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Enhancement of Rural Livelihoods Through Cluster Front Line Demonstrations on Pigeonpea Variety (Amaravati) in Ananthapuramu District of Andhra Pradesh

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ABSTRACT

Background: Pigeonpea (*Cajanus cajan* L.) is the predominant pulse crop growing in the Ananthapuram district during *kharif* season with a normal area of 53994 ha. The production and productivity of pigeon pea is low due to most farmers were using long-duration variety of pigeon pea (LRG-41), which faces terminal drought, leading to lower yields in the district and constant efforts were made to increase production by interventions of Krishi Vigyan Kendra, Reddipalli of Ananthapuram. Moreover, the study area falls under arid and semi-arid climatic conditions.

Methods: Krishi Vigyan Kendra has conducted cluster frontline demonstrations (CFLD) in pigeonpea from 2017-18 to 2019-20 in a total of 160 ha to assess the performance of enhanced, high yielding and wilt resistant pigeon pea variety *i.e.,* LRG-52 along with integrated crop management practices in KVK espoused villages in Ananthapuramu district.

Result: The upshots divulged that the demonstrated variety was chronicled as high-pitched yields compared to farmers' practices in the course of the study window and touched upon in 12.45, 47.62 and 11.73 per cent increase in harvest was during 2017-18 to 2019-20 respectively. The demonstrated yield was 596 kg/ha, 124 kg/ha and 581 kg/ha compared to farmer's practice of 530 kg/ha, 84 kg/ha and 523 kg/ha from 2017-18 to 2019-20 respectively. The technology gap, extension gap was recorded 904 kg/ha, 1376 kg/ha and 919 kg/ha, 66 kg/ha, 40 kg/ha and 61 kg/ha during 2017-18, 2018-19 and 2019-20 respectively. The technology index was ranging from 60.2 to 91.7 during temporal variation from 2017-18 to 2019-20. It can be concluded that pigeon pea production can be enhanced by encouraging farmers through the adoption of medium duration, high yielding variety LRG-52, upgraded technologies and ensuring need-based inputs in due time.

Key words: Cluster frontline demonstrations, Economics, Gap, Growth, Pigeon pea, Yield.

INTRODUCTION

Cluster front line demonstrations (CFLD) on pulses were initiated during 2016-17 under centrally sponsored scheme of the National Food Security Mission (NFSM).

It is a unique approach for accelerating the production potential of pulses. It is channelized through Krishi Vigyan Kendra's (KVKs) to demonstrate improved, newly released varieties with best management practices and methods of integrated crop management and integrated pest management to exploit the production potential of crops at different locations in a given farming system for dissemination of various technologies (Sahaja *et al*., 2020).

Pigeonpea is a wonder pulse crop that has grown purely under rainfed conditions in Ananthapuramu district. It can be cultivated as a sole and inter crop with a meagre investment for the crop due to resource poor farmers growing a local variety with long duration, moisture stress and intermittent dry spells (Sahaja *et al*., 2019). However, due usage of the long duration traditional Pigeonpea varieties and continuous failure of the North-East (NE) monsoon coincides with the crop critical stages (Flower bud initiation, flowering, pod development in the district are the major drawbacks for the declined productivity (Pavankumarreddy *et al*., 2020).

Pigeon pea was cultivating in 73361 ha, production of 0.4 lakh tons with 8.5 q/ha in the study area. Farmers are experiencing lower yields than the district and national average productivity. The study area consists of major red soils (*Alfisols*) with undulating topography, they are facing drought during *kharif* season, inadequate rainfall, untimely rainfall and depleting of ground water. Pigeon pea reaps, low yields are due to severe moisture stress and the existing variety is long duration compared to improved variety. However, a miniscule of the farmers looking ahead for medium duration, drought resistant variety that suits the Ananthapuramu district with average rainfall of 550 mm and

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length of growth period ranges from 130-150 days. The major trick of cultivating pigeon pea in Ananthapuramu district was facing terminal drought.

In the above real time agri scenario an awakening attempt was made by Krishi Vigyan Kendra, Reddipalli demonstrated a pigeon pea variety LRG-52 called Amaravathi, bold seeded, medium duration and moderately tolerant of helicoverpa, maruca, pod fly, fusarium wilt and sterility mosaic diseases developed by ANGRAU in the embraced villages to uplift the harvestable basket of the field.

