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Impact of Large Scale Demonstration on Productivity and Profitability of Blackgram Under Rainfed Conditions of Chamarajanagara District, Karnataka (Zone-6)

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ABSTRACT

Background: Blackgram is a major pulse crop grown next to horsegram and greengram in Chamarajanagar district. Unavailability of high yielding and yellow mosaic resistant varieties, poor agronomic and pest management practices has led to drastic fall down in productivity and profitability of blackgram in Chamarajanagara district.

Methods: Large scale demonstration was conducted in an area of 60 ha covering 150 farmers of K. Mukahalli, Kotamballi, Devalapura, Doddatuppuru and Y.K. mole villages. Further the integrated crop management practices in blackgram variety LBG-791 was demonstrated during *Pre-kharif* of 2020-21, 2021-22 and 2022-23 by ICAR-Krishi Vigyan Kendra, Chamarajanagara, Karnataka.

Result: The Yellow mosaic disease incidence was significantly less in LBG-791 (1.40%) when compared to T-9 (Farmers' variety) (66.8%). Adoption of LBG-791 along with improved crop management practices resulted in 121.5% higher mean grain yield as compared to farmers practice. Higher Benefit: Cost ratio of 1.94 was recorded with integrated crop management practices as compared to farmers' practices (1.03). The study exhibited mean extension and technology gap of 379 kg/ha and 119 kg/ha respectively. Further the mean technology index was 14.73 per cent. These results indicate that there is a great opportunity for farmers of Karnataka (Zone-6) for increasing productivity and profitability of the blackgram crop by adoption of Integrated Crop Management Practices (ICMP).

Key words: B:C ratio, Blackgram, Productivity, Yellow mosaic disease, Yield.

INTRODUCTION

Among different pulse producing countries, India is one of the largest producers of pulses. Pulses play a crucial role in maintaining the nutritional security and soil health. In Indian diet most importance has been given to pulses next to cereals, as they are rich in protein and essential nutrients. Black gram (*Vigna mungo*) a short duration legume crop belongs to the family Fabaceae flourishes well in all seasons either as sole or as intercrop. In India, blackgram occupies an area of 44.93 lakh ha with a production and productivity of 29.26 lakh tonnes and 651 kg/ha respectively. However in Karnataka, the area, production and productivity were 3.02 m ha, 1.86 m t and 614 kg/ha, respectively (Anonymous, 2017). The Chamarajanagar district is a border district of Karnataka having varied agro-climatic conditions with diversified cropping situation. Among different pulses grown in district, black gram occupies major area next to horsegram and greengram. The district productivity of black gram is 203 kg/ha (Anonymous, 2018a). There is a huge yield gap in district when compared to national and state productivity. The reasons for yield gap were non-availability of season based quality seeds and disease tolerant varieties resulted in increased pest and disease incidence particularly yellow mosaic virus disease, use of local and photo insensitive varieties followed by erratic rainfall, cultivation of crops under poor and marginal lands, broadcasting of seeds, no seed treatment with bio-fertilizers (Rhizobium and PSB), not practicing application of micronutrients, Poor management practices of pests and diseases (Anonymous, 2018b). In this context, the large scale demonstration of integrated crop management practices in blackgram variety LBG-791 was demonstrated with an objective of enhancing the productivity and profitability of farmers of Chamarajanagara district.

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MATERIALS AND METHODS

The study was carried out through conducting training programmes, method demonstrations and front line demonstrations (60 ha for 150 farmers) during *Pre-kharif* 2020-21 to 2022-23 in K. Mukahalli, Kotamballi, Devalapura, Doddatuppuru and Y.K. mole villages of Chamarajanagar district of Karnataka state for dissemination and popularization of the technologies. Group meetings were conducted in selected villages where the problem prevailed with respect to production technologies before demonstration. The interested farmers were opted to conduct the demonstrations after the group meeting (Choudhary, 1999).

Details of critical inputs provided

Blackgram variety (LBG-791):08 kg; Rhizobium and PSB bio-fertilizer: 200 g each; Zinc sulphate: 4 kg; Carbendazim: 500 g; Chloropyriphos: 500 ml were provided for all the 150 beneficiaries (0.4 ha/farmer).

Details of technologies

The package of improved technologies like line sowing, integrated nutrient management includes micro nutrient application (Zinc sulphate), integrated weed management, seed treatment with systemic insecticides, rhizobium and PSB and whole package were demonstrated as mentioned in Table 1. University of Agricultural Sciences, GKVK, Bengaluru developed a new blackgram variety namely LBG-791 (Suraksha) during 2019. It is a short duration (70-75 days) variety with yellow mosaic disease resistance with a yield potential of 900-1000 kg/ha under rainfed and 1200-1500 kg/ha under irrigated condition was opted for demonstration against farmers' variety T-9 short duration (70-75 days) susceptible to yellow mosaic virus disease.

