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ECONOMIC AND AGRONOMIC ASSESSMENT OF REDGRAM (*CAJANUS CAJAN*) AS AN ALTERNATIVE TO COTTON IN RAINFED LIGHT SOILS OF TELANGANA: A THREE-YEAR ON-FARM EVALUATION

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ABSTRACT

On-farm trial entitled economic and agronomic assessment of redgram (*cajanus cajan*) as an alternative to cotton in rainfed light soils of Telangana: a three-year on-farm evaluation was conducted during kharif 2018–19, 2019–20 and 2020–21 at 15 farmer-field locations in villages adopted by Krishi Vigyan Kendra, Garimellapadu, Bhadradri Kothagudem district, Telangana, India. Rainfed farmers cultivating light-textured soils face production uncertainty and high input costs, making crop choice an important component of risk management. Three practices were compared: T_1, redgram (pigeonpea; Cajanus cajan) at 90 × 60 cm with nipping at 45 days after sowing (DAS) and mepiquat chloride at 2 ml per 10 L water at flower initiation and peak flowering; T_2, redgram at 90 × 60 cm without the additional interventions; and T_3, cotton under farmer practice. Across the three-year summary, mean redgram yield was 1,297 kg ha^{-1} in T_1 and 1,214 kg ha^{-1} in T_2, compared with 1,458 kg ha^{-1} in cotton. Despite lower yield, T_1 recorded the highest mean net return (₹42,953 ha^{-1}) and benefit:cost ratio (2.36), while cotton recorded ₹24,145 ha^{-1} and 1.44, respectively. Relative to cotton, T_1 reduced cultivation cost by 42.8% and increased net returns by 77.9%; T_2 reduced cultivation cost by 44.2% and increased net returns by 61.4%. T_1 also recorded more primary and secondary branches per plant than T_2 and cotton. The results indicate that every aspect of crop cultivation redgram at 90 × 60 cm with nipping at 45 days after sowing (DAS) and mepiquat chloride at 2 ml per 10 L water at flower initiation and peak flowering showed lower costs and more returns and cotton have shown higher costs and lower returns.

KEYWORDS: *Cajanus cajan*; cotton; rainfed agriculture; light-textured soils; on-farm trial; net returns; benefit:cost ratio

1. INTRODUCTION

Pulses are an essential component of India's food and agricultural systems because they supply affordable dietary protein while supporting the sustainability of crop production. Their importance extends beyond human nutrition, as several pulse crops establish symbiotic relationships with nitrogen-fixing bacteria and contribute to nutrient cycling within agricultural soils. Among these crops, redgram or pigeonpea (*Cajanus cajan* (L.) Millsp.) is particularly important in tropical and subtropical farming environments. Its adaptability to rainfed cultivation, established market demand and suitability for inclusion in diversified cropping systems make it a valuable option for improving the resilience of smallholder agriculture.

The economic importance of pulse cultivation is reinforced by the continuing need to improve India's domestic pulse supply. Government estimates recorded national pulse production of approximately 242.46 lakh tonnes in 2023–24, while reported imports during the same period were about 47.38 lakh tonnes (ministry of agriculture and farmers welfare (2024). These statistics illustrate the scale of the pulse economy and the continuing role of imports in supplementing domestic availability. They also provide a broader justification for investigating production options that can strengthen pulse cultivation in suitable agricultural regions. Nevertheless, national production and import figures do not directly quantify the pulse requirement of Telangana. State-specific conclusions should therefore be based on official regional statistics or clearly identified estimates of consumption, production and supply.

Rainfed production systems are exposed to rainfall variability, soil-moisture constraints and fluctuating input and output prices. In such settings, crop choice should be judged not only by harvested yield but also by production cost, net return and the stability of farm income. Pigeonpea (redgram; *Cajanus cajan* (L.) Millsp.) is a pulse crop suited to a range of rainfed environments and can contribute dietary protein and diversification in cereal- and fibre-dominated systems. Recent Indian

research has continued to examine improved pigeonpea management, resource conservation and farm profitability under rainfed conditions (Kumar *et al.,* 2023; Sudha Rani *et al.,* 2024; Sarkar *et al.,* 2025).

