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Front line demonstration in pigeonpea (*Cajanus cajan* L.): An effective strategy to increase the livelihood of the farmers in Vellore district

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Abstract
Frontline demonstration in pigeonpea is to popularize the improved package of practices in farmers field in order to assess the impact of technology transfer and to identify the lacuna in recommended technology with the traditional farming practices. In order to boost the productivity in Vellore district, Tamil Nadu, Agricultural Research Station, Virinjipuram has conducted 20 frontline demonstration in pigeonpea during kharif season 2018-19 and 2019-20. The results were compared with the introduction of a new variety along with the newer technologies with farmers practice. The results on frontline demonstration studies revealed that, an average grain yield of 1300.20 and 1342.0 kg ha^{-1} was obtained in demonstrated plots during 2018-19 and 2019-20, respectively as against the farmers practice which recorded 881.20 and 950.80 kg ha^{-1}, respectively with 47.50 and 41.14 per cent increase over farmers practice. During the demonstration, various gaps such as technology gap reported as 299.80 and 258.0 kg ha^{-1} during 2018-19 and 2019-20, respectively. The highest extension gap of 419.0 kg ha^{-1} was observed during 2018-19 and 2019-20 (391.20 kg ha^{-1}), which shows more emphasize to educate the pigeonpea farmers through various means of adoption. The technology index showed the feasibility of the demonstrated technology in farmers field and varied from 21.20 to 18.66 per cent. With the use of improved package of practices on an average additional investment of Rs.3700/- ha^{-1} and Rs. 4400/- ha^{-1} was made for demonstration. The excess expenditure incurred resulted in the highest net return in demonstration plots of Rs. 40,500/- ha^{-1} as compared to farmers practice of Rs.23,260/- ha^{-1} with 42.56 per cent increase in net return and Rs. 42,200/- ha^{-1} as compared to farmers practice of Rs.27,040/- ha^{-1} with 35.92 per cent increase in net return over farmers practice during 2018-19 and 2019-20, respectively.

Keywords: Front-Line demonstration, impact studies, pigeonpea, improved technology package, farmers practice

Introduction
Pigeonpea, (*Cajanus cajan* L.) is one of the important pulse crop and provides an indispensable source of supplementary protein to vegetarian diet and often referred as poor man's meat. Pigeonpea have a wide range of climatic adaptation and performs differently to changing agriculture scenario. India is the largest producer in the world with 26 per cent share in global production by producing 25.23 million tonnes of pulses with total area of 29.99 million hectares. The average productivity of country is about 841 kg ha^{-1} against average global productivity of 1023 kg ha^{-1} (DES, 2018) [2]. The major pulse contributing states are Madhya Pradesh (33%), Maharashtra (13%), Rajasthan (12%), Uttar Pradesh (9%), Karnataka (8%), Andhra Pradesh (5%), Gujarat (4%), Jharkhand (3%) and Tamil Nadu (2%). In case of Tamil Nadu state, Vellore district the area under pigeonpea occupies an area of about 14609 hectare with the state average yield of 720 kg ha^{-1}. Adoption of traditional farming system and non-adoption of recommended package of practices due to lack of awareness, knowledge and conviction about the latest technologies, abiotic and biotic stresses serve as the key factors for declining of potential yield in pigeonpea. Keeping this in view, the present study was focussed on front-line demonstration in pigeonpea to popularize the new high yielding variety as well as improved package of practices in farmers field for transfer of recent production technologies so as to enhance the production potential of pigeonpea.

Materials and Methods
Frontline demonstration (FLD) in pigeonpea was conducted during the Kharif season for a period of two years (2018-19 and 2019-20) in the selected villages of Vellore District, Tamil Nadu. Totally twenty pigeonpea growers were adopted for demonstration in Veerakovilmedu and Velampattu villages of Katpadi block in Vellore district covering 10 hectare area of

pigeonpea. An improved new variety of pigeonpea viz., CO(Rg) 8, a long duration variety was demonstrated with full package of practices viz., Proper tillage, seed rate, seed treatment and flat bed sowing method along with the application of recommended dose of fertilizers, proper irrigation, weed management and plant protection measures with newer chemicals were demonstrated at farmers field (Table 1).

