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Impact of cluster frontline demonstrations in productivity enhancement and dissemination of pigeon pea production technology in Dholpur, Rajasthan

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Abstract
The field study was carried out by Krishi Vigyan Kendra, Dholpur to assess the yield gap of Pigeon Pea through Cluster frontline demonstration. Demonstrations on improved technologies were conducted in 40 ha at 133 framers' fields of Dholpur district during Kharif season of 2019-20 and 2020-21. Improved crop management practices recorded the highest mean seed yield of 16.67 q ha-1 which was 18.77 per cent higher than the yield obtained with farmers practice (14.30 q ha-1). The extension gap technological gap, and technological index were recorded 2.67 q ha-1, 4.52 q ha-1 and 24.50 per cent respectively. Due to adoption of improved package of practices, demonstration plots recorded higher average seed yield over local check.

Keywords: CFLD on pigeon pea, economics, technology and extension gap

Introduction
Pulses are one of the important segments of Indian agriculture. The important pulse crops are Chickpea (45.53%), Pigeon pea (17.06%), Urdbean (13.40%), Mungbean (7.76%), Lentil (5%) and Field pea (5%). The major pulse producing states are Madhya Pradesh (33%), Maharashtra (13%), Rajasthan (12%), Uttar Pradesh (9%), Karnataka (8%), Andhra Pradesh (5%), Gujarat (4%), Jharkhand (3%), Tamil Nadu, (2%), and Telangana (2%) which together for about 91 per cent of the total production [4]. Among the pulses, Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important pulse-cum-grain legume crop in semi-arid tropical and subtropical areas of the world. It is a second most important grain legume crop next to chickpea accounting for about 20 per cent of total pulse production [11], occupies a prominent place in Indian dry land agriculture by covering an area of around 3.9 m ha with productivity of 729 kg ha-1. India is the world's largest producer and consumer of pulses including pigeon pea. Pigeonpea is an important *kharif* pulse crop grown in India. Area under pigeonpea in India is about 4.42 million hectare with an annual production of 2.89 million tonnes and productivity of 655 kg/ha [3]. The average productivity of Pigeon pea in Rajasthan state was produced about 586 kg/ha in 8858 ha area. In Dholpur district pigeon pea was cultivated in an area of 209 hectare with the production of 306 tones with a productivity of 1608 kg /ha during 2019-2020 [2]. Dholpur district has very low area and Productivity of Pigeon pea due to poor knowledge about newly released crop production and protection technologies and their management practices in the farmers' fields. Over a period, a number of improved pulses varieties and production technologies have been developed, but full potential of these varieties as well as technologies could not be exploited due to low rate of adoption and low yields. The proposed Centrally Sponsored Scheme 'National Food Security Mission (NFSM) is to operationalize the resolution of NDC and enhance the production of rice, wheat and pulses [1]. The aims of the cluster front line demonstration to target the select districts by making available the improved technologies like promotion of Integrated Nutrient Management (INM) Integrated Pest Management (IPM), promotion of micronutrients/gypsum/bio- fertilizers, promotion of sprinkler irrigation, and Extension, training and mass media campaign. Keeping the above point in view, the CFLDs on Pigeon Pea using improved production technologies was conducted with the objective of showing the productive potentials of the new production technologies under actual farming situation. These demonstrations were conducted under the close supervision of scientists of Krishi Vigyan Kendras, Dholpur. Hence, there is need for expansion of area and production in pulses in Rajasthan. Cluster Front Line Demonstrations

(CFLDs) under National Food Security Mission (NFSM) playing key role in introduction of improved varieties and production technologies in pulses.

