



# Response of Green Gram Demonstrated Technology under NICRA Cluster Front Line Demonstration in Nagaur, Rajasthan, India

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

A comparative study was conducted under the National Innovations in Climate Resilient Agriculture (NICRA) Cluster Front Line Demonstration (FLD) initiative in Nagaur district, Rajasthan, spanning the 2022-23 and 2023-24 cropping seasons. The objective was to evaluate the agronomic and economic performance of an improved management package for green gram (*Vigna radiata*) against conventional farmer practices. Observations revealed enhanced root nodulation in the FLD plots. The mean number of nodules per plant at 20 days after sowing (DAS) was 11.58 and 10.60,

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and at 40 DAS was 24.40 and 24.12 for the respective years. Correspondingly, nodule dry weight per plant at 20 DAS (30.15 & 70.54 units) and 40 DAS (24.87 & 63.22 units) was also greater under the FLD system. Significantly higher grain yields were recorded in the FLD plots (10.30 q/ha and 9.94 q/ha for 2022-23 and 2023-24, respectively) compared to the farmer practice plots. The Technology Index for the demonstrated package was relatively low (39.19% and 43.24%), indicating effective technology transfer. The calculated Extension Gap ranged between 1.77 and 2.35 q/ha. Economic analysis showed superior net returns from the FLD plots (₹53,422/ha in 2022-23 and ₹58,379/ha in 2023-24) with higher Benefit-Cost ratios (3.02 and 3.19) compared to the local check (2.39 and 2.81). These results strongly suggest that the adoption of the improved package of practices promoted via the NICRA FLD program significantly boosts both the productivity and profitability of green gram cultivation in the region.

**Keywords:** NICRA FLD; economics; growth and yield attributes; technology index.

## 1. INTRODUCTION

Leguminous crops are essential for Indian agriculture because they supply organic matter from waste from plants and improve soil fertility through biological nitrogen fixation (Tomar et al., 2023). With chromosomal number  $2n=2x=22$ , the green gram (*Vigna radiata* (L.) Wilczek), a member of the *Fabaceae* family (Sub-family *Papilionaceae*), is the third-most important pulse crop in India, behind pigeon pea and chickpea. Green gram farming, which has its main origins in India, is widely distributed throughout East Asia, Southeast Asia, and the Indian subcontinent. It accounts for about 16 percent of India's total pulse acreage. According to Kumar et al., (2017), green grams are prized for their high protein (20–25%), low fat, high fiber, superior palatability, market appeal, and ease of digesting.

Although these qualities, it has difficulties with productivity, which may result in yearly declines. According to agricultural data, India produced 15.93 lakh hectares of green gram in 2023–2024—a slight increase from 15.57 lakh hectares in 2022–2023. 3.74 million tonnes was expected to be produced nationally in 2022–2023 (The Government the 3rd Advance Estimates, cited in Green Gram Outlook, 2023).

Enhancing productivity sustainably can be achieved through strategies like Integrated Nutrient Management (INM). INM involves the judicious use of combined organic, inorganic, and biological nutrient sources to maintain optimal yields, preserve or improve soil physicochemical properties, and deliver nutrient solutions that are technically sound, economically viable, practically feasible, and environmentally safe (Mishra et al., 2022). There is a growing emphasis on growers adopting INM

to boost productivity while sustaining soil health. Organic amendments represent a key component or alternative strategy within INM to improve production outcomes (Meena et al., 2015). Front Line Demonstrations (FLDs) are designed to assess new production technologies and management systems under real-world farming conditions. Conducted under the guidance of Krishi Vigyan Kendra (KVK) scientists, initiatives like the NICRA project FLDs facilitate on-farm evaluation and gather crucial farmer feedback on demonstrated interventions.

## 2. METHODOLOGY

The Krishi Vigyan Kendra (KVK), which is associated with Agriculture University in Jodhpur, carried this study at Athiyasan, Nagaur. The Central Research Institute for Dryland Agriculture (CRIDA), located in Hyderabad, is the central sponsor of the National Innovations in Climate Resilient Agriculture (NICRA) self-initiative, which included the research. Tests in the field were carried out on farmers' holdings in Deshwal village, Nagaur district, Rajasthan, throughout the 2022–2023 and 2023–2024 *kharif* seasons. In the selected villages, 90 Front Line Demonstrations (FLDs) covering 36 hectares have been immersed up. The FLD plots, which used an improved package of practices, were directly compared to the nearby control plots that remained operational with traditional farmer solutions as part of the methodology.