Observations on different growth (plant height, number of branches) and yield parameters (number of pods per plant, number of seeds per pod and 100 seed weight) were taken from five randomly selected plants. Yellow mosaic disease incidence (%) was calculated by counting the number of plants infected and total number of plants in a one meter square area separately (Archana *et al*., 2018). The yield data were collected from both the demonstration and farmers practice by random crop cutting method and economics assessment was done as per prevailing market prices. Cost of cultivation, gross returns, net returns and B:C ratio were calculated as per the procedure outlined by Saravanakumar (2021). Improved blackgram growing technologies were introduced to targeted farmers through extension approaches through regular follow up field visits, on and off campus training programs to farm men and women, interactions, group discussions and through distribution of technical bulletins on Integrated crop management in blackgram. Further field days were organized by inviting the farmers from other nearby villages and media coverage was also done to reflect the maximum impact. The technology gap, extension gap and the technology index were calculated by adopting suitable formulae (Singh *et al*., 2022 and Sunil *et al*., 2020).

Extension gap=

Demonstration yield - Farmers' practice yield

Technology gap= Potential yield - Demonstration yield

Technology index=

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

Statistical analysis

Further statistical analysis (Z test for two mean) was done for all growth parameters, yield parameters and grain yield and yellow mosaic disease incidence to check the level of significance (Das and Giri, 2003). The response of blackgram variety LBG-791 under rainfed condition of Chamarajanagar district was similar in all the years. Therefore, only mean data of three years was discussed.

Table 1: Assessment of gaps.

Technologies	Farmers practice	Demonstration	% Gap
Variety	Local	LBG-791	100
Seed rate	25-30 kg/ha	15-20 kg/ha	80
Sowing	Broadcasting/Line sowing	Line sowing (30 cm × 10 cm)	65
Seed treatment	No seed treatment	Seed treatment with systemic insecticide followed by Rhizobium and PSB @ 500 g/ha, respectively	100
Nutrient management	Imbalanced use of chemical fertilizers	Application of FYM 3t/ha, RDF @ 25:50:25 NPK kg/ha, $ZnSO_4$ @ 10 kg/ha, Foliar application DAP @ 2% during pre-flowering	85
Weed management	Hand weeding	weeds were controlled by using herbicide Pendimethalin 1 kg/ha in 500 liter of water as pre-emergence within two days after sowing + one intercultivation @ 35-40 DAS	100
Plant protection	No application of plant protection chemicals	Need based plant protection chemicals were used	75

RESULTS AND DISCUSSION

Assessment of gaps

The information collected by survey on technology adoption showed that there was a huge gap between demonstrated technologies when compared to farmers' practices (Table 1). The cultivation of local and unsuitable varieties for the zone by the farmers is one of the major causes for getting lower yield. The seed rate used by the farmers showed that 20% of the farmers used the recommended seed rate whereas 80 per cent of the farmers were using 25-30% extra seed rate. The information further revealed that 60 per cent of the farmers were following broadcasting method of sowing and rest of the farmers followed line sowing. Seed treatment for pest and disease management was not a common practice. 100% farmers were not following the seed treatment and therefore, there was a huge gap of 100%. Fertilizer usage pattern was also not proper at farmers' level. 90% of the farmers were not using potassium as well as zinc sulphate. Further 100% farmers were lack of knowledge about foliar spray of DAP @ 2%. Recommended dose of fertilizers was applied only by 10% of farmers. Biofertilizers (Rhizobium and PSB) play a crucial role in enhancing the yield of blackgram. The information on biofertilizers use revealed that 100% farmers were not using biofertilizers. Weed management plays an important role in deciding the yield under rainfed conditions. At present situation timely availability of labours has become a major problem in turn resulted in high weeding cost. Hence hand weeding is a risky task for timely weeding. Therefore Integrated weed management is a best option in curbing the weeding cost (Table 1). Incidence of sucking pests *viz.* white fly, jassid, *etc.* was another major factor affecting crop yield adversely. The practices for management of sucking pests were adopted only by 20-25% of the farmers. Similarly, disease management practices were not adopted by majority of farmers.

