

[5]Assistant Professor (Plant Pathology), College of Agriculture, Jhilai, SKN Agriculture University, Jobner (Rajasthan)

*Corresponding author E-mail: akshaychittora@gmail.com

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ABSTRACT

The study was undertaken to investigate the impact of front line demonstrations on chickpea. Krishi Vigyan Kendra, Dausa, (Rajasthan) conducted 305 frontline demonstrations on chickpea variety GNG-1958, GNG-2144 and CSJ-515 in an area of 146.3 hectares during Rabi season of 2017-18, 2018-19 ,2019-20, 2020-21, 2021-22, 2022-23, 2023-24 and 2024-25 having the similar number of traditional practices or local check in different blocks in Dausa district of Rajasthan. The yield attribute of frontline demonstration trials and potential yield of the respective variety and year were compared to estimate the yield gap which were further categorized into technology and extension gap. Technology gap (890 kg/ha) was the highest in case of CSJ-515 in 2017-2018 and lowest (446 kg/ha) in case of GNG 2144 in the year 2024-25. Technology index was found highest of 37.08 per cent in case of CSJ-515 in the year 2017-18 and lowest 17.15 per cent in case of GNG 2144 in 2023-24. The average technology index was found 25.37 per cent. The results of the demonstrations observed that on an average seed yield of chickpea under improved technology ranged from 15.10 to 21.54 q/ha with a mean of 18.67 q/ha which was 14.57 per cent more yield as compared to local check. Moreover, the seed yield was also recorded substantially higher under demonstration (20.83 q/ha) over district average (15.45 q/ha) and state average (9.34 q/ha). Further, findings of the study revealed that from per hectare average additional yield 2.38 q/ha, net monetary return Rs. 53956/ha, additional returns Rs. 12491/ha, effective gain Rs. 12246/ha and benefit: cost ratio 2.26 were obtained under improved technology as compared to farmers' practice. The study revealed that overall percent increase in net returns was 33.58 percent, which shows the front line demonstrations in respect of percent increase of yield and B: C ratio is sufficient for increasing production of chickpea and increasing living standard of farmer's community.

Keywords **:** Impact, frontline demonstrations, chickpea, economics, technology index, B: C ratio

Introduction

Pulses are the climate resilient crops as they promote sustainable agriculture, fix atmospheric nitrogen, improve soil fertility and use lesser water compared to other crops. Pulses occupy a prominent place in human nutrition particularly among the lower income groups of people in developing countries like India. India is the largest producer and consumer of pulses with maximum area coverage in the world.

Chickpea (*Cicer arietinum* L.) is one of the oldest pulse crops that have been grown for over 8,000 years (Dhuppar *et al.*, 2012). It is one of the most important *rabi* pulse crops cultivated predominantly in northern India. It is the cheapest source of protein (18-22 %), carbohydrates (52-70 %), fat (4-10 %) and minerals. In Rajasthan it is grown in 718751 lakh hectare area having production of 1808707 metric tonnes. Chickpea is the major pulse crop grown in *rabi* season in Dausa district of Rajasthan. During 2024-25 chickpea was grown in 24168 hectare area with total production of 38631 metric tons having productivity of 1598 kg/ha (Anonymous, 2024).

Front-line demonstrations (FLD) are the field demonstrations conducted under the close supervision of scientists of the National Agriculture Research System (NARS). The main objective of front-line demonstrations is to demonstrate newly released crop production and protection technologies and their management practices at the farmers' field under different agro-climatic regions and farming situations. While demonstrating the technologies in the farmers' field, the scientists are required to study the factors contributing higher crop production, field constraints of production and thereby generate production data and feedback information.

Materials and Methods

The present study was conducted at farmers' fields of Dausa district of Rajasthan during *rabi* season from 2017-18 to 2024-25. A total of 305 demonstrations in 146.3 hectares area having similar number of traditional practices or local check were carried out in sandy loam or loamy soil under irrigated conditions. The chickpea crop was sown in last week of October to first week of November and harvested in second fortnight of March across the years. The variety CSJ 515 was used in demonstrations in Ralawas and Dholawas village during 2017-18, Shriramchandrapura village during 2020-21 and Chhareda and Bhanwta village in 2021-22 while variety GNG-1958 was demonstrated in Rambas village during 2018-19 and Barh Dabar Kalan village during 2020-21. Chickpea variety GNG 2144 was used for front line demonstrations in Dehlawas, Khanwas and Manpuria villages in 2019-20, Sultanpura village in 2023-24 and Hamawas village during 2024-25. The area falls under agroclimatic zone IIIa namely "Semi-Arid Eastern Plains" of Rajasthan. After preliminary survey and interactive meetings, farmers were trained to follow the package and practices for chickpea cultivation as recommended for the zone.

