P-ISSN 2322 - 0678 & E-ISSN 3048 - 9946
Gujarat Journal of Extension Education Vol. 39 : Issue 1 : June - 2025 https://doi.org/10.56572/gjoee.2025.39.1.0026

ENHANCING THE PRODUCTIVITY OF SOYBEAN THROUGH ON FARM TRIALS

Shakir Ali Qayyum Ali Syed[1], S. K. Roy[2] and Anita Deshmukh[3]

1 Principal Scientist, ICAR- ATARI, Pune, Maharashtra - 411021
2 Director, ICAR- ATARI, Pune, Maharashtra - 411021
3 Senior Research Fellow, ICAR- ATARI, Pune, Maharashtra - 411021
Email : shakirataripune@gmail.com

ABSTRACT

This study evaluates the enhancing productivity of soybean impact of On-Farm Trials (OFTs) on soybean productivity, technological adoption, and economic performance in Maharashtra, India, from 2018 to 2022. A total of 27,069 OFTs were conducted across 16 soybean varieties, comparing the effects of Recommended Practices (RP) and Farmers' Practices (FP). Results demonstrated a significant increase in Yield under RP, with an average yield of 1791 kg/ha, reflecting a 14.45% improvement over FP. The key factors contributing to yield enhancement included the use of high-yielding varieties, balanced fertilization, timely sowing, and integrated crop management practices. Evaluation of the Extension Gap (EG), Technology Gap (TG), and Technology Index (TI) revealed substantial disparities in the adoption of improved technologies, emphasizing the need for targeted extension services. Economic analysis indicated that the average net return under RP was ₹53,208/ha, with a benefit-cost ratio of 2.82, compared to ₹37,138/ha and a ratio of 2.22 under FP. These findings demonstrate that the adoption of advanced agronomic practices through OFTs can significantly enhance both the productivity and economic viability of soybean cultivation, suggesting the potential of OFTs as a key strategy for improving agricultural outcomes in India.

Keywords : *on farm trial, soybean, productivity*

INTRODUCTION

India is ranked as the fourth-largest producer of oilseeds globally, following the United States, China, and Brazil, contributing around 10% of the total global oilseed production. The country accounts for nearly 20% of the world's oilseed cultivation area, with oilseeds occupying about 12% of India's total arable land, covering approximately 29.17 million hectares. 2021-2022, India produced 37.7 million tons of oilseeds, yielding an average of 1059 kg per hectare (DA&FW, 2022). Oilseeds represent the second most significant sector in agriculture after cereals, contributing 10% to the overall value of agricultural commodities and 3% to India's GDP.

India's varied agroecological zones support the cultivation of a wide range of oilseed crops. However, production is often concentrated in high-risk regions, such as arid areas with unpredictable rainfall and degraded soils, which result in substantial annual variability. Despite efforts to develop high-yielding varieties (HYVs), improvements in oilseed productivity have been limited. This is primarily due to a lack of technological advancements and farmers' reluctance to adopt new cultivars. The high costs of fertilizers and pesticides, which are required in large quantities, further discourage farmers from implementing these innovations. As a consequence, the potential Yield for many oilseed crops has stagnated.

Soybean (Glycine max (L.) Merr.) is a key crop that serves as both an oilseed and a legume, contributing around 25% of global oil production. It is prized for its high protein content, about 40%, and its oil content of approximately 20%. Beyond its significant oil and protein content, soybeans offer essential amino acids and lysine, which are often deficient in the diets of many populations. With the growing gap between supply and demand for edible oils, India has become heavily reliant on imports. In 2021, the country imported around 13.35 million tons of edible oils, which accounted for 60% of its total demand, valued at ₹1,17,000 crore.

The gap between yields observed in demonstration plots and those achieved by farmers exceeded 22% during the 2016-2017 period, highlighting the need for improved agricultural practices. Although the varietal replacement rate for soybean varieties under 10 years old is 78%, further improvements are necessary to meet the rising demand for edible oils.

