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Factors affecting productivity of black gram in Mohali district of Punjab

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Abstract
The cluster frontline demonstrations on black gram variety Mash 114 were conducted on 20 ha area by Krishi Vigyan Kendra, S.A.S. Nagar (Mohali) in three blocks of district Mohali namely Kharar, Majri and Dera Bassi during *kharif* season of 2018-19. The results revealed that use of yellow vein mosaic virus tolerant variety + seed treatment with rhizobium culture + line sowing + plant protection measures (mechanical control + insecticide) recorded higher average yield (9.5 q/ha) over control plots (7.92 q/ha). Benefit cost ratio for demonstration and control plots was 1.57 and 1.37, respectively. The yield increase of demonstration plots over control plot was observed 19.94%. Thus, it can be concluded that the black gram productivity could be enhanced by encouraging the farmers through adoption of recommended technologies which were followed under demonstration plots.

Keywords: Black gram, cluster frontline demonstrations, productivity, yellow vein mosaic virus, yield

Introduction
Pulses play an important role in Indian agriculture by providing proteinaceous grains and nutritive fodder. These also increase soil fertility for obtaining high yield in succeeding crops. Pulses contribute 11 per cent of the total intake of proteins in India (Reddy, 2010) [9]. These are referred to as poor man's meat and rich man's vegetable (Singh and Singh 1992) [10]. Black gram is native to India (Vavilov, 1926) [12]. Among the various pulses, black gram contains approximately 25-28% protein, 4.5-5.5% ash, 0.5-1.5% oil, 3.5-4.5% fibre and 62-65% carbohydrate on dry weight basis (Kaul, 1982) [7]. It is valued for its high digestibility and freedom from flatulence effect (Fary, 2002). Like other pulse crops, black gram plays a vital role in maintaining nitrogen balance in the soil. It possesses nodules on its roots, containing *Rhizobium* sp (nitrogen fixing bacteria), which fixes nitrogen in symbiotic association with the plant and release a significant amount for plant growth and development. India is the largest producer as well as consumer of black gram. In India black gram is prsently cultivated over an area of 5.44 Mha (*kharif* + *rabi*) and recorded an average production of 3.56 Mt at a productivity level of 655 kg/ha (Anonymous 2019) [1]. In Punjab state, black gram was grown on 2.1 thousand hectare area with production of 1.1 thousand tones and average yield of 5.01q/ha during 2016-17 (Anonymous, 2018) [2]. To improve crop yield, indiscriminate use of pesticides by the farmers leads to phytotoxicity and destruction of beneficial organisms such as predators, parasitoids, microorganisms and pollinators (Luckman and Metcalf, 1978) [8]. Integrated pest management (IPM) approach is the best alternative to overcome such problems. To promote crop diversification, efforts were made by KVK (Krishi Vigyan Kendra), Mohali to enhance productivity of black gram by conducting cluster frontline demonstrations (CFLDs) at the farmer's field with adoption of IPM strategy in district Mohali. FLD is the major tool to disseminate new technology at farmer's field which is designed to overcome the problems faced by farmers at field level in order to show the worth of improved package of practices for enhancing the crop productivity.

Materials and Methods
The CFLDs were conducted over 20 ha area, divided into three clusters under the project "Cluster Frontline Demonstration on Pulses" during *kharif* season 2018.

A total of 55 innovative farmers from three blocks namely Majri, Kharar and Dera Bassi of district S.A.S. Nagar (Mohali) were selected by KVK, Mohali for this project. Only those farmers were considered under CFLDs who also cultivated local black gram varieties at their fields. District Mohali of Punjab falls under submountainous zone where rice-wheat rotation is practiced generally.

Farmers were guided regarding benefits of crop diversification and maintenance of soil health to increase crop yield where cultivation of pulses plays an important role. They were advised for cultivating yellow vein mosaic virus (YVMV) resistant variety of black gram. The seed treatment was performed with rhizobium culture at the time of sowing which helps to increase grain yield. Farmers were trained to follow the package and practices for black gram cultivation as recommended by the Punjab Agricultural University, Ludhiana and need based input materials provided to the farmers (Table 1). The farmers were also advised for line sowing to maintain row to row distance of 30 cm in demonstration plots. For demonstration plots, timely advisories on integrated crop management (ICM) and integrated pest management (IPM) were given to the farmers. In case of control plots, traditional practices were followed with Mash 338 and other desi local varieties by the farmers. Yield data was collected separately from both plots (demonstration and control) under the supervision of KVK scientists. The results were compiled and analyzed by t-test at 5% level of probability ($p \leq 0.05$) using least significant difference (LSD) test through SAS analysis (Gomez and Gomez, 1984) [5].

