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Popularization of vegetable pigeonpea (*Cajanus cajan*) in central Gujarat through demonstration in farmers field

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ABSTRACT

Conventional pigeonpea [*Cajanus cajan* (L.) Millsp.] is harvested as seed but for the purpose of vegetable, it is harvested immature. At this stage it is a nutritious and delicious vegetable and forms a substitute for green pea (*Pisum sativum* L.). Pigeonpea is one of the most important pulse crops of the Panchmahals district of Gujarat. However, productivity of pigeonpea in the district is very low. Attempts were made to improve productivity and to increase area under pigeonpea by adopting high yielding varieties (HYVs). In order to compare conventional pigeonpea with HYVs, 75 front line demonstrations were carried out in systematic manner on farmers' field to show the worth of new varieties in comparison to local check and thereby convincing farmers about potentialities of improved production management practices of pigeonpea for further adoption involving feasible and effective scientific package of practices. The demonstrations clearly showed on enhancement of productivity, simultaneously area under pigeonpea cultivation was also noticed to be increased. The yield (green pod) was found to be increased from 4 300 kg/ha in local check to 7 300 kg/ha in demonstrations. Similarly, the benefit cost ratio for HYVs was also increased to 3.22 as compared to local check (2.27). The economics and benefit cost ratio can be further improved to 3.23 when slightly higher inputs for cultivation and marketing. The impact of pigeonpea FLDs was analysed which showed improvement of knowledge and satisfaction of farmers as the main reason for mass scale adoption.

Key words: Frontline demonstration, Pigeonpea, Production technology

Among sub-tropical legumes, pigeonpea or red gram [*Cajanus cajan* (L.) Millsp.] occupies an important place in rainfed agriculture. Vegetable pigeonpea is characterized by large pods and seeds are easy to shell. It has some anti-nutritional factors like phyto-lectins, but they are heat sensitive and hence destroyed during cooking. Vegetable pigeonpea can also be grown in slightly degraded soil, backyards, field bunds land with undulating topography etc. The fresh seeds (green seeds) can be frozen and canned for commercialization and export. It is more easily digested and cooked. It is a good source of protein, vitamins (A, C, B complex), minerals (Ca, Fe, Zn, Cu), carbohydrates and dietary fibers, etc. Compared to pulse, it has five times more beta carotene content, three times more thiamine, riboflavin and niacin content and has double vitamin C content. Besides it has higher shelling percent (edible grains) (70%) than that of green peas (52%). These all factors indicate that pigeonpea is nutritionally rich vegetable and it can be used in daily cuisine. Even after this, the farmers' adoption rate for vegetable pigeonpea has been poor, mainly due to inferior pod and seed characteristics of commercial cultivars. A survey conducted at this KVK revealed that the farmers prefer pigeonpea which is having more number of pod, bold seed, and good taste, these physical characteristics indicate that green pods are also liked for harvesting pigeonpea for vegetable purpose (Saxena 2010). The consumers preferred long (5-7 cm), wide (1.5-2.0 cm), pods with high numbers of seeds per pod (4-7). The preference of cultivars varied amongst farmers depending on whether the green pods or shelled seeds were to be presented to the consumer. With respect to seeds, hundred seed weight (HSW) was the only single criterion affecting consumer acceptance. In view of this preference, the varieties which were bred or are cultivated mainly for vegetables (pod) purpose should be recommended for planting in the area where pigeonpea is an important crop. Consequently var. GT 1, Vaishali, Mahima, Ganesh, etc. may be recommended for cultivation in central Gujarat region. The vegetable pigeonpea can successfully be taken for cultivation as intercrop with maize and sesamum, where it was found to help reduce incidence of phyllody disease of sesamum.

