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Impact of Cluster Front Line Demonstrations on Productivity and Profitability of Pigeonpea under NFSM in Beed District of Maharashtra, India

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ABSTRACT

Background: Pulses are the integral part of many diets across the globe and they have great potential to improve human health, conserve our soils, protect the environment and contribute to global food security. India is the largest producer, consumer and importer of the pulses in the world. Pigeonpea is an important pulse crop that plays an important role in the food and nutritional security of people in the developing countries and contributing to protein intake. It is a soil building crop and being a leguminous crop, fixes atmospheric nitrogen through symbiotic fixation, there by helps in N cycling within the ecosystem.

Method: Cluster frontline demonstrations on BDN 711 variety of pigeonpea were conducted bsy Krishi Vigyan Kendra, Khamgaon of Beed District, Maharashtra State. Cluster frontline demonstration of pigeonpea variety BDN 711 were conducted during 2019-20 to 2022-23 on 80 ha area in 200 number of total demonstrations. Pigeonpea variety BDN 711 released by Vasantarao Naik Marathada Krishi Vidyapeeth is resistant to wilt, drought tolerant and suitable for medium type of soils. Improved cultivation practices were demonstrated at farmer's field for four consecutive years by active participation of farmers with an objective of improved technologies of pigeonpea production potentials.

Results: The result of the demonstrations concluded that an average yield of pigeonpea under improved technology ranged from 1430 kg/ha to 1800 kg/ha with a mean 1664 kg/ha; which was 30.61 per cent higher over farmers practice (1274 kg/ha). Morever, average yield recorded was higher under demonstrations over district and state average. The study exhibited mean extension gap of 391 kg/ha, mean technology gap 535 kg/ha with mean technology index 25.23 per cent. Higher mean net return of Rs. 71912/ha with mean B:C ratio 2.36 was obtained with improved technologies in comparison to farmers practice. The results clearly indicated that the beneficial impact of front line demonstrations over the farmers practices towards enhancing the productivity of pigeonpea cultivation in Beed district of Maharashtra state, India. Demonstrated technologies proved more remunerative and economically viable compared to farmers traditional practices in pigeonpea cultivation.

Key words: Economics, Front line demonstrations, Pigeonpea, Technology gap, Variety, Yield.

INTRODUCTION

India is major pulse growing country. The pulses are integral part of cropping systems all over the country. Pulses are the climatic resilient crops as they promote sustainable agriculture, decreases green house gases, fix atmospheric nitrogen, improve soil fertility and use less water compared to the other crops (Singh *et al*., 2016; Meena and Biswas, 2013). Pulses are considered as life blood of agriculture because they occupy a unique position in every known system of farming as a main, catch, cover, green manure, intercrop, relay and mixed crop.

In India pigeonpea is mainly grown in Maharashtra, Karnataka, Madhya Pradesh, Uttar Pradesh, Gujrat, Jharkhand, Telangana and Andhra Pradesh. In India pigeonpea covered an acreage of 4.80 million ha contributing 4.28 million tons of production with an average productivity 892 Kg/ha during 2021-22. In Maharashtra, pigeonpea is grown over an area of 13.35 Lakh ha with an production 12.36 Lakh tons and productivity 1012 Kg/ha; Beed district of Maharashtra reported to produce 68257 tons of pigeonpea from an area 75,839 ha with productivity of 900 Kg/ha (Agri. *Stat*-2021).

