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KVK interventions in yield and economics of black gram cultivation through cluster frontline demonstrations

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Abstract
An investigation studies in Black gram cultivation was carried out during 2020-21 and 2021-22 the Rabi seasons in the Kancheepuram district of Tamil Nadu. In an area of 60 ha, 150 farmers were identified for implementing 150 demos in 0.4 ha area to demonstrate the improved technologies for Blackgram production and its attributes on yield and economics of cultivation. The technologies recommended for adoption included resistant varieties, Bio agent applications, Soil test based fertilizer usage, and Integrated Pest management practices. Critical inputs like seeds, bioagents, Pulse wonder and with traps were distributed to the farmers. Training on Integrated Crop Management practices was conducted for improving the adoption level for effective implementations. In the study period of two years, demonstrated areas recorded yield increase compared to farmer's fields. The yield obtained in the demonstrated field was 10.17 q/ ha (VBN 6), 10.48 q/ kg in VBN 8 compared to farmer's field 9.5 q/ha during 2020-21 and 7.75 q/ha (VBN 8) and 6.13 q/ha in demonstrated and farmers' fields during 2021-22 respectively. The percent yield increase observed was 7.05 for VBN 6, 10.42, and 18.76 for VBN 8 during demonstrations. The demonstrated plots showed high net returns and benefit cost ratio (1.75 in 2020-21 and 1.68 in 2021-22)) when compared to farmer's practices 1.43 (2020-21) and 1.31 (2021-22) respectively. The benefitted farmers were encouraged to seed farm registration which in turn increased their income.

Keywords: CFLD, pulse production, yield, technology gap, extension gap, technology

Introduction
Black gram production shares the major income source for the farmers in Kancheepuram district after Paddy cultivation. Black gram is a good and chief source of protein for the preparation of idly batter. Though the crop is preferably grown after the Paddy harvest, the area under cultivation is less resulting in lower yield. District average productivity is 850 kg/ha. Kancheepuram lies in the Northern Eastern Zone of Tamil Nadu. The total cultivable area is 142141.40 ha out of which Black gram covers 2201.37 ha of total Pulses are of 2679.81 ha (District handbook 2021-22). The crop is mainly grown as sole, intercrop in Groundnut, and as border crop in the Paddy and Vegetable fields. Despite the release of various Agricultural technologies, the farmers are still facing the problem of quality seed supply and adoption of Crop management practices.
Krishi Vigyan Kendra, Kattupakkam located in the district has a major role in disseminating the technologies for the benefit of the farmers. The Cluster Frontline Demonstrations in Pulses sanctioned by the National Food Security Mission under the Government of India promotes to transfer of ICM practices among the farming community in large numbers involving training, demonstrations, field visits, and collecting feedback. To increase area, production, and productivity under Black Gram, Cluster Frontline Demonstrations were conducted in 60 ha during 2020-21 and 2021-22 covering 150 demonstrations in villages of Kancheepuram and Chengalpattu districts.

Materials and Methods
The present study was carried out by the Krishi Vigyan Kendra, Kattupakkam, Tamil Nadu Veterinary and Animal Sciences University during the Rabi season of 2020-21 (Nerumbur, Nerkundram, Pullalur, Mayankulam, Vadagal and Kongadu villages) and 2021-22 (Sooradimanagalam, Thathalur, Pullalur and Elayanarvelur villages). The demonstrations included the following practices.

- Variety released from Tamil Nadu Agricultural University, Coimbatore (VBN 6 & VBN 8).
- Seed treatment with *Trichoderma viride* @ 4 gm/kg of seeds.
- Soil application of Farmyard manure @ 12 t/acre.
- Need based fertilizer applications and INM practices.
- Foliar applications of TNAU Pulse Wonder @ 2 kg/acre.
- Adoption of Integrated Pest and Disease management practices.
- Manual hand weeding.
- Harvesting and processing.

