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Augmentation of Higher Yields and Economic Profitability in Blackgram through Cluster Front Line Demonstrations at Southern Agro-climatic Zone of Tamil Nadu, India

N. Senthil Kumar*[1], M. Paramasivan[2], J. Rajkumar[3], K. Kumanan[3], R. Jeyasrinivas[3], J. Bhuvaneswari[2], M. Surulirajan[1]

[1]*Coconut Research Station, Thanjavur, Tamil Nadu, India*
[2]*Agricultural College and Research Institute, Thoothukudi, Tamil Nadu, India*
[3]*Agricultural College and Research Institute, Pudukkottai, Tamil Nadu, India*

ABSTRACT

The present study was carried out at Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Thoothukudi district of Tamil Nadu, India to know the yield gap between improved package and farmer's practice under Front Line Demonstration. Black gram (Vigna mungo L.) is one of the most important pulse crop cultivated in southhern districts of Tamil Nadu. It is having lower yield in farmer's field due to multiple constraints. One of the major constraints of its lower productivity was non-adoption of improved technologies. The yield of black gram was realized ranged from 500 to 700 kg ha^{-1} which is low compared to the potential yield under irrigated conditions. Since there is a huge scope to increase the yield under this situation by creating awareness of the latest technologies, intervened by conducting Front Line Demonstrations (FLDs) with the latest technologies as a full package. The package included improved practices viz. varieties and technologies for crop establishment, weed, nutrient, pest and disease management and moisture stress mitigation in Blackgram. A total of 50 FLDs under 40 hectares were conducted in Nanguneri blocks of Nanguneri Taluk, Tirunelveli district, Tamil Nadu during 2019-20 under TNIAMP- (Tamil Nadu Irrigated Agriculture Modernization Project) in Pachaiyar Sub Basin. The yield obtained in individual farmer's holding revealed that, in blackgram, a maximum grain yield of 832 kg ha^{-1} was obtained with the latest technologies at Nanguneri Block of Tirunelveli district which is 19.5% higher than farmer's practice (696 kg ha^{-1}). In terms of monetary advantage, 28.0% higher net return was realized. It is inferred that, the increase in awareness level of varieties, time of sowing, seed rate, seed treatment, herbicide application, foliar spray, moisture stress mitigation and pest and disease management contributed to higher yields and income. The above results confirm that the adoption of scientifically improved technologies over farmers' practices will improve the productivity of pulses in the state as well as in the country which can help in minimize the pulse production and consumption gaps.

Keywords: *TNIAMP, Pachaiyarsub-basin, FLD, Blackgram, Production technology, Stress mitigation, Yield, Economics*

Introduction

Pulses are a vital component of the food and economy of the Indian subcontinent. The country is the largest producer and consumer of pulses. Though India accounts for 25% of the world's pulse production, the country is also the largest importer of pulses Despite the large production and import, the per-capita availability of pulses in India is only 43 g day^{-1} against the ICMR recommendation of 65 g day^{-1}.hectare area under pulses in India is 28.83 million hectare, production is 25.72 million tones and productivity is 8922 kg ha^{-1} [1]. Pulse crops play an important role in sustaining intensive agriculture by improving physical, chemical and biological properties of soil and are considered excellent crops for the diversification of cereals- based cropping systems [12].

Black gram is one of the important crops among the pulses crop. Black gram (*Vigna mungo* L.) is a short-duration crop belonging to leguminacae family. Black gram is rich in protein (25-26%) and grown as intercrop, catch crop also as sole crop. It is also called as urd bean. In India, the area under black gram cultivation is 3.30 million ha producing 1.60 million tonnes, with a mean productivity of 0.49 kg ha^{-1} and contributes 11% of total production in the country [10]. It also acts as cover crop and its deep root system protects the soil from erosion. The crop also improves soil fertility by symbiotic fixation of atmospheric nitrogen in root nodules. Blackgram area accounts for about 19 per cent of India's total pulse acreage which contributes 23 per cent of total pulse production. India currently represents the largest producer of black gram accounting for more than 70% of the global production. In India during kharif 2019-20, the area covered under black gram is 37.52 lakh ha as against 38.18 lakh ha in last year. Tamil Nadu leads first in productivity with an average yield of 775 kg ha^{-1} [9].

Improved pulse production is a way to increase the farm income and profitability of farmers along with sustaining soil health for enhancing the productivity in long run. Generally, the grain yield ranged from 500 to 700 kg ha^{-1} depending upon the management practices followed during the crop growth period. The reasons for low productivity are low adoption of high-yielding varieties, non-availability of quality seeds in time, delay in sowing, inadequate plant population, low adoption of improved agronomic practices, heavy weed infestation, low

*Corresponding Author: ***N. Senthil Kumar***

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adoption of foliar nutrient application, no supplemental irrigation and inadequate plant protection [14].