To address these issues, On-Farm Trials (OFTs) have been introduced to enhance productivity and gather direct feedback from farmers (Jha *et al.,* 2020). These trials serve as a platform for directly showcasing the latest research, technologies, and best practices in farmers' fields, which helps bridge the knowledge gap. OFTs have proven effective in introducing new technologies to farmers, raising awareness, and encouraging better cultivation practices (Ghintala *et al.*, 2018; Singh *et al*., 2014). Comprehensive scientific data concerning toxicity, effectiveness and economics of the chemical insecticide is essential in decision-making towards pest management (Rai *et al.*, 2020). Gap is due to various factors such as lack of knowledge (Ali & Singh (2021),Moreover, these trials expose farmers to new soybean varieties and recommended production techniques, ultimately replacing outdated methods and reducing technological gaps.

OBJECTIVE

To assess the technological, extension gaps and technology index for soybean

METHODOLOGY

The study area covers agricultural regions across Maharashtra where soybean cultivation is widespread. Between 2018 and 2022, 27,069 on-farm trials (OFTs) were conducted, each spanning 0.4 hectares. These demonstrations aimed to evaluate 16 different soybean varieties, utilizing the recommended agricultural practices (RP) package and comparing them to farmers' traditional practices (FP). A baseline survey was conducted between 2019 and 2023 to identify challenges in soybean-growing areas. The survey revealed several factors contributing to lower crop yields, including the use of low-quality local seeds, lack of seed treatment, absence of soil testing, improper sowing techniques, and indiscriminate or imbalanced use of inorganic fertilizers and plant protection chemicals. Data collection and sampling techniques: Before implementing the demonstrations on farmers' fields, group meetings were organized to select the participating farmers. These farmers received comprehensive training on specific soybean cultivation practices. They were also provided with improved seed varieties and essential inputs to carry out the demonstrations effectively.

For the improved crop cultivar, all technological interventions were implemented according to the recommended package of practices (Table 1). The impact of these interventions, including the adoption of improved cultivars and recommended agricultural practices, was documented and analyzed at the demonstration sites. The data on grain yield from the demonstration plots and the farmers' traditional plots were recorded to assess various parameters, such as the percentage yield increase, technology and extension gaps, and the technology index. Data collection was conducted at the demonstration sites nationwide.

Methods of data analysis: Data were collected from farmers' plots where OFTs were implemented. The key parameters analyzed included percentage yield increase, technology and extension gaps, technology index, and grain yield, focusing on the technological, economic, and sustainability aspects (Table 2). In this study, the technology index was operationally defined based on the technical feasibility achieved through the demonstrations, following the description by Ghintala *et al.,* (2018). The extension gap (EG), technology gap (TG), and technology index (TI) were calculated using the formulas provided by Samui *et al.,* (2000) and Yadav *et al.,* (2004), as outlined in equations (1–4). The performance data were collected, compiled, and compared to draw interpretations and make inferences.

Extension gap = Yield from demonstration – Yield from farmers practice (1)

Technology gap = Potential Yield - Yield from demonstration (2)

Incremental returns = Returns from demonstration – Returns from farmer's practice (3)

$$\text{Technology index (\%)} = \frac{\text{Potential Yield – Demonstration yield}}{\text{Potential Yield}} \times 100 \quad (4)$$

RESULTS AND DISCUSSION

The findings revealed that among the 15 soybean cultivars analyzed, MAUS-725 exhibited the highest concentration of OFTs, measuring 13.49 %, followed by KDS-753 at 12.98%, KDS-726 at 11.80%, KDS-992 at 9.95%, MAUS-992 at 8.94%, and MAUS-612 at 8.09 %. The remaining cultivars collectively accounted for 34.74% of the total OFTs concentration. These cultivars were sourced from soybean-producing districts within zone 8.