MATERIALS AND METHODS

An extensive survey was conducted to collect information pertaining to various usage of vegetable pigeonpea in the Panchmahals district. Seventy five farm families each from seven villages (who grew pigeonpea) were selected from three Talukas, viz. Goghamba, Kalol,

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and Godhra for gathering the information. A questionnaire containing 10 questions were put to the respondents and data were analyzed. To popularize the improved vegetable pigeonpea production practices, constraints in vegetable pigeonpea production were identified through participatory approach. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in vegetable pigeonpea production. Farmers were also asked to rank the constraints they perceive as limiting vegetable pigeonpea protection in order of preference. The quantification of data was done by first ranking the constraints and then calculating the Rank Based Quotient (RBQ) as given by Sabarathnam (1988), which is as follows:

$$RBQ = \frac{\Sigma fi\ (n + 1 - ith)}{N \times n} \times 100$$

where, fi, Number of farmers reporting a particular problem under i^{th} rank; N, number of farmers; n, number of problems identified.

Based on top rank farmers problems identified, front line demonstrations were planned and conducted at the farmers' field under Technology Demonstration for Harnessing Pulses Production Programme. In all, 150 full package frontline demonstrations were conducted to convince them about potentialities of improved variety of pigeonpea Vaishali during the years 2009, 2010 and 2011. All the participating farmers were trained on all aspects of pigeonpea production management. Recommended agronomic practices and genuine seeds were used for front line demonstration (FLD) in 0.5 ha area. A one fifth area was also devoted to grow local standard check. To study the impact of front line demonstrations, out of 75 participating farmers, a total of 50 farmers were selected as respondent through proportionate sampling. Production and economic data for FLDs and local practices were collected and analyzed. The technology gap and technology index were calculated using the following formulas as given by Samui *et al.* (2000):

$$\text{Technology gap} = \text{Potential yield} - \text{Demonstration yield}$$

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstrated yield}}{\text{Potential yield}} \times 100$$

Knowledge level of the farmers about improved production practices of pigeonpea before frontline demonstration implementation and after implementation was measured and compared by applying dependent't' test. Further, the satisfaction level of respondent farmers about extension services provided was also measured based on various dimensions like training of participating farmers, timeliness of services, supply of inputs, solving field problems and advisory services, fairness of scientists, performance of variety demonstrated and overall impact of FLDs. KVK farm demonstrated the performance of various varieties of pigeonpea, viz. K Sel, GT 1, Virgin, Vaishali, Mahima, Ganesh, and BDN 2 in demonstration block.

The selected respondents were interviewed personally with the help of a pre-tested and well structured interview schedule. Client Satisfaction Index was calculated as developed by Kumaran and Vijayaragavan (2005).

The individual obtained score

$$\text{Client Satisfaction Index} = \frac{\text{The individual obtained score}}{\text{Maximum score possible}}$$

The data thus collected were tabulated and statistically analyzed to interpret the results.

RESULTS AND DISCUSSION

Results of study on the utilization of pigeonpea in compared to green pea was found to be 45% more among the farm families of Panchmahals Gujarat. The vegetable pigeonpea is used for various culinary purposes, viz. kachodi (40.55%), green sabji (20.23%), paratha (10.25%), Undhiya (5.9), khichari and pulav (8.15%), masala curry (10.00%) and green dahl (5.5%) etc. by the farm families. The survey conducted in Godhra, Ghoghmba and Kalol taluk of Panchmahals, where vegetable pigeonpea is consumed on a large scale, suggest that the rural consumers preferred pods with green base colour with minor or dense streaks on its surface. In contrast, the urban consumers preferred green colour pods. For vegetable purposes, generally large pods are preferred since they are attractive and relatively shell easily. Although seed number/pod in the various commercial varieties ranged between 3 and 7, but on an average, the optimum seed number/pod that is easily marketed is 4-7. The most popular vegetable pigeonpea cultivars have long pods and large seeds (weighing at least 25 to 35 g/100 seeds when green) (Table 1). These cultivars are grown as a normal field crop grown for seed purpose, but immature pods are also harvested at an appropriate stage for use as vegetable. This practice is more prevalent around cities where green pods can readily be marketed at attractive prices. After harvesting some green pods, the rest crop is left for producing dry seeds. The per cent varietal performance of the Panchmahals farmers were in following descending order : K Sel (40), Abhaya Vaishali (30), Mahima

