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Yield maximization and popularization of improved production technology in black gram through CFLD on Pulse programme in Shivpuri district of Madhya Pradesh

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Abstract
Black gram (*Vigna mungo* L. Hepper) is one of the most important pulse crops, grown throughout the country. The productivity of Black gram is low because of non-adoption of available technologies by the farmers. In this view Krishi Vigyan Kendra, Shivpuri conducted 200 demonstrations at farmers field of Shivpuri district during the last 4 years i.e., from 2017-18 to 2020-21 through integrated crop management (ICM). It revealed that increase in crop yield was found due to variation in agro-climatic situations under rain fed condition. The result showed that, an average highest yield of FLDs plots of Black gram by adopting ICM technology was 8.54 q/ha compared to farmers practice (6.60 q/ha). Adoption of improved production technology increased the yield 25.39 per cent over farmer practices. The average technological gap, extension gap and technological index were noticed 3.58 q/ha, 1.94 q/ ha and 29.39 per cent respectively. The average net profit of Rs. 23966 per ha was recorded under FLDs plot over Rs 14200 per ha under farmer practice. The higher average grain yield was recorded in demonstration plots over the years compared to local check due to increased knowledge and adoption of full package of practices. However, year wise fluctuation in yield was observed which might be attributed to climatic fluctuations in different years.

Keywords: Technological gap, extension gap, technology index, front line demonstration (FLD) and integrated crop management (ICM)

Introduction
In a country like India, pulses, also called as grain legumes are the cheapest and most widely consumed source of protein. They are also used as feed and fodder for cattle and other pet animals. They contain very good amount of protein ranging from 20 to 30% which is two to three times greater than that of cereals. Pulses are also good source of lysine which is an essential amino- acid for human body. They also compliment that of cereals to provide protein and other nutrients for human dietary requirement. That's why; they have become highly important in 'Cereal-pulse' diet, particularly for the vegetarian people (Chatterjee, 1975).[1] Thus, for overcoming the widespread malnutrition in developing country like India, increased production and higher consumption of pulses is considered one of the best ways.
Among the different pulses, black gram is a rich source of protein which is one of the essential nutrients of the human diet. Black gram contributes to 10% of the national pulse production. The crop improves the soil fertility by fixing atmospheric nitrogen in the soil. It is reported that, black gram and green gram are reported to meet up to 50 per cent of their requirement from the N2 fixed by them (Anon 1972) [2]. Black gram is a rich source of vegetable protein containing about 24 per cent protein, which is almost three times that of cereals and apart from that it provides many other minerals and vitamins (Anonymous, 2017).[3] In addition, it is also used as nutritive fodder, especially for milch animals (Sathe, 1996).[4]
For the production of black gram, a number of technologies are present but farmers adopt them rarely and are still practicing the unscientific methodologies. Many production technologies for black gram cultivation have been evolved for increasing the productivity but farmers have hardly adopted a few of them and those in a nonscientific manner. It is well accepted fact that front line demonstrations on crops are important to minimize the technological gap among farming community. The aim of the present study is to identify the production constraints, to know the technology gap between the potential yield and demonstrated yield, extension gap between demonstrated yield and yield under famers practice and technology index, through various extension methods including the Participatory Rural Appraisal (PRA) and ultimately help farmers to boost the production and productivity of black gram which is an important

pulse crop in Shivpuri district of Madhya Pradesh having crop coverage share of about 15-20%.

Materials and Methods

The Frontline demonstrations (FLDs) were conducted on farmers' field to demonstrate the impact of integrated crop management technology on Black gram productivity over four years during *kharif* 2017--18 to 2020-21. Each FLD was laid out on 0.4 ha area, adjacent 0.4 ha was considered as control for comparison (farmer's practice). The integrated crop management (ICM) technology comprised of improved variety, proper tillage operations and recommended seed rate, seed treatment with bio agents, weed management and proper nutrient and pest management based on economic threshold level (Table 1).

The FLD was conducted to study the technology gap between the potential yield and demonstrated yield, extension gap between demonstrated yield and yield under existing practice and technology index. The yield data were collected from both the demonstration and farmers practice by random crop cutting method. Qualitative data was converted into quantitative form and expressed in terms of per cent increase in yield. (Narasimha Rao *et al.*, 2007) [5].

The data was further analyzed by using simple statistical tools. The technology gap, extension gap and technological index were calculated (Samui *et al*., 2000) [6].

Technology gap = Potential yield – Demonstration

Yield Extension gap = Demonstration yield – Farmers yield

Technology index = {(Potential yield - Demonstration yield) / Potential yield} X 100

Table 1: Comparison of Improved production technology and Farmers practices of Black gram under FLD

S. No.	Technology	Improved practices	Farmers practice	GAP (%)
1	Variety	PU 31& Pratap Urd1	Local	100
2	Land preparation	Ploughing and harrowing	Ploughing and harrowing	Nil
3	Seed rate	15 kg/ha	20 kg/ha	33.3
4	Sowing method	Line sowing	Line sowing	Nil
5	Seed treatment	Biofertilizers and Trichoderma	No seed treatment	100
6	Fertilizer dose (NPK kg/ha)	20:50:20	12:30:0	Partial gap
7	Post-emergence herbicide	Imazathapyr (@ 0.80 l/ha)	No herbicide	100
8	Plant protection	IPM	Indiscriminate application	100
9	Grading the produce	Grading followed	Not followed	100

Results and Discussion

Black gram is the most important kharif pulse crop of Shivpuri district of Madhya Pradesh. Deterioration in soil health and crop productivity is being observed due to continuous use of local varieties, injudicious use of fertilizers and pesticides. Frontline demonstrations are effective educational tools in introducing various new technologies to the farmers to boost the farmer's confidence level by comparison of productivity levels between improved production technologies in demonstration trials. The results obtained through FLDs data are being discussed as following.