In front line demonstrations of chickpea special emphasis was given to proper seed rate (60-80 kg/ha), balanced use of fertilizers (40 kg/ha N and 20 kg/ha P_2O_5), seed treatment with pesticides (carbendazim 50 WP @ 1g/kg + fipronil 5 SC @ 10 ml/kg) and proper need based plant protection measures. In traditional or local check plots farmers were using local seed for sowing, higher seed rate, imbalance dose of fertilizers, improper seed treatment and plant protection measures. The basic information was recorded from the demonstration and control plots and analyzed for comparative performance of the front line demonstrations (FLDs) and farmer's practice. The yield data were collected both from the demonstrations and farmers' practice by random crop cutting method and analyzed by using simple statistical tools. These were further used for calculation of cost of cultivation, gross returns, net returns, additional cost, additional returns and benefit:cost ratio. The cost of cultivation included all the expenditures right from land preparation to harvest. Gross return was calculated by multiplying of produce to prevailing market price. The benefit cost (B: C) ratio was calculated dividing the gross monetary return by the total cost of cultivation. Technology gap, extension gap and technology index were being worked out suggested by Raj *et al*. (2013) as per formula given below:

$$\%\ \text{Increase in Yield} = \frac{\text{Yield of Demonstration} - \text{Yield of farmer practice}}{\text{Yield of farmer practice}} \times 100$$

Technology gap = Potential yield (kg/ha) –Yield of demonstration (kg/ha.)

Extension gap = Yield of Demonstration Yield (kg/ha) –Yield under farmer practice/ traditional practices (kg/ha.)

$$\text{Technology Index} = \frac{\text{Pi} - \text{Di}}{\text{Pi}} \times 100$$

Where, Pi = Potential yield of the crop

Di =Demonstration yield of the crop

Additional cost (Rs. /ha.) = Cost of cultivation of demonstration (Rs./ha.) – cost of cultivation of farmer practice (Rs./ha.)

Additional return (Rs. /ha.) = Gross return of demonstration (Rs./ha.) – Gross return of farmer practice (Rs./ha.)

Effective gain (Rs. /ha) = Additional return (Rs./ha.) – Additional cost (Rs./ha.)

B:C Ratio = Gross return/ cost of cultivation

Results and Discussion

Before implementing frontline demonstrations at the farmer's field, participatory rural appraisal was done. Based on this, major gap was observed between improved technology and farmer's practice of chickpea cultivation in Dausa district of Rajasthan (Table 1). Among varying technological component partial gap, full gap and no gap was observed in the component *viz.*, variety, seed rate, seed treatment, method of sowing, weed management, fertilizer management and plant protection measures. These gaps observed at the farmer's field are ascribed to the slow pace of extension activities, coupled with unreached extension system, poor accessibility of advanced or improved agro-technologies especially among small holder farmers and other vulnerable groups (Shivran *et al*., 2020). Under farmer's practice, generally seed of local/ old variety with low yield potential was sown instead of newly recommended varieties for the zone with improper application of improved recommended package technologies. On the basis of observed gap, under the demonstration improved variety seed of GNG 1958, GNG 2144, and CSJ 515, fungicide, insecticide and bio-fertilizer *Rhizobium* culture for seed treatment and insecticide for plant protection measure were provided to the partner farmers by the Krishi Vigyan Kendra and other component *viz.* chemical fertilizers like sulphur and all other crop management practices were timely performed by the partner farmer itself under the supervision of KVK scientists. Almost similar findings have also been observed by Bhargav *et al*. (2017), Saikia *et al*. (2018), Meena *et al*. (2021) and Meena *et al.* (2022).

