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Frontline Demonstration A Tool to Study Drought Tolerant and High Yielding Red Gram Variety for Davanagere District, India

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A B S T R A C T

Red gram (*Cajanus cajan*) grown in an area of 2.51 lakh hectares with the production of 1.21 lakh tonnes and productivity was 482 kg/ha in India. The Cluster Frontline Demonstrations C(FLD's) on BRG-5 variety of pigeon pea were conducted by Krishi Vigyan Kendra of Davanagere District, Karnataka State.BRG-5 variety was released by University of Agricultural Sciences, Bengaluru during 2014-15, which is resistant to wilt. Improved cultivation practices were demonstrated in farmer's fields for three years. The results of the demonstration showed higher yield when compared to the local (traditional variety) where we followed improved production technology for red gram. The average increased per cent seed yield is 30.88 over the years from front line demonstrations compared to farmer practice plots. However, during the year 2018-19, the per cent increase in seed yield was 37.72. Average gross return and net return were ₹ 49695 and ₹ 25916 ha^{-1} respectively in demonstration plot (BRG-5) as against ₹ 37162 and ₹ 17110 ha^{-1} in farmer practice (BRG-2). The other parameters which include extension gap, technological gap and technology index were studied for assessment of technology adoption rate. The average extension gap, technology gap and technological index were 2.82 q/ha, 6 q/ha and 33.35 per cent, respectively. The studies clearly indicates positive impact of frontline demonstrations against the farmers practice towards increased productivity in red gram by following the production technology under rain fed farming of Davangere district of Karnataka state, India.

Introduction

Redgram (*Cajanus cajan* L.) is one of most important pulse crop which is rich in protein and in India which is also called as Pigeon pea or *Arhar* or *Tur*. World major redgram producing countries are India (38.90 lakh tonnes) followed by Malawi (4.34 lakh tonnes), Myanmar (3.47 lakh tonnes), Tanzania (0.90 lakh tonnes) and Haiti (0.44 lakh tonnes).In India, Red gram takes the second position in total pulse production with 1.21lakh tonnes of production in an area of 2.51 lakh hectares in the year 2020 at a productivity level of 482 kg/ha. Maharashtra is the major producer of redgram with 1.07millon tonnes

followed by Madhya Pradesh (0.84 million tonnes) and Karnataka (0.77 million tonnes) (Rajendrer *et al.,* 2018). The Nutrient content of the redgram in 100 g contains 48.19g of carbohydrates, 22.4 g of protein, 2.74 g of fat, 1.39 mg of calcium and 2.3 mg of Zinc (Aruna Talari *et al.,* 2018). Redgram is a pulse crop as it fix the atmospheric nitrogen in symbiotic association with rhizobium bacteria present in the root nodules. This will helps in improving the soil fertility and reduce the inorganic fertiliser..The main source of protein for vegetarian is pulses, red gram crop contains about 22 percent protein which is almost three time that of cereals. The major share of the countries protein is supplied by redgram. Many of the red gram varieties are used for the dual purpose (green vegetable peas and seeds).

For well-balanced diet there should be combination of cereals and pulses. Redgram is best suited with cereals and nutritionists favour this as an essential ingredient for balanced diets. It plays an important role in biological fixation of nitrogen through the nodules and in turn helps in sustainable agriculture by enriching the soil nutrients. They will also enhance the water holding capacity of the soils and as they are deep rooted very well suited for the rain fed farming. In Southern Karnataka, Davanagere district red gram occupying an area of 7265 hectare with the production of 8931 metric tonnes and productivity of 685 kg/ha. The different factors that influence the potential yield of the crop is mainly due to unconventional methods like sowing of traditional varieties, lack of knowledge on high yield varieties, seed treatment with bio fertilisers and bio pesticides, spraying of the macro nutrients, Integrated pest and disease management (pod borer –Helicoverpa) and mainly red gram crop is grown under rain fed farming. National food Security Mission for pulses (2007-08) to increase the pulse production and productivity through the cluster frontline demonstration (CFLD). Under the CFLD activity main aim is to select the districts to implement the improved technologies like introduction of high yielding varieties, integrated nutrient management (INM), integrated pest management (IPM), Popularising the pulse magic, method demonstration, training and mass media campaign. A maximum increase of 86.72% was recorded in pigeon pea.(Ministry of Agriculture and Farmers Welfare, Final report 2017) CFLD's were conducted to show the worth of high yielding and wilt resistant BRG-5 variety of red gram. It is a drought-resistant crop suitable for rainfed farming and used as an intercrop with maize, finger millet, groundnut and young arecanut gardens. For the benefit of farmers in nationwide NFSM-CFLD programs initiated by The Ministry of Agriculture and Farmers Welfare, Government of India.