Crop Performance and Yield

The performance of Black gram crop with the adoption of improved technologies is assessed over a period of four years and is presented in table 1 and 2. From the demonstrations it revealed that, the integrated crop management practice in black gram recorded 29.39 per cent increase in the yield as compared to the farmers practice (6.60 q/ha) as against 8.54 q/ha in demonstrated technology. The average yield varied in each of four years however, average highest yield (10.62q/ha) was recorded during 2017-18. This may be attributed to variation in rainfall and its distribution during the crop growth and reproductive stage and better utilization of applied nutrients (Poonia and Pithia, 2011) [7]. The above findings are in similarity with the findings of Raju Teggelli *et al.* (2015) [8] and Tomar (2010) [9]. The higher yield of black gram under demonstrated technology was due to use of latest high yielding varieties, integrated nutrient management and integrated pest management (Tomar *et al*., 1999 and Singh *et al 2020*) [10, 11].

Table 2: Performance of front line demonstrations on Black gram in Shivpuri district of MP

Year	No. of Demonstrations	Area (ha)	Yield (q/ha)			% increase in yield over farmers practice
			Potential yield	Demonstration Yields	Farmers practice	
2017-18	50	20	12.5	10.62	6.90	35.02
2018-19	50	20	12.0	8.75	7.50	16.40
2019-20	50	20	12.0	8.88	7.50	18.40
2020-21	50	20	12.0	5.93	4.50	31.77
Average	50	20	12.12	8.54	6.6	29.39
Total	200	80				

Table 3: Technological gap Extension gap and Technological index of black gram

Year	Area(ha)	Technological gap (q/ha)	Extension gap (q/ha)	Technological index (%)
2017-18	20	1.88	3.72	15.04
2018-19	20	3.27	1.23	27.25
2019-20	20	3.12	1.38	26.00
2020-21	20	6.07	1.43	50.58
Average	20	3.58	1.94	29.72

Technology Gap

The technology gap means the differences between potential yield and yield of demonstration plot. The technology gap of demonstration plots were 1.88, 3.27, 3.13 and 6.07 q/ha during 2017-18, 2018-19, 2019-20 and 2020-21 (Table-3), respectively. On an average technology gap under four years FLD programme was 3.58 q/ha. The technology gap observed may be attributed to dissimilarity in the soil fertility status, crop protection practices and local climatic situations.

Extension Gap

Extension gap means the differences between demonstration plot yield and farmers practice yield. Extension gap of 3.72, 1.23, 1.38, and 1.43q/ha was noticed during four years demonstration programme of 2017-18, 2018-19, 2019-20 and 2020-21 (Table-3), respectively. On an average extension gap under four year FLD programme was 1.93q/ha which emphasized the need to educate the farmers through various extension programs i.e. front line demonstration for adoption of improved production and protection technologies, to revert the trend of wide extension gap. The findings are in accordance with Sunilkumar *et al.* (2018) [12]. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap and enhance farmers' income and national production of black gram.

Technology Index

Technology Index indicates the feasibility of the demonstrated technology in the farmers' fields. Lower the value of technology index, higher is the feasibility of the improved technology. The technology index varied from 15.4 to 50.58 per cent (Table-3). On an average technology index was observed 29.72 per cent during the four years of FLD programme, which shows the efficacy of good performance of technical interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield performance of black gram. Similar findings were reported by Saikia *et al.* (2018) [13].

Economic Return

The economic performance of FLDs (presented in Table 4) showed profitable trend under demonstrated technology. The cultivation of black gram under improved technologies gave higher net return of Rs. 16500, 31135, 33740 and 14489 per as compared to farmers practices (Rs 6000, 19550, 24250 and 7000) per ha in 2017-18, 2018-19, 2019-20 and 2020-21 respectively. An average net return and B:C of demonstration field was 23966 Rs/ha and 2.23 respectively as compared to farmers practice (Rs 14200 per ha and 1.78). Similar findings were reported by Singh *et al*. (2014)[14] and Raju Teggelli *et al.* (2015).[8] The benefit cost ratio of demonstrated technology was higher than farmer's practices in all the years and this may be due to higher yield obtained under improved technologies compared to farmer practices. These finding are in line with the findings of Mokidue *et al.* (2011).[15]

Table 4: Impact of improved production technology on economics of Black gram

Year	Cost of cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		B:C Ratio	
	Demo	Farmer practice	Demo	Farmer practice	Demo	Farmer practice	Demo	Farmer practice
2017-18	22000	20000	38600	25000	16500	6000	1.82	1.33
2018-19	18600	17500	49735	37050	31135	19550	2.70	2.12
2019-20	20000	18500	53740	42750	33740	24250	2.68	2.31
2020-21	20572	20000	35061	27000	14489	7000	1.70	1.35
Average	20293	19000	44284	32950	23966	14200	2.23	1.78

Conclusion

It is concluded from the study that there exists a wide gap between the potential and demonstration yields in Blackgram mainly due to technology and extension gaps and also due to the lack of awareness about new technology in black gram cultivation in Shivpuri district of Madhya Pradesh. The FLD produces a significant positive result and provided the researcher an opportunity to demonstrate the productivity potential and profitability of the latest technology in farmers' field conditions, which they have been advocating for long time. This could be besieging some of the constraints in the existing transfer of technology system in the current situations. The productivity gain under FLD over existing practices of black gram cultivation created greater awareness and motivated the other farmers to adopt suitable production technology of black gram in the district. However, yearly variation in yield of black gram in both the plots i.e., demonstration plot and farmers practice was observed which suggested an opportunity to researchers to develop more resilient technologies to climate.

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