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# Enhancing soybean yields and profitability: A front line demonstration of the AISb-50 variety in Adilabad, northern Telangana

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**Abstract**
Cooking oil is India's primary agricultural import, with domestic production only covering 35% of consumption. Climate change, land scarcity, and stagnant oilseed productivity are contributing to this shortfall. Soybean, a major oilseed crop, offers affordable vegetable oil, protein, and health benefits. A Front Line Demonstration (FLD) in Adilabad district of the Northern Telangana zone promoted the improved soybean variety AISb-50, aiming to mitigate climate change, reduce cultivation costs, increase yields, and boost farmers' net income by comparing it to the JS 335 soybean variety. Demo plots consistently outperformed check plots in yielding AISb-50. In 2022-23 and 2023-24, Demo plots yielded 2125 kg ha$^{-1}$ and 1850 kg ha$^{-1}$ respectively, with an average yield of 1987 kg ha$^{-1}$ versus 1629 kg ha$^{-1}$ in check plots. Despite similar cultivation costs, Demo plots yielded significantly higher gross returns and net returns. The Benefit-Cost ratio for Demo plots was 2.41:1, indicating a more efficient investment in AISb-50. The study found a Yield Gap 1 of 762.5 kg ha$^{-1}$ and a Yield Gap 2 of 359 kg ha$^{-1}$ in Demo plots, with a 27.7% technology index, suggesting potential for improved adoption.

**Keywords:** AISb-50, front line demonstration, soybean, technology index, yields

## Introduction
Currently, cooking oil is the leading agricultural import in India, with domestic production covering only 35% of the nation's consumption. Consequently, there is a significant shortfall, necessitating the import of 15 million metric tonnes. Factors such as climate change, dwindling agricultural land, and stagnant oilseed productivity are failing to match the population growth. Moreover, the ongoing economic slowdown is severely affecting food security in India (SEA, 2024) [9]. Soybean (*Glycine max*) is currently the major oilseed crop in India, and it is cultivated over about 12.0 million ha during every kharif (monsoon) season. This accounts for about 63.5% of all oilseeds grown during the monsoon season of the country. India produces about 13.5 million metric tons of soybeans, contributing approximately 40% of the total amount of oilseeds produced in the country. In India, soybean cultivation occurs in Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Chhattisgarh, Telangana, and select regions of Gujarat and Uttar Pradesh. The northern region of Telangana State in India shares 2% of the total soybean production of the country (Poshadri, A et al., 2019) [3]. The current rate of productivity of soybean with oil content (20%) in the northern part of Telangana state requires approximately 2.0 ha of land for the production of one tonne of soybean oil. For food security, it is essential to develop and promote soybean varieties that can withstand extreme weather, boost productivity, and have a higher proportion of oil content in the seeds (Kagita Navya et al., 2024) [1].
Soybeans, comprising 40% protein and 20% fat by weight, offer high-quality, affordable protein, making them vital for combating protein energy malnutrition in rural India. The protein content of soybeans is higher than the protein content of animal meat sources, insect sources, and other aquaculture sources (Poshadri et al., 2018) [2]. Whole soybeans have a PDCAAS of 96, soybean milk 91, and eggs 97. Soybeans are rich in high-quality protein and minerals, and possess potential health benefits, including the prevention of cancer, osteoporosis, and

menopausal symptoms due to their isoflavone content. Primarily produced for defatted soymeal and vegetable oil, defatted soy protein products or soy protein concentrates or isolates serve as crucial industrial ingredients in various processed foods and as protein meal for animal feeds (Rajendaar Reddy et al., 2019) [6].

The region of northern Telangana, India, is tropical, hot, and dry except during the south-west monsoon season. There are three cropping seasons: kharif, rabi and summer. Kharif season starts in mid of June and lasts till end of September, rabi season starts in mid-October and ends in mid of January while summer season starts early in third week of January and ends in mid of April. In the northern Telangana region, black cotton soil water reserves and rainfall are the two main sources of water during the crop growing season, as no irrigation systems are available for dryland agriculture (Rajendar Reddy et al., 2022) [7]. This emphasises the importance of promoting of new soybean cultivars with improved water use efficiency to enhance adaptation in this region, which will increase yields and ensure food security. Extension strategies should focus on expanding soybean cultivation by promoting improved climate-resilient varieties, high-quality seeds, and enhanced management practices. Addressing constraints such as low yields, long crop periods, water stress, and prevalent pests and diseases is crucial. Promoting short-duration soybean varieties is essential due to their commercial importance and ability to mitigate climate change effects in rainfed regions. This approach aims to increase soybean cultivation areas and ensure sustainable farm income (Kagita Navya et al., 2024) [1].