Materials and Methods

Cluster Frontline Demonstrations (CFLD) are used to assess the integrated crop management practices of Red gram conducted at Davanagere district during 2017-2019 for three years. Under National Food Security Mission for pulses CFLDs were conducted in 75 farmer's field in different villages are Marikunte, Rameshwara and Devarahalli of Davanagere district. The demonstration conducted in an area of 40hectares with complete production technology of red gram. The list of farmers according to year wise arranged and complete data were taken. The production technology were implemented such as seed rate -15kg/ha, seed treatment with bio fertilisers-500g/ha (rhizobium and phosphorous solubilising bacteria (PSB))and bio fungicides 4g/kg of seed (*Trichoderma*), spraying of pulse magic @ 5 kg/ha, integrated pest management practices like installation of pheromone traps and timely spraying of chemicals and post-harvest technologies.

The technology gap between the demonstration and farmers practice is clearly mentioned (Table1). The land was brought to fine titlh and sowing taken up with seed cum fertiliser drill and data collected from both the demonstration and check plots. To study the yield potential and to know how much area the technology had been spread through these demonstrations conducted at different locations. KVK conducted the awareness camps on the

production technology of red gram, method demonstration of seed treatment before the onset of monsoon. The beneficiary farmers were selected in consultation with department of agriculture, we conduct training program and provide the critical inputs like seeds (BRG-5), bio fertilisers (Rhizobium and PSB), pheromone traps (@ 10/ha and pulse magic to the selected CFLD farmers. Literature developed on the red gram production technology was provided to the farmers. Regular follow up field visit to diagnosing the pest and diseases and timely monitoring the activities. Field days were conducted in the villages along with the extension officers from line departments and farmers from surrounding villages to the technologies demonstrated were superior over the farmer practices. The average yield of each demonstrations and farmers practice, cost of cultivation, gross return, net return and benefit cost ratio (B: C ratio) was taken for interpretation of the results. The extension gap, technology gap, technology index, % increase in the yield over farmer practice and benefit cost ratio were calculated using the following formula as suggested by Samui *et al.,* (2000).

Extension gap = Demonstration yield - Local check yield…(1)

Technology gap = Potential yield - Demonstration yield…(2)

$$\text{Technology Index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100 \ldots(3)$$

$$\text{Percent increase in yield} = \frac{\text{Demo yield– check yield}}{\text{Check yield}} \times 100 \ldots(4)$$

$$\text{Benefit cost ratio} = \frac{\text{Gross return } (\square.ha^{-1})}{\text{Gross Cost}(\square.ha^{-1})} \ldots(5)$$

Results and Discussion

Grain yield

The percent increase in the grain yield in demonstration over farmers practice was 27.8, 37.72 and 27.13 during the years 2017, 2018 and 2019 respectively with an average increase of 30.88 %.

The highest grain yield of 12.23 q/ha recorded in demonstration plot during the year 2018-19 as against 8.88 q/ha in farmer's practice. With all the best improved technologies the average yield of the red gram under demonstration plot recorded 11.99 q/ha in comparison with 9.17 q/ha in farmers practice (Table 2).

The difference yield levels were observed in the different years is mainly due to climatic factors such as rainfall, low temperature, and different soil characters with different locations, pest and diseases incidence. The increase in the yield in demonstration over farmers practice is mainly due to growing of high yielding and wilt resistant variety BRG-5. This variety is medium duration with 150-160 days, seed treatment will control the pest and diseases for 25 days, application of recommended dose of fertilisers along with micro and macro nutrient sprays, proper spacing and nipping practice. The similar findings were reported by Chaitanya *et al.,* (2020); Ganga Devi *et al.,* (2020); Dinesh *et al.,* (2021).

Economics

The average gross cost, gross return and net return of ₹20328 ha^{-1}, ₹.49695ha^{-1} and ₹25916ha^{-1} were recorded for three years. The highest gross return and net return of Rs.61150 and Rs.28417 were recorded during the year 2018 and 2019 respectively. Highest Benefit cost ratio of 3.34 was obtained during 2019-20 and lowest B:C ratio was recorded 1.57 during the year 2018-19 under the demonstration (Table 3)In farmer's practice, the average gross cost (₹20068 ha-1),gross return (₹37162ha^{-1}), net returns (₹17110ha-1) and B: C ratio (1.85) were recorded.

