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Scaling-up of Chickpea (*Cicer arietinum* L.) Productivity and Profitability through Cluster Front Line Demonstrations and Pulse Seed Hub in Kota district of Rajasthan

K. M. Sharma[1*], Mahendra Singh[2], M. C. Goyal[3] and Anil Kumar Sharma[4]

Krishi Vigyan Kendra, Borkhera, Kota (Rajasthan)-324001 India

[1]Asstt. Professor (Agronomy), [2]Senior Scientist & Head,

[3]Professor (Extension Education), [4]Senior Research Fallow

*Corresponding Author E-mail: kmsharma.kvk@gmail.com

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ABSTRACT

Chickpea is a major rabi pulse crop in Kota district of Rajasthan. To exploit the existing production potential and popularize improved variety GNG-1958 and technologies, cluster frontline demonstrations were conducted on chickpea crop by Krishi Vigyan Kendra, Kota during rabi 2016-17 to 2018-19 on farmer fields. Technological interventions demonstrated consisted of improved variety GNG-1958, seed treatment with carbendazim50 WP @ 2.0 g /kg seed & inoculation of Rhizobium & PSB culture, soil treatment by Trichoderma viride @2.5-3.0 kg ha^{-1}, sowing in 30 cm rows apart, recommended doses of NP (20-40 kg ha^{-1}) and zinc sulphate @ 25 kg ha^{-1} and need based integrated pest management. Analysis of three years data reveled that demonstrated technologies recorded mean yield of 2070 kg ha^{-1} which represents 20.77 per cent yield enhancement over local check (1714 kg ha^{-1}). Economic analysis confirmed the cost-effectiveness of the demonstrated techniques on farmer fields. Mean additional cost of improved technologies worked out to be Rs.1660 ha^{-1} which in turn, provided average addition returns of Rs. 16110 ha^{-1}. CFLD techniques on pooled basis, fetched net returns of Rs. 70110 ha^{-1} with B:C ratio of 3.37, higher in comparison to local practice (Rs. 54000 ha^{-1}, B:C ratio 2.93). Yield gap analysis indicated average extension gap of 356 kg ha^{-1} which emphasizes the need for bridging existing extension gap through transferring the improved technologies. Values of technology gap ranged from 463 to 774 kg ha^{-1}, with a mean of 610 kg ha^{-1} while technology index in the present study varied between 17.28 to 28.88 per cent. Quality seed production of chickpea variety GNG-1958 was taken by KVK Kota under Pulse Seed Hub and provided to large number of farmers which strengthen chickpea production in the Kota district.

Key words: *Chickpea, B:C ratio, Frontline demonstration, Technology index, Yield gap*

INTRODUCTION

Pulses are an important group of food crops that can plays a vital role to address national food and nutritional security in India. The share of pulses to total food grain basket is around 9-10 per cent and are a rich source of protein (@20-25 per cent, it is double the protein content of wheat and thrice that of rice.

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India, with more than 29 M ha pulses cultivation area, is the largest pulse producing country in the world. It ranks first in area and production with 34 per cent and 26 per cent contribution; respectively (GOI, 2018).

India is the major chickpea producing country and contributing for over 75 per cent of total world chickpea production. Chickpea shared 40.5 to 46.34 per cent in total pulse production in India and contributes the single largest share in India's export basket of pulses registering 63.73 per cent and 70.92 per cent in the total pulses export during 2016-17 and 2017-18 respectively (Anonymous, 2018). Rajasthan is one of the major chickpea producing states, normally contributes more than 15 per cent to the total production of our country. Area of chickpea in Rajasthan state fluctuates as per rainfall patterns every year. As per the average of last five years ending in 2015-16, chickpea was cultivated in the area of 13.61 lakh ha with average productivity of 831 kg ha^{-1} in the Rajasthan. Comparatively, Kota district of Rajasthan cultivated chickpea in the 3885ha area only with average productivity of 1352 kg ha^{-1} (GOR, 2017). Kota district has higher production potential of chickpea in Rajasthan state due to better irrigation facilities and suitable clay loamy soils. Therefore, there existed ample scope for strengthening chickpea production in the Kota district through vertical as well as horizontal measures. Major constraints for low productivity in the district include use of old variety seeds, lack of seed treatment & bio-fertilizer inoculation, inadequate weed management, inadequate & improper fertilizer and inadequate plant protection measures specially against pod borer and fungal diseases.