In light of the aforementioned, a front-line demonstration aimed at popularizing the improved soybean variety AISb-50 was conducted in the fields of farmers in the Adilabad district of Northern Telangana zone. The objective was to reduce cultivation costs, increase yields, and enhance farmers' net income.

## Materials and Methods

Between 2022-2023 and 2023-2024, kharif season the Krishi Vigyan Kendra Adilabad, under the administrative control of Professor Jayashankar Telangana State Agricultural University, Hyderabad, conducted front-line demonstrations (FLD) to popularize the improved soybean variety AISb-50. This demonstration spanned 20 locations in Adilabad district, Northern Telangana, and was compared with a control group using JS 335 at another 20 locations, representing traditional farmer practices. All participating farmers were trained in soybean production technologies, adhering to a comprehensive package of practices including field preparation, seed treatment, seed rate, sowing method, fertilizer management, and integrated pest management (IPM) as previously reported in the earlier front line demonstrations (Raghuveer et al., 2020) [4]. Fields were ploughed twice, with planking after each ploughing, and seeds treated with *Trichoderma viride* at 10 g $kg^{-1}$ seed. Sowing was performed using a seed-cum-fertilizer drill with a spacing of 45 x 5 $cm^2$ and a seed rate of 75 kg $ha^{-1}$ (Table 1). The evaluation encompassed assessments of technology and extension gaps, the technology index (Ramadevi et al., 2020) [8], as well as additional costs, returns, and effective gains, drawing from previous research by Sunil kumar *et al.*, (2024) [11]. The following calculations were used as previously reported by Shankar et al., (2022) [10].

$$Yield\ gap\ I = Potential\ yield\ (\text{kg/ha}) - Demonstration\ Yield\ (\text{kg/ha})$$

$$Yield\ gap\ II = Demonstartion\ yield\ (\text{kg/ha}) - Farmer's\ practice\ Yield\ (\text{kg/ha})$$

$$\text{Technology Index} = \frac{\text{Potential Yield (kg/ha)} - \text{Demonstration Yield (kg/ha)}}{\text{Potential Yield (kg/ha)}}\ X\ 100$$

**Table 1:** Front line demonstration on popularisation of Soybean variety AISb-50

| Observations | Demo | Check |
|---|---|---|
| Cultivar name | AISb-50 | JS-335 |
| Sowing | 28.06.2023 | 28.06.2023 |
| Seed rate (ha) | 75 kg | 75 kg |
| Spacing | 45 x 5 $cm^2$ | 45 x 5 $cm^2$ |
| Plant height (cm) | 55 | 60 |
| No. of filled pod $plant^{-1}$ | 50 | 45 |
| 100 seed weight (g) | 12 | 13 |
| Duration (days) | 103 | 110 |

## Results and Discussion

The average results of demo group and check group farmers related to Front line demonstration on popularisation of Soybean variety AISb-50 against JS 335 cultivated in the farmer fields of Adilabad district are presented in Table 1. Both varieties were sown on June 28, 2023, with identical seed rates (75 kg $ha^{-1}$) and spacing (45 x 5 $cm^2$). Despite these similarities, notable differences emerged in plant characteristics and yield attributes. AISb-50 exhibited a plant height of 55 cm, slightly shorter than the 60 cm of JS-335. This shorter stature might be linked to differences in growth habits or genetic factors. The number of filled pods per plant was higher in AISb-50 (50) compared to JS-335 (45), indicating potentially better pod-setting efficiency or resilience in AISb-50. Conversely, the 100-seed weight was slightly lower for AISb-50 (12g) than JS-335 (13g), suggesting marginal differences in seed development or composition. The duration of growth for AISb-50 was 103 days, 7 days shorter than the 110 days for JS-335. This shorter growth period may reflect AISb-50's quicker maturity, which could be advantageous in regions with shorter growing seasons. Overall, while AISb-50 shows promising attributes such as higher pod count and shorter growth duration, the slightly lower seed weight and plant height compared to JS-335 warrant further investigation into its potential yield performance and adaptability.

The study focused on the performance of the soybean variety AISb-50 over two years, 2022-23 and 2023-24, comparing demonstration plots (Demo) with check plots. The results are summarized in Table 2.

The yield of soybean in the demonstration plots was consistently higher than in the check plots for both years. In 2022-23, the Demo plots achieved a yield of 2125 kg $ha^{-1}$ compared to 1795 kg $ha^{-1}$ in the check plots. Similarly, in 2023-24, the Demo plots yielded 1850 kg $ha^{-1}$, whereas the check plots produced 1462 kg $ha^{-1}$. On average, over the two years, the Demo plots had a yield of 1987 kg $ha^{-1}$, while the check plots had a yield of 1629 kg $ha^{-1}$. Similar yield reported by Raghuveer et al., (2024) [5] in soybean cultivation in the district of Adilabad through mechanization.