Yield variability

During the period from 2018 to 2022, demonstration yields of soybean exhibited significant increases compared to farmers' practice (FP), with enhancements of 28.44%, 23.40%, 23.15%, 19.42%, 16.45%, and 14.84% (corresponding to yields of 24.75, 23.73, 22.50, 21.10, 20.66, and 17.57 q/ha, respectively). In contrast, yields under FP during the same years were 19.27, 19.23, 18.27, 17.30, 18.12 and 15.30 q/ha. The variability in soybean cultivar performance over the research period underscored differences in yield potential. Soybean seed yields under FP ranged from 754 to 1930 kg/ha, while under recommended practice (RP), yields ranged from 832 to 2475 kg/ha (Table 2). The five-year average seed yield under RP was 1791 kg/ha, representing a 14.45% increase over the FP five-year mean of 1555 kg/ha. The highest recorded seed yields under RP were 24.75 q/ha in 2022 and 23.73 q/ha in 2020. Of the 15 cultivars evaluated, 5 were demonstrated only once, precluding further parameter determination. Across all soybean cultivars assessed under RP, Yield increases relative to FP ranged from 4.59% (PDKV Amba (AMS 100-39)) to 28.44% (MAUS-725). These results highlight the significant enhancement in demonstration yields over FP across the five-year period, reinforcing the efficacy of RP in soybean cultivation. The adoption of RP, supported by On-Farm Trials (OFTs), was critical to this improvement, indicating the importance of deploying improved cultivars and advanced agronomic practices. Variations in seed yield between FP and RP, as well as among different cultivars, reflect the influence of both agronomic factors and technological advancements on crop outcomes.The findings from this study are corroborated by previous research conducted by Singh *et al.,* (2018) and Singh *et al.,* (2019). Additionally, annual fluctuations in seed yield were observed, attributed to varying environmental conditions. In 2021, soybean yields were particularly low due to untimely and excessive monsoon rainfall in key soybean-growing regions of India, which resulted in moisture stress during critical crop growth stages and consequently reduced productivity (IMD, 2022). Notably, the yield gap has shown a narrowing trend due to favorable weather conditions and the broad implementation of improved cultivars and technologies on farmers' fields through Front Line Demonstrations (FLDs), as noted by Kumar and Meena (2013) and Raut *et al.,* (2016).

Table 1 Difference between farmers' practice and demonstrated practices for the use of intervention

Intervention	Farmer's practices	Demonstrated practices	Gap
Soil application	No soil treatment	*Trichoderma viride* @ 5kg/ha with 250kg FYM/ha	Absolute
Variety	Local Variety	Improved variety	Varietal gap
Seed rate(kg/ha)	100-125	75-80	Excessive usage
Seed Treatment	No application	Thiamotham 30FS @ 10ml per kg seed	Absolute
Method of sowing	Line sowing by seed drill	Line sowing with seed cum fertilizer drill, BBF, ridge and furrow	Partly
Spacing	No optimum spacing and plant population	45*4-5 cm	Partly
Nutrient management	Indiscriminate imbalance use of fertilizers	Soil test based fertilizer application	Absolute
Weed management	No management/hand weeding	Spray Combination of Imazethapyr + Imazamox (premix) 70WG @ 0.070 kg ai/ha PoE 20 DAS	Absolute
Harvesting	Harvested of over-matured crop	Harvested at right stage based on maturity indices	Absolute

Adoption gap

The evaluation of the Extension Gap (EG), Technology Gap (TG), and Technology Index (TI) over a five-year period provides key insights into soybean productivity trends and the adoption of agronomic innovations. The EG, ranging from 64 to 548 kg/ha, highlights notable disparities in extension services, emphasizing the need for targeted educational programs to reduce this gap. A substantial TG of 18.34 q/ha underscores critical shortcomings in the implementation of technologies and recommended practices, indicating the need for optimized agronomic strategies to achieve maximum yield potential. The observed variability in TI, from 1.00% to 67.44%, underscores the feasibility of adopting new technologies while highlighting the necessity for widespread dissemination among farmers. The observed wide EG signals that farmers require enhanced education and skills development to successfully integrate advanced cultivars and technologies. Addressing this growing extension gap is essential, and it is anticipated that integrating the latest production techniques, coupled with using high-yielding, disease- and pest-resistant cultivars, will mitigate this issue. Among the various metrics, the TG is particularly crucial, as it reflects the limitations inherent in the application of technology and gaps in the recommended agronomic packages. These gaps may be attributed to inconsistencies in soil fertility, climatic and environmental conditions, varietal incompatibility, and incomplete adoption of improved practices. Comparable findings were reported by Patel *et al.* (2013) in a similar study focused on Front Line Demonstrations (FLDs). The TI serves as an indicator of the practical feasibility of new technologies and the extent to which farmers have adopted them. High TI values for specific cultivars, such as KDS-344, suggest that additional refinement in technology and practice implementation is required to optimize performance in farmers' fields.