A direct comparison of redgram and cotton is particularly relevant for farmers cultivating rainfed light soils, where both agronomic performance and the cost of production influence crop choice. Cotton cultivation may involve substantial expenditure on seed, fertilizers, weed control, plant protection and harvesting. Redgram also requires appropriate expenditure on crop establishment, nutrient management, weed control and pest management, but its overall cost structure may differ from that of cotton. Whether these differences translate into higher profitability depends on crop yield, prevailing market prices, labour requirements and seasonal production risks. An assessment based on net returns and benefit–cost ratio can therefore provide more meaningful information for farm-level decisions than a comparison based on yield alone.

A three-year on-farm evaluation offers an opportunity to examine these differences under varying seasonal conditions. Multi-year observations can help distinguish consistent crop advantages from outcomes associated with an unusually favourable or unfavourable season. Assessing both crops under farmers' field conditions also improves the practical relevance of the findings, particularly when crop management and input use reflect local production practices. Annual and pooled comparisons of yield, cultivation cost, gross returns, net returns and benefit–cost ratio can establish whether redgram offers an economically viable alternative to cotton in the target environment. Where available, information on rainfall distribution, pest incidence and variation in output prices can further strengthen the interpretation of seasonal results.

In view of these considerations, the present investigation was undertaken to assess the agronomic performance and economic feasibility of redgram as an alternative to cotton in rainfed light soils of Telangana through a three-year on-farm evaluation. The study compares the productivity and cultivation economics of the two crops and examines the consistency of their relative performance across years. The findings are intended to provide field-based evidence to guide crop-selection decisions, promote suitable diversification in rainfed farming systems and identify opportunities to improve farm income while contributing to the regional production of pulses.

Crop-management practices can alter pigeonpea architecture and reproductive development. Nipping of the terminal growing point is used to modify apical dominance and encourage branching; recent work has explicitly evaluated crop geometry and nipping effects on pigeonpea morpho-phenological traits (Fanish *et al.,* 2025), while research in Telangana has also reported responses under rainfed conditions (Veeranna *et al.,* 2020). Responses may depend on environment, cultivar and management. Mepiquat chloride is a growth regulator, but the performance of a combined nipping–mepiquat package must be evaluated under the specific conditions in which it is recommended rather than assumed from the effect of either practice alone.

Cotton may generate high gross receipts, but its production can require substantial expenditure on seed, nutrients, crop protection and harvesting. An alternative crop may therefore be economically preferable even where its physical yield is lower, if it reduces costs sufficiently. This study used a three-year, 15-location on-farm summary from Bhadradri Kothagudem district to compare redgram management options with cotton farmer practice. The objectives were to (i) compare yield and branching attributes, (ii) quantify cost, gross income, net income and benefit:cost ratio, and (iii) assess the potential of the redgram package as an economic alternative to cotton in rainfed light soils.

2. MATERIALS AND METHODS

2.1 Study area and duration

On-farm trial entitled economic and agronomic assessment of redgram (*cajanus cajan*) as an alternative to cotton in rainfed light soils of Telangana: a three-year on-farm evaluation was conducted during kharif 2018–19, 2019–20 and 2020–21 at 15 farmer-field locations in villages adopted by Krishi Vigyan Kendra, Garimellapadu, Bhadradri Kothagudem district, Telangana, India. Redgram crop is situated in rainfed light soils where the average annual rainfall was 650 mm. Redgram variety PRG -176 was sown with a spacing of 90 × 60 cm, with a seed quantity of 3 kg acre^{-1}. Sowing operations were carried out between 15 June and 15 July in each year, depending on rainfall occurrence and the availability of suitable soil moisture. Three practices were compared and the treatments are Redgram crop cultivation under two different demonstration practices and cotton crop cultivation as under farmers' practice as mentioned in table 1. Seeds were immersed for three hours in a 100 ppm $ZnSO_4$ solution, prepared using 10 g of zinc sulphate per 100 L of water, with the soaking solution maintained at one-third of the intended volume. After treatment, the seeds were spread in the shade until their moisture content returned to the initial level. A fungicidal slurry was then prepared using carbendazim 75% WP at 2 g kg^{-1} seed, with 5 mL of water per kilogram of seed. The treated seeds were dried under shade before being used for sowing.Weed interference was managed through a combination of pre-emergence and selective post-emergence herbicide applications. Pendimethalin was applied soon after sowing at 1.2–1.5 L acre^{-1}, diluted in approximately 200 L of water per acre. Subsequent weed control was determined by the type and intensity of weed infestation. Imazethapyr was used at the reported rate of 300 ml acre^{-1} for susceptible broad-leaved weeds. Where grassy weeds were predominant, the reported alternatives included Turga Super at 400 mL acre^{-1} or propaquizafop at 250 mL acre^{-1}. These treatments formed part of the weed-management schedule adopted for the crop. A basal fertilizer dose was supplied at sowing to support early crop establishment and subsequent growth. The fertilizer programme comprised 10 kg N acre^{-1}, 100 kg SSP acre^{-1} and 15 kg MOP acre^{-1}. The fertilizers were applied according to the production practices followed in the field.The crop was inspected periodically for the occurrence of insect pests and diseases. Appropriate insecticidal and fungicidal treatments were

