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Research Article

PERFORMANCE EVALUATION OF DIFFERENT CULTIVARS OF CHICKPEA (*CICER ARIETINUM*) UNDER CLUSTER FRONT LINE DEMONSTRATION PROGRAMME IN CHANGING CLIMATE SCENARIO IN SAMASTIPUR DISTRICT, BIHAR

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Abstract: The pulse cultivation has been drastically reducing in recent years mainly due to less and irregular precipitation during monsoon and reduction in winter days as this crop does not suit well to warm climate, resulting in shortage of pulses in the market. The chickpea has been most preferred pulse in Samastipur to be grown in *rabi* season. The present study was conducted to revive the chickpea cultivation employing new cultivars by KVK, Samastipur and carried out during *rabi* season in different blocks of the district during the years 2015-16, 2016-17 and 2017-18. The Cluster Front Line Demonstration on chickpea varieties, namely, BGM-547 and GNG-1581 were taken up during each year for 15, 33 and 18 clusters respectively. These demonstrations recorded higher average grain yield (13.75, 14.60 and 14.40 q/ha) of chickpea as compared to average yield obtained from farmers practice (12.5, 9.47 and 11.73 q/ha) computed to increase in yield by 9.09 %, 15.13% and 18.54 % during 2015-16, 2016-17 and 2017-18 respectively. Similarly, the benefit: cost ratio was 1.78, 2.11 and 2.08 respectively. The technology gap (q/ha), extension gap (q/ha) and technology index (%) were 6.25, 1.25 and 31.25 during 2015-16, 5.40, 5.13 and 27.00 were during 2016-17 and 9.60, 2.67 and 40.00 were 2017-18. The significant increase in yield is attributed due to introduction of new varieties in cluster mode. This mode facilitates better crop management resulting in better quality production.

Keywords: *Chickpea, B:C ratio, Technology index*

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Introduction

Chickpea (*Cicer arietinum* L.) is the most important rabi season food legume crop in India. During 2018-19, chickpea production has been estimated to be about 10.13 m tones, which is about 43% of total pulse production (23.22 m/tones) in India. India has made remarkable progress in expending chickpea area and production [1]. Particular reference to chickpea in Bihar, the area of chickpea has declined due to growing popularity and public policy emphasis on rice-wheat system reduction in winter days, although productivity has increases from 550 kg/ha to 1000 kg/ha [2]. It is cultivated in Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka, Chhattisgarh, Bihar and Jharkhand which contributes more than 95% of the total chickpea production in the country. It contains 18-22 % protein, 61-62% carbohydrate and 4.5 % of fat [3]. Nutrient management play a pivotal role that greatly affect the growth and yield of chickpea because this crop do not suit well to warm climate. With increasing temperature and associated weather fluctuations due to climate change and shift in major chickpea cultivable area from cooler regions of Northern India to warmer region of Central and Southern India, imparting drought and heat stress resistance in chickpea has become indispensable. With an accelerated growth rate and initiation taken by the government under National Food Security Mission, the target of 10.22 m/tones chickpea production by the years 2030 can be achieved successfully [4].

These demonstrations are carried out under the investigation of agricultural scientists and feedbacks from the different farmers has to be generated on the demonstrated technology.

Keeping the importance of Cluster Front line Demonstration (CFLD) the KVK, Samastipur conducted demonstrations on chickpea at farmer's field under irrigated condition. The present study has been undertaken to evaluate the difference between demonstrated technologies and farmers practice in chickpea crop.

Materials and Methods

The study was carried out in operational area of Krishi Vigyan Kendra, Samastipur during 2015-16, 2016-17 and 2017-18. The harvested paddy fields were selected from different villages/clusters (each of 0.2 to 0.4 ha) of the district [Table-1]. The soil was sandy loam/loam in texture. Soil samples were collected from different farmers field of selected clusters. The soil sample were air dried, crushed and passed through 2 mm sieve and initial soil properties were determined as per standard methods [5]. The soils of farmers field were medium in organic carbon, available nitrogen in Bithan and Shivajinagar blocks and phosphorous in 5 blocks (high in Rosera block). The available potassium was low in all block and nitrogen in Kalyanpur, Mohaddinagar, Patori and Rosera blocks [Table-2]. All the farmers trained for improved package of practices through training programme. Materials for the present study with respect to CFLD and farmers practices are given in [Table-3]. Many farmers grow this crop by their own methods kept as local broadcasting standard check. The critical inputs were supply to the farmers by the KVKs, other inputs like balanced fertilizers, additional agro-chemicals, weedicides, irrigation facility were managed by farmers himself as per recommendation of scientists of KVK.