Government has initiated National level Cluster Frontline Demonstrations on pulses, through Krishi Vigyan Kendra under Agriculture Technology Application Research Institute (ICAR-ATARI) in the year 2015-16 to demonstrate the production potential of new varieties and related technologies to restore confidence amongst the farmers. Frontline demonstrations are one of the important process for dissemination of improved technologies and to establish its production potentials on the farmer's field. Therefore, cluster frontline demonstrations were conducted in Kota district on chickpea crop during 2016-17 to 2018-19 with a view to demonstrate new variety GNG-1958 and improved technologies on farmer fields to exploit the existing potential of productivity. Further, to enhance the quality and quantity of pulses seed in the country, a project on creation of seed-hubs (2016-17 to 2018-19) has been initiated under National Food Security Mission (NFSM) with the mandated objectives and targeted seed production of latest varieties across 24 states in the country. Krishi Vigyan Kota also taken under Pulse Seed Hub project to produce quality seeds of pulses for strengthening seed availability among the farming community.

Therefore, Cluster Front Line Demonstrations (CFLDs) were conducted to introduce innovative package of practices of chickpea and seed production taken under pulse seed hub for making available the improved variety seeds in the Kota district with a view to encourage chickpea production and productivity. The present investigation has been undertaken to evaluate the impact of Cluster Front Line Demonstration and creation of pulse seed hub on productivity and profitability of chickpea in Kota District.

MATERIALS AND METHODS

Cluster Frontline demonstrations (CFLDs) were conducted by the Krishi Vigyan Kendra Kota (Agriculture University Kota) for popularization of chickpea variety GNG-1958 and improved agro-techniques under NFSM during *rabi* seasons of year 2016-17 to 2018-19 on farmer fields of Kota district. CFLDs were conducted in 120 ha area on 285 farmer fields covering 16 different villages of operational area of KVK, Kota namely Laxmipura, Chhiparda, Umarhedi, Arliya Jagir, Bhagwanpura, Suhana, Chomakot, Nimoda Hariji, Haripura, Padasliya, Nayapura, Kamolar, Bagtari, Nangalheri, Khajuri and Rajpura. Kota District falls under Agro-

climatic Zone-V "Humid South-eastern plain zone" of Rajasthan. The climate in the district is semi-arid and moderate. Soils of the study area are clay loam in texture with low nitrogen, low to medium phosphorus, high in available potassium and widely deficient in zinc. Clay loam texture of soils with better water holding capacity favors the cultivation of chickpea even with single irrigation. The area under each FLD's were kept 0.4 to 0.5 ha. Farmer's for the CFLDs were selected in different blocks based on group meeting taking in to consideration mainly the suitable site and adaptive attitude of the farmers. Technological gap analysis was carried out for deciding technological interventions under demonstration which are presented in table-1. Technological interventions demonstrated under CFLDs consisted of improved variety GNG-1958 (Marudhara), seed treatment with Carbendazim 50 wp @ 2 g kg^{-1} seed & inoculation with Rhizobium & PSB cultures, soil treatment with *Trichoderma viride* @ 2.5-3.0 kg ha^{-1}, sowing at 30 cm. rows spacing, recommended NP (20:40 kg ha^{-1}) & zinc sulphate @20-25 kg $ha^{-1}$and need based plant protection measures.

Table 1: Technological gap analysis for CFLD on Chickpea

Technological point	Existing Farmer's practice	Recommended practice
Variety	Local seed /variety GNG-469, Dahod yellow	Variety GNG-1958
Seed rate	Seed rate 90-100 kg ha^{-1}	Seed rate 75-80 kg ha^{-1}
Crop geometry	Sowing crops in 22.5 cm rows	Sowing crops in 30 cm rows
Seed treatment	No or rare proper seed treatment	Seed treatment with carbendazim 50WP @ 2.0 g kg^{-1}seed
Biofertilizer inoculation	No use of Rhizobium and PSB cultures	Inoculation with Rhizobium and PSB cultures
Soil treatment	No soil treatment	Soil treatment by *Trichoderma viridie* @ 2.5-3.0 kg ha^{-1}
Fertilizer application	Improper use of DAP fertilizer mixed with seed	Recommended doses of NP (20:40 kg ha^{-1}) as basal, $ZnSo_4$ @ 20-25 kg ha^{-1}
Weed management	No hand weeding or use of weedicide	PE application of Pendamethalin 30 EC @ 1.0 kg ai ha^{-1} and hand weeding at 40-45 DAS
Insect-pest management	Indiscriminate use of insecticides such as Chlorantriprenol	Need based spray of quinolpholphos 25 EC @ 1.0 litre ha^{-1} or indoxacarb 15.8 EC 0.3 litre ha^{-1}or imamectin benzoate 5AG@ 0.18 kg ha^{-1}

Before sowing of crop, selected farmers were provided trainings on agro-techniques of chickpea. Critical inputs decided based on technological gap analysis were provided to the farmers and other suggested inputs were managed by farmers. Crop was sown during first to third week of November by drilling in 30 cm rows apart with seed rate of 75-80 kg ha^{-1}.