Materials and Methods

In order to increase the awareness among the farmers on improved production technologies in black gram cultivation, field demonstrations were planned and conducted at the farmers field under Tamil Nadu – Irrigated Agriculture Modernization Project (TNIAMP) in Pachaiyar Sub Basin of Tirunelveli District, Tamil Nadu, India. The objective of the study is an area expansion and productivity enhancement of pulses under crop diversification in gap areas. The demonstration on black gram with improved production technologies was conducted in 40 hectares and 50 beneficiaries holdings under irrigated condition in Nanguneri block of Nanguneri Taluk, Tirunelveli district, Tamil Nadu during 2019-20 (Dec-Jan). The latest production technologies in comparison with the farmers' practices were demonstrated in the selected farmer's holdings. The packaging technology included improved varieties and technologies for crop establishment, weed, nutrient, pest and disease management are as follows.

Table 1. Package of Improved production technologies adopted in demonstration plot

Particulars	Improved production technologies
Variety	Blackgram VBN 6
Time of sowing	December – January
Seed rate	30 kg ha^{-1}
Seed treatment	Seed treatment with polymer (3 ml kg^{-1} of seeds), imidachloprid (1.5 ml kg^{-1} of seeds), *P. fluorescens* (10 g kg^{-1} of seeds), rhizobium (30 g kg^{-1} of seeds) and phosphobacteria (30 g kg^{-1} of seeds)
Method of sowing	Dibling the seeds with a spacing of 30 x 10 cm
Herbicide application	Application of pendimethalin 3.3 l ha^{-1} pre-emergence herbicide on 3 DAS followed by imazethapyr 10% SL @ 500 ml ha^{-1} and quizalofop ethyl 5% EC @ 1.0 l ha^{-1} when weeds are at 2- 3 leaf stage
Foliar spray	Pulse wonder @ 5 kg ha^{-1} at flowering
Plant protection measures	Monitoring of pests and diseases throughout the crop period and spraying of thiomethoxam @ 100 g ha^{-1} against sucking pests, chlorantraniliprole @ 150 ml ha^{-1} against pod borers, carbendazim @ 250 g ha^{-1} against powdery mildew and soil application of *P. fluorescens* @ 2.5 kg ha^{-1} against root rot disease

Result and Discussion

Grain yield

The grain yield obtained under Improved Practices and Farmers' Practices is given in Table 2.

The intervention was implemented at Alwaneri panchayat in Nanguneri block. The demonstrations were conducted as per recommendation in package along with full farmers' participation.

Name of the Block	Grain Yield in IP (kg ha^{-1})			Grain Yield in FP (kg ha^{-1})			% yield increase over FP
Nanguneri	Max	Min	**Average**	Max	Min	**Average**	19.54
	920	745	**832**	795	598	**696**	

Before the TNIAMP intervention, the farmers were adopting a conventional method in which the recommended crop geometry was not maintained and also had not practiced proper management practices which resulted in a reduction of plant population and corresponding yield. As part of the intervention, the farmers were advised to follow the improved cultivation practices. Besides, the farmers adopted local variety before the intervention. The farmers were also advised to follow biofertilizer and bio-inoculants application, DAP spray, pulse wonder booster to have better crop establishment and maximize productivity. The blackgram variety TNAU Vamban 6 was used as a test variety due to its higher potential yield, marketing value and resistance to yellow mosaic virus.

The average yield data was assessed and recorded a yield of 832 kg ha^{-1} under pulse area expansion intervention (improved production technologies). The lowest average grain yield of 696 kg ha^{-1} was recorded in farmers' practice. The percentage in improved practices yield increase over farmers' practice was 19.54 percent. Adoption of suitable variety, using good quality seeds and correct seed rate, treating the seeds with pesticides, biofertilizers, and biocontrol agents, sowing at optimum plant spacing, weed management through herbicides, supplementing nutrients through foliar spray and adoption of proper pest and disease management measures played a vital role in increasing the grain yield when compared to the farmers' Practices.