Table 2: Average Yield, technology gap, extension gap and technology index of soybean as affected by recommended and farmers' practices

Variety	Potential Yield (q/ha)	Farmer Yield (q/ha)	Demo Yield (q/ha)	Yield increased (%)	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology index (%)
Cv AMS-MB5-18 (Suvarna Soya)	20.00	11.38	12.58	10.54	07.42	1.20	37.10
MAUS 725	25.00	19.27	24.75	28.44	0.25	5.48	01.00
KDS-992 (Phule durva)	39.00	17.30	20.66	19.42	18.34	3.36	47.03
MAUS-612	25.31	15.30	17.57	14.84	07.74	2.27	30.58
MAUS-992	39.00	18.12	21.10	16.45	17.90	2.98	45.90
JS-20-34	20.30	10.35	11.75	13.53	08.55	1.40	42.12
KDS- 726 (Phule Sangam)	25.00	18.27	22.50	23.15	02.50	4.23	10.00
JS 9305	20.00	12.38	13.71	10.74	06.29	1.33	31.45
MAUS-158	25.10	19.30	20.80	07.77	04.30	1.50	17.13
KDS-753 (Phule Kimaya)	25.00	19.23	23.73	23.40	01.27	4.50	05.08
NRC-142	28.00	15.91	17.87	12.32	10.13	1.96	36.18
PDKV Amba (AMS 100-39)	20.87	13.93	14.57	04.59	06.30	0.64	30.19
KDS 344 (Phule Agrani)	25.55	07.54	08.32	10.34	17.23	0.78	67.44
MACS 1188	24.75	19.20	21.10	09.90	03.65	1.90	14.75
PDKV yellow gold (AMS-1001	21.73	15.80	17.58	11.27	04.15	1.78	19.10

In contrast, the cultivar MAUS-725 exhibited a lower TI, indicating a more viable production system. The seed yield gap depends upon technological gap and the extent of the technological gap in different production components of the technology contributes differently to the yield gap (Kakkad et al., 2021 Damor et al., 2021). Similarly,a substantial technological gap was identified for diseases and their control similar to Dodiya et al. (2023),These outcomes are consistent with previous research findings by Meena et al., (2012) and Patil et al., (2015), and align with studies conducted by Singh et al., (2012), Patel et al., (2013), Shah et al. (2019) and Singh (2015)

Economic performance

The economic performance of soybean cultivation in various districts of Maharashtra, evaluated through On-Farm Trials (OFTs) (Table 3), emphasizes the impact of these trials on the economic feasibility of soybean farming in the state's key soybean-producing areas. The average cost of cultivating soybean varieties using advanced production technologies was ₹38,352 per hectare, in contrast to ₹36,799 per hectare under Farmers' Practices (FP). Among the different varieties, MAUS-725 yielded the highest net returns under Recommended Practices (RP), at ₹84,750 per hectare, while KDS-992 (Phule Durva) provided the highest net returns of ₹56,425 per hectare under FP. In contrast, the lowest net returns were recorded by Cv AMS-MB5-18 (Suvarna Soya) with ₹28,559 per hectare under RP and KDS-344 (Phule Agrani) with ₹14,354 per hectare under FP.