The crops were sown during the Rabi season (October-November) in irrigated conditions. At the farmer's field, their method of cultivation was followed and in the demonstration fields, the recommended practices were adopted. The soil was sandy loam to clay loam with pH 6.5-7.6. Before sowing *Trichoderma viride* @ 4 gm/kg seed treatment was given and then broadcasted @ 20 kg/ha. Irrigation given four times during critical stages of the crop. Weeding is done on 30-35 days after sowing manually. Pheromone traps and sticky traps @ 12 Nos/ha installed to monitor the borers and whiteflies incidences. Field visits were made to observe the growth parameters and record yield data. Economic analysis of Black gram demonstration included the cost of inputs like seed, fertilizers, pesticides, etc. purchased by the farmers (in farmers' practice)/provided by the KVK (in demonstration plots) as well as hired labor (if any), ploughing charges by bullocks/tractor (if any) and post-harvest operation charges (if any) paid by the farmers. The gross and net returns were worked out accordingly by taking the cost of cultivation and the price of grain into consideration. Similarly, the benefit-cost ratio was worked out as a ratio of gross returns and corresponding cost of cultivation (Mishra *et al.*, 2009). The different parameters as suggested by Yadav *et al.* (2004) [14] were used for calculating gap analysis, cost, and returns.

Technology gap = Demonstration yield – Potential yield

Extension gap = Demonstration yield – Farmer's practice yield

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

Results and Discussion

The production techniques (Table 1) followed by the farmers indicated that the cultivation of high yielding varieties and due importance on integrated practices were not followed resulting in low yield and low market value. Farmers also did not follow seed treatment with bioagents, an important component in increasing the yield and yield attributes of pulse crops as stated by Kumar and Elamathi, (2007) [5]. Similar observations for gaps in improved technologies and farmers' practices were also observed by Burman *et al.* (2010) [2] and Kumar *et al.* (2014) [6] in different crops.

Table 1: Comparison between package of the practices recommended and farmer's practice followed for Blackgram

S. No.	Details	Recommendations	Farmer's practice
1.	Farming situations	Rabi and Irrigated	Rabi and Irrigated
2.	Variety	VBN 6, VBN 8	Local variety
3.	Seed rate (kg/ha)	20.0	25.0
4.	Manures and Fertilizers	As per soil testing	Imbalance usage
5.	Weed management	Hand weeding	Weedicides applied
6.	Plant protection measures	IPM measures adopted. Pesticides applied based on pest and disease infestations.	Excess pesticides used

The yield of the crop from Table 2 shows that yield in the demonstrated field recorded 10.17 q/ha in VBN 6 and 10.48 q/ha in VBN 8 variety compared to local variety (9.50 q/ha). The percent increase in yield of demonstration plots over farmers' plots ranged from 7.05 to 18.76 percent. This increase in grain yield of demonstration plots was mainly due to the recommended package of practices. Use of resistant high yielding varieties of Black gram, optimum sowing time, seed treatment, judicious use of fertilizers and application of crop boosters, and integrated weed and plant protection measures followed under CFLDs attributed the yield of Black gram compared to farmer's practices. In farmer's practices, the use of local varieties, excess application of fertilizers, and unwanted pesticide usage resulted in low yield and increased cultivation costs (Table 2). Dwivedi *et al.* (2019) [4] reported similar reports in Chickpeas.

Table 2: Black gram yield as influenced by recommended practices

Year	Variety	Area (ha)	Yield q/ha			Percent increase over farmer practices	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index
			Potential Yield	Recommended Technologies	Farmers Practice				
2020-21	VBN 6	4	8.5	10.17	9.5	7.053	1.67	0.67	-19.65
2020-21	VBN 8	26	9.88	10.49	9.5	10.42	0.61	0.99	-6.17
2021-22	VBN 8	30	9.88	7.28	6.13	18.76	-2.6	1.15	+26.32

Technology gap

The technology gap means the difference between the potential yield and yield of the demonstration field. The technology gap in the demonstration yield over potential yield was 1.67 (VBN 6), 0.61 (VBN 8), and (-) 0.26 in VBN 8 during 2020-21 and 2021-22 respectively. The observed technological gap may be attributed to the dissimilarity in the soil fertility status, insect pest attack, and uneven rainfall distribution that prevailed during crop season at different locations. Similar findings were observed by Chandrakar *et al.* (2018) [3]. The results were found to be satisfactory as the technology gap was found to be reducing. Similarly, Mubarak and Shakoor (2019) [10] reported technological interventions for Reducing Yield Gaps in Rice.

