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Impact of front line demonstration on production productivity and net returns of pigeon pea under rain fed condition

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Abstract
The present study were conducted by Krishi Vigyan Kendra, Jamui (Bihar Animal Sciences University, Patna) in the Kharif season on an area of 40 ha. in all 208 demonstrations during 2019-20 and 2020-21 in Jamui district. Front line demonstration (FLD) is an appropriate technique to transfer the technologies at farmers field. The findings in respect of Pigeon pea, overall yield trend of 208 demonstrations in an area of 40 ha ranged of 12.5 q ha^{-1} to 12.8 q ha^{-1} with an average of 12.65 q ha^{-1} and yield increase ranged from 40 to 42% over the farmers practice. The technology gap, extension gap and technology index were recorded with an average 2.35 q ha^{-1}, 3.85 q ha^{-1} and 15.6% respectively. The increment in yield under front line demonstration was due to spreading of latest technologies viz. improved variety, seed treatment, line seeding, use of balance fertilizer, installation of bird purcher and multiplication caze etc. Improved technologies gave higher mean net returns of Rs. 84,570 ha^{-1} with benefit cost ratio 2.35 as compared to farmers practice (Net returns Rs. 39,700 ha^{-1}, B:C ratio 1.75). The results clearly indicated that FLD is an appropriate technology for demonstration as well as the transfer of improved agricultural innovation to the farming community. Hence FLD have a broad scope for increasing area, production and productivity of Pigeon pea crop.

Keywords: Front line demonstration, pigeon pea, yield, net return, technology gap, extension gap, technology index

Introduction
India is the largest producer, consumer and importer of pulses. Pulses are a good chief source of protein for a majority of the population in India. Protein malnutrition 11% of the total intake of proteins in India (Reddy, 2010). Pulse cultivation was an integral part of cropping system in Bihar with 1644.8 thousand ha area under total pulse and production of 987.4 thousand tones and yield of 524 kg ha-1 in 1970-71. In last four decades there has been drastic with reduction in pulses area with only 500 thousand ha area only under pulses in 22013-14 and these area substituted by other crops mainly rice and wheat. This decline pulse area has been largely attributed to relatively higher profitability of rice and wheat as comparison to legumes (Malik 1994). Pigeon pea is one of the most preferred pulse consumed in Bihar but the area and production has been reduced to 21.9 thousand ha area and 36.5 tonnes respectively in 2013-14 which was in 1965-66, 172 thousand ha and 147.8 thousand tones. If we look at the decadal data in 1970-71, 1980-81, 1990-91 and 2000-01 the area and production of pigeon pea was 150.3 (‘000ha) and 147.8 (‘000t), 93.7 (‘000ha) and 91 (‘000t), 66.2 (‘000ha) and 82.3 (‘000t) and 43.7 (‘000ha) and 58.9 (‘000t) respectively showing a steady decline in an area and thereby production.

The productivity of pigeon pea has always been more than the national average with highest yield in 2013-14 of 1147 kg ha-1, but the matter of concern ia a very few farmers are opting for pigeon pea cultivation and one of the reason is also its being long duration crop with maximum field occupancy. In Bihar traditionally long duration varieties (> 200 days) of pigeon pea are grown which are highly photoperiod-sensitive taking about 40 weeks to mature exposesing the crop to terminal drought stress and frosts. Almost every year the crop is damaged by frost leading to lower yields and poor quality seeds. There is need to identify sources of tolerance/resistance for this constraint and design appropriate breeding strategies to develop suitable varieties. Besides a number of biotic and biotic factors also deter farmers to take up pigeon pea cultivation (Pushpa Singh, 2016) [11]. Over the last few years the area production and productivity of Pigeon pea was increased due to inception of Cluster Front Line Demonstration at farmers field. Front line demonstration is an appropriate technique to

transfer the latest agricultural technologies at farmer's field. The aim of the Front line demonstration is to convey the technical message to farmers if they use recommended package and practices then the yield and profitability per unit area can be increased easily. The Jamui district of Bihar has cultivated more than 10000 thousand hectare area cultivated under Pigeon pea but the productivity level is very low. The reasons for the low productivity are use of poor quality of seed and traditional method of cultivation. Keeping the above point of view the Cluster Front Line of demonstration on Pigeon pea by using quality seed and improved production techniques was conducted under rain fed situation with the objective of enhancing productivity and profitability to the farmers.

Materials and Methods

Front line demonstration on Pigeon pea were conducted by the Krishi Vigyan Kendra, Jamui (Bihar Animal Sciences University, Patna) in Kharif season in the farmers field during 2019-20 and 2020-21. Training were organised involving the selected farmers before demonstrating of the technologies. All 208 Front line demonstrations in 40 ha. area were conducted in different villages of the district. The technologies were demonstrated for the present study with respect to FLD are given here under.