The overall average net returns and benefit-cost (B: C) ratio for RP were ₹53,208 per hectare and 2.82, respectively, compared to ₹37,138 per hectare and 2.22 for FP. Although the cost of cultivation was higher under RP due to increased investment in advanced farming techniques, RP resulted in superior net returns and a higher B: C ratio compared to FP. This indicates that adopting recommended practices offers economic benefits. The observed improvements in economic performance on demonstration plots are primarily attributed to seed treatment, balanced fertilization, timely sowing using mechanical methods, and integrated crop management, all of which were facilitated by the OFTs.

The gains observed in RP over FP, despite the higher input costs, underline the economic advantages of OFTs when assessed over a five-year period. These findings are consistent with previous studies by Hiremath *et al.* (2007) and Hiremath and Nagaraju (2009). Over this period, the average increase in returns from RP compared to FP ranged from ₹2,656 per hectare to ₹44,250 per hectare, with an average additional return of ₹16,070 per hectare. The average increase in input costs under RP over this period was ₹53,208 per hectare, suggesting enhanced profitability and economic viability for the demonstration plots. The higher incremental returns from the demonstrations can be attributed to the adoption of superior production technologies and ongoing monitoring and expert support from agricultural scientists (Lathwal, 2010; Singh *et al*., 2012; Patel *et al.*, 2013; Vamshi *et al*., 2024; Kapur *et al*., 2023; Prajapati *et al*., 2022)

Table 3: Economic Performance of Soybean crop as affected by recommended practices and farmer's practices

Variety	Net Return (₹/ha)		B:C ratio		Incremental net return (₹/ha)
	Farmer	Demo	Farmer	Demo	
Cv AMS-MB5-18 (Suvarna Soya)	25903	28559	1.70	1.93	2656
MAUS 725	40500	84750	1.96	3.17	44250
KDS-992 (Phule durva)	56425	66062	2.46	2.83	9637
MAUS-612	50361	77118	2.58	3.34	26756
MAUS-992	43050	60450	1.90	2.24	17400
JS-20-34	34725	48450	2.56	4.18	13725
KDS- 726 (Phule Sangam)	41411	60910	2.17	2.83	19498
JS 9305	32500	39650	4.64	5.21	7150
MAUS-158	44882	66712	2.00	2.62	21830
KDS-753 (Phule Kimaya)	29946	50645	1.60	2.54	20698
NRC-142	35550	49590	1.88	1.91	14040
PDKV Amba (AMS 100-39)	29842	39236	1.99	2.30	9393
KDS 344 (Phule Agrani)	14354	28697	1.60	2.21	14343
MACS 1188	50660	60790	2.50	3.01	10130
PDKV yellow gold (AMS-1001	26959	36500	1.77	2.05	9541

CONCLUSION

The On-Farm Trials (OFTs) conducted in Maharashtra have demonstrated substantial potential for improving soybean yields by integrating advanced agricultural practices and technology. These trials have not only validated the effectiveness of high-yielding, disease-resistant soybean varieties but have also highlighted the importance of site-specific agronomic practices tailored to local conditions. The increased yields achieved through these trials underscore the significant role that targeted agricultural interventions can play in enhancing productivity and ensuring food security.

To build on the successes of these trials, it is crucial to institutionalize their practice across broader regions in Maharashtra. Expanding the network of on-farm trials would facilitate disseminating improved practices and technologies, making them accessible to many farmers. Strengthening collaborations between research institutions, extension agencies, and local farmers will ensure that new techniques are practical and effective under real-world conditions.

POLICY IMPLICATIONS

Policy initiatives should focus on sustained investment in on-farm trials, including adequate research and development funding, emphasising creating high-yielding and resilient soybean varieties suited to diverse agroecological zones. Additionally, capacity-building programs should be prioritized to empower farmers with the skills and knowledge needed to adapt and optimize new agricultural practices. Monitoring and evaluation systems must be implemented to assess the impact of these trials, allowing for adaptive management and continuous improvement of extension strategies. Furthermore, policy support in the form of subsidies for quality inputs, access to credit, and incentives for technology adoption will be crucial in motivating farmers to participate in these initiatives. By fostering a robust framework of on-farm trials, Maharashtra can significantly enhance soybean productivity, contributing to regional self-sufficiency in edible oil production and reducing dependency on imports. The insights gained from these trials can also serve as a model for other states, furthering national efforts towards sustainable agricultural growth.