In order to study the impact of technology package, control plot was also kept where the farmer practices were followed. The study was also aimed to identify the technology gap between demonstrated and control plot yield under existing farmers practice. The yield data was obtained from demonstration and control plot (farmers practice) by random crop cutting method. The technology gap, Extension gap and technological index (Samui *et al*., 2000) [7] were calculated by using the following formula as given below.

$$\text{Percent increase yield} = \frac{\text{Demonstration yield} - \text{Farmers' yield}}{\text{Farmers Yield}} \text{ X100}$$

Technology gap = Potential yield – Demonstrated yield

Extension gap = Demonstrated yield – Yield under existing practice

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstrated yield}}{\text{Potential Yield}} \text{ X100}$$

Results and Discussion

Impact of technology practice

The various gaps encountered between the farmers practice and improved package of practices in pigeonpea under FLD was presented in table 2. Among the various improved technologies full gap (100 per cent) was observed in technology interventions viz., use of new and high yielding varieties, higher seed rate, seed treatment, method and time of sowing, weeding and partial gap of 50 per cent was observed in the usage of fertilizer and pesticide application leading to the definite yield reduction in the achievement of potential yield. Farmers were not much aware about the recent agricultural technologies. In general, farmers mainly rely on the usage of local or old varieties instead of new and high yielding varieties. In addition, the non-availability of the seeds in time and lack of knowledge and interest in obtaining the newer information might be the major reasons. Likewise, they use higher seed rate without seed treatment leading to the failure of better nodulation for nitrogen fixation and higher pest incidence. Besides this, apart from major interventions they give prior importance for sowing immediately after the onset of summer rains without proper agronomic practices with the available low yielding seeds.

Burman *et al*., (2010) [1] reported that there is a gap in adoption of technology in major pulse crop both in rainfed and irrigated cropping system. The results revealed that, an average grain yield of 1300.20 and 1342.0 kg ha^{-1} was obtained in demonstrated plots during 2018-19 and 2019-20, respectively as against the farmers practice which recorded 881.20 and 950.80 kg ha^{-1}, respectively. The significant higher yield in case of demonstrated plots resulted in 47.50 and 41.14 per cent increase over farmers practice due to lack of awareness and knowledge. Similar trend of crop wise per cent increase in pigeonpea was also reported by Singh (2002) [9] and Singh *et al*., (2019) [8] with the use of high yielding varieties, production and protective measures that improve the yield in pulses.

The technology gap, the difference between potential yield with the demonstration yield was 299.80 and 258.0 kg ha^{-1} during 2018-19 and 2019-20, respectively during the demonstration period. This technology gap observed may be attributed to the variation in soil structure, type, soil fertility, agricultural practices and local climatic conditions as reported by Singh *et al*. (2007) [10].

Extension gap was observed as 419.0 and 391.20 kg ha^{-1} which is almost double the technology gap in both the years tested during the demonstration period. The highest extension gap of 419.0 kg ha^{-1} was observed during 2018-19 and 2019-20 (391.20 kg ha^{-1}), which shows more emphasize to educate the pigeonpea farmers through various means of adoption of improved production as well as protection technologies so as to reverse this trend of wider extension gap in the years to come. More and more use of latest crop production technologies with the high yielding varieties will subsequently results in the reduction in an alarming trend. Similar findings is also in corroboration with the findings of Pandey *et al*. (2017) [5]

The technology index shows the feasibility of the demonstrated technology in farmers field. The technology index varied from 21.20 to 18.66 per cent. Higher the technology index reflected the insufficient extension services for transfer of technology. Lower the value of technology index, shows the efficacy of good performance of various technological interventions. The variation might differ according to the properties of soil, fertility status and local abiotic and biotic stresses as reported by Kumar *et al*. (2014) [3]