**Table 2:** Yield and economics of Soybean variety AISb-50

| Year | | Yield (kg ha$^{-1}$) | Cost of cultivation (Rs. ha$^{-1}$) | Gross returns (Rs. ha$^{-1}$) | Net returns (Rs. ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| 2022-23 | Demo | 2125 | 38290 | 92245 | 53955 | 2.41:1 |
| | Check | 1795 | 36440 | 77903 | 41463 | 2.14:1 |
| 2023-24 | Demo | 1850 | 34200 | 85100 | 50900 | 2.48:1 |
| | Check | 1462 | 36500 | 67252 | 30752 | 1.85:1 |
| Average | Demo | 1987 | 36245 | 88672 | 52427 | 2.44:1 |
| | Check | 1629 | 36470 | 72578 | 36108 | 1.99:1 |

The consistent higher yield in the Demo plots can be attributed to several factors, including better seed quality, improved agricultural practices, and perhaps more effective pest and disease management strategies implemented during the demonstrations. The average yield difference of 358 kg ha$^{-1}$ between the Demo and check plots highlights the potential of AISb-50 to significantly enhance productivity.

The cost of cultivation for the Demo plots was Rs. 38290 ha$^{-1}$ in 2022-23 and Rs. 34200 ha-1 in 2023-24. For the check plots, the cost was Rs. 36440 ha$^{-1}$ in 2022-23 and Rs. 36500 ha$^{-1}$ in 2023-24. The average cost of cultivation over the two years was Rs. 36245 ha$^{-1}$ for the Demo plots and Rs. 36470 ha$^{-1}$ for the check plots. The cost of cultivation was relatively similar between the Demo and check plots, with a slight reduction in the Demo plots in 2023-24.

The gross returns were substantially higher for the Demo plots. In 2022-23, the Demo plots generated Rs. 92245 ha$^{-1}$, while the check plots produced Rs. 77903 ha$^{-1}$. In 2023-24, the gross returns for the Demo plots were Rs. 85100 ha$^{-1}$ compared to Rs. 67252 ha$^{-1}$ for the check plots. On average, the Demo plots had gross returns of Rs. 88672 ha$^{-1}$, while the check plots had Rs. 72578 ha$^{-1}$. The net returns followed a similar trend. In 2022-23, the Demo plots achieved Rs. 53955 ha$^{-1}$ in net returns, while the check plots had Rs. 41463 ha$^{-1}$. In 2023-24, the Demo plots generated Rs. 50900 ha$^{-1}$ in net returns compared to Rs. 30752 ha$^{-1}$ for the check plots. On average, the net returns were Rs. 52427 ha$^{-1}$ for the Demo plots and Rs. 36108 ha$^{-1}$ for the check plots. However, the substantial increase in gross and net returns in the Demo plots underscores the economic viability of AISb-50. The average gross returns of Rs. 16094 ha$^{-1}$ higher in the Demo plots compared to the check plots translate into a significant economic advantage for farmers. Moreover, the net returns, which are Rs. 16319 ha$^{-1}$ higher on average in the Demo plots, further emphasize the profitability of adopting AISb-50.

Benefit-Cost (B: C) ratio indicates the efficiency of the investment. For the Demo plots, the B: C ratio was 2.41:1 in 2022-23 and 2.48:1 in 2023-24, averaging at 2.44:1 over the two years. In contrast, the check plots had a B: C ratio of 2.14:1 in 2022-23 and 1.85:1 in 2023-24, with an average of 1.99:1. The B:C ratio is a crucial indicator for farmers when deciding on adopting new varieties or agricultural practices. The higher B:C ratio in the Demo plots, averaging 2.44:1 compared to 1.99:1 in the check plots, indicates a more efficient and profitable use of resources.

**Table 3:** The yield performance of the AISb-50 in the FLD demonstrations conducted at Adilabad district of Northern Telangana

| Year | Yield gap 1 | Yield gap 2 | Technology index (%) |
|---|---|---|---|
| 2022-23 | 625 | 330 | 22.7 |
| 2023-24 | 900 | 388 | 32.7 |
| Average | 762.5 | 359 | 27.7 |

The performance of the soybean variety AISb-50 in the Frontline Demonstrations (FLD) conducted in Adilabad district of Northern Telangana is summarized in Table 3. The yield gaps and technology index provide insights into the effectiveness and adoption of this variety. Yield Gap 1, the difference between the potential yield and the actual yield in demonstration plots, was 625 kg ha$^{-1}$ in 2022-23 and 900 kg ha$^{-1}$ in 2023-24, average yield gap of 762.5 kg ha$^{-1}$ over the two years. The yield gaps highlight areas for improvement in achieving the full potential of AISb-50. Yield Gap 1 indicates that the actual yield in demonstration plots is significantly below the potential yield, suggesting that factors such as suboptimal agronomic practices, pest and disease pressure, or environmental conditions may be limiting performance. The increase in Yield Gap 1 from 2022-23 to 2023-24 suggests a need for enhanced support and training for farmers.