undertaken whenever required, following the recommended crop-protection practices.Harvesting was performed approximately 135–140 days after sowing, when the majority of the pods had developed a brown colour indicative of maturity. Following harvest, the seeds were dried to a moisture level of approximately 8–10% before sale to facilitate handling, storage and marketing.Cotton served as the reference crop for evaluating the economic and agronomic suitability of redgram. It was cultivated by participating farmers using their customary production methods under the prevailing rainfed conditions. The management operations, input expenditure, crop yield and economic returns associated with cotton were documented and compared with the corresponding observations for redgram. This approach enabled an assessment of redgram as a potential alternative to the established cotton-based production system under actual farm conditions.

Table 1: Treatments and cultivars imposed in the trail

Treatment	Management practice	Interpretation	Cultivars
T_1	Redgram at 90 × 60 cm; nipping at 45 DAS; mepiquat chloride at 2 ml per 10 L water at flower initiation and peak flowering	Integrated redgram package	PRG-176
T_2	Redgram at 90 × 60 cm	Redgram without the additional nipping and mepiquat interventions	PRG-176
T_3	Cotton under farmer practice	Comparator/farmer practice	Rasi BG-II

2.2 Observations, economic calculations and Statistical analysis

The available variables were mean seed yield (kg ha^{-1}), primary and secondary branches per plant, cost of cultivation, gross income, net income and benefit:cost ratio. Year-wise yield, net returns and benefit:cost ratios were also reported. The following standard identities were used for interpretation: net returns = gross income − cost of cultivation; benefit:cost ratio = gross income ÷ cost of cultivation. Values are presented as reported in the source. Percentage changes relative to cotton were calculated from the reported three-year means as [(redgram value − cotton value) ÷ cotton value] × 100. Cost reductions were calculated as [(cotton cost − redgram cost) ÷ cotton cost] × 100. The original site-by-year observations were analyzed using a mixed model with treatment as a fixed effect and year and location as random effects; treatment × year interaction were examined and presented in figures 1-4.

3. RESULTS

3.1 Seed yield across treatments and years

The reported three-year mean seed yield was 1,297 kg ha^{-1} under T_1, 1,214 kg ha^{-1} under T_2 and 1,458 kg ha^{-1} under cotton (T_3). Thus, the two redgram treatments produced 11.0% and 16.7% lower mean yield, respectively, than cotton. Within redgram, T_1 exceeded T2 by 83 kg ha^{-1} (6.8%). The year-wise pattern was not uniform: cotton had the highest reported yield in 2018–19 and 2019–20, whereas T_1 exceeded cotton in 2020–21 (1,418 versus 1,024 kg ha^{-1}) (Table 2 and figures 1-4).

Table 2: Treatment wise cost of cultivation of red gram and cotton (means of 3 years).