MATERIALS AND METHODS

Cluster frontline demonstrations were executed by Krishi Vigyan Kendra, Reddipalli, Ananthapuramu district of Andhra Pradesh during *kharif* season in the clientele farmer's farmfrom 2017-18 to 2019-20 to appraise the performance of LRG-52 (Amaravati) and package of practices on production and productivity of pulses. A group of cooperative farmers and were teamed based on their participation and interactive response received during the preliminary survey and interactive assessment. The sum total of 150 demonstrations in 60 ha extent area were canalised by the active participation of clientele with an intent to evident that the improved technologies of pulses had a great opportunity of production potential in different villages of province.

The technology was shown in six communities in the area, which are located between latitudes 14.5597° and 14.345138°N, longitudes 77.714332° and 77.70334°E and elevations of 335-349 meters above mean sea level (MSL). Overall, the demonstration farm soil had a sandy loam texture, was neutral to slightly saline (pH 7.4 to 8.1), had low to medium organic carbon content (0.41 to 0.52 per cent), low to medium available nitrogen content (226 kg/ha to 347 kg/ha), low to medium available P_2O_5 (10.9 to 52.7 kg/ha) and medium to high available K_2O (120.2 to 350 kg/ha). The number of demonstrations, villages, mandals and the total area covered according to year wise depicted in Table 1.

For outstanding results, the representative farmers were trained to take up the updated package and practices for scientific pigeon pea production through on and off-campus training, technique demonstrations, group meetings and awareness workshops. Soil testing, fertilizer treatment, line planting, timely weed management measures, integrated pest management and other activities were all ensured. Critical inputs, such as an improved high-yielding variety (LRG-52- Amaravati), recommended insecticides and information, were delivered to the catalogued farmers well before the monsoon arrival. The demo farms were monitored regularly by a topic expert team from Krishi Vigyan Kendra, Reddipalli and visits were scheduled to collect data, monitor crops and sort out location-specific varietal interactions with the environment.

Finally, a field day was planned at the pod development to maturity stage in convergence mode, bringing together demonstration holding farmers, other farmers in the village, Scientists from University and ATARI, Department of Agriculture officials and local extension functionaries to demonstrate the superiority of the technology and the variety's production potential. At the time of harvest, crop yield was recorded and reported from the demonstration and control plots. The most practical way to accomplish this is to demonstrate the recommended improved technology on farmer's fields through front-line demonstrations, with the goals of calculating input costs and monetary returns between front-line demonstrations and farmer's methods and identifying yield gaps between farmer's practices and front-line demonstrations.

The basic data was gathered from the farmer's field and compared to the performance of the CFLD and the farmer's practise. The yield data was acquired using a random crop cutting method from both the demonstration and farmers' practises and then examined using simple statistical tools. Gross returns (kg/ha), cost of cultivation (kg/ha) and net returns (kg/ha) were used to quantify the economics. The gross returns were calculated by multiplying grain yield with current market price for the commodity in each year. The cost of cultivation includes the cost of agricultural operations from seed to seed, including labour wages at the current wage rate. Gross returns less cost of cultivation gaps between farmer's practises and front-line demonstrations are included in net returns.

$$\text{Benefit cost ratio} = \frac{\text{Gross returns (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

$$\% \text{ Increase in yield} = \frac{\text{Yield obtained in improved variety} - \text{Yield obtained in farmers variety}}{\text{Yield obtained in farmers variety}} \times 100$$

The technology gap, extension gap and technology index of the study were calculated as per the formulae given by Yadav *et al.,* (2004).

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmer's practice yield

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

RESULTS AND DISCUSSION

Rainfall situation vs yields in the domain of experiment

The monthly rainfall data from 2017-2018 to 2019-20 for the Ananthapuramu district is shown in Table 3. The crop growing season of pigeonpea during 2017-18 was experienced by deficient in rainfall with a negative rainfall deviation of 60.2%. From planting to harvest, the crop had a deficiency rainfall with a negative deviation ranging from 19.3 to 95.9%. Despite the fact that there was a quantitative shortfall in rainfall, the amount received was adequate for pigeon pea to produce a larger yield than farmer practise and district average yields.

While the average annual rainfall in 2018-19 was 559.8 mm, which was greater than the domain area's usual rainfall

(495.8 mm). Further, the distribution of rainfall was quite uneven and unfavourable for the growth and development of the pigeonpea. Crop was experienced sufficient moisture during the juvenile vegetative phase though it deviated from normal rainfall. An excessive amount of rainfall was coincided during peak flowering to pod development stage (*i.e.*, September and October months) with excess relative humidity packed with high wind velocity congenial for the spread of mite incidence leads to poor plant yield of pigeon pea packed with maruca and pod borer incidence later on deficit rainfall during the November and December months crop experiences the dry spell leads to meagre harvests where quantity rainfall doesn't matter.

