Environment and Ecology 41 (4C) : 2814—2819, October—December 2023
Article DOI: https://doi.org/10.60151/envec/RADZ3869
ISSN 0970-0420

# Impact of Frontline Demonstrations on Red Gram Yield, Economics and Yield Gap Analysis in Telangana

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Received 24 May 2023, Accepted 3 October 2023, Published on 15 December 2023

## ABSTRACT

The present investigation on red gram was conducted in different villages of Nalgonda and Yadadri Bhuvanagiri district of Telangana state during the *kharif* season (June-January) of 2018-19, 2019-20, and 2020-21 respectively. Total of 30 demonstrations was organized in farmer's fields in the districts during the study period. The main objective of frontline demonstration is to increase the productivity, economics of red gram and to decrease the yield gap. Results revealed that the average red gram yield registered under the demonstration plot was 1517 kg ha$^{-1}$ in comparison to 1397 kg ha$^{-1}$ under farmer's practice field with a percentage increase of 8.59. During the study period the average gross returns (86833 Rs ha$^{-1}$), net returns (56145 Rs ha$^{-1}$) and B: C ratio (2.83:1.0) was more in demonstration plot when compared to farmers practice (79945 Rs ha$^{-1}$ gross returns, 48953 Rs ha$^{-1}$ net returns and 2.59:1.0 B: C ratio respectively). Further, there was average increase of additional returns of Rs 12904 ha$^{-1}$, Rs 1635 ha$^{-1}$ and Rs 7036 ha$^{-1}$ recorded in demonstrated technology during 2018-19, 2019-20 and 2020-21 respectively. Regarding the yield gap analysis, average extension gap of 120 kg ha$^{-1}$, technology gap of 483 kg ha$^{-1}$ and technology index of 24.15% was recorded. By adopting innovative approaches like large scale demonstrations, real demonstrations, the extension gap and technology gap could be reduced further for different farming systems to attain self-sufficiency in pulses thereby increase in farmers' income.

**Keywords** Frontline demonstration, Economics, Redgram, Technology gap, Yield.

## INTRODUCTION

Red gram (Pigeonpea) crop is popularly known as Tur or Arhar in India. It is the second most important pulse crop in the country after chickpea. The scientific name is *Cajanus cajan*. It plays a vital role to address national food and nutritional security as they are inexpensive source of protein (20-25%), vitamins and minerals. In India, pulses are generally cultivated in poor soils in which no other crop can be grown with

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minimum resources like water and nutrients. Worlds major redgram producing countries are India (42.80 lakh tonnes), Malawi (4.24 lakh tonnes), Myanmar (3.38 lakh tonnes),Tanzania (1.36 lakh tonnes) and Haiti (1.23 lakh tones). India accounts for about 80% of the total world pigeon pea production and major redgram producing states in the country are Karnataka 14.10 lakh ha (34.84 lakh acres) Maharashtra 11.76 lakh ha (29.05 lakh acres), Madhya Pradesh 4.37 lakh ha (10.80 lakh acres), Uttar Pradesh 3.64 lakh ha (8.99 lakh acres) and Telangana 2.27 lakh ha (5.56 lakh acres) (Redgram Outlook Report 2023).

Red gram is a deep-rooted and drought-tolerant leguminous food crop. Numerous nodules are present on roots and they contain a *Rhizobium bacterium*, which fixes atmospheric nitrogen. Red gram has a unique characteristic of restoring and maintaining soil fertility by improving physical properties of soil. Red gram is a rich source of protein (around 22%), which is about three times that of cereals and supplies a major share of the country's protein requirement to vegetarian population. It is mainly consumed as 'dal' which is split in nature and is a preferential pulse for Indians. Seeds are also rich in iron, iodine, and essential amino acids like lycine, tyrocene, cystine and arginine. The outer seed layer and the kernel part provide a valuable feed/concentrate to milch cattle. The dry sticks of the plant are used for fuel, thatches, storage bins (baskets) making. Besides, pigeon pea has ability to solubilize occluded P and highly insoluble calcium-bound P by their root exudates in addition to improving the soil fertility.