Rhizobium is widely distributed in soils of the tropics and has the ability to fix atmospheric nitrogen in symbiotic association. Inoculation of Rhizobium culture in legumes increased the crop yield from 20-80% and left beneficial effect on the subsequent crop yield. Increased grain legume production depends on effective symbiotic nitrogen fixation through successful legume inoculation (4). Several workers have reported that seed inoculation with Rhizobium has significantly increased the growth and yield of legume crops (8). Application of bio-inoculants like Pseudomonas fluorescence and Trichoderma viride improved the growth parameters of black gram. Trichoderma, a saprophytic fungus is known to be one of the best candidates of biocontrol agents. Trichoderma species are effective biocontrol agents for several soil-borne fungal plant pathogens including M. phaseolina and some species are also known for their abilities to enhance systemic resistance to plant disease as well as overall plant growth as reported by [2].To realize the maximum yield potential of blackgram during summer and rainy season, maintenance of optimum space made available to the individual plant is of prime importance. Row and plant spacing has to be worked out to get desired spacing. The spacing requirement depends upon the growth behaviour of genotype. So it is required to maintain spacing to obtain higher yield [15].

In irrigated black gram cultivation, weed management play a vital role in influencing the grain yield. Proper weed management eliminates the weed population in the initial and later emergence of grasses and broad-leaved weeds paved the way forward for better crop growth. The importance of weed management in getting good yield was reported by [7] and [5]. Foliar nutrients also facilitate easy and quick absorption of nutrients.

The improper pod filling is one of the major causes for low yield in pulses. The nutrient sprays could improve the physiological efficiencies and play a significant role in raising crop yields [3]. Foliar supplement of nutrients could have enhanced the level of available nutrients resulting in better plant growth and development [13]. TNAU pulse wonder would have accelerated various metabolic processes by means of macro and micronutrients [5]. The presence of macro and micro-nutrients and growth promoters in pulse wonder might have supplemented the nutrient demand of the crop at the critical stages, resulting in better growth and development of the crop and ultimately resulting the yield attributing characters and grain yield [6].

Economics

The farmers were able to witness the outcome of the demonstration in economic terms like the cost of production and corresponding returns for the investment made. The details of the economic analysis are tabulated in Table 3.

Table 3. Pooled analysis of Economics under Improved and Farmers' Practices

Name of the Block	Improved Practices (Rs. ha^{-1})				Farmers Practices (Rs. ha^{-1})				% NR increase over FP
Nanguneri	Gross Cost	Gross Return	Net Income	BC Ratio	Gross Cost	Gross Return	Net Income	BC Ratio	28.0
	27282	59648	32367	2.18	31300	49907	23284	1.59	

Before the intervention, the farmers were able to get only low yield than the potential yield due to management practices resulting in high cost of cultivation and poor yield cum economic returns from the investment made. After the intervention, the farmers practiced the recommended technologies and package of practices in an integrated manner which resulted in expected yield and economic returns. The economic analysis reveals that, before the intervention, the average net return was only Rs. 23284 ha^{-1} per hectare from farmers practice whereas it rose to Rs.32367 ha^{-1} in improved practice, respectively, resulting raise in benefit-cost ratio from 1.59 to 2.18. In terms of monetary advantage, 28.0% higher net return was realized. The variation seen in improved practices and farmers plot could be considered as a gap between adoptions of the recommended package of practices.

Outcome and Effects of Intervention

The outcome and effects of the intervention made in the beneficiaries holdings are tabulated in Table 4.

Table 4. Outcome and effects of the intervention made in the beneficiaries

Particulars	Before Intervention	After Intervention
Nature of sowing	Broadcasting	Line sowing and also sowing with machinery
Intercultural Practices Adopted	Earthing-up	weeding, top dressing and pulse wonder spray
Improved cultivation practices in blackgram	Nil	40 ha
Horizontal spread of area expansion and pulse productivity enhancement (Area & farmers covered)	Nil	40 ha and 50 farmers
Pulse wonder spray technology followed (%)	Nil	100
Average yield (kg/ha)	713	845

Conclusion

It is inferred that the increase in awareness level on varieties, seed quality, seed rate, seed treatment, time of sowing, use of herbicides, foliar spraying of nutrients and adoption of pest and disease management played a vital role in increasing the grain yield when compared to the farmers' practices which contributed to higher yields and income. The very important aspects that contributed to increased yield are improved varieties, seed treatment with biofertilizers and bio-inoculants, maintenance of optimum plant population through adoption of correct seed rate, optimum sowing time, and use of herbicides for effective management of grasses and broad- leaved weeds. Hence, it can be concluded that an increase in awareness level on improved production technologies contributed to higher yields and income in blackgram under irrigated conditions in pachaiyar sub-basin of southern the Agro-climatic zone of Tamil Nadu, India.

Future scope of this study

This study will highly amenable and beneficial of farmers of other sub-basins of Tamil Nadu

Conflict of interest

The authors announce that they have no conflict of interest

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