Chickpea yield

Total 305 frontline demonstrations of chickpea under Tribal Sub Plan scheme were demonstrated during 2017-18 to 2024-25 to showcase potentials of demonstrated improved variety and performance of recommended package of practices in agro-climatic zone of Dausa. The findings obtained during last eight years (Table 2) revealed that the average seed yield of chickpea through improved technology ranged from 15.10 to 21.54 q/ha as compared to 13.30 to 17.90 under farmers practice (local check). Average yield of total 305 demonstrations was 18.67 q/ha from improved technology whereas, the average yield from farmer's practices was 16.29 q/ha. Under improved technology 10.10 to 20.33 per cent increase in yield over the local check was recorded. Thus, there was on an average 14.57 per cent increase in demonstration yield over local check during eight years of demonstrations. Demonstrated chickpea variety GNG-2144 gave the highest seed yield (21.54 q/ha) during year of 2024-25. The results also revealed that seed yield under improved technology as well as under farmer's practices were higher than the district and state average yield during all the years of demonstrations. On an average the results clearly indicated that the increase in yield in demonstrations over local check was the impact of improved production technology of chickpea over the existing practices towards enhancing the yield of chickpea in different clusters of Dausa district. Fluctuations in yield observed during the study years were mainly on account of variation in soil conditions, its fertility levels, rainfall pattern, sowing time and crop management practices. The higher yield of chickpea could be attributed to adoption of improved variety with improved production practices of chickpea. These results corroborate the findings of Reager *et al*. (2020) and Meena *et al*. (2020) in green gram and Wadkar *et al*. (2018) and Kumar (2014) in chickpea. Further, on an average, 5.38 q/ha higher seed yield of chickpea was recorded under improved technology over district average. Similarly, 11.49 q/ha higher seed yield of chickpea was recorded under improved technology over state average. Moreover, higher seed yield was also recorded under farmers practice over district and state average. It was due to use of high yielding improved varieties, improved agronomic practices and adoption of improved management practices. Meena *et al.* (2021) and Meena *et al*. (2022) also reported that higher grain yield of chickpea was recorded under front line demonstrations over district and state average.

Adoption gap

Adoption gap is considered a key factor for enhancing the productivity of chickpea. Gap analysis was done by evaluating the extension gap, technology gap and technology index to measure the magnitude of adoption technology.

Technology gap

The data of table 2 depicted the technology gap in demonstration yield against potential yield which ranged from 4.46 to 8.90 q/ha during different years of demonstrations. Technology gap was maximum (8.90 q/ha) with demonstration variety CSJ-515 during 2017-18 and minimum (4.46 q/ha) during 2024-25. On an average technology gap during eight years of demonstrations were 6.32 q/ha for chickpea cultivation in Dausa district. The technology gap observed may be attributed to dissimilarity in crop management practices and variation in soil fertility and local agro-climatic situations. It indicates the constraints in implementation of technology and drawbacks in our package of practices. This also reflects the poor extension activities, which resulted in lesser adoption of package of practice by farmers. Hence, extension activities and location specific technological recommendations appear to be necessary to decline the technology gap. These results corroborate the findings of Jat *et al*. (2013), Meena *et al.* (2022) and Yadav and Khan (2025).

Extension gap

Extension gap is considered a parameter to know the yield difference between the demonstrated improved technology and farmer's practices. Results of the demonstrations (Table 2) stated that the extension gap ranging between 1.65 and 3.64 q/ha was found between improved technology and farmer's practices during period of study. The extension gap was highest 3.64 q/ha and lowest 1.65 q/ha during the year 2024-25 and 2021-22, respectively. On an average extension gap during period of study was 238 kg/ha for chickpea cultivation in Dausa district. So as to enhance the farmers income, there is need to reduce the wider extension gap, therefore, it is necessary to educate the farmers through various means for more adoption of recommended improved high yielding varieties and implementation of latest agro-techniques. The results were in conformity with Reager *et al*. (2020) and Meena *et al*. (2020) in green gram and Meena *et al* (2022) and Jat *et al*. (2024) in chickpea.

Technology index

The technology index is a parameter to show the feasibility of the improved technology at the farmer's fields. The lower value of technology index indicate more feasibility of improved technology and higher technology index reflects the inadequate transfer of proven technology to growers and poor extension services. Data on technology index presented in table 2 showed that the highest technology index was 37.08 per cent and lowest was 17.25 per cent which were recorded during 2017-18 and 2024-25, respectively. Further, on an average technology index of 25.37 per cent was observed during eight experimental years of chickpea in Dausa district, which shows the efficacy of good performance of technical interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield performance of chickpea at farmer's field. The technology index infers that there is plentiful scope in improvement in production and productivity of chickpea in the district. Similar findings were recorded by Jat *et al*. (2013), Bhargav *et al*. (2017), Wadkar *et al*. (2018), Reager *et al*. (2020) and Meena *et al*. (2021).