All steps like site and farmer selection, layout of demonstration, farmer's participation etc. were followed as suggested by Choudhary (1999). Monitoring of CFLD sites were done by periodical visits and needful suggestion were given to the farmers. Field days were also organized at crop maturity to demonstrate the results of CFLD among other farmers of the neighboring area for acceptance & further adoption of improved technologies. The crop was harvested during last week of March to first week of April. Data related to yield and cost of cultivation were collected separately

for CFLD plots and farmers practice (local check) plots. The average prices of inputs and output commodities prevailed during each year of demonstrations were taken for calculating cost of cultivation, net return and benefit cost ratio. The technology gap, extension gap and technology index were calculated as suggested by Samui et al. (2000).

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmers yield

Technology index (%) = (Technology gap/ Potential yield) × 100

RESULTS AND DISCUSION

Yield performance: Overall performance of technological packages demonstrated in participatory mode under CFLDs of chickpea has been found quite encouraging. A perusal of data presented in table.2 clearly revealed that application of improved technologies resulted in substantially higher chickpea yield than that of local check (farmer's practice) during all the three years (2016-17 to 2018-19). The average yield during three years ranged from 1906 to 2217 kg ha^{-1} under CFLD plots as against 1548 to 1877 kg ha^{-1} under farmers practices (local check). Three years pooled data shows that demonstrated technologies recorded mean yield of 2070 kg ha^{-1} which represents 20.77 per cent yield enhancement over local check (1714 kg ha^{-1}). Enhancement in productivity of chickpea under CFLDs in comparison to farmer's local practice could be ascribed mainly to the higher yielding capacity of improved variety GNG-1958 and recommended package of practices applied. The variety showed better branching, comparatively higher number of pods per plant, bold size grain with seed index around 24 g and also found moderately resistance to wilt disease. Yield enhancement in chickpea crop though frontline demonstrations at different locations were also documented by Tiwari and Tripathi (2014), Sharma et al. (2015) and Prajapati et al. (2019).

Table 2: Impact of Frontline Demonstrations on yield performance of Chickpea

Season & Year	Variety	No. of FLD	Area of FLD (ha)	Yield (kg/ha)		% increase in yield over FP	District average yield (kg/ha)
				IT	FP		
Rabi 2016-17	GNG-1958	60	30.0	2088	1718	21.56	1702
Rabi 2017-18	GNG-1958	100	40.0	1906	1548	23.12	1508
Rabi 2018-19	GNG-1958	125	50.0	2217	1877	18.09	1739
Mean				**2070**	**1714**	**20.77**	**1650**

IT- Improved techniques FP- Farmer's local practice

Yield gap & Technology Index: A perusal of data (Table-3) further reveals the need for transferring the feasible improved technologies among farmers to bridge the extension yield gap. The values for extension gap ranged from 340 to 370 kg ha^{-1} with a mean value of 356 kg ha^{-1} during the period of demonstration. Technology gap which implies researchable issues for realization of potential yield ranged from 463 to 774 kg ha^{-1}, with a mean of 610 kg ha^{-1} during three years of demonstration. Yearly variation in the technology gap might be due to dissimilarity in soil fertility status, temperature variation as well as change in location of demonstration sites. 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 (Katare *et al.*[4]). Technology index in the present study varied between 17.28 to 28.88 per cent with mean value of 22.75 per cent. Variation in technology index during three seasons might be attributed to dissimilarity in the soil condition and temperature pattern.

Table 3: Yield gap and technology index of Frontline Demonstrations on Chickpea

Season & Year	Potential Yield (Kg/ha^{-1})	Extension Gap (Kg/ha^{-1})	Technology Gap (Kg/ha^{-1})	Technology Index (%)
Rabi 2016-17	2680	370	592	22.09
Rabi 2017-18	2680	358	774	28.88
Rabi 2018-19	2680	340	463	17.28
Mean	2680	356	610	22.75

IT- Improved techniques FP- Farmer's local practice

Impact on Profitability:

Data on economic indicators i.e. gross cost of cultivation, gross returns, net returns and B:C ratio of cluster front line demonstrations are presented in Table 4. The gross cost of chickpea cultivation under improved practice ranged from Rs. 27893 to 31787 ha^{-1} with a mean value of Rs.29603 ha^{-1} against local check where it ranged from Rs.25437 to 30560 ha^{-1} with an average cost of Rs.27943 ha^{-1}. Additional cost of improved technologies ranged from Rs. 1227 to Rs.2456 ha^{-1} with average investment of Rs.1660 ha^{-1} which in turn fetched additional returns of Rs.13852 to Rs.19731 ha^{-1} with average addition gains of Rs.16110 ha^{-1}. Improved techniques recorded a mean IBCR value of Rs. 9.70. It is evident that improved technologies fetched substantially higher net returns than local check during all the years of demonstration. CFLD practice on three years average, fetched net returns of Rs 70110 ha^{-1} with B:C ratio of 3.37, higher in comparison to local practice (Rs 54000 ha^{-1}, B:C ratio 2.93). Higher B:C ratio and additional returns clearly shows that demonstrated improved techniques were found cost effective & feasible on farmer's fields. Farmers were also found highly convinced with the variety GNG-1958 and other technological interventions due to higher yield advantage with least additional investment. The variation in B:C ratio during different years might be due to variation in yield and input output values in that particular year.

Table 4: Economic indicators of chickpea production under Frontline Demonstration

Year	Gross Cost of cultivation (Rs. ha^{-1})		Gross Return (Rs. ha^{-1})		Net Returns (Rs. ha^{-1})		B:C ratio		Δ cost due to IT (Rs. ha^{-1})	Δ Return due to IT (Rs. ha^{-1})	IBCR
	IT	FP	IT	FP	IT	FP	IT	FP			
2016-17	31787	30560	111076	90118	79289	59558	3.49	2.95	1227	19731	16.08
2017-18	27893	25437	88307	71103	60414	45666	3.17	2.8	2456	14748	6.00
2018-19	29129	27831	99756	84606	70627	56775	3.42	3.04	1298	13852	10.67
Mean	**29603**	**27943**	**99713**	**81942**	**70110**	**54000**	**3.37**	**2.93**	**1660**	**16110**	**9.70**

IT- Improved techniques FP- Farmer's local practice

Impact on horizontal expansion of chickpea in the district

Krishi Vigyan Kota popularized and disseminated the improved variety of chickpea GNG 1958 through conducting cluster frontline demonstration. ICAR sanctioned a pulse seed hub project costing Rs.150.0 lakh to this Krishi Vigyan Kota with the aim of production, procurement and promotion of quality seeds of pulses, targeting of 2100 q in three years. Quality seed of chickpea variety GNG-1958 was undertaken by KVK, Kota and produced 255.7 q, 422.7 q and 723.5 q seed of this variety during 2016-17, 2017-18 and 2018-19; respectively under pulse seed hub which was provided to farmers for rapid expansion of chickpea acreage in the Kota district. Generally, wilt and pod borer are the major problems for chickpea cultivation but introduction of variety GNG 1958 which is

moderately resistant to fusarium wilt was popularized through front line demonstrations. Selected farmers under cluster frontline demonstration were also motivated at village to keep 20-25 per cent produce as seed for large scale multiplication and farmers to farmers' diffusion. Most of them followed and kept seeds of chickpea which were used during next *rabi* season sowing. Large quantity of seed also made available through pulse seed hub production & procurements and with the support of line departments. As depicted in Fig.1, chickpea cultivation was adopted on a wider scale in the Kota district such that the acreage increased from mere 2164 ha in *rabi* 2015-16 to 51400 ha in *rabi* 2017-18 & 35940 ha in *rabi* 2018-19 (GOR 2017 & GOR 2018).

