Performance of fusarium wilt-resistant pigeonpea variety BRG-5 under cluster frontline demonstrations in Tumkur district of Karnataka

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ABSTRACT

Cluster frontline demonstrations (CFLDs) under National Food Security Mission (Pulses) were carried out during 2017 to 2021 in different villages of Tumkur district of Karnataka where 200 demonstrations on pigeonpea on an area of 80 ha were carried out by the active participation of farmers with the objective to demonstrate the benefits of fusarium wilt resistant pigeonpea variety with improved technologies. The improved technologies consisted of use of improved wilt resistant variety, seed treatment with *Rhizobium* culture, soil application of *Trichoderma* and phosphate solubilising bacteria (PSB), balanced fertilizer application and integrated pest management. There existed full gap in case of use of variety, sowing method, seed treatment, plant protection and weed management and partial gap in fertilizer dose. An average yield 9.54 q per ha was recorded under CFLDs as compared to 7.07 q per ha in farmers' practice. The demonstrations resulted in higher average net return of Rs 27,867 per ha as compared to Rs16,659 in farmers' practice. There was an increase of 90.90 per cent in net return in demonstrations as compared to check. The benefit-cost ratio of pigeonpea cultivation under improved cultivation practices was 2.18, whereas, it was 1.74 under farmers' practice. The technology gap between potential yield and yield of demonstration plots was lowest (29.18%) in Thimalapura, Tiptur Tq, Tumkur district, whereas, highest gap (37.68%) was found in Handalakuppe, Kunigal Tq, Tumkur district. Extension gap under CFLDs ranged from 25.51 (Chikkahonnavally, Tiptur Tq, Tumkur district) to 64.63 (Thimalapura, Tiptur Tq, Tumkur district) per cent which emphasized the need to educate the farmers through various extension means.

Keywords: Pigeonpea; CFLD; extension gap; technology gap, productivity

INTRODUCTION

Pigeonpea is a tropical and sub-tropical species particularly suited for rainfed agriculture in semi-arid areas due to its deep taproot, heat tolerance and fast growing habit (Mallikarjuna et al 2011). Its demand in India is significant because it can provide high quality protein in diet, especially to the vegetarian population (Bhattacharjee et al 2013). It is a fast growing, hardy, widely adaptable and drought resistant (Bekele-Tessema 2007). Its deep taproot is able to extract nutrients (like P) from the lower layers of soil and bring them to upper layers where they can benefit other crops (Valenzuela 2011).

It provides green forage for animal feed when other forage crops have vanished due to a lack of rainfall during the dry season (Sloan et al 2009). It is a tropical perennial pulse crop that includes a good amount of carbohydrates, proteins, vitamins, minerals and vital amino acids and its seeds can be eaten fresh (immature) or dried (mature) (Syed and Wu 2018). It is well known for delivering food proteins in rainfed agriculture, which is typically farmed in low-cost places in impoverished nations (Cheva-Isarakul 1992) and it considerably improves food and feed security in Africa, Asia and South America (Martínez-Villaluenga et al 2010).

Pigeonpea is cultivated in larger area in the states such as Maharashtra, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu (Kalaghatagi et al 2021). In India, pigeonpea was grown over an area of 4.72 million ha with production of 4.32 million tonnes and productivity of 914 kg per ha in 2020-21. In Karnataka, it was grown over an area of 1.63 million ha with production of 1.24

million tonnes and productivity of 759 kg per ha in 2020-21 (Anon 2023).

The productivity of pigeonpea in Karnataka is lower than national average reasons being use of local varieties, attack of pests and diseases, faulty sowing practices, improper crop geometry, avoidance of use of biofertilizers, other intercultural operations and the climate which limit its potential yield.

Since most of the pigeonpea crop is grown under rainfed situation, the farmers find it very difficult to manage fusarium wilt affecting pigeonpea if the variety is susceptible. In order to demonstrate the production potential of the crop, improved technologies through cluster frontline demonstrations were conducted using wilt resistant pigeonpea variety BRG-5 released from University of Agricultural Sciences, Bangalore, Karnataka.