S.No	Particulars	Red gram Rs. /ha^{-1}	Red gram Rs. /ha^{-1}	Cotton Rs. /ha^{-1}
		T_1	T_2	T_3
1	Field preparation cost	8625	8625	8625
2	Seed rate (kg)	7.5	7.5	2.0
3	Seed cost	1000	1000	3500
4	Sowing cost	1400	1400	1500
5	Fertilizers cost	4800	3500	8500
6	Weeding /Tillage cost	6500	6500	8600
7	Pest and disease cost	3300	3815	12591
8	Harvesting cost	6000	6000	12000
9	Total cost of cultivation	31625	30840	55316
10	Yield (kg/ha)	1297	1214	1458
11	Gross income	74577.5	69805	79461
12	Net income	42953	38965	24145

13	B:C	2.36	2.26	1.44

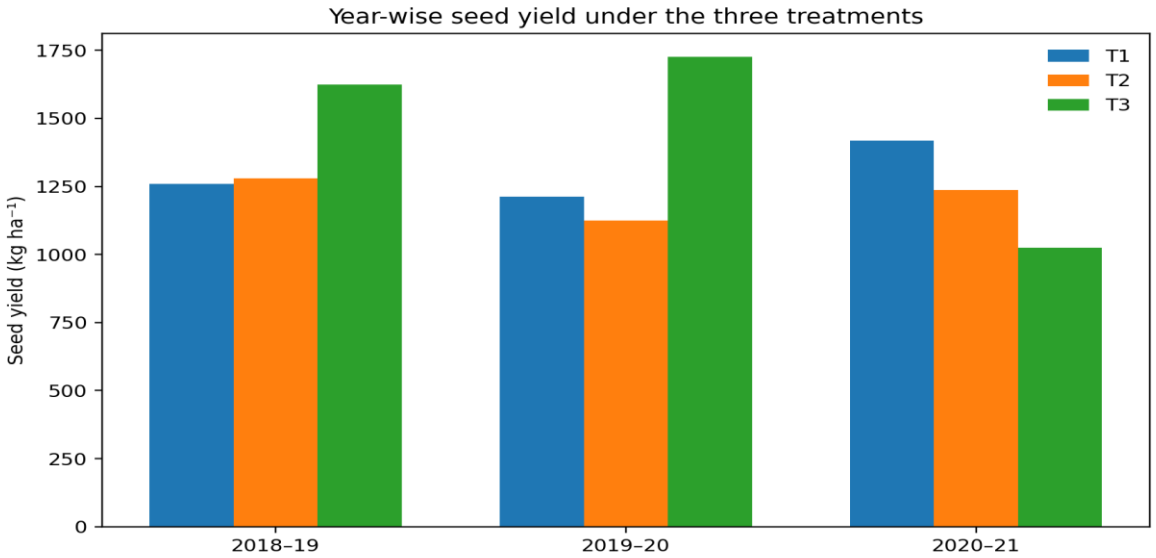


Figure 1. Year-wise seed yield reported for the three treatments. Values are descriptive; uncertainty estimates were not available.

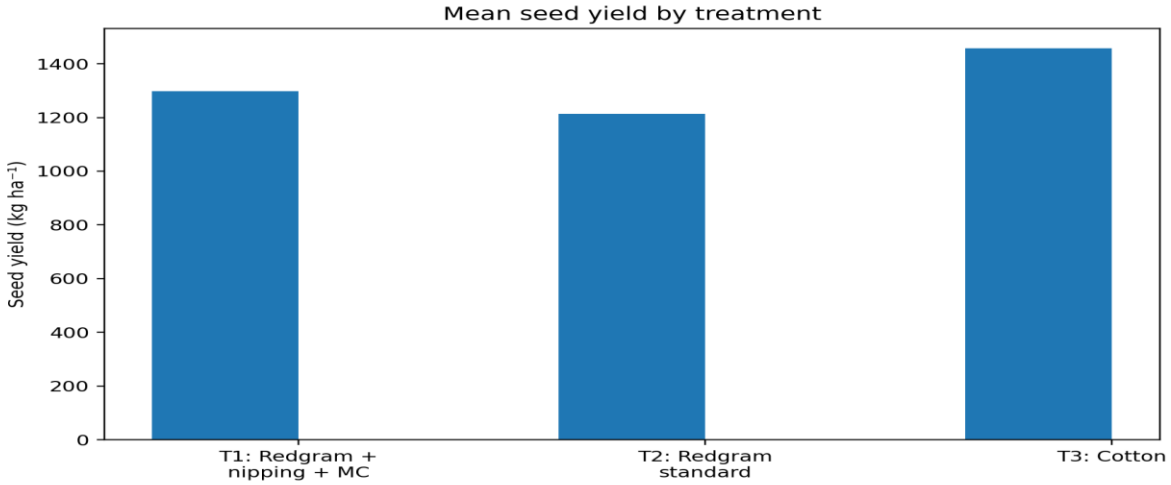


Figure 2. Three-year mean seed yield by treatment.