It is a drought resistant crop suitable for dryland farming, variations in weather like prolonged drought and excess rainfall or for other deviations, it offers support/subsistence to cropping systems and predominantly used as base crop with other crops. Pigeon pea is a multi-purpose crop that fits very well in cropping systems as intercrop with black gram, green gram, castor, sorghum, soybean, cotton, maize and groundnut in states like Karnataka, Maharashtra, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh and Telangana. These cropping systems increase production and improve soil fertility, thus aid in sustainable agriculture.

Even though very many number of high yielding varieties have been released in the country, the productivity of red gram remains stagnant around 700 kg/ha compared to its potential yield (1500-3000 kg/ha). This gap in terms of yield of crop may be due to several biotic and abiotic factors. Since it is mainly grown as rainfed crop, variations in rainfall (Delayed, erratic, improper distribution, terminal drought, or heavy down-pour) during *kharif* season in addition to this, the crop grows on marginal lands by resource-poor farmers, who commonly grow the crop under traditional areas with medium or long-duration varieties with lesser or without the use of any inputs like fertilizers, irrigation, herbicide and pesticides.

To ensure self-sufficiency, the projected demand of pulses is 39 million tonnes by 2050 which necessitates an annual growth rate of 2.14% (Vision 2050 report IIPR).

## MATERIALS AND METHODS

The front-line demonstration on Redgram was carried out by DAATT Center, Yadadri Bhuvanagiri in Nalgonda and Bhongiri districts during 2018-19, 2019-20 and 2020-21 respectively. Total of 30 FLD's were organized (10 demonstration/each year). The demonstrations were carried out at different locations to study the yield potential and spread of the technology to a larger area. The soils under demonstration were sandy loams with medium fertility status. Each front-line demonstration was laid out in 0.4 ha and farmers allotted some area for carrying out their traditional practice. The data on the growth, performance of the crop, pest and disease incidence, yield, economics and farmer's feedback was recorded from time to time to assess the comparative performance.

Awareness programs on the importance of pulses were conducted by DAATT center staff before start of *kharif* season in all the locations. The beneficiary farmers were selected and training program was conducted on the production technology of redgram as recommended by Professor Jayashankar State Agricultural University (PJTSAU). The technological interventions with the improved package of practices are presented given in Table 1. Farmer's Practices were compared with demonstration field practices to identify the adoption gaps. The gaps were categorized into three groups, as no gap given in as score of 1, partial gap given as score of 2 and full gap given a score of 3. Based on scores obtained by the individuals, considering mean and standard deviation the respondents were categorized as low (Mean -0.5 SD), Medium (Mean +- 0.5 SD) and high (Mean + 0.5 SD). Adoption gap index was calculated based on the formula suggested by Dubey *et al.* (1981). Adoption gap index was the percent deviation in farmers practice as compared to the improved practices.

$$\text{Adoption gap index} = \frac{R-A}{R} \times 100$$

Where,

R= Total no.of improved practices

A= Total no of improved practices adopted by the farmer

Critical inputs like seed, seed treatment chemicals with bio-fertilisers, pheromone traps and pesticides were provided to farmers. Literature on package of practices was distributed to farmers. Monitoring and follow- up visits were conducted at regular intervals; pest and disease incidence was observed, and need-based agro-advisories were recommended to farmers and their feedback was also recorded. In the case of local checks, the traditional practices were followed using existing varieties.

Field days were conducted in demonstration fields at each location where beneficiary farmers of FLD's and other farmers in the village, officials from the Department of Agriculture and local extension functionaries participated and observed the technology's superiority over farmer's practice. Red gram crop yields were recorded from the demonstration and control plots at the time of harvest to visualize the technology difference and disseminate the technology on a large scale. By using the yield parameters extension gap, technology gap, yield gap and technology index were calculated as procedure suggested by Samui *et al.* (2000).