- Improved variety (LRG – 41)
- Seed treatment with fungicide and insecticide
- Line Sowing
- Weed management (Pendamethalin at 1.00 kg ai ha^{-1})
- Installation of Multiplication Cage
- Installation of Bird Purchar

Seed of improved variety (LRG-41), recommended chemicals, Multiplication cage and Bird purcher were made available to the selected farmers after being trained. In demo plot use of improved seed, seed treatment, line sowing recommended dose of fertilizer, installation of Multiplication Cage and Bird Purcher and plant protection measures were demonstrated in the farmer's field through FLD of different locations whereas in local check (adjoining farmers field) existing practices being used by farmers followed. Twenty hectare area was demonstrated along with control plot as local check during both the years. Soil of the area was sandy loam in texture with pH 7.4, organic carbon 0.62% medium in available Nitrogen, Phosphorus and Potash. The total rainfall recorded during the crop period were 836 and 731 mm respectively. The seed were treated with fungicide (Thiram @ 2 g / kg) and insecticide (Chloropyriphos @ 5 ml / kg) as a seed treatment technology. Treated seed (18 kg ha^{-1}) was sown in line at 75 cm distance in June month during both the years. The fertilizer was given as per recommended dose 20 kg Nitrogen and 40 kg Phosphorus per hectare as basal dose. Pre-emergence herbicide pendamethalin at 1.00 kg ai ha^{-1} was applied within 48 hours of sowing. At the time of flowering bird purcher and multiplication cage were installed @ 12 and 25 per ha respectively in the field for encouraging birds such as sparrow and king crow etc. the data were calculated from both front line demonstration plots as well as control plots (FP) and analyzed by using simple statical tools. Technology gap, extension gap and technology index were calculated (Samui *et al.* 2000) [10] by using following formula as given below.

Technology gap = Potential Yield – Demonstration Yield
Extension Gap = Demonstration Yield – Farmers Yield

$$\text{Technology Index} = \frac{\text{Technology gap}}{\text{Potential Yield}} \text{ X } 100$$

Table 1a: Difference between FLD plots and Local Check (Farmers Practice)

S. No.	Particulars	Demonstration plot	Local Check (FP)	Gap
01.	Variety	Improved Variety (LRG-41)	Local	Full gap
02.	Seed Rate	18-20 kg ha^{-1}	22-25 kg ha^{-1}	High seed rate
03.	Seed treatment	Treatment with Fungicide and Insecticide	No seed treatment	Full gap
04.	Method of Sowing	Line Sowing	Broadcasting	Full gap
05.	Weed management	Pre- emergence herbicide Pendamethalin	Not used	
06.	Fertilizer	20:40:0 (N:P:K) as basal	No use of fertilizer	Full gap
07.	Installation of Multiplication Cage	25 ha^{-1}	Nil	Full gap
08.	Installation of Bird Purcher	12 ha^{-1}	Nil	Full gap
09.	Plant Protection	Need Based	Improper measures	Partial gap
10.	Technical Guidance	Time to Time	Nil	Full gap

Table 1b: Performance of Pigeon pea on productivity under front line demonstration and farmers practice.

Year	Area in ha	No. of Farmers	Yield q ha^{-1}			% percent increase over local check
			Potential	Demo	Check	
2019-20	20	111	15	12.50	8.9	40
2020-21	20	97	15	12.80	8.7	42
Polled	20	104	15	12.65	8.8	41

Table 1c: Performance of Pigeon pea on technology gap, extension gap and technology index under front line demonstration and farmers practice

Year	Technology Gap (q. ha^{-1})	Extension Gap (q. ha^{-1})	Technology Index %
2019-20	2.50	3.6	16.6
2020-21	2.20	4.1	14.6
Pooled	2.35	3.85	15.6

Table 1d: Economic analysis of front line demonstration plots and farmers practice:

Year	Cost of cultivation Rs. ha^{-1}		Gross Return Rs. ha^{-1}		Net Return Rs. ha^{-1}		B:C Ratio	
	FLD Plots	Farmers Practice	FLD Plots	Farmers Practice	FLD Plots	Farmers Practice	FLD Plots	Farmers Practice
2019-20	24,500	22,150	80,640	60,000	56,140	37,850	2.3	1.7
2020-21	25,400	22,450	88,500	64,000	63,100	41,550	2.4	1.8
Pooled	24,950	22,300	84,570	62,000	59,620	39,700	2.35	1.75

Result and Discussion

Grain Yield: The front line demonstration studies were carried out at various locations of Jamui district in Kharif season 2019-2- and 2020-21. The grain yield of Pigeon pea obtained over the years under recommended practices as well as farmers practice are presented in table 1. Grain yield of Pigeon pea ranged from 12.5 q ha^{-1} to 12.8 q ha^{-1} with mean yield of 12.5 q ha^{-1} under recommended practices on farmers field as against a yield ranged from 8.7 q ha^{-1} to 8.9 q ha^{-1} with a mean of 8.8 q ha^{-1} recorded under farmers practice. The result clearly indicated that the grain yield of Pigeon pea crop obtained under recommended practices due to use of improved variety, seed treatment, line seeding, weed management practices, balance fertilizer, need based plant protection measures and installation of bird purcher and multiplication caze. It has been observed that above technologies improve germination process and increase the germination. It results in uniform crop stand especially in adverse situation like low moist and high moist conditions. Similar result of yield enhancement in Pigeon pea crop in front line demonstration have been documented by singh 2002 and Raju *et al.* 2015 [14].