Extension gap

Extension gap of 0.67 q/ha, 0.99 q/ha, and (-) 2.6 q/ha was observed during 2020-21 and 2021-22, respectively (Table 2). It shows the difference between in yield obtained in the demo and the farmer's plot. The results matched with earlier findings of Rachhoya *et al.* (2018) [11] and Saravanankumar (2018) [13]. Adopting the latest technologies in crop production will help in reducing the extension gap. This emphasized the need to educate the farmers through various extension means. The Cluster Front Line Demonstration can help in the adoption of improved production and protection technology. Meena and Aishwarya (2018) [7] reported Greengram production increase through Frontline Demonstrations.

Technology index

The technology index shows the feasibility of the evolved technology at the farmers' fields. The lower value of the technology index is the feasibility of the technology (Mishra *et al.*, 2007) [9]. The data (Table 2) showed that maximum technology index values (-) 19.65 and (-) 6.17 were observed in VBN 6 and VBN 8 in 2020-21 and 26.32 during 2021-22 respectively. This variation in the technology index might be due to prevailing weather conditions in the area during the years of study.

Performance of the demonstrated variety

Black gram VBN 8 variety performed well yielding 10.49 q/ha with an average 58 number of pods per plant compared to the farmer's check variety 9.50 q/ha with 38 pods per plant (Table 3.) while VBN 6 recorded 10.17 q/ha with 48 pods per plant in 2020-21 and 7.28 q/ha (43 pods per plant) in VBN 8 during 2021-22. This also showed resistance to Yellow Mosaic Virus disease incidence. The yield gap (VBN 8) was minimized to the extent of 22.24% in district yield and 64.40% in state yield respectively. Similar reports are given by Meena and Singh (2016) [8] in moth bean.

Table 3: Performance of demonstrations

Year	Variety	Yield q/ha				Yield gap Minimized (%)	
		Recommended Practice	District Average D	State Average S	Farmers yield F	District	State
2020-21	VBN 6	10.17	8.50	6.32	9.50	19.65	60.92
	VBN 8	10.49				22.24	64.40
2021-22	VBN 8	7.28	5.17	5.87	6.13	24.02	18.76

q/ha Economic parameters

The economic analysis of the data for the study period for Black gram (Table 4) clearly revealed that during both the years of study, the gross return, net returns and benefit: cost ratio were higher in demonstrations where recommended practices were adopted. The benefit cost ratio of demonstrated fields was 1.06 (VBN 6) and 1.75 (VBN 8) in 2020-21 and 1.68 in 2021-22 respectively. These results were in line with the earlier findings by Kumar *et al.* (2014) [6] and Anuratha *et al.* (2018) [1]. Sanjay *et al.* (2020) [12] reported the role of CFLD in enhancing productivity of Black gram under rainfed conditions.

Table 4: Economic parameters

Year	Farmer's Existing practice			Demonstrations		
	Gross cost (Rs. /ha)	Net return (Rs. /ha)	B:C Ratio	Gross Cost (Rs. /ha)	Net return (Rs. /ha)	B:C Ratio
2020-21	40,250.00	17,250	1.43	38,745.00	25,410.00 (VBN 6) 28,855.00 (VBN 8)	1.06 (VBN 6) 1.75 (VBN 8)
2021-22	29,397.33	9,230.80	1.31	31267.33	21170.00	1.68

Fig 1: Field visit – Pest monitoring

Fig 2: Pulse wonder application

Fig 3: Black gram harvesting

Conclusion

By adopting the recommended practices and improved technology, the yield of Black gram crop can be increased to a greater extent in the district. Yield and economic returns increased by adopting the proven in Black gram. The increase was attributed due to use of high yielding recommended varieties sowing techniques, nutrient management, weed management and plant protection measures taken in accordance of recommended package of practices. Favorable, benefit cost ratio indicated the economic viability of the Cluster Frontline Demonstrations and encouraged the farmers for adoption. Thus, it can be concluded that technology gaps can be reduced by providing scientific intervention to the farmers which will lead to enhance the production and productivity of Black gram in the district. Moreover, the reduction of the technology index in general in Black gram crops over the year of the study exhibited the feasibility of technologies demonstrated in frontline demonstrations. Further there is need to educate the farmers for adoption of improved technologies through CFLDs on Black gram crop so that poor farmers with limited resources could improve their livelihood and diversify their farming situation.

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