Technology gap=Potential yield-Demonstration yield

Extension gap=Demonstration yield-Farmer's yield

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

Percentage increase in yield

$$= \frac{\text{Demonstration yield–Farmer's practice yield}}{\textit{Farmer's practice yield}} \times 100$$

Economics of the demonstration plot and farmer practice were recorded, based on economics the other parameters like additional costs, effective gain, additional returns, incremental B:C ratio were calculated.

Additional cost=Demo cost (Rs)-Famerspractice cost.

Additional return=Demonstration return-Farmer practice returns.

Effective gain=Additional returns-Additional cost
Incremental B:C ratio=Addito returns /Additional costs.

## RESULTS AND DISCUSSION

**Adoption gaps :** Full gaps were identified for varietal, seed treatment, nipping, irrigation and pest management. Fertilizer management and weed management showed partial adoption gaps. Sowing time and seed rate showed no adoption gap as presented in Table 1. The results are in line with the findings of Jyothi and Venkata Subbiah (2019). The distribution of respondents based on adoption gaps revealed that 55.6% of them were observed with high adoption gap, while medium and low adoption gaps with equal proportion of 22.2% each were observed. Hence, it is found every need to educate the farmers on improved practices of crop management.

**Adoption gap index :** The adoption gap index was calculated and found to be 77.78% which indicates that there is urgent need for technological interventions by the scientists. Hence, it was planned to take up the frontline demonstrations in farmer's fields.

**Technology gap :** The difference between potential yield and demonstration yields ranging from 52 to

**Table 1**. Details of recommended package of practices for Red gram.

| Sl. No. | Particulars | Demonstration | Farmers practice | Gap |
|---|---|---|---|---|
| 1 | Seed | PRG-176 (Medium duration) | LRG-41 (Long duration) | Full gap |
| 2 | Seed rate | 5 to 7.5 kg/ha | 6 to 7. 5 kg/ha | No gap |
| 3 | Seed treatment | Fungicide Thiram @3g/kg, insecticide Imidacloprid @ 5 ml/kg seed and Biofertilizer Rhizobium culture @ 500g/ ha | No seed treatment | Full gap |
| 4 | Sowing time | June- July (*kharif*) | June- July (*kharif*) | No gap |
| 5 | Fertilizers | 50 kg P as basal and 20 kg N/ha, foliar spray with Multi-K @ 2.5 kg/ha at flowering to pod initiation stage. application of 2 kg PSB in 200 kg FYM | 100 DAP kg/ha | Partial gap |
| 6 | Weed management | Pendimethalin 30 EC @ 2.5 L/ha as pre-emergence herbicide followed by post-emergence application of Imazethapyr @ 750 ml/ha at 20 to 25 days after sowing | Inter-cultivation at 25-40 DAS | Partial gap |
| 7 | Nipping practice | Removal of terminal branches to enhance side branches | Not practiced | Full gap |
| 8 | Irrigation | Irrigation at flower bud stage to avoid moisture stress | Not irrigated | Full gap |
| 9 | Pest management | Spray with neem oil @ 5 ml/L for sucking pests, bird perches @ 20/ha, pheromone traps @ 20/ha (Helicoverpa 10 and Spodoptera10), Chlorantraniliprole @ 0.4 ml/L for maruca pod borer (IPM practices followed) | Only chemical control when Severe (IPM practices not followed) | Full gap |

1017 kg/ha, with an average of 483 kg/ha. The difference in technology gap in different years was due to more feasibility of the variety to the recommended technologies during the study period. The technology gap might be due to dissimilarity in soil fertility status, pest and disease incidence and local weather conditions as varieties respond distinctly to diversified environments. Hence to narrow down the technology gap, location-specific high-yielding varieties with a specific package of practices addressing higher yields, have-to be developed.