Economics

Economics, an important parameter to reject and accept the technology was estimated under the investigations. Seed yield, cost of variable inputs, labour charge and sale price of produce determine the economic returns and these vary from year to year. Economics of improved technology under frontline demonstration were estimated on the basis of prevailing market rates. Data showed (table 3) that higher gross monetary return (Rs.126701/ha.), additional returns (Rs.20566 ha.) were recorded with improved technology demonstration compared to farmer's practice in the year 2024-25 in the chickpea variety of GNG-2144. The higher net returns (Rs.80413/ha.), effective gain (Rs.21544/ha.) and B: C ratio (2.73) were noted with improved technology demonstration compared to farmer's practice in the year 2024-25 in the chickpea variety of GNG-2144. The present investigation showed that improved technology fetched higher net return to the tune of Rs.25238/ha to Rs.80413/ha with the average of eight years was Rs.53956/ha. However, under farmer practices the net return ranged from Rs.16870/ha to the Rs 58873/ha over the years and its average value fetched Rs.40391/ha. Further, on the average of all eight years of study revealed that improved technology demonstration gave higher average gross returns (Rs.96042 /ha.), additional returns (Rs.12492/ha.), average net return (Rs.53956/ha.), effective gain (Rs.12246/ha.) and benefit: cost ratio (2.26) compared to farmer practice. Higher B:C ratio was observed in demonstrations over local check across the years. The higher effective gain and additional returns obtained under frontline demonstrations could be due to improved technological interventions and non-monetary factors, timely operations of crop management practices and scientific monitoring at different stages of crop. Further, favorable benefit:cost ratio obtained under improved technological intervention under specific agro-ecological situation proved the economic viability of the technological intervention and convinced the farmers on utility of interventions. Similar economic benefits owing to adoption of improved technology interventions were also reported by Reager *et al*. (2020), Meena *et al*. (2020), Meena *et al*. (2021) and Jat *et al.* (2024).

Conclusion

Finding of present study concluded that adoption of improved technologies through frontline demonstrations has a long-term impact on production and productivity of chickpea and changing the knowledge, attitude and skills of farmers. The percent increment in yield and net return of chickpea to the extent of 10.10 to 20.33 per cent and 17.75 to 49.60 per cent respectively under improved technology as compared to the farmer's practice created greater awareness. Under demonstrations farmers obtained net profit of Rs.53955/ha with B: C ratio of 2.26. Participatory farmers have opined that they will continue to apply accepted technological package in coming season. The beneficiary farmers of demonstrations also play an important role as source of information and quality seed for wider dissemination of the high yielding variety of chickpea for other nearby farmers.

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Table 1: Technological gap between FLDs and farmers' practices on chickpea

Products	**Technological Interventions**	**Farmers Practice**	**Gap**
Variety	CSJ 515, GNG 1958 and GNG 2144	Own available seed and RSG 973	Full gap
Seed rate	60-80 kg/ha	80-90 kg/ha	Partial gap
Seed treatment	Carbendazim 50WP 1 g/kg + Thiram 75WP 2.5 g/kg and Fipronil 5 SC 10 ml/ kg	Fipronil 5 SC 5 ml/ kg	Full gap
Method of sowing	Line sowing by seed drill	Line sowing by seed drill	No gap
Fertilizer dosage	N : P (20:40) kg/ha	N : P (15:30) kg/ha	No gap
Weed management	Pre emergence application of Pendimethalin 30EC @ 0.6 kg a.i./ha and hand weeding at 35 DAS	Two hand weeding at 30 and 50 DAS	Partial gap
Irrigation	Two irrigation at flowering and pod development stage	Two irrigation at flowering and pod development stage	No gap
Plant protection measures	Dimethoate 30 EC @ 500 g/ha or Emamectin benzoate 5 SG @ 200 g/ha	Quinolphos 1.5% @ 25 kg/ha	Partial gap

Table 2: Comparative statement of yield and other parameters of front line demonstrations on chickpea in different blocks of Dausa district of Rajasthan