Table 1 Varietal performance of pigeonpea

Germplasm	Days to		Seeds/ pod	Pods/ plant	Pod length (cm)	100 green seed weight (g)
	Flowering	Maturity				
Local	85	120	2.3	076.2	3.2	18
BDN 2	90	135	3.4	178.6	5.2	21
AGT 2	90	135	3.1	189.4	4.7	20
GT 1	90	135	3.3	150.2	4.5	22
Vaishali	110	140	3.1	205.8	4.5	20
Abhaya Vaishali	95	120	4.4	194.6	5.9	25
Mahima	90	120	4.3	183.9	6.4	30
Ganesh	100	130	4.9	218.4	6.7	30
Virgin	105	125	4.2	225.3	6.8	28
K Sel	120	150	5.4	205.8	7.5	35
SEm±	1.3	3.08	0.14	6.54	0.13	0.55
CD (P=0.05)	3.92	6.47	0.14	19.25	0.338	1.16

(28), Virgin (25), GT 1(20). Most of the respondents were unaware about all the performance of different varieties, they grew only local available strain of pigeonpea. The local Ganesh and Mahima cultivars matured the earliest (130 days) for vegetable purpose, whereas K Sel and Vaishali were late varieties (150 days).

Constraints in pigeonpea production

Farmers' pigeonpea production problems were documented in this study. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in pigeonpea production. The ranking given by the different farmers are presented in Table 2. A perusal of table indicates that lack of suitable HYVs was given the top most rank by 29 respondent farmers. The FLD participants were provided HYVs seeds as critical inputs. Based on the ranks given by the respondent farmers for the different constraints listed out in Table 2, the rank based quotients were calculated and presented in Table 3.

The analysis of data presented in the Table 3 revealed that lack of suitable HYVs, low soil fertility, weed infestation and followed by leaf hopper infestation were the major constraints in pigeonpea production. Other constraints such as low technical knowledge, wilt, pod fly infestation, pod borer infestation, damage by wild animals and erratic rainfall were also found to reduce pigeonpea production. More or less similar results have been reported by Hassan *et al.* (1998), Ouma *et al.* (2002) and Joshi *et al.* (2005).

Performance of FLD

A comparison of productivity levels between demonstrated variety and local checks is shown in Table 4. During the period under study it was observed that in front line demonstrations, the improved pigeonpea variety Vaishali recorded the higher grain yield (75.00 q/ha) compared to local check (43.00 q/ha). The percentage increase in the yield over local check was 74.40. Similar yield enhancement in different crops in frontline demonstration has amply been documented by Haque (2000), Tiwari and Saxena (2001), Tiwari *et al.* (2003), Hiremath *et al.* (2007), Mishra *et al.* (2009), Kumar *et al.* (2010) and Dhaka (2010). From these results it is evident that the performance of only improved variety was found better than the local check under local conditions. Farmers were motivated by results of agro technologies applied in the FLDs trials and it is expected that they would adopt these technologies in the coming years. Yield of the frontline demonstration trials and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index. The technology gap shows the gap in the demonstration yield over potential yield and it was 5.00 q/ha. The best potential yield comes from the scientist's field where all inputs are given at optimum level. The observed technology gap may be attributed to dissimilarities in soil fertility, salinity and erratic rainfall and other vagaries of weather conditions in the area. Hence, to narrow down the gap between the yields of different varieties, location specific recommendation appears to be necessary. Technology index shows the feasibility of the variety at the farmer's field. The lower the value of technology index more is the feasibility. Table 4 revealed that the technology index values were 6.25%. The finding of the present study is in consonance with the findings of Hiremath and Nagaraju (2009) in case of onion crop.