**Extension gap :** The extension gap is the difference between demonstration yield and farmers yield and Table 2 depicts that the gap ranged from 20 kg to 245 kgs with an average gap of 120 kg/ha. The gap is attributed to improved technology with high yielding variety in the demonstration. This gap advocates the need of DAATTCs to educate non-beneficiary farmers through various extension means like awareness programs, training programs on scientific practices in cultivation, demonstration of seed treatment, timely ago advisories and complete adoption of demonstrated technology. The increased awareness created by the extension functionaries would motivate the farmers to adopt improved practices and there by reduce the extension gap. The findings are in line with the reporting's of Vamshi *et al.* (2022).

**Technology index :** It shows the feasibility of the demonstrated technology, including the variety in the farmer's field. The lower the value of the technology index indicate more is the feasibility of the technology. The data presented in Table 2 indicated that the technology index was ranging from 2.6 to 50.85 with an average of 24.15 wider gap in technology

**Table 2.** Red gram yield under demonstration and farmer's practice.

| Year | Potential yield | Demonstration yield | Farmer's practice yield | Yield gap percentage | Technology gap | Extension gap | Technology index (%) |
|---|---|---|---|---|---|---|---|
| 2018-19 | 2000 | 1620 | 1375 | 17.81 | 380 | 245 | 19.00 |
| 2019-20 | 2000 | 1948 | 1928 | 1.03 | 52 | 20 | 2.60 |
| 2020-21 | 2000 | 983 | 888 | 10.70 | 1017 | 95 | 50.85 |
| **Average** | **2000** | **1517** | **1397** | **8.59** | **483** | **120** | **24.15** |

**Table 3.** Economics of red gram under demonstration and farmer's practice.

| Year | Demonstration plot | | | | Farmer's practice | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gross returns (Rs/ha) | Cost of cultivation (Rs/ha) | Net returns (Rs/ha) | B: C ratio | Gross returns (Rs/ha) | Cost of cultivation (Rs/ha) | Net returns (Rs/ha) | B: C ratio | Additional returns (Rs/ha) |
| 2018-19 | 91935 | 30000 | 61935 | 3.06 | 78031 | 29000 | 49031 | 2.69 | 12904 |
| 2019-20 | 110549 | 31000 | 79549 | 3.56 | 109414 | 31500 | 77914 | 3.47 | 1635 |
| 2020-21 | 58016 | 31065 | 26951 | 1.86 | 52392 | 32477 | 19915 | 1.61 | 7036 |
| **Average** | **86833** | **30688** | **56145** | **2.83** | **79945** | **30992** | **48953** | **2.59** | **7192** |

index during the study period may be because of differences in yields in different years due to varied rainfall distribution. During the year 2019-20, the lowest technology index of 2.6% was attained because of better monsoon during the entire crop growth. However, the technology index was high in the rest of the years due to irregular rainfall distribution. The present findings of extension gap, technology gap and technology index are in accordance with Raja Madhusekar *et al.* (2022).

**Yield details :** Data from Table 2 revealed that the highest grain yield of 1620 kg/ha, 1948 kg/ha, 983 kg/ha recorded which was more than the yields 1375 kg/ha, 1928 kg/ha and 888 kg/ha of farmers practices during the years 2018-19, 2019-20 and 2020-21 respectively. The average red gram yield under the demonstration plot with improved technology registered as 1517 kg/ha in comparison to 1397 kg/ha under farmer's practice. The percent increase in grain yield of the demonstrations over farmers' practice was 17.81, 1.03 and 10.70 during the study period, with an average increase of 8.59%. The difference in yield observed during different years was due to variation in rainfall distribution, dissimilarities in soil fertility levels at different locations, pest and disease incidence. Improvement in yield under demonstration over the farmer's practice might be due to sowing of high yielding variety i.e.PRG-176 mailnly because of its medium duration, suitable to areas of red chalka soils and suitable for low rainfall receiving area, seed treatment for control of pests and diseases up to 20 days after sowing, use of an optimum dose of fertilizers, timely weed control and nipping practice. The present findings are in confirmatively with Narendar *et al.* (2022) and Dinesh *et al.* (2021).