MATERIAL and METHODS

Cluster frontline demonstrations (CFLDs) on pigeonpea under National Food Security Mission (Pulses) using new crop production technologies were carried out by the ICAR – Krishi Vigyan Kendra, Tumkur, Karnataka during kharif season from 2017 to 2021 for five years in the farmers' fields of 5 villages with the objective of showing the productive potentials of the new fusarium wilt resistant pigeonpea variety and production technologies under real farm situation over the locally cultivated varieties.

Total 200 CFLDs on an area of 80 ha were conducted in different villages. Each demonstration was laid out on 0.4 ha area; adjacent 0.4 ha was considered as control for comparison (farmers' practice). The integrated crop management technology comprised improved variety of pigeonpea BRG-5, proper seed rate, seed treatment with *Rhizobium* and *Trichoderma* and proper nutrient and pest management (Table 1).

Optimum plant population was maintained in the demonstrations. The sowing was done in the first week of June; the fertilizers were applied as per soil test-based recommendation as and when required. Other agronomic practices were followed as per recommendation. Technology gap and extension gap were calculated as per Samui et al (2000) as given below:

Technology gap = Potential yield – demonstration yield

Extension gap = Demonstration yield – farmers' yield

RESULTS and DISCUSSION

The gap between the existing and recommended technologies of pigeonpea in district Tumkur, Karnataka is presented in Table 1. Full gap was observed in case of use of resistant variety, seed treatment and plnat protection and partial gap in case of seed rate. These could be the reasons for not achieving potential yield of the crop.

Farmers were not aware about recommended technologies. Farmers in general used local or old-age varieties instead of recommended high yielding resistant varieties. Unavailability of seed in time and lack of awareness were the other reasons. Farmers followed dense sowing against the recommended line sowing because of which they applied higher seed rate than the recommended.

Yield: The data given in Table 2 reveal that an average yield 9.54 q per ha was recorded under CFLDs as compared to farmers' practice (7.07 q/ha). The highest average yield in the CFLD plots was 11.10 q per ha and in farmers' practice it was 8.75 q per ha. The lowest yield in CFLDs was 7.75 q per ha and in farmers' practice it was 5.65 q per ha.

Higher grain yield in demonstration plots over the years compared to local check could be due to application of full package of practices viz variety BRG-5, timely sowing, seed treatment with biofertilizers (*Rhizobium* and PSB), *Trichoderma* @ 4 g per kg of seed, use of balanced dose of fertilizers (10 kg N and 20 kg P_2O_5 per ha), proper method and time of sowing, timely weed management and need-based plant protection. Similar observations were made by Tomar (2010) in chickpea.

Economics: The input and output prices of commodities prevailed during the period of demonstrations were taken for calculating net return and benefit-cost ratio. The demonstrations resulted in higher average net return of Rs 27,867 per ha as compared to Rs16,659 in farmers' practice (Table 3).

Thus there was an increase of 90.90 per cent in net return in demonstrations as compared to check. Similar findings were reported by Singh et al (2014).

Table 1. Improved practices applied and farmers' practice for cultivation of pigeonpea under CFLDs

Technology	Improved practice	Farmers' practice	GAP (%)
Variety	BRG-5	BRG-2	Full gap
Land preparation	Ploughing and harrowing	Ploughing and harrowing	No gap
Seed rate	12.5 kg/ha	17.5 kg/ha	High seed rate
Sowing method	Line sowing	Line sowing	No gap
Seed treatment	Using biofertilizers and *Trichoderma*	No seed treatment	Full gap
Plant protection	IPM	Indiscriminate application of plant protection chemicals	Full gap

Table 2. Effect of integrated crop management technologies on yield of pigeonpea under CFLDs