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India, particularly Maharashtra region, from last few decades is facing severe problem of drought due to vagaries of monsoon like late onset, early withdrawal, prolonged dry spell between two rains *etc*. As a result of this, crop failure due to lack of water availability has become a common phenomenon. Lack of moisture at pod development stages is one of the major reasons that limits yield of crops. Though pigeonpea is widely grown in Beed district, various factors influences potential yield of the crop such as, faulty sowing practices, lack of knowledge about high yielding and disease resistant varieties. Lack of awareness about seed treatment with biofertilizers *Rhizobium, PSB*, *Trichoderma viridae* and improper management of pod borer. Above all in the district predominantly noticed problems for pigeonpea cultivation was high incidence of wilt and terminal drought condition. Hence drought tolerent variety appeared to be major challenges to increase productivity. Tolerant crop varieties with consistently higher yields under deficit rainfall are having paramount importance. This can be achieved by using drought tolerant varieties and improved cultivation practices. With this background, cluster front line demonstrations were conducted to show the worth of high yielding and drought tolerant BDN 711 improved variety of pigeonpea. Indian Government imports large quantity of pulses to fulfill the domestic requirement of pulses. In this regard, to sustain this production and consumption system, Govt. of India has initiated cluster frontline demonstration (CFLDs) under national food security mission. Front line demonstration is the method of field demonstration evolved by the ICAR with the inception of technology mission on pulses. The main aim of this programme is to demonstrate latest crop production and protection technology and crop management practices at the farmers fields under different agroclimatic zones and real farming situation under the supervision agricultural scientists.

MATERIALS AND METHODS

Technology demonstration on pigeonpea variety BDN 711 was conducted by Krishi Vigyan Kendra, Khamgaon (under administrative control of VNMKV Agriculture University, Parbhani, Maharashtra) during 2019-20, 2020-21, 2021-22 and 2022-23 (4 consecutive years) in district of Beed. A group of co-operative farmers were identified based on their participation and feedback received during interactive meeting. Farming situation of demonstration plot and farmers controlled plot was rainfed. Critical inputs for the technologies to demonstrated were distributed to the farmers after the training like improved high yielding variety, recommended agrochemicals and literature and regular visit, monitoring and pest and disease advisory services management by the KVK scientist to the demo farmers. Finally field demonstrations were conducted involving selected farmers, other farmers in the village, scientists from university, officials from department of agriculture and local extension functionaries to demonstrate the superiority of technology. The total 50 number of demonstarion were conducted over an area of 20 ha each year. In general soil of the area under study was medium to heavy and medium fertility status. The component demonstration technology in pigeonpea was comprised *i.e.* university recommended improved variety BDN 711, which was medium duration, escaping terminal drought and wilt resistant. In the demonstration, one control plot was also kept where farmers practices were followed. The demonstrations were 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 was collected from both the demonstration and farmers practice by random crop cutting method and analyzed by using simple statistical tools. The percent increase yield, technology gap, extension gap and technology index were calculated by using following formula as per Samui *et al*. (2000), as given below;

Percent increase in yield =

$$\frac{\text{Demonstration yield-farmers practice yield}}{\text{farmers practice yield}} \times 100$$

Technology gap = Potential yield - Demonstration yield

Extension gap =

Demonstration yield-farmers practice plot yield

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{potential yield}} \times 100$$

RESULTS AND DISCUSSION

Frontline demonstrations studies were carried out in Beed district of Maharashtra state in *Kharif* season from 2019-20 to 2022-23. Major gap was observed between improved technology and farmers practice of pigeonpea cultivation in Beed district of Maharashtra (Table 1). Among varying technological component, full gap was observed in the component *viz*., variety, seed treatment, seed inoculation and irrigation and partial gap was observed in seed rate, spacing, fertilizer dose and plant protection measures. These gaps observed at the farmers field were ascribed to slow pace of extension activities; coupled with unreached extension system, poor accessibility of improved agro-technologies especially among small holder farmers (Shivran *et al*., 2020). Under farmers practice, seed of local/ old variety with low yield potential was sown instead of newly recommended varieties for the zone with improper application of improved recommended package technologies. On the basis of observed gap, under the demonstration, improved variety BDN 711, fungicide, insecticide, biofertilizer (*Rhizobium* and PSB culture) soil sample testing, VNMKV diary were provided to partner farmers by KVK and other crop management practices were timely performed by the partner farmer himself under the supervision of KVK Scientist. Similar findings have also been observed by Krishna Avtar Meena *et al*. (2022).