ACKNOWLEDGEMENT

This research was supported by the Krishi Vigyan Kendras of Maharashtra, where soybean cultivation provided valuable insights and expertise that significantly contributed to the study.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest

REFERENCES

Ali, Shaukat and Singh, Balbir (2021) Technology gap assessment and productivity gain through front line demonstrations in greengram. *Gujarat Journal of Extension Education* 32(2):60-65.

Damor, C. B., Rathod, D. M. and Chauhan, C. D. (2021) Knowledge and adoption of recommended scientific practices of castor growers about castor cultivation. *Gujarat Journal of Extension Education* 32(1):16-19.

Department of Agricultural Cooperation and Farmers Welfare (DAC&FW). (2018) Presentation on vegetable oils vis-a-vis soybean in India. http://www.sopa.org/presentations_2018/Vegetable%20oils%20vis-a-vis%20 Soybean%20in% India.pdf.

Department of Agriculture and Farmers Welfare, Economics and Statistics Division. (2022) Agriculture Statistics at a Glance. Ministry of Agriculture & Farmers Welfare. Government of India. http://desagri.gov.in

Dodiya, H. D., Patel, D. B. and Patel, S. M. (2023) Technological Gap in Adoption of Pomegranate Cultivation Practices by the Pomegranate Growers. *Gujarat Journal of Extension Education,* 36(1):109-112.

Ghintala Akshaya, Bheiru Singh and Mukesh Kumar Verma. (2018) Impact of front-line demonstrations on mustard productivity in Hanumangarh, Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences* 7(9): 1942–46.

Hiremath S M and Nagaraju M. V. (2009) Evaluation of frontline demonstration trails on onion in Haveri, Karnataka. *Karnataka Journal of Agricultural Science* 22(5): 1092–93.

Hiremath S M, Nagaraju M. V. and Shashidhar K. K. (2007) Impact of frontline demonstration on onion productivity in farmer's field. National Seminar on Appropriate Extension Strategy Management Rural Resources, University of Agricultural Sciences Dharwad, Benguluru, pp. 20–100.

India Meteorological Department (IMD) (2022) Annual Report. Information science and knowledge resource development division. Government of India. https://mausamjournal.imd. gov.in/.

Jha A. K., Chatterjee K, Mehta B. K. and Kumari M. (2020) Effect of technological interventions of cluster frontline demonstrations (CFLDs) on productivity and profitability of black gram (Vigna mungo L.) in Sahibganj district of Jharkhand. *International Journal of Chemical Studies*. 8(5): 2124–27.

Kakkad, D. M., Patel, G. R. and Patel, S. R. (2021) Knowledge level of FLD and non FLD farmers about castor production technology. *Guj. J. Ext. Edu.* 32(2):45- 48.

Kapur, L. T., Gajjar, M. M. and Thakor, R. F. (2023) Impact of frontline demonstration of SRI method in rice on productivity and profitability. *Gujarat Journal of Extension Education,* 36(1):68-71. https://doi.org/10.56572/gjoee.2023.36.1.0013.

Kumar Raj and Meena D. S. (2013) Soybean production sustainability in south eastern Rajasthan. *The Journal of Rural and Agricultural Research* 13(2): 9–11.

Lathwal O. P. (2010). Evaluation of frontline demonstrations on blackgram in irrigated agro ecosystem. Annals of Agricultural Research 31(1–2): 24–27.

Meena O. P, Sharma K. C, Meena R H and Mitharwal B. S. (2012) Technology transfer through FLDs on mungbean in semi-arid region of Rajasthan. *Rajasthan Journal of Extension Education* 20: 182–86.