Year	Yield (q/ha)						Increase in yield (%)
	Check			Demonstration			
	Maximum	Minimum	Average	Maximum	Minimum	Average	
2017	8.25	2.50	5.54	10.50	3.50	7.23	30.50
2018	9.00	6.50	7.55	11.00	8.50	9.97	32.55
2019	9.00	6.50	7.56	11.00	8.75	10.22	35.18
2020	9.25	6.50	7.62	11.25	8.75	10.23	34.25
2021	8.25	6.25	7.11	11.75	9.25	10.06	41.49
Average	8.75	5.65	7.07	11.10	7.75	9.54	34.79

The benefit-cost ratio of pigeonpea cultivation under improved cultivation practices was 2.18, whereas, it was 1.74 under farmers' practice. This could be due to higher yield obtained under demonstration plots as compared to local check (farmers' practice). Similar observation was made by Mokidue et al (2011).

Technology gap: The technology gap between potential yield and yield of demonstration plots was lowest (29.18%) in Thimalapura, Tiptur Tq, Tumkur district, whereas, highest gap (37.68%) was recorded in Handalakuppe, Kunigal Tq, Tumkur district (Table 4).

The technology gap so observed could be attributed to dissimilarities in the soil fertility status, agricultural practices and local climatic conditions.

Extension gap: Extension gap under CFLDs ranged from 25.51 (Chikkahonnavally, Tiptur Tq, Tumkur district) to 64.63 (Thimalapura, Tiptur Tq, Tumkur district) per cent (Table 4) which emphasized the need to educate the farmers through various extension means viz frontline demonstrations for adoption of improved production and protection technologies.

More and more use of latest production technologies with high yielding varieties would subsequently change this alarming trend of galloping extension gap.

CONCLUSION

It was concluded from the study that higher grain yield was recorded under CFLDs as compared to the farmers' practice. Intervention with improved technologies under CFLDs such as improved variety BRG-5, proper seed rate, use of biofertilizers and IPM resulted in better performance. Average increase in yield due to improved technologies was 34.79 per cent. There was also an increase of 90.90 per cent in the net return.

There existed a technology gap ranging from 29.18 to 37.68 per cent and extension gap of 24.27 to 64.63 per cent. The increase in productivity under CFLDs over existing practice of pigeonpea cultivation

Table 3. Effect of integrated crop management technologies on economics of pigeonpea under CFLDs

Year	Economics								Increase in net return (%)
	Check				Demonstration				
	Gross cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B-C ratio	Gross cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B-C ratio	
2017	30,514	21,640	8,874	1.40	39,765	21,560	18,205	1.84	205.14
2018	21,500	40,770	19,270	1.89	22,600	53,838	31,238	2.38	62.10
2019	22,500	41,607.5	19,107.5	1.85	24,000	56,210	32,210	2.34	68.56
2020	22,500	41,927	19,427	1.86	24,000	56,287	32,287	2.34	66.19
2021	22,500	39,115	16,615	1.74	25,000	50,395	25,395	2.02	52.84
Average	23,903	37,012	16,659	1.74	27,073	4,7658	27,867	2.18	90.90

Table 4. Technology gap and extension gap of pigeonpea under CFLDs

Year	Name of village	Number of demonstrations	Potential yield of demonstration variety (q/ha)	Technology gap (%)	Extension gap (%)
2017	Thimalapura, Tiptur Tq, Tumkur dist	25	16.00	29.18	64.63
2018	Handalakuppe, Kunigal Tq, Tumkur dist	25	16.00	37.68	24.27
2019	Gunnagere, Kunigal Tq, Tumkur dist	50	16.00	36.12	26.02
2020	Chikkahonnavally, Tiptur Tq, Tumkur dist	50	16.00	36.06	25.51
2021	Ippadi, Kunigal Tq, Tumkur dist	50	16.00	32.93	41.49

Varieties tested: Check (BRG-2), Demonstration (BRG-5: Dual purpose, medium duration variety, resistant to wilt); National average yield of pigeon pea: 7.98 q/ha, State average yield of pigeon pea: 6.92 q/ha, District average yield of pigeon pea: 6.55 q/ha

created awareness among the farmers who motivated the other farmers to adopt suitable production technology of pigeonpea cultivation in the district.