Yellow mosaic disease incidence and growth and yield parameters

An optimistic response from the blackgram growers of Chamarajanagar was obtained about the new variety and agricultural technologies as they have got good results from the front line demonstrations (FLD). The per cent incidence of yellow mosaic virus disease was significantly higher with local variety (Plate 1) as compared to LBG 791 (Plate 2) presented in Table 2. These results may be attributed by biochemical compounds on the leaves, which repelled insects from host plant (Taggar *et al.*, 2014). On the other hand, physical factors such as leaf area, pubescence and lamina thickness must also be taken into account regarding host selection and might play a role in imparting resistance in black gram plants to *B. tabaci* (Pavishna *et al.,* 2019 and Taggar and Gill, 2012).

The growth and yield parameters are presented in Table 2. Adoption of LBG-791 with improved crop management practices has recorded significantly higher mean number

Table 2: Effect of front line demonstrations on growth and yield parameters of blackgram variety LBG-791 under rainfed conditions.

Particulars	Year										Average	
	2020			2021			2022					
	Demonstration	Farmers practice	Z value P≤0.01	Demonstration	Farmers practice	Z value P≤0.01	Demonstration	Farmers practice	Z value P≤0.01	Demonstration	Farmers practice	Z value P≤0.01
Plant height (cm)	46.2±2.75	54.4±2.59	13.4**	41.2±2.37	51.2±6.34	8.3**	43.8±2.94	53.5±2.70	15.0**	43.7±3.39	53.6±4.46	17.1**
Number of branches per plant	4.40±0.23	3.50±0.48	9.5**	4.10±0.32	3.73±0.42	4.1**	4.30±0.26	3.42±0.37	11.5**	4.30±0.31	3.55±0.44	14.1**
Number of pods per plant	44.3±3.45	28.3±3.04	21.6**	40.1±4.41	24.7±3.43	17.4**	42.2±4.44	29.4±3.68	13.8**	41.5±4.57	27.5±3.93	25.1**
Number of seeds per pod	7.38±0.22	7.00±0.25	6.9**	7.08±0.29	6.40±0.42	7.6**	7.25±0.29	6.90±0.43	3.95**	7.20±0.31	6.78±0.45	7.7**
100 seed weight (g)	5.43±0.17	4.20±0.36	17.2**	5.03±0.39	4.10±0.41	10.0**	5.29±0.25	4.20±0.75	7.6**	5.30±0.33	4.16±0.54	17.9**
Per cent yellow mosaic incidence	1.25±0.67	66.2±8.84	40.1**	1.48±0.65	66.7±8.92	39.9**	1.33±0.58	67.7±8.18	44**	1.40±0.64	66.8±8.68	71.4**

of branches per plant (4.3), number of pods per plant (41.5), number of seeds per pod (7.20), 100 seed weight (5.30 g) as compared to local variety with farmers practices (3.55, 27.5, 6.78, 4.16 g respectively). Whereas the plant height was significantly higher with local variety with farmers practice (53.6 cm) as compared to the LBG-791 with improved crop management practices (43.7 cm). This difference is mainly attributed to their genetic variability and varietal difference. Further reduced incidence of yellow mosaic disease also contributed for better growth and yield parameters. These results were in confirmation with findings of Patel *et al.* (2013) and Singh *et al*. (2018).

Grain yield

Grain yield of blackgram has varied in different years, which might be due to the soil moisture availability and rainfall condition, climatic aberrations, disease and pest attacks as well as the change in the location of trials every year (Naik *et al*., 2015 and Sing *et al*., 2022). However, the maximum grain yield was recorded with improved management practices with LBG-791 plots (FLD) as compared to farmers' practice plots in all the three years (Table 3). The increase in yield in demonstration plots could be attributed to adoption of improved practices of crop production (Fig 1). The per cent increase in yield varied from 116.3% to 127.1% from 2020 to 2022, respectively.

Technology gap, extension gap and technology index

In demonstration plots the mean technology gap of 119 kg/ha was recorded (Table 3). Technology gap shows that there is need to create further awareness among the farmers about the improved crop management practices through various extension means Mukherjee (2003) and Mitra and Samajdar (2010). The higher mean extension gap of 379 kg/ha was recorded (Table 3). It may be due to higher yield of blackgram variety in demonstration plots. Adoption of new improved production technologies with new high yielding and disease resistance variety has helped in reducing the extension gap. These results were in conformity with Hiremath and Nagaraju (2010). Technology index showed the feasibility of the



Plate 1: LBG-791 black gram variety free from yellow mosaic disease.