Materials and methods

The CFLDs of Pigeon Pea was conducted during kharif season 2019-20 and 2020-21 by the KVK Dholpur. The demonstrations were conducted in farmer's field of 4 different villages (Lookoopura, Dhondikapura, Moosalpur and Sarkankhera) in the year 2019-20 and 3 different villages (Chourakhera, Kankret and Ekta) in 2020-21, Dholpur District. The area under each demonstration was 0.4 ha. Farmers were trained to follow the package and practices for pigeon pea cultivation. The treatment comprised of recommended practice (Improved variety ICPL-88039 and PA 291), integrated nutrient management-@ N:P:K:S (20:40:20:20) kg/ha + Zinc Sulphate @ 15 kg/ha + Rhizobium + PSB @ 5 g/kg seed, integrated pest management- deep ploughing + seed treatment with *Trichoderma viridae* @ 5 g/kg seed + Carbandazim @ 2gm /kg seed + Fipronil 5 % SC 10 ml/kg seed + Use of Emamectin Benzoate @250 ml /ha for pod-borer at 50 % flowering and small pod stage and Neem oil @ 5ml/lit for sucking pest etc. vs. farmers practice. The need based inputs were provided to the beneficiaries. In case of local check, the traditional practices were followed by using existing varieties. An area of 20 hectare (2019-20) and 20 hectare (2020-21) was covered with plot size 0.4 ha, under cluster front line demonstration with active participation of 80 (2019-20) and 53 (2020-21) farmers respectively. In general, the soil of the experimental sites were Sandy and Sandy loam. Crop was sown between 15 June to 15 July with a spacing of 45 cm and seed rate was 20 kg/ha. The seeds were treated with *Trichoderma viridae* @5 g/kg seeds then inoculated by Rhizobium and phosphosolubilizing bacteria biofertilizers each 5g/kg of seeds. Application of Imazethapyr @100g a.i. /ha at 25-30 DAS. Spray of Neem oil @2.5/ltr at flower initiation and install the pheromone trap for monitoring of pod borer. Before conducting the demonstration farmers group meeting and training were also organized. The farmers field and crop growth were frequently monitored and gosthi and field day were organized with extension functionaries and block level development officer at demonstration plots to visualize the technology difference and disseminate the technology at large scale. The production data on different parameters was collected from farmers practice and demonstration plots and calculated the Gross return, cost of cultivation, net returns and benefit cost ratio (B:C ratio) by using prevailing prices of inputs and outputs. We also collected data of both CFLD plots as well as Farers Practice control plots for extension gap, technology gap, technology index along with the benefit cost ratio (Samui *et al.*, 2000) [10]. as given below :

- **Technology gap=** Potential Yield - Demonstration Yield
- **Extension gap=** Demonstration Yield - Farmer's Yield
- **Technology index =** $\frac{\text{Potential Yield} - \text{Demo. Yield}}{\text{Potential Yield}} \text{ X } 100$
- **Additional Return** = Demonstration return – Farmers practice return
- **Benefit – Cost Ratio** = $\frac{\text{Gross Return}}{\text{Gross cost}}$
- **Percent increase yield**= $\frac{\text{Demonstration yield – farmers yield X 100}}{\text{Farmers yield}}$

Table 1: Details of recommended package of practices for Red gram

S. No.	Technological practices	Recommended practice	Farmer's practice	Gap
1.	Variety	Pusa 2002, Pant Arhar 291 and ICPL 88039	Own seed, Local varieties	75%
2.	Land preparation	3 ploughing	3 ploughing	Nil
3.	Seed rate	20 kg/ha	25 kg/ha	60%
4.	Seed treatment for wilt & Rhizoctonia	Carbendazim 2 gm or Thiram @ 2.5 gm /kg seed	Seed treatment by 25 %	75%
5.	Seed treatment for Termite control	Fipronil 5 % SC 10 ml/kg seed	Seed treatment by 20 %	80%
6.	Method of sowing & Crop geometry	Line sowing 45 x 30 cm	Broadcasting and mixed cropping	75%
7.	Time of sowing	15 June to 30 June	15 June to 30 June	Nil
8.	Fertilizer	Recommended N:P:K:S (20:40:20:20) kg/ha as basal dose	N:P:K (00:40:00) kg/ha as basal dose	70 %
9.	Weed Management	Use of Pendimethalin @ 1 kg a.i./ha as pre-emergence and Imazethapyr 10 S.L.@ 50 g a.i./ha post-emergence	No use of herbicide for weed management	70%
10.	PP measures for Pod borer	Use of Emamectin Benzoate @250 ml /ha for pod-borer at 50 % flowering and small pod stage and Neem oil @ 5ml/lit for sucking pest	No use	85%

Table 2: Productivity, Extension gap, Technology gap and Technology index of Pigeon Pea under CFLDs.

Year	Name of Variety	No. of demo.	Area	Seed Yield (Q/ha)			% increase	Extension Gap	Technology Gap	Technology Index
				Potential	CFLD	FP				
2019-20	ICPL 88039	80	20.00	25	17.00	14.00	21.43	3.00	8.00	32.00
2020-21	PA 291	53	20.00	18	16.95	14.60	16.12	2.35	1.05	17.05
Average		66.5	20	21.5	16.97	14.30	18.77	2.67	4.52	24.52