3.2 Branching attributes

The summary reported 16 primary and 25 secondary branches plant^{-1} in T_1, compared with 14 and 23 in T_2 and 11 and 17 in cotton. Relative to T_2, T_1 had 14.3% more primary branches and 8.7% more secondary branches. Relative to cotton, T_1 had 45.5% more primary branches and 47.1% more secondary branches. These descriptive differences are consistent with a more highly branched canopy under T_1, but the data do not establish whether the differences were statistically significant or whether they directly caused yield responses.

Table 3. Branching attributes of red gram and cotton

Attribute	T_1 (Redgram)	T_2 (Redgram)	T_3 (cotton)
Primary branches plant^{-1}	16	14	11
Secondary branches plant^{-1}	25	23	17

3.3 Cost of cultivation and profitability

Redgram seed treatment with fungicides like carbendazim @ 2 g/kg before sowing effectively controls fungi and reduces incidence of both seed and soil borne fungi. Redgram Seed treatment with Rhizobium culture can increase the yield upto 20 - 25 %. Seed rate needed 7.5 kg/ha-^{1} with a spacing 90cm x 60cm Rs. 1000/- ha^{-1} and the seed cost with the cotton crop is 2

kg/ha^{-1} Rs. 3500/- ha^{-1} with a spacing 90 x 90 cm. The higher plant height may be because of competition for light, water and space which resulted in increased plant height of crops in closer spacing as compared to wider spacing. The fertilizer cost of red gram treatment T_1 is ₹4800 ha^{-1}; corresponding value for T_3 cotton was ₹8500 and which is ₹3700 ha^{-1} higher than the $T_{1..}$ Mean cultivation costs were ₹31,625 ha^{-1} for T_1 and ₹30,840 ha^{-1} for T_2, compared with ₹55,316 ha^{-1} for cotton. The redgram packages therefore reduced reported costs by 42.8% and 44.2%, respectively. T_1 recorded gross income of ₹74,577.50 ha^{-1} and net income of ₹42,953 ha^{-1}; corresponding values for T_2 were ₹69,805 and ₹38,965 ha^{-1}. Cotton recorded the highest gross income (₹79,461 ha^{-1}), but the lowest net income (₹24,145 ha^{-1}), reflecting its much higher production cost. T1 net returns were ₹18,808 ha^{-1} higher than cotton, equivalent to a 77.9% increase. T_2 net returns were ₹14,820 ha^{-1} higher than cotton (61.4%) (Table. 2 and figure 3-4).