Impact of Economics

Different technological inputs viz., introduction of new and high yielding variety, recommended dose of fertilizers, seed treatment, need based plant protection measures were absolutely considered as the strong interventions for an increase in yield with good return and the data was presented in table 3. With the use of improved package of practices on an average additional investment of Rs.3700/- ha^{-1} and Rs. 4400/- ha^{-1} was made for demonstration. The excess expenditure incurred resulted in the highest net return in demonstration plots of Rs. 40,500/- ha^{-1} as compared to farmers practice of Rs.23,260/- ha^{-1} with 42.56 per cent increase in net return and Rs. 42,200/- ha^{-1} as compared to farmers practice of Rs.27,040/- ha^{-1} with 35.92 per cent increase in net return over farmers practice during 2018-19 and 2019-20, respectively. This variation in the per cent might be due to the existence of local market price fluctuations prevailed. The highest yield obtained under improved technologies compared to farmers practice reflected in the addition return was also reported by Lathwal (2010) [4] and Raj *et al*. (2013) [6].

Table 1: Improved technology package Vs farmers practice under front-line demonstration in pigeonpea

S. No	Particulars	Technology interventions	Farmers practice	Gap (%)
1.	Variety	CO (Rg) 8	Local variety	100
2.	Fertilizer dose (Kg/ha)	Basal application Farm yard manure: 5000 NPK : 25:50:25	Use of lower dose of fertilizers and non-application of Farm-yard manure as basal	50
3.	Seed rate (Kg/ha)	8	Higher seed rate	100
4.	Seed treatment	1.Rhizobium + Phosphobacteria+ Trichoderm: 25g/kg 2. Carbendazim: 3 g/kg	No seed treatment	100
5.	Sowing method	Flat bed sowing	Broadcasting and as intercrop in Ground nut ecosystem	100
6.	Weeding	Pre-emergence Pendimethalin : 1.25 kg/ha Hand weeding : 45 days after sowing	Hand weeding alone at a later stage	100
7.	Plant protection	Installation of pheromone traps for Gram podborer, Pheromone traps (*Helicoverpa armigera*) :12 traps/ha Need based application of Indoxacarb @15.8 EC: 73 g a.i /ha	No judicious use	50

Table 2: Estimation of Yield and gap in improved technology package Vs farmers practices in pigeonpea under front-line demonstration

Year	Demo units	Demo Area (ha)	Average yield (kg/ha)		% increase	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index
			IP	FP				
2018-19	10	5	1300.20	881.20	47.50	299.80	419.0	21.20
2019-20	10	5	1342.00	950.80	41.14	258.00	391.2	18.66

IP: Improved package; **FP**: Farmers practice

Table 3: Economic impact of improved package Vs farmers practices in pigeonpea under front-line demonstration

Year	Cost of cultivation (Rs.ha)		Additional cost in IP (Rs/ha)	Gross Income (Rs/ha)		Net return (Rs./ha)		Profit (Rs./ha)	Increase over FP (%)
	IP	FP		IP	FP	IP	FP		
2018-19	24500	20800	3700	65000	44060	40500	23260	17240	42.56
2019-20	24900	20500	4400	67100	47540	42200	27040	15160	35.92

IP: Improved package; **FP**: Farmers practice

Conclusion

The findings clearly reveals that front-line demonstration influentially brought out that the yield of pigeonpea could be increased with interventions viz., varietal improvement, seed rate, seed treatment, recommended fertilizer applicaion, timely weed management and need based application of insecticides. FLD produces a significant positive results and also provides an oppurtunity for the researcher to demonstrate the productivity potential under real-farming situation. The effective demonstration actually reduces the technological and extension gap as the farmers were not aware of improved package of practices. There is no doubt, inorder to lower the technology index, technologial and extension gap, FLD acts as an accelerating tool in pigeonpea among the farming community for better production. Hence with these adoption of improved package of practices in pigeonpea result in area expansion and higher productivity per unit area.

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