Table-1 *Details of farmers and cluster in different blocks of Samastipur district under CFLD programme*

Year	No of farmers	Name of selected blocks of Samastipur Districts					
		Kalyanpur	Bithan	Mohaddinagar	Patori	Shivajinagar	Rosera
2015-16	15	01 (01)	01(01)	06 (01)	06 (01)	01 (01)	-
2016-17	33	02 (01)	-	15 (01)	-	-	16 (01)
2017-18	18	-	-	07 (01)	11 (01)	-	-

Table-2 *Soil test parameters from demonstrated fields in selected blocks (Pooled data of farmers)*

Blocks	Name of Blocks of Samastipur Districts					
	pH (1:2)	EC (dsm^{-1})	Organic carbon (%)	Available N (kg/ha)	AvailableP_2O_5(kg/ha)	AvailableK_2O (kg/ha)
Kalyanpur	7.9-8.2	0.74	0.62	272	46	143
Bithan	7.8-8.1	0.63	0.69	284	42	129
Mohaddinagar	8.0-8.2	0.77	0.57	259	49	167
Patori	7.9-8.2	0.76	0.60	274	39	177
Shivajinagar	7.8-8.2	0.77	0.66	282	42	158
Rosera	8.0-8.2	0.78	0.58	263	52	162

Table-3 *Comparison of cultural practices adopted by farmers and CFLD*

Cultural operations	Prevailing Practices	CFLD employing improved cultivation practices
Seed	Use of local seed	BGM-547 and GNG-1581
Seed quality	Small non-graded seed	Bold graded brownseed
Seed treatments	-	Treated with Bavistin followed by *Rhizobium* and PSB
Method of sowing	Broadcasting	Line sowing by seed drill
Fertilizer application	-	100 kg DAP + 33 kg MOP + 125 kg Phospho-gypsum per ha
Control measures	Single spray of pesticide when severe problem occurs	Two spray of insecticides to control of insects and application of micronutrients for more branches and healthy plants as well as grains

Table-4 *Yield, technology gap, extension gap and technology index of chickpea in Samastipur*

Year	Name of variety	No of demonstration	Yield (q/ha)							Yield increase (%)	% increase over check	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
			Potential	Demonstration plots			Check plots							
				Max.	Min.	Av.	Max.	Min.	Av.					
2015-16	BGM-547	15	20	16.80	11.60	13.75	13.70	11.30	12.50	9.90	10.00	6.25	1.25	31.25
2016-17	BGM-547	33	20	14.95	14.25	14.60	10.72	8.22	9.47	35.13	54.17	5.40	5.13	27.00
2017-18	GNG-1581	18	24	16.80	12.00	14.40	12.09	11.37	11.73	18.54	22.76	9.60	2.67	40.00
SEm (±)				0.55	0.42		0.40	0.34						
CD (P=0.05)				1.62	1.27		1.22	1.03						

Table-5 *Gross return, cost of cultivation, net return and B: C ratio of chickpea in Samastipur*

Year	Expenditure and return								Net return increase (%)
	Check plots				Demonstration plots				
	Gross cost (Rs/ha.)	Gross Return (Rs/ha.)	Net return (Rs/ha.)	B:C ratio	Gross cost (Rs/ha.)	Gross Return (Rs/ha.)	Net return (Rs/ha.)	B:C ratio	
2015-16	27000	43750	16750	1.62	27000	48125	21125	1.78	26.11
2016-17	25615	33145	9845	1.29	24200	51100	26900	2.11	173.23
2017-18	26900	45747	18847	1.70	27000	56160	29160	2.08	54.72

Sale rate of chickpea during- 2015-16: Rs3500/q ; 2016-17: Rs.3500/q; 2017-18: Rs.3900/q

The chickpea cultivars BGM-547 and GNG-1581 were shown during first to second week of November in each year under demonstration in furrow at 30x10 cm spacing at a seed rate of 80kg/ha at all the sites. Before sowing the seed was inoculated with bio-fertilizer (*Rhizobium* and Phosphate solubilizing bacteria) @ 20 g/kg seed and the treated seeds were dried in shade for an hour. The mean rainfall of 709.7 mm was received during the crop growth periods. Nipping was done as soon as crop attained height of 15-20 cm. All recommended practices were followed to raise a good crop.

In case of local check plots, existing practices being followed by the farmers. Regular visits by the KVK scientists to demonstration field were made to guide the farmers. These visits were also help to collect feedback information from different farmers for further improvement in research and extension programme. Field days, awareness camps and group meetings were also organized at the demonstration plots to provide the opportunities for vicinity farmers to witness the benefits of these demonstrated technologies the improved technology included quality seed, seed treatment and maintenance of optimum plant population etc. Recommended weed control measure and irrigation were applied according to requirement of the crops. The crop was harvested at perfect maturity with suitable method. Desired yield data were collected through field observations. Gross return was calculated by multiplying yield into prevalent local market price of the crop. For estimating input cost, the sum of expenditure on land preparation, planting method, fertilizer, insecticide, fungicide, herbicide, irrigation cost, labour harvesting cost *etc,* were calculated from each demonstration.

Further net return and benefit cost ratio were calculated from these data. To estimate the technology gap, extension gap and technology index formulae were used as follows [6]:

Technology gap = Potential yield – Demonstration yield,
Extension gap = Demonstration yield – Farmers yield,
Technology index = Technology gap /Potential yield x 100.