## ECONOMICS

From the economics of the experiment presented in Table 3, it was evident that during the study period of 2018-19, 2019-2020 and 2020-21, the highest gross returns were Rs 91,935/-, Rs 1,10,549/- and 58,016/- respectively which is higher than the farmers practice i.e. Rs 78,031/-, Rs 1,09,414/- and Rs 52,392/- respectively. The net returns of demonstration plot was Rs 61935/-, Rs 79549/- and 26951/- recorded higher than farmer's practice i.e Rs 49,031/-Rs 77,914/- and Rs19,915/-ha$^{-1}$ during 2018-19, 2019-20 and 2020-21 respectively. The benefit cost ratios recorded in demonstration plot was 3.06, 3.56 and 1.86 during the years of 2018-19, 2019-20 and 2020-21 were higher compared to farmer's practice plots with 2.69, 3.47 and 1.61 respectively during the study period.

The average gross returns (86833 Rs ha$^{-1}$), net returns (56145 Rs ha$^{-1}$) and B:C ratio (2.83:1.0) recorded was more in the demonstration when compared to farmers' practice gross returns (79945 Rs ha$^{-1}$) net returns, 48953 Rs ha$^{-1}$ and B : C ratio of 2.59:1.0 during the study period, these findings are in line with Narendar *et al.* 2022. Further, there was average additional returns increase of Rs 12904 ha$^{-1}$, Rs 1635 ha$^{-1}$ and Rs 7036 ha$^{-1}$ recorded in demonstration plots during 2018-19, 2019-20 and 2020-21 respectively.

The gain of Rs 12904/-, Rs 2135/-, Rs 8448/- was recorded respectively during the study period in demonstration fields. The findings are in line with Raja Madhusekar *et al.* (2022) and Narendra *et al.* (2013).

## CONCLUSION

The Cluster Frontline demonstrations conducted by

DAATTC, Yadadri Bhuvanagiri recorded highest yields and economic returns compared to farmers' practice. The percent increase of the demonstrated technology of about 24.15% over farmers' practice was because of selection of high yielding variety with drought tolerance, improved production technology of redgram like optimum seed rate, seed treatment to ward off pests and diseases during initial stages, weed control, timely nutrient management, and pest control. The higher benefit-cost ratios proved the economic viability of the technological interventions and with respect to yield gap analysis, the demonstrations acted as an effective tool for disseminating the scientific production technology by creating greater awareness and motivating non-beneficiary farmers for complete adoption by building confidence in them.

The study emphasizes the need of DAATT Center's to educate more farmers through various innovative extension approaches by including FPO's, ICT's, awareness programs and skill-oriented training programs, field days at demonstration fields, farmers fairs and exposure visits organized for the adoption of scientific practices in the cultivation of crop. Further, location-specific research strategies for different farming systems and extension programs could reduce the extension and technology gap. The frontline demonstrations could be popularized by conducting more FLD's for wider adoption among the farming community paving the way for horizontal spread of technology, since they can double production, increasing farmers' income and attaining self-sufficiency in pulses production in our country.

## Further research

Cultivars with shorter and medium duration, high grain yielding, drought tolerant, pest resistant varieties for pod borer and wilt disease resistance varieties have to be developed. Technology for seed-to-seed mechanization must be developed. Studies should be conducted on water conservation technologies during period of uncertainty of rainfall.

## ACKNOWLEDGMENT

District Agricultural Advisory and Transfer of Technology Center, Yadadri Bhuvanagiri is thankful to the Director of Extension, PJTSAU, Hyderabad for providing funds for conducting the FLDs and farmers who always show faith in DAATT Center, Yadadri Bhuvangiri.

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