Patel M. M, Jhajharia A. K., Khadda B. S. and Patil L. M. (2013) Frontline demonstration: An effective communication approach for dissemination of sustainable cotton production technology. *Indian Journal of Extension Education and Rural Development* 21: 60–62.

Patil L. M., Modi D. J., Vasava H. M. and Gomkale S. R. (2015) Evaluation of front line demonstration programme on green gram variety meha (IPM-99-125) in Bharuch district of Gujarat. *Journal of Agriculture and Veterinary Science* 8(9): 2319–380.

Prajapati, P. J., Kachhadiya, N. M. and Parmar, V. S. (2022) Yield gap analysis through front line demonstration of integrated nutrient management in cotton. *Gujarat Journal of Extension Education,* 34(1):117-120. https://doi.org/10.56572/gjoee.2022.34.1.0023.

Rai, A. K., Khajuriaand, S. and Kanak Lata (2020) Impact of front line demonstrations in transfer of groundnut production technology in semi-arid region. *Guj. J. Ext. Edu.* 31(1):6–10.

Raut R. L., Verma V. K., Barpete R. D. & Jain Sanjay. (2016) Soybean yield gap analysis through frontline demonstration in Satpura plateau of Madhya Pradesh. *International Journal of Environment, Agriculture and Biotechnology* 1(2): 122–24.

Samui S. K., Miha S., Roy D. K., Mandal A. K. and Saha D. (2000) Evaluation of frontline demonstration on groundnut. *Journal of Indian Society Coastal Agricultural Research* 18: 180–83.

Shah, K. A., Nayaka, P. and Lad, A. N. (2019) Impact of cluster frontline demonstration of scientific cultivation practices of major pulses in Navsari district of Gujarat. *Guj. J. Ext. Edu*. 30(1):38-41.

Singh A. K, Agrawal S. B, Kirar B. S, Sharma T. R, Rawat A. and Khan M. I. (2018) Impact of production technology on productivity and profitability of soybean under Kymore Plateau and Satpura hills agro-climatic zone of Madhya Pradesh. *The Pharma Innovation Journal* 7(10): 82–84.

Singh D. (2015) Impact of front-line demonstrations on the productivity of carrot in Dholpur district of eastern Rajasthan. *Indian Journal of Extension Education and Rural Development* 7(2–3): 94–95.

Singh J, Dhillon B S, Astha and Singh P. (2012) Front line demonstration-An effective tool for increasing the productivity of summer moong in Amritsar district of Punjab. *An Asian Journal of Soil Science* 7(2): 315–18.

Singh R. P., Das S. K., Bhasker Rao, W. M. and Reddy M. N. (1990) Towards Sustainable Dryland Agricultural Practices, pp. 1–106. ICAR-Central Research Institute of Dryland Agriculture, Hyderabad.

Singh S. R. K., Anupam Mishra, Alok Suryawanshi and Varsha Shrivastava. (2019) Effect of varietal intervention on the Yield of soybean crop across agro-climatic zones in Madhya Pradesh: A cluster approach. *Journal of Pharmacognosy and Phytochemistry* 8(2): 408–410.

Singh, S. R. K., Mishra A, Gautam U. S., Dwivedi A. P. and Prem Chand. (2014) Scouting technological vis-a-vis extension gaps in soybean production in Madhya Pradesh. *Indian Research Journal of Extension Education.* 14(2): 41–45.

Vamshi, M., C., Veni Padma and Naik, V. Ravinder (2024) Construction of test and measurement of knowledge level of cluster frontline demonstrations pulse farmers. *Gujarat Journal of Extension Education,* 37(1):94-100. https://doi.org/10.56572/gjoee.2024.37.1.0015.

Yadav D. B., Kamboj B. K. and Garg R. B. (2004) Increasing the productivity and profitability of sunflower through front line demonstrations in irrigated agro-ecosystem of eastern Haryana. *Journal of Agronomy* 20: 33–35.

Received : February 2025 : Accepted : April 2025