Results and Discussion

In Samastipur district soil texture is sandy, sandy loam to loamy sand which varies according to blocks. The study conducted in clearly indicated that soil fertility plays a significant role to achieve higher yield of chickpea crops [Table-2]. Higher grain yield in demonstrated plots with improved cultivation that soil fertility enhanced the capability of soil to produce more which plays a pivotal role in yield. As we know that exhaustive cereal-cereal system has deleterious effect on soil quality from last few decades and agricultural sustainability has been confronting a big challenge in future. Therefore, change in cropping pattern can play a big role to enhance and revitalize soil health by fixing atmospheric nitrogen available form in soil which also benefits to the succeeding crops [7-9].

The results of 66 demonstrations conducted during rabi 2015-16, 2016-17 and 2017-18 at farmers' field in Samastipur district are presented in [Table-4] as per the proforma provided by ICAR Agricultural Technology Application Research Institute (ATARI), Patna (Zone-IV).

Results indicated that use of high yield varieties, balance use of fertilizers and micronutrients and control of insect and disease during 2015-16, maximum number of farmers were motivated to take up chickpea next years under strict supervision of scientists from KVK, Samastipur.

A comparison of productivity levels between local check and demonstrated varieties are shown in [Table-4]. The grain yield of chickpea obtained under demonstration were 13.75 14.60 and 14.40 q/ha as compared to that from farmers field as 12.50, 9.47 and 11.73 q/ha during 2015-16, 2016-17 and 2017-18 respectively. Demonstration plot resulted in 10%, 54.17 and 22.76% respectively higher grain yield from local check. Similar findings have also been observed by Sandhu and Dhaliwal, (2016) [10] and Meena and Singh, (2017) [11], where results from demonstrations plots observed to be higher in summer green gram crop. The major differences observed between demonstration package and farmers' practices were introduction of seed treatment with biofertilizer, method and time of sowing, fertilizer doses and method of its application and plant protection measures. Nipping prevents the botanical activity. The branches were more firm and the number of flowers and pots per plant increases. The reason of low yield of chickpea at farmers field was that optimum sowing time was not followed due to non-availability of quality seed. More than 90% of farmers practiced broadcast method and as in most of the cases the plant population at farmers field was two – three times higher than that of recommended seed rate. Lack of popularization of seed cum fertilizer drill for sowing and use of inadequate and imbalanced dose of fertilizers, especially the nitrogenous and phosphate fertilizers by farmers, wouldn't make it possible to fetch potential yield. Mechanical weed control was costly and chemical control was quite uncommon in Samastipur. This finding is similar to Singh *et al*. (2013). It is evident from the results that the yield of demonstration was found better than the local check (farmer's practice) under the similar environmental conditions.

The technology gap evaluated is 6.25, 5.40 and 9.60 q/ha during 2015-16, 2016-17 and 2017-18 respectively. The observed technology gap presented in [Table-4] is due to various constraints such as soil fertility, availability of low moisture content, seed treatment method, sowing time, fertilizer application and climatic hazards etc. Hence, to reduce the yield gap location specific recommendations for varieties, soil testing and timely sowing appears to be necessary. The 1.25 q/ha extension gap found in 2015-16 whereas 5.13 q/ha was in 2016-17 and 2.67 q/ha was in 2017-18. The findings are similar to the findings of Raj, *et al*., (2013) [12], Meena, (2017) [13] and Shivran, *et al*., (2020) [14]. The technology index showed the suitability of varieties at farmers' field. Lower technology values indicated that feasibility of variety among the farmers is more. The technology index was 31.25 %, 27% and 40 % during 2015-16, 2016-17 and 2017-18 respectively. This finding is in corroboration with the findings of Poonia and Pithia, (2011) [15] and Kumar, *et al*., (2018) [16], Kumar and Jain, (2021) [17].

The economics of chickpea production under CFLD have been presented in [Table-5]. Economics analysis of the yield performance revealed that CFLD recorded higher gross return (Rs 48125 /ha during 2015-16, Rs. 51100 /ha during 2016-17 and Rs. 56160 /ha in 2017-18) respectively with higher benefit-cost ratio 1.78, 2.11 and 2.08 as compared to 1.62, 1.29 and 1.70 of local check. The net return increased by 26.11 % and 173.23 % and 54.72% during 2015-16, 2016-17 and 2017-18 respectively. Raj *et al*., (2013) also prove the similar results in which demonstration plot gave higher net return from the check farmers' practice.

Conclusion

It is concluded from the study that through CFLD of recommended technologies, yield of chickpea can be increased to its potential yield in Samastipur district. It is an effective tool for increasing the production and productivity of pulses and changing the knowledge, attitude and skill of farmers and also built the relationship and confidence between farmers and scientists. This will substantially increase the income as well as livelihood of the farming communities.

Application of research: Study will helpful for substantially increase the income as well as livelihood of the farming communities.

Research Category: Front line demonstration

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Study area / Sample Collection: Samastipur district, Bihar, India

Cultivar / Variety / Breed name: Chickpea (*Cicer arietinum*)

Conflict of Interest: None declared

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