Further during 2019-20 received deficit rainfall from opening of window to the harvest, but the quantum of distribution matters and that eventually fetches the yields. Though the rains were deficit in June and July soaking rain of 20-30mm is sufficient to germinate and sustain further to a period of flowering. In spite of stress at vegetive stage excess rainfall later on *viz*., September and October lures the soil profile to saturate and support the pigeon pea for sufficient vegetative growth and luxurious flowering later on received rains pinch is higher than the normal also utilised by the crop as a common old age proverb every drop count matters in drylands. Here the same matched with thepigeonpea yield added a step ahead yield of big basket of produce among the three years of study period too.

Adoption gap

Partial adoption gaps were identified for fertilizer application and pest management. Full adoption gap was identified for variety, seed rate, intra plant spacing and seed treatment. No adoption gap was identified in sowing time presented in Table 2. The findings revealed that farmers need to be educated to fill the adoption gaps, which are to an extent partial to full gaps through demonstrations in the cluster approach (Jyothi and Subbaiah, 2019).

Seed yield

The potential yield of demonstrated variety under rainfed conditions was 15-18 q/ha, whereas under irrigated conditions was 22.5-25 q/ha. The demonstrated variety was recorded highest yield *viz.,* 596, 224 and 581 respectively compared to farmers practice (530, 184 and 523 kg ha^{-1}) in all the study period and increase in yield was 12.5, 21.7 and 11.1 per cent during 2017-18 to 2019-20 respectively (Table 4). The variety LRG-52 resulted superior on yield in comparison with LRG-41 (local check) in different years, it might clearly indicate that the adoption of appropriate technology, variety LRG-52 and timely management practices increases yield of

Table 1: Details of cluster frontline and frontline demonstrations were conducted during 2017-18 to 2019-20.

Year	Mandal/Cluster	Village	No. of demonstrations	Extent of area (ha)
2017-18	Mudigubba	Nallacherlopalli	30	12
		Mukthapuram	10	4
		Mukthapuramthanda	10	4
2018-19	Mudigubba	Nallacherlopalli	20	8
		Mukthapuram	10	4
	Bathallapalli	Raghavampalli	20	8
2019-20	Bathallapalli	Raghavampalli	20	8
	Singanamala	Peddamatlagondi	20	8
		Chinnamatlagondi	10	4
		Total	150	60

Table 2: Ascertained adoption gaps in pigeon pea crop management practices.

Item	Improved practice	Farmer's practice	Gap
Variety	LRG-52 (Amaravathi)	LRG-41	Full gap
Seed rate	7.5 kg/ha	10 kg/ha	Full gap
Intraplant spacing	Maintaining of 20 cm by thinning	Not maintaining good space and 2-3 plants per hill	Full gap
Seed treatment	Carbendazim 50% WP@ 2.5 g/kg seed	No seed treatment	Full gap
Sowing time	June-July	June-July	No gap
Fertilizer	Balanced fertilization as per recommended dose of fertilizers (20-50-40 NPK kg ha^{-1})	Applying 45-115-0 kg ha^{-1}	Partial gap
Pest management	Neem oil @ 5 ml/lit and Cholrophyriphos @ 2.5 ml/lt, Acephate 1 g/lt, Thiodicarb@ 1 g/lt, Novaluron 1 ml/lt, spinosad @ 0.3 ml/lt of water for control of pod borer complex	Acephate 1 g/lt, Emamectin benzoate @ 1 g/lt, Carbendazim @1 g/lt, Lamba cylothrin @2 ml/lt of water	Partial gap
Harvesting	Mechanical harvesting	Manual harvesting	Full gap

pigeonpea and these outcomes were in conformity with the study conducted by (Urre *et al*., 2019).

During 2018-19 recorded lower yields over other two years which might be due to unfavourable environmental conditions *viz*., high rainfall during flowering stage leads to the flower drop. Excessive amount of rainfall was coincided during peak flowering to pod development stage (*i.e*., September and October months) with excess of relative humidity packed with high wind velocity congenial for the spread of mite incidence leads to poor plant yield of pigeon pea packed with maruca and pod borer incidence later on deficit rainfall during the November and December months crop experiences the dry spell leads to lowest yield among the study period. In all the years, demonstrated variety showed higher yield compared to farmers variety and it ranged from 11.1 to 21.7 per cent.