Table 3: Economics of cluster frontline demonstrations on Pigeon Pea under CFLDs

Year	Gross Cost (Rs. / ha)		Gross Return (Rs. / ha)		Net return (Rs. ha-1)		Additional gain (Rs. ha-1) in CFLD	B:C ratio	
	CFLD	FP	CFLD	FP	CFLD	FP		CFLD	FP
2019-20	37548	35040	98600	46158	61052	49390	52442	2.63	2.31
2020-21	32200	30800	101700	87600	69500	56800	14100	3.15	2.85
Average	34874	32920	100150	66879	65276	53095	33271	2.89	2.58

Results and discussion

Grain yield and Percent Increased

The grain yield and gap analysis of Red gram in demonstrated field's and farmer's practice is presented in (Table 2). Data revealed that average grain yield of demonstrated field's was higher from farmer's practice in both years. The results revealed that grain yield of Red gram under cluster frontline demonstrations were 17.00 and 16.65 Qt ha-1as compare to 14.00 and 14.60 Qt ha-1 recorded in farmer's practice. The average grain yield was recorded 16.97 q/ha under CFLD and 14.30 q/ha in farmers filed and yield increase of 21.43 and 16.12 per cent, respectively. The above finding was in accordance with Singh *et al., (*2018) [13], Jayalakshmi Mitnala *et al.,* (2018) [7], Singh *et al.,* (2020 B) [9] and Singh and Singh (2020) [8].

Extensions gap

The difference between demonstrated yield and yield under existing farmers practice is extension gap. Extensions gap were observed as 3.00 and 2.35q/ha for pigeon pea, respectively during demonstration period (Table 2). The average extension gap was recorded as 2.67 q/ha. This finding is in corroboration with the findings of Jayalakshmi Mitnala *et al.,* (2018) [7], Singh, *et al.,* (2019) [14], Singh *et al.,* (2020 B) [9] and Singh and Singh (2020) [8].

Technology gap

The difference between the potential yield of the variety and yield of demonstration is technology gap. The difference between potential yield and demonstration plots yield was 8.00 and 1.05 q/ha in pigeon pea, respectively during demonstration period (Table 2). The average technology gap was observed 4.52 q/ha. The findings are in line with that reported by Vijaya Lakshmi *et al.* (2017) [15], Jayalakshmi Mitnala *et al.,* (2018) [7], Singh *et al.,* (2020 B) [9] and Singh and Singh (2020) [8].

Technology index

The ratio between technology gap and potential yield expressed as percentage is technology index. The average technology index was observed 32.00 and 17.05 per cent in pigeon pea (Table 2). The average technology index was recorded as 24.52 per cent in pigeon pea crops. Similar findings were reported by Singh, *et al.,* 2019 [14], Singh *et al.,* (2020 A) [12], Singh *et al.,* (2020 B) [9] and Singh and Singh (2020) [8].

Economics analysis of red gram

Economic performance of red gram under cluster frontline demonstration was depicted in (Table 3). The economic analysis results revealed that the red gram recorded higher total return from recommended practice (CFLD's) were 98600 (ICPL 88039) in 2019-2020 and 101700 (PA 291) in 2020-21 as compared to 46758 and 87600 in farmer's. Practice respectively. The net returns were 61052 (ICPL 88039) in 2019-2020 and 69500 (PA 291) in 2020-21 as compared to 49390 and 56800 in farmer's. Practice respectively. It was economically observed that additional returns were 52442 (ICPL 88039) and 14100 (PA 291) in recommended practice in both the years. The benefit cost ratio also recorded higher in recommended practice with 2.63 and 3.15 as compared to 2.31 and 2.85 in farmer's practice in both the years during 2019-20 and 2020-21, respectively. Similar findings were also reported in frontline demonstrations on pulse crops by Dwivedi *et al.,* (2011) [6], Dwivedi *et al.,* 2014 [5], Singh *et al.* (2018) [13], Singh, *et al.,* (2019) [14], Jayalakshmi Mitnala *et al.,* (2018) [7], Singh *et al.,* (2020 B) [9] and Singh and Singh (2020) [8] also reported higher yield and net returns as well as benefit cost ratio as compared to local practices.

Conclusion

Cluster frontline demonstrations on pulses (pigeon pea) were conducted in 40 ha at 133 framers' fields of Dholpur district during Kharif season of 2019-20 and 2020-21. Improved crop management practices recorded the highest mean seed yield of 16.67 q ha-1 which was 18.77 per cent higher than the yield obtained with farmers practice (14.30 q ha-1). It was observed that potential yield can be achieved by imparting scientific knowledge to the farmers, providing the quality need based inputs and proper application of inputs. Horizontal spread of improved technologies may be achieved by the successful implementation of frontline demonstration and various extensions activities like training program, field day, exposure visit organized in CFLDs program in the farmer's fields.

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