Pigeonpea yield

During four years of study results obtained are presented in Table 2. The results revealed that the demonstration on pigeonpea recorded an average seed yield of 1664 kg/ha under demonstrated plots as compared to farmers practice (1274 kg/ha) The highest seed yield in the demonstration plot was 1800 kg/ha during 2021-22. The average yield of pigeonpea increased under demonstration 30.61 per cent over farmers practice (Table 2). These results clearly indicated that the higher average seed yield in demonstration plots over farmers practice might be due to integrated crop management practices and adoption of drought resistant of

BDN 711 variety. Adoption of scientific package of practices like seed treatment with bio-fertilizers and need based right plant protection practices resulted in higher yields. The above findings are similar in lines with Raju *et al*. (2015) and Kishor Zade *et al*. (2020).

Technology gap

The data given in Table 2 depicted the technology gap as a difference between potential yield and demonstrated plot yield. The technology gap observed during different years was 770, 450, 400 and 522 kg/ha during 2019-20, 2020-21, 2021-22 and 2022-23 respectively. On an average technology gap observed in four years under cluster front line demonstration implemented villages was 535 kg/ha. The highest technology gap 770 kg/ha was recorded in 2019-20 followed by 522 kg/ha (2022-23), 450 Kg/ha (2020-21) and 400 kg/ha (2021-22) (Table 2). This also reflects the poor extension activities, which resulted in lesser adoption of package of practice by farmer. Hence, extension activities and location specific technological recommendation apper to be necessary to decline the technology gap. The above findings are similar in lines with Meena *et al*. 2021 and Keshavreddy *et al*., 2018.

Extension gap

Extension gap is considered as a parameter to know the yield difference between the demonstrated improved technology and farmers practices. Results of the demonstrations (Table 2) stated that the extension gap ranging between 280 to 550 kg/ha was found between demonstrated technology and farmers practices. The extension gap observed during different years was 280, 350, 550 and 383 kg/ha during 2019-20, 2020-21, 2021-22 and 2022-23, respectively. On an average extension gap observed in four years under CFLD implemented villages was 391 kg/ha. The highest extension gap 550 kg/ha was recorded in 2021-22 followed by 383 Kg/ha (2022-23), 350 kg/ha (2020-21) and 280 kg/ha (2019-20). So, to enhance the farmers income, there is need to reduce wider extension gap. Therefore, it is necessary to educate the farmer's through various means of extension for more adoption of recommended improved high yielding varieties and implementation of latest agro-technique in pigeonpea. The above findings are similar to the findings of Krishna Avtar Meena *et al*. (2022) Keshavreddy *et al*. (2018) and Kishor Zade *et al*. (2020).

Table 1: Differences between technological intervention and farmers practices under frontline demonstration on pigeonpea.

Component	Technological intervention	Farmers practices	Gap
Variety	BDN 711	Khadka	Full
Seed rate	7.5 Kg/ha	30 to 40% higher	Partial
Seed treatment	*Trichoderma viridae* 5 gm/ Kg seed	No seed treatment	Full
Seed inoculation	Rhizobium and PSB culture with 10 ml/Kg seed	No Seed inoculation	Full
Sowing method	Line sowing	Line sowing	No gap
Sowing time	Last week of june tor 2nd week of july	Last week of june tor 2nd week of July	No gap
Spacing	90 × 20 cm	90 × 90 cm	Partial
Fertilizer dose	Balanced fertilization as per soil test values 25:50:00 Kg/ha (NPK)	Imbalance use of fertilizer	partial
Irrigation	Supplemental irrigation at flowering	No irrigation	Full
Plant protection	IPM- Pheromone trap @ 05/plot +bird percher (T-shaped) @ 10/plot + spray First spraying: NSKE 5% at the time of initiation of flower Second spraying: Quinolphos 25% EC Third spraying: Emamectin Benzoate 5% SG	Repeated use of only chemical insecticide	Partial gap with high cost

Table 2: Yield, technology gap, extension gap and technology index in pigeonpea cultivation during 2019-20, 2020-21, 2021-22 and 2022-23.