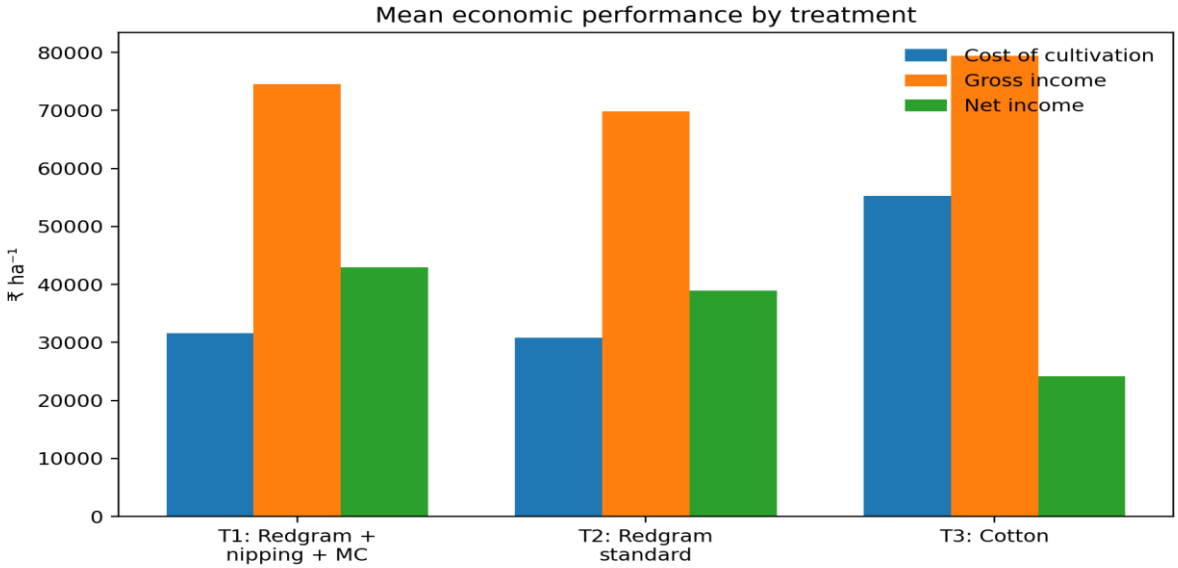


Figure 3. Mean cost of cultivation, gross income and net income.

3.4 Benefit:cost ratio and year-wise economic variation

The reported mean benefit:cost ratios were 2.36 for T_1, 2.26 for T_2 and 1.44 for cotton. On the basis of the supplied figures, each rupee of cultivation cost was associated with ₹2.36 gross income under T1, ₹2.26 under T2 and ₹1.44 under cotton. The annual summaries show that T_1's net returns increased from ₹37,050 ha^{-1} in 2018–19 to ₹52,514 ha^{-1} in 2020–21. Cotton net returns declined to ₹13,184 ha^{-1} in 2020–21, the same year in which its yield fell to 1,024 kg ha^{-1}. Such annual differences may reflect weather, pest pressure, market prices or other factors, but the dataset does not contain evidence to identify the cause.

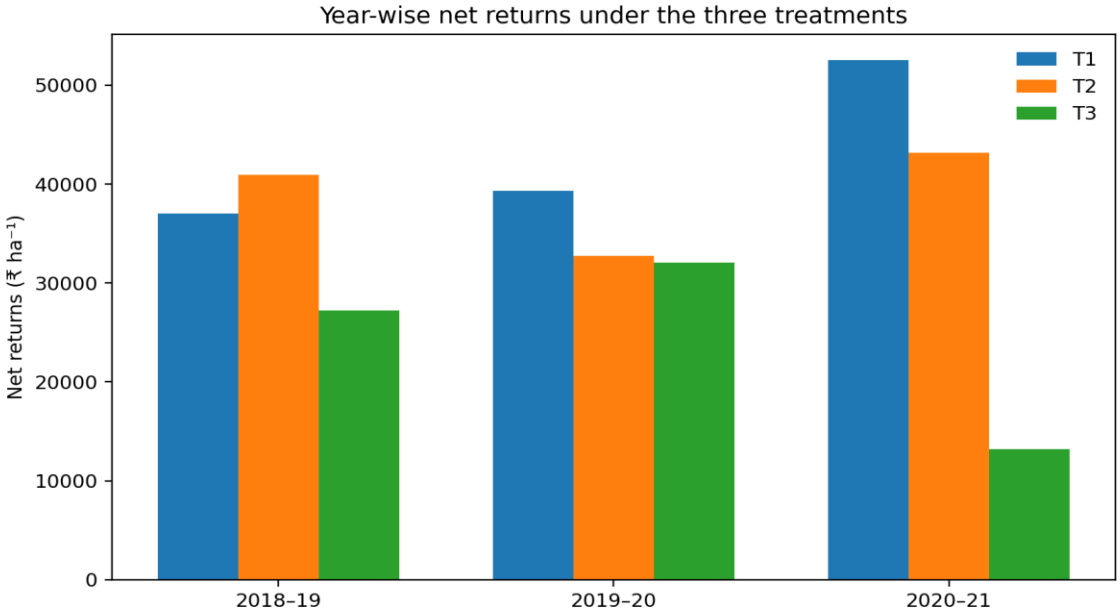


Figure 4. Year-wise net returns from the reported trial summary.