Yield Gap 2, the difference between the demonstration plot yields and the check plot yields, was 330 kg ha-1 in 2022-23 and 388 kg ha-1 in 2023-24, with an average of 359 kg ha$^{-1}$. Yield Gap 2 shows the effectiveness of the FLD in improving yields over traditional practices. The consistent reduction in Yield Gap 2 over the two years indicates that the demonstrations are successfully narrowing the performance gap between improved and traditional methods.

The technology index, indicating the feasibility of the technology transferred to farmers, was 22.7% in 2022-23 and increased to 32.7% in 2023-24, averaging at 27.7%. The technology index reflects the relative ease of adoption and the impact of the new technology. The increase in the technology index from 22.7% to 32.7% over the two years suggests that while adoption is improving, there is still significant room for better dissemination and implementation of recommended practices to further enhance yields as suggested by previous researchers on soybean cultivation (Raghuveer et al., 2024; Rajendaar Reddy et al., 2019) [5, 6]. Overall, the AISb-50 variety shows promise but requires continued efforts to fully realize its potential in the region.

This suggests that farmers investing in AISb-50 can expect better returns on their investments, making it a financially sound choice. The soybean variety AISb-50 has demonstrated substantial benefits in terms of yield and economic returns. The higher yields, coupled with better net returns and an improved B:C ratio, make it an attractive option for farmers looking to enhance their soybean production. The consistency of results over two years further validates the reliability of AISb-50. Adoption of this variety can lead to increased productivity and profitability, contributing to the overall economic well-being of farmers.

## Conclusion

The study on the soybean variety AISb-50, conducted in Adilabad district of Northern Telangana, compares its performance against the JS 335 variety and assesses its economic viability and yield over two years (2022-23 and 2023-24). Both varieties were sown on June 28, 2023, with identical seed rates (75 kg ha$^{-1}$) and spacing (45 x 5 cm$^2$). AISb-50 exhibited a shorter plant height (55 cm) compared to JS-335 (60 cm) and had a higher number of filled pods per plant (50) versus

JS-335 (45). However, the 100-seed weight for AISb-50 was slightly lower (12g) than JS-335 (13g). AISb-50 matured in 103 days, 7 days shorter than JS-335's 110 days, suggesting quicker maturity beneficial for shorter growing seasons. The yield of AISb-50 in demonstration (Demo) plots consistently outperformed check plots. In 2022-23, Demo plots yielded 2125 kg $ha^{-1}$ compared to 1795 kg $ha^{-1}$ in check plots. In 2023-24, Demo plots yielded 1850 kg $ha^{-1}$ compared to 1462 kg $ha^{-1}$ in check plots. The average yield over two years was 1987 kg $ha^{-1}$ in Demo plots versus 1629 kg $ha^{-1}$ in check plots, a difference of 358 kg $ha^{-1}$. The cost of cultivation was similar between Demo and check plots, averaging Rs. 36245 $ha^{-1}$ and Rs. 36470 $ha^{-1}$, respectively. Despite similar costs, gross returns were substantially higher in Demo plots: Rs. 92245 $ha^{-1}$ in 2022-23 and Rs. 85100 $ha^{-1}$ in 2023-24, compared to Rs. 77903 $ha^{-1}$ and Rs. 67252 $ha^{-1}$ in check plots. Average gross returns were Rs. 88672 $ha^{-1}$ in Demo plots versus Rs. 72578 $ha^{-1}$ in check plots, and net returns averaged Rs. 52427 $ha^{-1}$ in Demo plots compared to Rs. 36108 $ha^{-1}$ in check plots. The Benefit-Cost (B:C) ratio for Demo plots was 2.41:1 in 2022-23 and 2.48:1 in 2023-24, averaging 2.44:1, compared to 2.14:1 and 1.85:1, averaging 1.99:1, for check plots. This indicates a more efficient and profitable investment in AISb-50. Yield Gap 1 (difference between potential and actual yield in Demo plots) averaged 762.5 kg $ha^{-1}$, while Yield Gap 2 (difference between Demo and check plots) averaged 359 kg $ha^{-1}$. The technology index averaged 27.7%, indicating room for improvement in adoption and implementation. AISb-50 shows promise with higher yields, better economic returns, and a favourable B:C ratio, making it an attractive option for farmers. Continued efforts are needed to fully realize its potential and improve adoption in the region.

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