The FLD interventions included using quality-certified seeds of improved green gram varieties (MH-421, MH-1142), line sowing at a 30 cm x 10 cm spacing, balanced fertilizer application based on soil health recommendations, and need-based application of plant protection measures. Data collection commenced with harvesting at physiological maturity. For nodulation studies,

five plants were randomly selected from each demonstration and control plot per cluster at both 20 and 40 Days after sowing.

These plants were carefully uprooted, roots washed, and nodules meticulously detached and counted to determine the average number per plant. Nodule biomass was assessed by recording fresh weight, followed by sun-drying for two days and subsequent oven-drying at 70°C to constant weight for dry weight determination. Key yield attributes, specifically mean pod length and mean pods per plant, were recorded from the sampled plants. Grain yield was quantified from both FLD and farmer practice plots using standardized crop cutting methods. Basic statistical analysis was applied to the yield data. Economic viability was assessed by calculating gross returns (yield × prevailing local market price), net returns, and the Benefit-Cost ratio (following principles similar to Samui et al., 2000). Technology adoption and performance were evaluated using standard indices (Yadav et al., 2004):

- Technology Gap = Potential Yield – Demonstration Yield
- Extension Gap = Demonstration Yield – Farmers' Yield
- Technology Index (%) = Potential Yield / Technology Gap × 100

### 3. RESULTS AND DISCUSSION

Evaluation of Front-Line Demonstrations (FLDs) incorporating technological packages revealed significant enhancements in green gram grain yield compared to conventional farmer practices over two consecutive years (Table 1). The adoption of high-yielding varieties, balanced fertilization including micronutrients, and integrated pest/disease management strategies motivated farmers to cultivate green gram under the scientific guidance of KVK, Athiyasan Nagaur-I. Quantitative data indicated superior root nodulation in demonstration plots versus control plots. Nodule count per plant was higher at both 20 days after sowing (11.58 & 10.60) and 40 DAS (24.40 & 24.12) in FLD plots across both years. Similarly, nodule dry biomass per plant showed increases at 20 DAS (30.15 & 70.54) and 40 DAS (24.87 & 63.22) in the demonstration plots relative to the farmer practice plots. This improvement in nodulation may stem from enhanced rhizobial colonization

within the rhizosphere, facilitated by increased micronutrient availability (Meena et al., 2012). Yield component analysis in 2022-23 showed that variety MH-421 in demonstration plots yielded 9.12 grains/pod, 10.02 cm pod length, 19.28 pods/plant, and a 38.60 g test weight. In 2023-24, variety MH-1142 yielded 7.65 grains/pod, 7.72 cm pod length, 17.27 pods/plant, and a 36.42 g test weight under the demonstration package.

These observations are consistent with Saravana kumar et al. (2021), who noted increased pod numbers over farmer methods. The advantageous effects of micronutrient foliar application on green gram are supported by previous studies (e.g., Kumawat et al., 2005). Micronutrients likely play a role in improving seed set, thus increasing seeds per pod.

Enhanced grain weight might be attributed to the facilitated translocation of photosynthates to developing grains following micronutrient application. Furthermore, a synergistic effect between micronutrient supplementation and rhizobial inoculation could potentially enhance nitrogenase activity, thereby boosting nitrogen fixation for improved plant growth and yield components, aligning with findings by Singh et al. (2010) and Choudhary et al. (2011).

Green gram grain yields under demonstration plots were 10.30 and 9.94 q/ha across the two implementation years, respectively, while yields under farmers' tactics were 7.89 and 7.99 q/ha (Table 1). As compared to the local check, the grain yield in the demonstration plots increased by 31.09% and 24.58% in the two years in question. Significant increases in yield brought about by technological interventions have been reported by Jain (2016), Kumar et al. (2018), Sandhu and Dhaliwal (2016), Dayanand et al., (2019), and Nain et al. (2014). Improved agronomic interventions, such as seed treatment, the most effective sowing time and technique, balanced nutrient management, including fertilizer application techniques, and comprehensive pest and disease control strategies, are largely held accountable for the observed yield differences between the demonstration and traditional practices.