The economics of pigeonpea production under front line demonstrations were estimated and the results have been presented in Table 5. Economic analysis of the yield

Table 3 Frequency distribution of RBQ values given by farmers (n=75)

Problems	RBQ	Overall rank
Lack of suitable HYVs	85.46	I
Low technical knowledge	69.2	V
Low soil fertility	74.26	II
Weed infestation	73.6	III
Intercropping	48.13	IX
Wild animals	45.2	X
Wilt	66.8	VI
Pod borer infestation	59.73	VIII
Pod fly infestation	67.46	VII
Leaf hopper infestation	73.06	IV

Table 2 Ranks given by farmers for different constraints (n=75)

Constraints	Ranks									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Lack of suitable HYVs	29	16	12	8	5	5				
Low technical knowledge	14	8	16	10	8	5	2	6	4	2
Low soil fertility	13	12	16	17	5	6	3	3		
Weed infestation	18	15	11	7	3	6	7	8		
Intercropping			5	8	5	10	20	35		
Wild animals	5	5	4	7	7	2	10	13	10	12
Wilt	6	4	15	11	13	26				
Pod borer infestation	10	10	9	6	7	5	8	10	5	5
Pod fly infestation	9	14	10	11	9	7	4	6	5	
Leaf hopper infestation	8	14	17	15	13		5			3

Table 4 Yield, technology gap and technology index of demonstration

Variables	Yield (q/ha)	Increase (%) over local check	Technology gap (q/ha)	Technology index (%)
Local check	43.00			
Demonstration (Vaishali)	75.00	74.4	5.00	6.25

performance revealed that front line demonstrations recorded higher gross returns (₹ 105 000/ha) and net return (₹ 60 200/ha) with higher benefit cost ratio (3.22) compared to local checks. These results are in line with the findings of Gurumukhi and Mishra (2003), Hiremath *et al.*(2007), Hiremath and Nagaraju (2009) in case of potato and onion. Further, additional cost of ₹ 2 000/ha in demonstration has yielded additional net returns ₹ 7 000/ha with incremental benefit cost ratio 3.23 suggesting its higher profitability and economic viability of the demonstration. Similar results were also reported by Hiremath and Nagaraju (2009).

Table 5 Economics of frontline demonstrations

Variables	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit cast ratio
Local check	26 500	60 200	33 700	2.27
Demonstration	32 600	105 000	72 400	3.22
Additional in demonstration	2 000	7 000	3 420	3.23*

*Incremental benefit cost ratio

Increase in knowledge

Knowledge level of respondent farmers on various aspects of improved pigeonpea production technologies before conducting the frontline demonstration and after implementation was measured and compared by applying dependent 't' test. It could be seen from the Table 6 that farmers mean knowledge score had increased by 34.28 after implementation of frontline demonstrations. The increase in mean knowledge score of farmers was observed significantly higher. As the computed value of 't' (5.46) was statistically significant at 5 % probability level. The results are at par with Narayanaswamy and Eshwarappa (1998), Singh and Sharma (2004), Singh *et al.* (2007). It means there was significant increase in knowledge level of the farmers due to frontline demonstration. This shows positive impact of frontline demonstration on knowledge of the farmers that have resulted in higher adoption of improved farm practices. The results so arrived might be due to the concentrated educational efforts made by the scientists.

Farmers' satisfaction

The extent of satisfaction level of respondent farmers over extension services and performance of demonstrated variety was measured by Client Satisfaction Index (CSI) and results presented in Table 7.

Table 6 Comparison between knowledge levels of the respondent farmers about improved farming practices of maize (n=75)

Mean score			Calculated 't' value
Before FLD implementation	After FLD implementation	Mean difference	
31.57	65.85	34.28	5.46*

*Significant at 5% probability level.

Table 7 Extent of farmers satisfaction of extension services rendered (n=75)

Satisfaction	Level number	Per cent
Low	9	12.00
Medium	30	40.00
High	34	45.33

Majority of the respondent farmers expressed high (45.33 %) to the medium (40%) level of satisfaction for extension services and performance of technology under demonstrations whereas, very few (12%) respondents expressed lower level of satisfaction. The results are in conformity with the results of Narayanaswamy and Eshwarappa (1998) and Kumaran and Vijayaragavan (2005) in case of bajra crop. The medium to higher level of satisfaction with respect to services rendered, linkage with farmers, and technologies demonstrated etc. indicate stronger conviction, physical and mental involvement in the frontline demonstration which in turn would lead to higher adoption. This shows the relevance of frontline demonstration.

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