Table 3. Mean yield and economic performance of trail

Indicator (mean)	T_1	T_2	T_3	T_1 vs T_3
Yield (kg ha^{-1})	1,297	1,214	1,458	−11.0%
Cost of cultivation(₹ ha^{-1})	31,625	30,840	55,316	42.8% lower
Gross income (₹ ha^{-1})	74,577.5	69,805	79,461	−6.1%
Net income (₹ ha^{-1})	42,953	38,965	24,145	+77.9%
B:C ratio	2.36	2.26	1.44	+63.9%

4. DISCUSSION

The main finding is the separation between physical yield and economic performance. Cotton produced the highest three-year mean yield and gross income in the supplied summary, yet it did not produce the highest net return because its cultivation cost was substantially greater. This distinction is central to farm-level decision-making: a crop with a lower gross receipt can be more remunerative when the cost base is lower. The pattern aligns broadly with Indian studies showing that improved pigeonpea management and rainfed production strategies can affect profitability as well as yield (Kumar *et al.,* 2023; Sudha Rani *et al.,* 2024; Vijay *et al.,* 2024; Sarkar *et al.,* 2025; Ramanjaneyulu *et al.,* 2025; Kumar *et al.,* 2021). Recent work on genotype × management combinations has also emphasized the importance of evaluating productivity and profitability together in semi-arid production systems (Sawargaonkar *et al.,* 2025). These studies provide context, not direct validation, because their locations, treatments and experimental designs differ from the present on-farm evaluation.

The T_1 package had the highest net income and B:C ratio among the three treatments, and its reported branch counts exceeded those of T_2 and cotton. Nipping may alter branching architecture by reducing apical dominance; field research in Telangana has evaluated nipping and plant geometry in pigeonpea (Veeranna *et al.,* 2020) in light textured soils. However, the current dataset compares a combined package, nipping plus two mepiquat chloride applications with redgram without these interventions. Cotton had relatively high yields in the first two years but a lower yield in 2020–21 due to uncertainty in rain fall, while T_1 had its highest yield and net returns in that year. Such variation could be relevant to risk-sensitive crop planning, but a three-year summary higher net return of 77.9 %, 61.3% were recorded in T_1 and T_2 as compared to cotton. The cost of cultivation of red gram crops is the total of costs incurred on various inputs that are used in different operations. The profitability of any enterprise depends upon income generating capacity and cost structure (Renuka *et al.,* 2019). Benefit- cost ration was indicating that with the cultivation of Redgram has more compared to the cotton. Recent modelling research on sowing strategies also indicates that the timing of sowing and associated moisture and temperature conditions are important considerations for rainfed pigeonpea productivity (Modelling climate-sensitive sowing strategies, 2025).

5. CONCLUSION

Under the conditions represented by the three-year on-farm summary from Bhadradri Kothagudem district, redgram recorded lower cultivation costs and higher net returns compared to cotton. The redgram package involving 90 × 60 cm spacing, nipping at 45 DAS and mepiquat chloride applications at flower initiation and peak flowering recorded the highest mean net return (₹42,953 ha^{-1}) and B:C ratio (2.36). The results support considering redgram as an economically promising alternative for rainfed light-soil farms.