Table.1 Technology Gap in adoption of improved production practices in Red gram

Si. No	Technology	Improved Practices	Farmer Practices	Gap in Adoption (100%)
1	Variety	BRG-5- Red bold seeds (wilt Resistant variety)	BRG – 2 white seeds (wilt susceptible variety)	100
2	Seed rate	15 kg/ha	20 kg/ha	High Seed rate
3	Seed Treatment	Bio fertilisers -Rhizobium and PSB @ 500g/ha . Bio pesticide – *Trichoderma* @4g/kg of seed	Not Followed	100
4	Macro Nutrients	DAP-75 kg/ha MOP- 50 kg/ha	DAP-50 kg/ha Urea-100kg/ha	59
5	Nutrient sprays	Pulse Magic @ 5kg/ha	Not followed	100
6	Micro nutrients	Zinc Sulphate -10kg/ha	No application	100
7.	Nipping	Nipping – Mechanised	Not practised	100
8	Plant Protection Measures	Integrated Pest Management (Traps installation)	Untimely management of pests.	100
9	Harvesting	Mechanical harvesting	Manual Harvesting	100

Table.2 Red gram yield under demonstration and farmers practice.

Year	Potential yield (q/ha)	Demonstrated plot (BRG-5)	Farmers Practice (BRG-2)	Increase in yield over Farmers Practice (%)
2017-18	18	11.86	9.28	27.8
2018-19	18	12.23	8.88	37.72
2019-20	18	11.90	9.36	27.13
Average	**18**	**11.99**	**9.17**	**30.88**

Table.3 Comparison of economics of Red gram cultivated under FLD and farmers field (check)

Year	Demonstration Plot				Farmers Practice				Additional returns (₹ha^{-1})
	Gross Cost (₹ha^{-1})	Gross Return (₹ha^{-1})	Net Return (₹ha^{-1})	B :C	Gross Cost (₹ha^{-1})	Gross Return (₹ha^{-1})	Net Return (₹ha^{-1})	B:C	
2017-18	21322	47456	26134	2.24	20388	37128	16790	1.83	10328
2018-19	27600	61150	23197	1.57	28000	44400	16400	1.19	16750
2019-20	12063	40480	28417	3.34	11816	29958	18142	2.53	10522
Average	**20328**	**49695**	**25916**	**2.38**	**20068**	**37162**	**17110**	**1.85**	**12533**

Table.4 Table showing the Extension gap, Technology gap and Technology index in Redgram

Year	Potential yield (q/ha)	Demonstration yield (q/ha)	Extension Gap (q/ha)	Technology Gap (q/ha)	Technology Index (%)
2017-18	18	11.86	2.58	6.14	34.11
2018-19	18	12.23	3.35	5.77	32.05
2019-20	18	11.90	2.54	6.10	33.88
Average	**18**	**11.99**	**2.82**	**6.00**	**33.35**

The difference in the net returns and B:C ratio varies mainly due to fluctuation in the market price and cost of critical inputs. The additional returns obtained in the demonstration is mainly due to high yielding varieties and use of pulse magic at time of 50% flowering. Similar studies were reported by Keshavareddy *et al.,* (2018) and Chaitanya *et al.,* (2020)

Yield gap analysis

The extension gap is obtained by deducting the farmers yield from demonstration yield. Table 3 depicts that the gap ranged from 2.54 to 3.35 with an average gap of 2.82 q/ha. The gap is attributed mainly due to improved production technology in demonstration. By this gap KVK needs to educate the non-beneficiary farmers through the extension methods like awareness, training, seed treatment, field days, method demonstration, field visit and timely farm advisory services and 100 percent improved production technology. The technology gap differs between potential and demonstration yields ranging from 5.77 to 6.14, with an average of 6.0 q/ha. The high yield variety introduction in the area and improved production technology in the different years during the study period. The technology index ranges from 32.05 to 34.11 percent, with average over the years is 33.35 percent. There is no significant variation in the technology index as the farmers practice the variety is BRG-2, which is white coloured seeds (Padma Veni1 *et al.,* 2018 and Sowmya *et al.,* 2022).

The cluster Frontline demonstration conducted by ICAR- Taralabalu KVK, Davanagere recorded the higher yield and economics returns compared to the farmers practice. The average percent increase in the yield of about 30.88 over farmer practice due to selection of high yielding variety with drought tolerant, wilt resistant and red seeds with improved production technology like seed treatment with bio fertilizers, weed control, integrated nutrient management, implementation of IPM technologies. The highest additional returns of ₹16750 ha^{-1} recorded during 2018-19 and average benefit cost ratio of recorded 2.38 in demonstration plots as against 1.85 in farmers practice. The KVK can play a vital role for no beneficiary farmers through the trainings, field days, method demonstrations, exhibitions, field visit, seed melas and exposure visits to demonstrated plots for adopting the improved production technologies of crops. BRG-5 red gram variety can be made popular among the farmers through the NFSM -cluster demonstrations.

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