Economics analysis

Economic returns were observed to be a function of yield. The sale price of pigeon pea was considered according to minimum support price of that crop in that year. Gross returns of cluster frontline demonstration on pigeon pea from the recommended practice (CFLD's) were 32482 Rs ha^{-1}, 12712 Rs ha^{-1} and 33698 Rs ha^{-1} respectively compared to farmers practice of 28885, 10442, 30334 Rs ha^{-1}during 2017-18, 2018-19 and 2019-20 respectively. The net returns were 17982 Rs ha^{-1}, 6902 Rs ha^{-1}, 16198 Rs ha^{-1}compared to 14635 Rs ha^{-1}, 4542 Rs ha^{-1}, 11584 Rs ha^{-1} during 2017-18, 2018-19 and 2019-20 respectively. It was observed that additional gain ranged from 2360-4614 Rs ha^{-1} in recommended practice proved to be beneficial in respect of yield and economics of pigeon pea in consecutive years and blocks of Ananthapuramu. Further it was also documented that demonstrated yield was higher than average yield of district, which was performed with crop cutting experiment by Department of Agriculture (Table 5). The average yield of district was 525 kg ha^{-1}, 65 kg ha^{-1} and 193 kg ha^{-1} during 2017-18, 2018-19 and 2019-20 respectively.

Technology gap

The technology gap is the difference between potential yieldand demonstration yield. The major technological gaps regarding recommended varieties, seed quality, sowing time, fertilizer dosage, fertilizer application method and plant

Table 3: Rainfall particulars of Ananthapuramu district from 2017-18 to 2019-20.

Month	Normal rainfall	2017-18		2018-19		2019-20	
		Actual	Deviation	Actual	Deviation	Actual	Deviation
June	63.9	63.9	0.0	59.2	-7.4	45.5	-28.8
July	67.4	18.8	-72.1	31.0	-54.0	26.0	-61.4
August	88.7	34.3	-61.3	96.8	9.1	66.1	-25.5
September	118.4	95.6	-19.3	178.4	50.7	195. 2	64.9
October	110.7	44.1	-60.2	186.6	68.6	157.5	42.3
November	34.7	5.3	-60.2	7.5	-78.4	36.8	6.05
December	9.9	0.4	-95.9	0.3	-96.9	14.1	50.5
January	1.6	10.4	550.0	0.0	-100	0.6	-62.5
Total	495.3	272.8		559.8		346.6	

Table 4: Pod yield and economics of pigeon pea influence by front line demonstration from 2017-18 to 2019-20.

Particulars	2017-18		2018-19		2019-20	
	Demo	FP	Demo	FP	Demo	FP
Grain yield (kg/ha)	596	530	224	184	581	523
Gross returns (Rs/ha)	32482	28885	12712	10442	33698	30334
Cost of cultivation (Rs/ha)	14500	14250	5810	5900	17500	18750
Net returns (Rs/ha)	17982	14635	6902	4542	16198	11584
B:C ratio	2.2	2.0	2.2	1.8	1.9	1.6
% Increase in yield	12.5		21.7		11.1	

Table 5: Extension gap, technology gap and technology index for 2017-18 to 2019-20.

Particulars	2017-18	2018-19	2019-20
Area (ha) in Ananthapuram district	71761	48972	39415
Average yield (kg/ha) crop cutting experiment	525	65	193
Production (MTs)	37675	3183	7607
Extension gap (kg/ha)	66	40	61
Technology gap (kg/ha)	904	1376	919
Technology index	60.2	91.7	61.2

protection measures were observed. The technology gap was recorded 904 kg/ha, 1376 kg/ha and 919 kg/ha during 2017-18, 2018-19 and 2019-20 respectively. During different years the disparity in technology gap may be attributed to more viability of preferred technologies, differential pattern of rainfall over different years.

Extension gap

The extension gap is the difference between the demonstration yield and farmers practice yield. The extension gap was recorded 66 kg/ha, 40 kg/ha and 61 kg/ha from 2017-18 to 2019-20 respectively (Table 5). The extension gap between 40 to 66 kg/ha during the study period illustrated the necessity to instruct farmers.

Technology index

The technology index is technology gap divided by potential yield and multiplied by 100. The technology index was recorded 60.2, 91.7 and 61.0 from 2017-18 to 2019-20 respectively (Table 5). The technology index was between 60.2 to 91.7 during the study period was illustrated the necessity to instruct farmers.

CONCLUSION

The study emphasizes that the need to educate the farmers in adoption of improved practices and technologies to narrow the extension gaps through various technology transfer centers. Potential yield of variety can be achieved by passing on scientific knowledge to the farmers, providing seeds of high yielding variety, need based quality inputs in due time and ensuring timely agricultural operations. Therefore, it is suggested that these factors may be taken into consideration to increase the scientific temperament of the farmers. The technologies demonstrated under cluster front line demonstrations had been exploited to obtain the maximum yield, net profit and additional income of pigeon pea cultivation which led to economic viability of the farming in the district. Short duration varieties performed well under rainfed conditions and also escaped from terminal moisture stress.

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