The technology gap was recorded as 7.25 q/ha in 2022-23 and 8.00 q/ha in 2023-24. This gap may be attributed to several limiting factors, including variations in soil fertility status, low soil moisture availability, untimely sowing, and unfavourable climatic events.



Pic 1. Field work

Table 1. Yield, technology gap, extension gap and technology index of green gram cultivation

Year	No. of farmers	Variety	No. of demo	Potential yield (q/ha)	Yield (q/ha)						Yield increase (%)	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
					Demonstration			Check						
					Max	Min	Av.	Max	Min	Av.				
2022-23	50	MH-421	50	18.5	11.25	9.5	10.30	8.90	6.94	7.89	31.09%	7.25	2.35	39.19
2023-24	40	MH-1142	40	18.5	10.50	9.45	9.94	8.73	7.52	7.99	24.58%	8.00	1.77	43.24

Table 2. Gross return, cost of cultivation, net return and B:C ratio of green gram cultivation

Year	Yield (q/ha)								Net return increase (%)
	Demonstration				Check				
	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	
2022-23	26450	79872	53422	3.02	24150	61154	37004	2.53	44.37
2023-24	26645	85024	58024	3:19	24350	68396	44046	2.81	31.74

\* Rs. 77.55 per kg rate in 2022-24 & Rs 85.58 per kg rate in 2023-25

To bridge this yield gap, it is imperative to implement location-specific strategies involving selection of suitable varieties, site-specific nutrient management through soil testing, and timely sowing practices. The extension gap-indicative of the difference in yield between demonstration and farmers' practices was 2.35 q/ha in 2022-23 and 1.77 q/ha in 2023-24. This substantial extension gap underscores the necessity of disseminating improved technologies to a broader farming community. Similar observations were reported by Raj et al., (2013), Jain (2016), and Kushwah et al., (2016). The technology index, which reflects the feasibility of improved varieties under real field conditions, was calculated at 39.19% in 2022-23 and 43.24% in 2023-24. These results align with the findings of Kumbhare et al. (2014), Bar and Das (2015), Sandhu et al. (2016), and Anuratha et al. (2019), Jakhar et al., (2022) indicating the relevance of the demonstrated technologies in bridging the existing yield potential under farmers' field conditions.

Table 2 provides specifics on the economic assessment of green gram cultivation under NICRA Front Line Demonstrations (FLDs). NICRA FLDs produced significantly higher gross returns of Rs. 79,872/ha in 2022-2023 and Rs. 85,024/ha in 2023-2024, according to an analysis of economic returns. In line with this, net returns for the corresponding years were Rs. 53,422/ha and Rs. 58,024/ha. Along with being more favorable under FLDs, the benefit-cost (B:C) ratio had values of 3.02 and 3.19 as opposed to 2.53 and 2.81 under local check plots. In 2022-2023 and 2023-2024, the net returns under the demonstration plots increased by 44.37% and 31.74%, respectively. These findings unequivocally demonstrate the financial benefit of enhanced farming techniques made possible by NICRA. Similar economic benefits from demonstration plots over farmers' traditional practices have been reported by Nain et al. (2015), Patil et al. (2015), Kumar et al. (2018), and Gireesh et al. (2019), indicating that adoption of recommended technologies can significantly enhance farm profitability.

#### 4. CONCLUSION

The cluster frontline line demonstrations conducted by Krishi Vigyan Kenra, Athiyasan, Nagaur under Agriculture University, Jodhpur had enhanced the yield of green gram and ensured rapid spread of recommended technologies of

green gram production by implementation of various extension activities like training programmes, field days, exposure visits etc. organized in farmer's field. The farmers included under NICRA project programme also played an important role for wider dissemination of the improved technologies for the nearby farmers. Therefore, it is suggested that policy maker may provide adequate financial support to frontline extension system for organizing FLD under the close supervision of agricultural scientists and extension functionaries.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I Rakesh Gurjar hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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