Technology Gap: Technology gap is the difference between potential yield and demonstration plot yield. Based on the observation technology gap ranged between 2.5 q ha^{-1} and 2.2 q ha^{-1} during study period. The average technology gap was observed 2.35 q ha^{-1}. These finding are similar to the finding of Mukharjee 2003. The technology gaps appear even if the front line demonstration are conducted under the close supervision of farm scientists at the farmers field. This may be attributed mainly due to lack of irrigation, infrastructure, uneven distribution of rainfall Chandra, variation in soil fertility cultivation on marginal is, non congenial weather conditions local specific crop management problems faced in order to harness the yield potential of specific crop cultivars under demonstration plots (Sagar Chandra, 2004 [16]; Vaghasia *et al.* 2005 [17]; Choudhary *et al*., 2007). These observations indicates that location specific crop management is needed of the hour to bridge gap in potential demonstration yields (Vedna *et al*., 2007) [18] becides strengthening of irrigation infracture in the region (Choudhary 2009b) [2].

Extension gap: The extension gap is the difference between demonstrated plot yield and farmers practice plot yield. The successful development, dissemination and adoption of improved technologies for small I holders depend on more than careful planning of research the use of appropriate methodologies in extension (Cramb, 2003 [4]; Biggs Smith, 1998) [1]. The extension gap showed an increasing trend. The extension gap ranging between 3.6 q ha^{-1} to 4.1 q ha^{-1} with an average of 3.85 q ha^{-1} (Hiremath and Nagaraju, 2010) [5]. The result indicated that there is a strong need to educate farmers for adoption of improved production technologies through various extension methods such as method demonstration of seed treatment, line seeding, proper seed rate, application of balance fertilizers and proper plant protection measures at right dose and right time. Extension yield gaps are the indicators of lack of awareness for the adoption of improved farm technologies by the farmers (Kadian *et al.* 1997; Vedna *et al.* 2007 [18]; Choudhary *et al.* 2009b) [2].

Technology Index: Technology Index was calculated as per the formula mentioned in materials and methods. Technology Index indicates the feasibility of generated farm technologies in the farmers field under existing agro climatic situation (Vedna *et al.* 2007 [18]; Choudhary *et al.* 2009b) [2]. Data in table c revealed that technology index varied from 16.6 to 14.6% during the period. On an average the technology index was observed 15.6% in front line demonstrations. This shows the efficiency and effectiveness of the improved technologies as a result of successful technical interventations. Thus achieving higher yields nearest to potential yields will accelerate the adoption of demonstrated technical interventions to increase the yield performance of Pigeon pea.

Economic analysis: Economics returns related to input and output prices of commodities prevailed during the study period were recorded. The cultivation of pigeon pea under FLD gave higher gross return (Rs. 80,640 & 88,500 ha^{-1}) as compared to farmers practice (Rs. 60,000 & 64,000 ha^{-1}). Highest net returns were recorded under front line demonstrations Rs. 56,140 and 63,100 as against to farmers practice i.e. Rs. 37,850 and 41,550 ha^{-1} during the years 2019-20 and 2020-21 respectively (Table d). The variations in the economics return may be attributed to the variable performance of respective pigeon pea cultivar in terms of yield under improved technologies in front line demonstration. Similar results were corroborated with Singh *et al.* 2014 [15].

The Benefit: Cost ratio of pigeon pea during 2019-20 and 2020-21 under improved package of practices were 2.3 and 2.4 respectively while it was 1.7 and 1.8 under farmers practice for the respective years. On an average higher B:C ratio was calculated (2.35) with improved package of practices, where as lowest was found in farmers practice (1.75). The higher benefit cost ratio in demonstration plots is because of higher yields obtained under improved technologies compared to farmers practice during the study period. These results are in corroboration with the findings of Mokiduee *et al*., (2011).

Conclusion

The present study indicated that productivity enhancement under front line demonstration over farmers practice of pigeon pea cultivation created greater awareness and motivated the other farmers to adopt the improved technologies. Front line demonstration is an effective tool for increasing the production and productivity of pigeon pea and it also change the knowledge, attitude, behavior and skill of the farmers. Improved technologies under FLD like improve variety, seed treatment, line seeding, use of balance fertilizer, weed

management practices, installation of bird purcher and multiplication caze, and need based plant protection measures were undertaken in a proper way. The beneficiaries farmers are also play an important role as a source of information to other nearby farmers. This also improved the relationship between farmers and extension workers and built confidence between them.

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