REFERENCES

Anonymous 2023. Agricultural statistics at a glance 2022. Economics and Statistics Division, Department of Agriculture and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India.

Bekele-Tessema A 2007. Profitable agroforestry innovations for eastern Africa: experience from 10 agroclimatic zones of Ethiopia, India, Kenya, Tanzania and Uganda. World Agroforestry Centre (ICRAF), Eastern Africa Region. Regional Land Management Unit (RELMA in ICRAF Project), World Agroforestry Centre, Eastern Africa Region, Nairobi, Kenya, 372p

Bhattacharjee S, Singh AK, Kumar M and Sharma SK 2013. Phosphorus, sulfur and cobalt fertilization effect on yield and quality of soybean [*Glycine max* (L) Merrill] in acidic soil of northeast India. Indian Journal of Hill Farming **26(2):** 63-66.

Cheva-Isarakul B 1992. Pigeonpea as a ruminant feed. *Asian-*Australasian Journal of Animal Sciences **5(3):** 549-558.

Kalaghatagi G, Wali SY, Patil MB and Vastrad SM 2021. Nutrient uptake of pigeonpea [*Cajanus cajan* (L) Millsp] with foliar application of water soluble nutrient mixtures. International Journal of Current Microbiology and Applied Sciences **10(8):** 72-75.

Mallikarjuna N, Saxena KB, Jadhav DR 2011. Cajanus. In: Wild crop relatives: genomic and breeding resources – legume crops and forages (K Chittaranjan, Ed), Springer-Verlag Berlin, Heidelberg, Germany, pp 21-33.

Martínez-Villaluenga C, Torres A, Frias J, Vidal-Valverde C 2010. Semolina supplementation with processed lupin and pigeonpea flours improves protein quality of pasta volume. LWT – Food Science and Technology **43(4):** 617-622.

Mokidue I, Mohanty AK and Sanjay K 2011. Corelating growth, yield and adoption of urd bean technologies. Indian Journal of Extension Education **11(2):** 20-24.

Samui SK, Mitra S, Roy DK, Mandal AK and Saha D 2000. Evaluation of frontline demonstration on groundnut. Journal of the Indian Society of Coastal Agricultural Research **18(2):** 180-183.

Singh AK, Manibhushan, Bhatt BP, Singh KM and Upadhyaya A 2013. An analysis of oilseeds and pulses scenario in eastern India during 2050-51. Journal of Agricultural Science **5(1):** 241-249.

Singh D, Patel AK, Baghel MS, Singh SK, Singh A and Singh AK 2014. Impact of frontline demonstration on the yield and economics of chickpea (*Cicer arietinum* L) in Sidhi district of Madhya Pradesh. Journal of AgriSearch **1(1):** 22-25.

Sloan J, Pathak S, Heitholt J, Rao S, Iyer H, Metz S, and Ware D 2009. Pigeonpea: a multipurpose, drought resistant forage, grain and vegetable crop for sustainable southern farms. Final Report for LS07-201, Sustainable Agriculture Research and Education Projects, Southern Texas, USA.

Syed R and Wu Y 2018. A review article on health benefits of pigeonpea [*Cajanus cajan* (L) Millsp]. International Journal of Food and Nutrition Research **2:** 15; doi: 10.28933/ijfnr-2018-09-0301.

Tomar RKS 2010. Maximization of productivity for chickpea (*Cicer arietinum* Linn) through improved technologies in farmer's fields. Indian Journal of Natural Products and Resources **1(4):** 515-517.

Valenzuela H 2011. Pigeonpea: a multipurpose crop for Hawaii. Hanai'Ai/The Food Provider, March-April-May Edition: 1-8.