Year	Potential yield (Kg/ha)	Average seed yield (Kg/ha)		Percent increase	Technology gap (Kg/ha)	Extension gap (Kg/ha)	Technology index (%)
		Demo	Farmers practice				
2019-20	2200	1430	1150	24.34	770	280	35.00
2020-21	2200	1750	1400	25.00	450	350	20.00
2021-22	2200	1800	1250	44.00	400	550	22.22
2022-23	2200	1678	1295	29.57	522	383	23.72
Mean	2200	1664	1274	30.61	535	391	25.23

Table 3: Economic impact of pigeonpea cultivated under FLD and Farmers practice during 2019 20, 2020-21, 2021-22 and 2022-23.

Year	No. of Demo	Area (ha)	Gross income Rs./ha.		Net income Rs./ha.		B: C ratio	
			Demo	Farmers practice	Demo	Farmers practice	Demo	Farmers practice
2019-20	50	20	75500	49500	57500	35500	1.90	1.61
2020-21	50	20	105000	85800	78000	60800	2.33	1.95
2021-22	50	20	113400	78750	76400	48750	3.06	2.62
2022-23	50	20	110748	85470	75748	52970	2.16	1.62
Mean	50	20	101162	74880	71912	49505	2.36	1.95

Technology index

The technology index is a parameter to show the feasibility of the improved technology at the farmers fields. Data on technology index presented in Table 2, showed that technology index was varied from 20 to 35 percent. On an average technology index observed was 25.23% for four years where front line demonstrations were conducted. This shows the efficiency and effectiveness of the improved technologies as a result of successful technical interventions to increase the yield performance of pigeonpea. This will accelerate the adoption of demonstrated technological intervention to increase the yield performance of pigeonpea at farmers field. Similar findings were recorded by Meena *et al*. (2021) and Krishna Avtar Meena *et al*. (2022).

Economics

Economics of improved technology under frontline demonstration was estimated (Table 3) on the basis of prevailing market rates. Economic returns related to input and output prices of commodities prevailed during the study period were recorded. The cultivation of pigeonpea under improved technologies CFLD gave higher net returns of Rs. 57500, Rs. 78000, Rs. 76400 and Rs. 75748 per hectare as against to farmers practices *i.e*., Rs. 35500, Rs. 60800, Rs 48750 and Rs. 52970 per hectare during the years 2019-20, 2020-21, 2021-22 and 2022-23, respectively (Table 3) Similar results were reorted by Singh *et al*. (2014) and Raj *et al*. (2013). The Benefit: cost ratio observed during different years 2019-20, 2020-21, 2021-22 and 2022-23 under improved cultivation practices were 1.90, 2.33, 3.06 and 2.16, respectively, while it was 1.61, 1.95, 2.62 and 1.62 under farmers practice for the respective years. The highest Benefit: cost ratio recorded in demo plots might be due to higher yields obtained under improved technologies compared to farmer's practices during all the four years (Table 3). Similar results were observed by Meena *et al*. (2021), Krishna Avtar Meena *et al*. (2022) and Raju *et al*. (2015).

CONCLUSION

The cluster frontline demonstration conducted on pigeonpea at the farmer's field revealed that the adoption of improved technologies significantly increased the yield as well as net returns to the farmers. Hence, there is need to disseminate the improved technologies among the farmers with effective extension activities like trainings and field demonstrations. The farmers should be encouraged to adopt the recommended package of practices realizing for higher returns. The beneficiary farmers of demonstrations may play also an important role as a resource person or source of information and quality seed for wider dissemination of the high yielding variety of pigeonpea to nearby farmers. The results indicated that the frontline demonstration with variety BDN 711 gave higher seed yield, monetary returns and B: C ratio over farmers practice.

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