REFERENCES

1. Kumar, N., Ahamad, A., Kumar, R., Singh, A.K., Prasad, S., Baheliya, A.K & Yadav G. (2023). Productivity and profitability of pigeonpea (Cajanus cajan)-based intercropping systems under diverse nutrient management practices in rainfed condition. Indian Journal of Agronomy 67(4): 431–436. https://doi.org/10.59797/ija.v67i4.150
2. Ministry of Agriculture and Farmers Welfare (2024). Production and import of pulses. Press Information Bureau, Government of India, New Delhi. .
3. Ministry of Agriculture and Farmers Welfare (2024) Final estimates of production of major agricultural crops for 2023–24. Press Information Bureau, Government of India, New Delhi.
4. Ramanjaneyulu, A.V., Sravanthi, D., Swetha, D., Sainath, N., Chary, D.S & Rajaiah P. (2025). Transforming rainfed pigeonpea cultivation in India: the impact of complete mechanization on growth, productivity and energy indices. Legume Research 48(Special Issue): 170–175. https://doi.org/10.18805/LR-5365
5. Sarkar, S., De, B., Das, P., Saha, D., Awasthi, D.P., Paul, N & Sen, D. (2025). Nutrient management approach to improve productivity and profitability of pigeonpea (Cajanus cajan) in north east hill zones of India. The Indian Journal of Agricultural Sciences 95(4): 400–405. https://doi.org/10.56093/ijas.v95i4.151803
6. Sudha Rani, K., Ravikishore, M., Narayana Swamy, G & Johnson, M. (2024). Performance of cluster frontline demonstrations on productivity and profitability of pigeonpea (*Cajanus cajan L.*) through improved technologies under rainfed conditions. Journal of Community Mobilization and Sustainable Development 19(Special Issue): 233–238. https://doi.org/10.5958/2231-6736.2024.00075.9
7. Veeranna, G., Pallavi, C.H., Mahesh, N., Rao, P.J.M., Padmaja, G., Fatima, T & Reddy, P.R.R. (2020). Performance of pigeonpea [Cajanus cajan (L.) Millsp.] under rainfed condition of Telangana through nipping technology. International Journal of Current Microbiology and Applied Sciences 9(5): 3489–3496. https://doi.org/10.20546/ijcmas.2020.905.414

8. Kumar, M.V.N., Ramya, V., Kumar, C.V.S., Raju, T., Sunil Kumar, N.M., Seshu, G., Sathish, G., Bhadru, D., Ramana, M.V (2021). Identification of pigeonpea genotypes with wider adaptability to rainfed environments through AMMI and GGE biplot analyses. Indian Journal of Genetics and Plant Breeding. 81:63-73.
9. Fanish, A.S., Shanmugam, P.S & Geetha, S. (2025). Productivity and morpho-phenological characters of pigeonpea [Cajanus cajan (L.) Millsp.] as influenced by crop geometry and nipping practice. Legume Research 48(9): 1553–1557. https://doi.org/10.18805/LR-5138
10. Vijay, J., Venkateshwar Rao, N., Sreenivasa Reddy. D., Mahesh, L., Venugopal, G., Prabhakar, G & Prashanthi, A. (2024). Effect of cluster front line demonstrations on productivity and profitability of redgram in Karimnagar District, Telangana, India. Journal of Experimental Agriculture International 46(10): 298–303. https://doi.org/10.9734/jeai/2024/v46i102950
11. Sawargaonkar, G.L., Kamdi, P.J., Kale, S., Shinde, S., Das, S.S & Kausadikar, H.K. (2025). Leveraging genotype × management synergies to enhance pigeonpea productivity, profitability, and sustainability in semi-arid tropics. Frontiers in Agronomy 7. https://doi.org/10.3389/fagro.2025.1590421
12. Modelling climate-sensitive sowing strategies for rainfed pigeonpea (Cajanus cajan (L.) Millsp.) using response surface methodology. (2025). Smart Agricultural Technology 12: 101173. https://doi.org/10.1016/j.atech.2025.101173
13. De, B., Saha, D., Das, P., Awasthi, D.P., Thangjam, B., Das, R.C, Bhowmik, T & Sen, D. (2025). Long-term assessment of organic nutrient management on the productivity, resilience, and profitability of pigeonpea (Cajanus cajan) in the North Eastern Region, India. Indian Journal of Agronomy 70: 68–74. https://doi.org/10.59797/ija.v70i.6282
14. Chowdary, M.S.B., Priya, P., Ashoka, P., Rajakumar, G.R & Biradar, A. (2025). Effect of buckwheat (Fagopyrum esculentum Moench.) intercropping on growth, yield and economics of pigeonpea [Cajanus cajan (L.) Millsp.] under rainfed conditions. Journal of Farm Sciences 38(3): 233–236. https://doi.org/10.61475/JFS.2025.v38i3.08
15. Renuka, R., Vijayakumari, M.D., Ali Baba & Meena, A. (2019). Economic analysis of Redgram cultivation in Gulbarga District of Karnataka State. The J. Res. PJTSAU 47(2)42-45.