Table 1: Details of need based inputs of black gram used in CFLD

S. No	Crital input	Name of critical input	Technology demonstrated
1	Seed	Mash 114	• High yielding and yellow mosaic virus resistant variety • Seed treatment with rhizobium culture @ half kg/acre seed • Weedicide: Pendimethalin@1litre/acre • Insecticides: Mechanical control & Ekalux 25 EC (quinalphos) @ 500ml/ acre to control hairy caterpillar • Asataf 75SP (acephate) @ 800g/acre to control pod borer (*Helicoverpa armigera*) and tobacco caterpillar (*Spodoptera litura*)
2	Seed treatment with culture	Rhizobium culture	
3	weedicide	Pendimethalin	
4	insecticides	Quinalphos Acephate	

Results and Discussion

The data (Table 2, 3) revealed that average yield in demonstration plots was 9.5 q/ha which was significantly higher than the average yield of control plots (7.92 q/ha). Earlier, similar pattern of higher yield in demonstration plots was observed by Veeramani *et al.* (2017) [13] who conducted CFLDs on black gram at Vallore district of Tamil Nadu. In case of our demonstration plots, gross and net returns were Rs. 54850/ha and Rs. 19850/ha, respectively whereas for control plots, gross returns were Rs. 47,000/ha and net returns were Rs. 12600/ha. The increase in yield was observed 19.94 per cent in demonstration plot over control plots. The benefit cost ratio for demonstration and control plots was 1.57 and 1.37, respectively. Hence, by adopting proven technologies of black gram, yield potential and economic returns from black gram cultivation can be raised for the farming community. These results were in line with the earlier findings by Saravanakumar (2018) [11] and Anuratha *et al.* (2018) [3].

Selection of crop variety is very important according to its suitability towards particular area. The selected variety, Mash 114 is fairly resistant to YVMV, bacterial leaf spot and cercospora leaf spot diseases. Thus, use of this variety saved the cost of fungicides and farmers got chemical free produce. Another practice which contributes to enhanced crop yield under demonstration plots is seed treatment with rhizobium culture. To ensure an optimum rhizobial population in the rhizosphere, seed inoculation of legumes with an efficient rhizobial strain is necessary. This helps to improve nodulation, N2 -fixation solicits crop growth and yield of leguminous crops (Henzell, 1988) [6]. Line sowing was practiced during demonstrations because it promotes better weed/disease management and easy harvesting. Other advantage of line sowing is possibility of reducing seed rates due to optimum placement of seeds in furrows. Only need based chemical use was practiced to control insects. Most of the black gram insects (Hairy caterpillars, tobacco caterpillars, pod borer) were below economic threshold level (ETL). Young larvae of hairy and tobacco caterpillar were collected by pulling the infested leaves and destroyed. Grown-up hairy caterpillars were destroyed by crushing them under feet. Insecticides were used only in few cases where insect level crossed ETL.

Table 2: Effect of improved technology on yield and economics of Mash 114

Treatment	Yield (q/ha)	Gross cost (Rs./ha)	Gross Return (Rs./ha)	Net Return (Rs./ha)	B:C ratio
T1: Farmers practice (broadcasting, irrational use of insecticides)	7.92	34400	47,000	12600	1.37
T2: (Rhizobium culture + line sowing + plant protection)	9.5	35000	54850	19850	1.57

Table 3: t-test comparing yield of demonstration and control plots

Treatment	Number of demonstrations	Mean Yield (q/ha)	Standard Deviation	Standard Error	Minimum	Maximum	p-value
T1	55	7.92	0.38	0.05	6.50	8.50	<0.0001*
T2	55	9.5	0.86	0.12	7.60	10.60	

T1-Demonstration Plots; T2-Control plots; *$p \leq 0.05$ = significant

Constraints faced by farmers

The yield of control plots of farmers was affected by various factors like improper seed selection, no seed treatment, broadcast method of sowing and unawareness of ICM and IPM techniques etc. Heavy losses in crop yield were observed due to hairy caterpillar attack. Due to favorable weather for

insect development and improper selection of insecticides by the farmers, the crop got adversely affected in control plots. On desi black gram varieties, attack of YVMV was noticed which cause crop loss. Therefore, low average yield was observed in control plots as compared to demonstration plots.

Conclusion

Results revealed that use of resistant variety, seed treatment with rhizobium culture, line sowing and plant protection measures (Mechanical control + need based use of insecticides) contributed to a great extent for achieving potential yield of black gram. Attack of hairy caterpillar was noticed under some demonstration plots but controlled with recommended technology. Successful implementation of CFLDs and dissemination of improved technology were achieved through various extension activities like training programme, kisan goshties, field days, exposure visits and harvesting days organized for farmers. KVK staff also motivated the farmers for self marketing of their produce. It can be concluded that newly introduced variety of black gram along with improved package of practices performed well in the Mohali district of Punjab.

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