Year	**Village**	**Block**	**Variety**	**No. of demo**	**Area (ha)**	**Yield of demo (kg/ha)**			**Average yield of local check (q/ha)**	**% increase**	**Extension gap**	**Technology gap**	**Technology index (%)**
						Highest	**Lowest**	**Average**					
2017-18	Ralawas and Dholawas	Ramgarh Pachwara	CSJ 515	50	20	16.5	13.5	15.10	13.30	14.10	1.80	8.90	37.08
2018-19	Rambas	Dausa	GNG-1958	40	20	22	16	18.07	15.85	14.00	2.22	6.93	27.72
2019-20	Dehlawas, Khanwas and Manpuria	Lawan and Nangal Rajawatan	GNG 2144	50	25	22	17	19.06	16.52	15.35	2.54	6.94	26.69
2020-21	Shriramchandrapura	Ramgarh Pachwara	CSJ - 515	13	6.5	21.0	18.0	19.38	17.15	13.0	2.23	4.62	19.25
2020-21	Barh Dabar Kalan	Lalsot	GNG-1958	12	4.8	20.0	17.0	18.5	16.2	14.5	2.30	6.5	26.0
2021-22	Chhareda, Bhanwta	Nangal Rajawatan and Ramgarh Pachwara	CSJ- 515	40	20	20.0	16.0	17.98	16.33	10.10	1.65	6.02	25.08
2021-22	Chandrana	Dausa	GNG-1958	20	10	19.5	16.0	17.7	16.0	10.60	1.70	7.3	29.20
2023-24	Sultanpura	Ramgarh Pachwara	GNG-2144	40	20	23	18	20.74	17.40	19.19	3.34	5.26	20.23
2024-25	Hamawas	Ramgarh Pachwara	GNG-2144	40	20	23.5	18	21.54	17.90	20.33	3.64	4.46	17.15
	Average					**20.83**	**16.61**	**18.67**	**16.29**	**14.57**	**2.38**	**6.32**	**25.37**
	Total			**305**	**146.3**								

Table 3: Economics of the front line demonstrations on chickpea in different blocks of Dausa district of Rajasthan

Year	**Variety**	**No. of demo**	**Area (ha)**	**Cost of cultivation (Rs./ha)**		**Gross return (Rs./ha)**		**% increase in gross return**	**Net return (Rs./ha)**		**% increase in net return**	**Additional cost (Rs./ha)**	**Additional return (Rs./ha)**	**Effective gain (Rs./ha)**	**B:C ratio**	
				Demo	**Local**	**Demo**	**Local**		**Demo**	**Local**					**Demo**	**Local**
2017-18	CSJ-515	50	20	31622	33510	56860	50380	12.86	25238	16870	49.60	-1888	6480	8368	1.79	1.50
2018-19	GNG-1958	40	20	33992	36230	80284	68524	17.16	46292	32294	43.35	-2238	11760	13998	2.36	1.89

2019-20	GNG 2144	50	25	44314	46278	98050	83035	18.08	53736	36757	46.19	-1964	15015	16979	2.21	1.79
2020-21	CSJ-515	13	6.5	44314	46278	103838	91956	12.92	59524	45687	30.29	-1964	11882	1964	2.34	1.98
2020-21	GNG - 1958	12	4.8	45014	46278	99350	86916	14.31	54336	40638	33.71	-1264	12434	13698	2.2	1.87
2021-22	CSJ - 515	40	20	43374	42678	91304	83384	9.50	47930	40706	17.75	696	7920	7224	2.10	1.95
2021-22	GNG - 1958	20	10	44774	42678	89960	81800	9.98	45186	39122	15.50	2096	8160	6064	2.01	1.91
2023-24	GNG-2144	40	20	45088	47262	118033	99830	18.23	72945	52568	38.76	-2174	18203	20377	2.62	2.11
2024-25	GNG-2144	40	20	46288	47262	126701	106135	19.38	80413	58873	36.59	-974	20566	21540	2.73	2.24
	Average			**42086.67**	**43161.56**	**96042.22**	**83551.11**	**14.71333**	**53955.56**	**40390.56**	**34.63778**	**-1074.89**	**12491.11**	**12245.78**	**2.26**	**1.91**
Total		**305**	**146.3**													

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