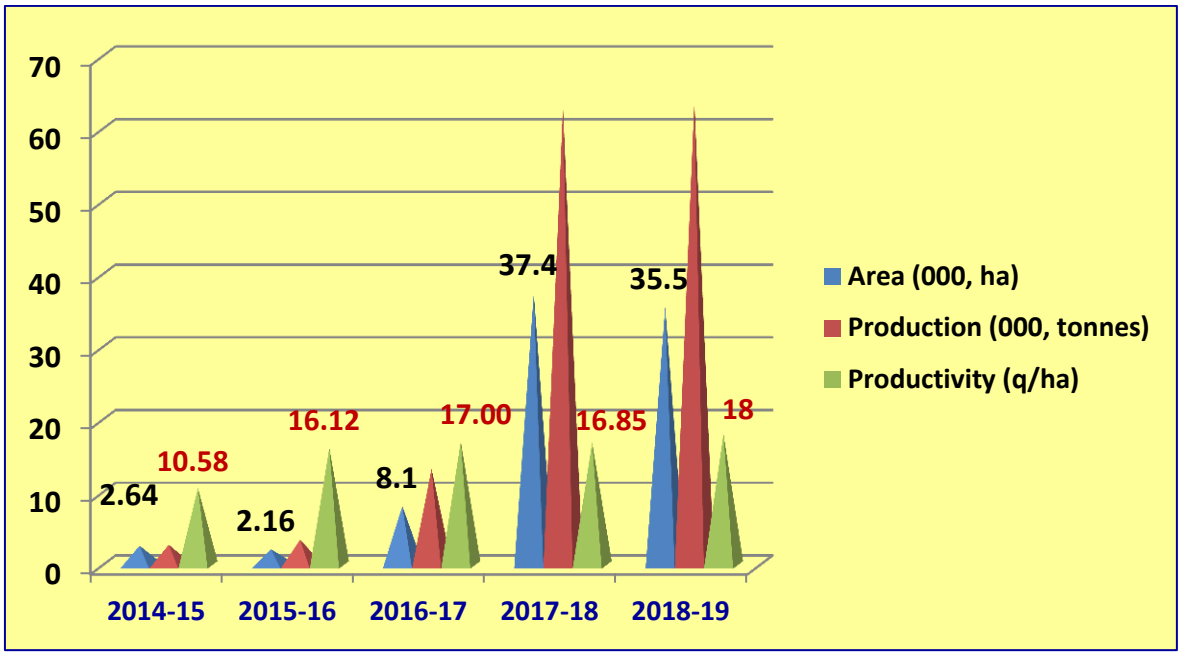

Fig. 1: Changing scenario of chickpea cultivation in Kota district during 2014-15 to 2018-19

CONCLUSION

Cluster front line demonstrations conducted on chickpea clearly indicates that chickpea has higher production potential in the Kota district with improved technological interventions. Chickpea productivity could be enhanced to the extent of 18.09 to 23.12 per cent on farmer fields in the Kota district through improved technologies with least additional cost. Variety GNG-1958 and demonstrated techniques were accepted by the farmers due to higher yield advantage. There is the need of transfer of adoptable technologies suitable for enhancing the productivity of chickpea crop through conducting such demonstrations as well as making available quality seed of improved varieties like GNG 1958. Technological and extension gaps can be bridged by popularizing package of practices with emphasis on improved variety seed, seed treatment, proper crop geometry, integration of bio-fertilizer inoculants, use of recommended fertilizers, weed management practices and integrated insect–pest management techniques. It is concluded that the CFLD programme is a successful tool in enhancing the productivity and profitability of chickpea crop through changing the knowledge, attitude and skill of farmers. There is need of strengthening quality seed production programmes like seed hub projects for making available among farming community. Pulse Seed Hub project playing very important role in producing quality seeds of pulses for strengthening pulse production.

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REFERENCES

Anonymous, (2018). Commodity Profile for Pulses-July, 2018. Directorate of Economics and Statistics (DES): Based on 3 rd Advance Estimates for 2017-18.

Choudhary, B. N. (1999). Krishi Vigyan Kendra - A guide for KVK managers. Publication, Division of Agricultural Extension, ICAR. 73-78.

GOI, (2018). Pulses Revolution from Food to nutritional security. Crops Division, Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare

GOR, (2017). Rajasthan Agricultural Statistics At a glance, Commissionerate of Agriculture, Rajasthan 2016-17:84

GOR, (2018). Rajasthan Agricultural Statistics At a glance, Commissionerate of Agriculture, Rajasthan 2017-18:84

Katare, S., Pandey S.K., & Mustafa, M. (2011). Yield gap analysis of Rapeseed-mustard through front line demonstrations. *Agric. Update*, *6*(2), 5-7.

Prajapati, P.J., Joshi, N.S., Patel, M.L. Parmar, V.S., Gadhita. K.K., & Hadiya, N.J. (2019). Impact of frontline demonstrations on yield of chickpea (*Cicer arietinum* L.) in Amreli district of Gujarat state. *Journal of Pharmacognosy and Phytochemistry*. *8*(2), 1431-1433.

Tiwari, B.K., & Tripathi, P.N. (2014). Yield gap analysis of chickpea (*Cicer arietinum*) through front line demonstration on farmer's fields. *The Journal of Rural and Agricultural Research*. *14*(1) 5-8.

Sharma, K.M., Verma, Harish, Asarey, R., & Sharma, K.C. (2015). Impact of Front Line Demonstrations on Productivity of Gram (*Cicer arietinum*) in Sawaimadhopur District of Rajasthan. *Indian Journal of Social Research*. *56*(5), pp 729-733.