Plate 2: T-9 black gram variety susceptible to yellow mosaic disease.

evolved technology at the farmers' fields. Lower value of technology index meant more feasibility of disseminated technology. The mean technology index was 14.73 % (Table 3). This might be due to variations in soil fertility, environmental variation and infestation of pest and diseases (Sunil *et al*., 2020). Similar results were obtained with Mokidue *et al.* (2011), Kumar *et al.* (2018) and Singh *et al*. (2022).

Economics

Adoption of a technology purely depends on its economic feasibility (Table 4). The average cost of cultivation was higher in demonstration plot (₹ 23892/ha) as compared to farmers practice plot (₹ 20948/ha). Average gross and net returns of ₹ 48219 and ₹ 23345/ha, respectively was obtained with demonstrated plots as compared to farmers practices (₹ 21647 and ₹ 699/ha, respectively) and similar trend was also observed with B:C ratio. Higher benefit cost ratio in demonstration could be the result of higher yield due to adoption of improved practices which were missing in local check plots. The results confirmed the findings by Paramasivan and Selvarani (2017) and Sing *et al*. (2022).

Suggestions from FLD farmers for further adoption of technologies

- Farmers requested to make available of LBG-791 blackgram variety under seed chain with subsidy as it is costly to purchase directly from market.
- Farmers requested to make available the biofertilizers in Raita Samparka Kendras for easy access.
- Making availability of pre emergence herbicides in main centers of taluks for easy access and requested to conduct method demonstrations and training programs for further more knowledge about safe usage of herbicides.

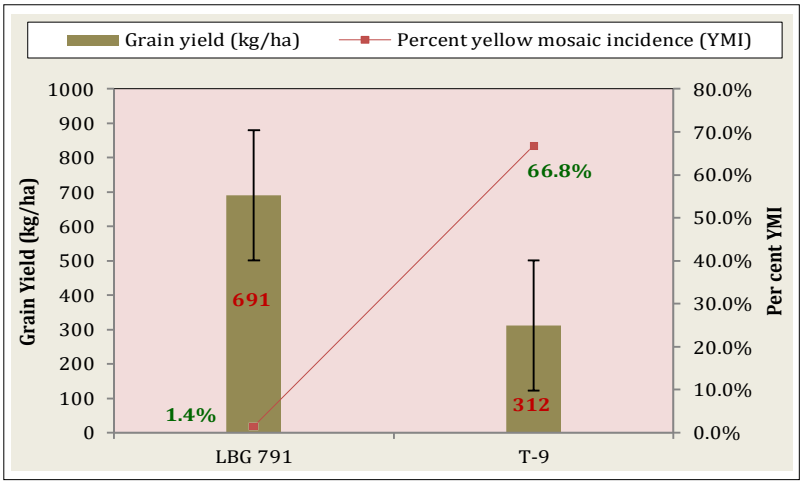

Fig 1: Grain yield as effected by YMI in black gram varieties.

Table 3: Yield performance and gap analysis of blackgram variety LBG-791 under rainfed conditions.

Year	Area (ha)	No. of demos	Grain yield (kg/ha)			Z value P≤0.01	% increase over check	Gap (kg/ha)		Technology index (%)
			P	D	F			Technology	Extension	
2020-21	20	50	810	742±117	337±53	21.2**	120.1	68	405	8.39
2021-22	20	50	810	610±104	282±49	19.0**	116.3	200	328	24.69
2022-23	20	50	810	720±116	317±54	21.0**	127.1	90	403	11.11
Mean			810	691±126	312±56	31.7**	121.5	119	379	14.73

Note: P= Potential; D= Demonstration; F= Farmers' practice.

Table 4: Economic analysis in blackgram variety LBG-791 under rainfed conditions under FLDs.

Year	Cost of cultivation		Gross returns		Net returns		Additional cost (Rs./ha)	Additional returns (Rs./ha)	B:C ratio	
	D	F	D	F	D	F			D	F
2020-21	24520	20840	52708	23553	28188	2713	3680	29155	2.15	1.13
2021-22	24954	20997	41495	19178	16541	-1819	3957	22317	1.66	0.91
2022-23	25148	21007	50453	22209	25305	1202	4141	28244	2.01	1.06
Mean	23892	20948	48219	21647	23345	699	3926	26572	1.94	1.03

CONCLUSION

Adoption of improved crop management practices along with LBG-791 a new short duration variety with resistance to yellow mosaic incidence has proven to be the best technologies in obtaining higher grain yield and given a new hope to other farmers of Chamarajanagar district and also helps in enhancing blackgram production and productivity through horizontal and vertical expansion.

Conflict of interest

All authors declared that there is no conflict of interest.

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