

PRE-EXTENSION DEMONSTRATION AND EVALUATION OF IMPROVED SESAME VARIETIES IN DABO HANA AND BURE DISTRICTS OF BUNO BEDELE AND ILU ABABOR ZONES, SOUTHWESTERN ETHIOPIA

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(Received 10th April 2025; accepted 29th June 2025)

ABSTRACT. The demonstration trial was conducted in the 2023 main rainy season in Dabo Hana and Bure districts of Buno Bedele and Ilu Ababor zones of Oromia Regional State, Ethiopia. The objectives were to create awareness, identify farmers' preferences towards sesame varietal selections, and evaluate the yield and economic profitability of improved sesame varieties. Consequently, based on sesame production potential and road availability, four kebeles were selected from both districts. Four improved sesame varieties (Hagalo and Obsa varieties in Dabo Hana district and Dicho and Yale varieties in Bure district) were demonstrated and evaluated along with the local variety. The trials were replicated across twelve demonstration sites, where similar necessary agronomic practices were applied. Yield, farmers' preferences, cost incurred, and profit obtained data were collected, where descriptive statistics, one-way ANOVA, matrix ranking, and partial budget were used to analyze the collected data. Descriptive analysis results revealed that the mean yield of 987.80, 575.00, and 673.62 kg ha⁻¹ was obtained from Hagalo, Obsa, and local varieties, respectively at Dabo Hana district, whereas 762.23, 442.07, and 493.34 kg ha⁻¹ were obtained from Dicho, Yale, and local varieties, respectively at Bure district. As a result, a statistically significant mean yield difference at (P<0.05) was observed. In terms of yield advantages, 46.6 and 54.5% of yield advantages were obtained from Hagalo and Dicho varieties over the local variety, respectively. Furthermore, the farmers' varietal preference matrix ranking shows Hagalo variety was preferred by the farmers in Dabo Hana district, whereas Dicho variety was selected in Bure district, having 4870 and 4168% MRR, respectively. Therefore, Hagalo and Dicho varieties were recommended for further scale-up and scale-out works in the study area and other similar agroecologies.

Keywords: *Demonstration, Farmers preferences, Sesame variety, Training, Yield advantage*

INTRODUCTION

Sesame (*Sesamum indicum* L. *Pedaliaceae*) originated in Africa and is produced globally in more than 75 countries [1]. The major sesame-producing countries are in Africa and Asia, with a total production of about 4.2 million tons per year. About 80% of the total global sesame production is contributed by the top 10 sesame-producing countries like India, Myanmar, Tanzania, Nigeria, Sudan, South Sudan, Burkina Faso, Chad, Ethiopia and Mozambique. Ethiopia shared around 2.64% of the global sesame production [1].

Sesame is the leading oil crop produced in Ethiopia and the second most export-earning crop next to coffee. Sesame production is increasing in Ethiopia, especially in the southwest and northwestern parts of the country, which is driven by high market value and the suitability of environmental conditions [2]. In 2020, the area allocated for sesame production was 375,119.95 ha, 45.7% of the estimated area under oil crop production [3]. In the same crop production season, the total area and volume of sesame production under medium-to-large commercial farming conditions were the highest in Tigray (56.42%), followed by Amhara (32.03%), Benishangul-Gumuz (7.25%), and Oromia (3.17%), whereas the total area and volume of production under smallholder farming systems were the highest in Amhara

(51.82%), followed by Tigray (30.88%), Oromia (9.41%), and Benishangul-Gumuz (7.34%) [3].

Sesame is a prominent crop and a significant contributor to the gross domestic product in Ethiopia [4]. It is predominantly grown by 95.5% of smallholders and 0.5% of medium-to-large commercial farmers for household food and a source of income under rain-fed conditions. Sesame seed oil is abundant in free fatty acids, primarily linoleic acid (37–47%), oleic acid (35–43%), palmitic (9–11%), and stearic acid (5–10%), containing trace levels of linolenic acid [5]. Despite the increasing demand and price of sesame in the world market, its productivity is declining from 8 to 3 q/ha in most parts of the country [6]. The major reasons are the lack of knowledge and skill in land preparation and agronomic practices, weather uncertainties, and pest outbreaks. As indicated by Tsehay [7], The lack of improved varieties and inappropriate use of fertilizers and pesticides are the major sesame production constraints. Wijnands, Biersteker [8], Were, Onkware [9], Dossa, Konteye [10] and Okello-Anyanga, Hansel-Hohl [11] also reported that the low yield of sesame is attributable to a lack of high-yielding and well-adapted varieties, susceptibility to capsule shattering, the prevalence of biotic and abiotic stresses, and a lack of modern production technologies such as optimal agronomic management practices, row planters, harvesters, and storage facilities.

To overcome the limitation of improved sesame variety in the southwestern parts of the country, an adaptation trial has been conducted by the pulse and oil crop research team of Bedele Agricultural Research Center, and the two well-performed sesame varieties (Hagalo and Dicho) were recommended [12]. The key parameters that were focused on during the adaptation trial were high-yielding and disease-tolerant varieties; however, the involvement of farmers in improved sesame varietal selection, which has a direct proportion within the future farmers' technological adoption, is neglected.

Therefore, this study was initiated with the objectives of creating awareness, documenting farmers' preference and selection criteria, and evaluating both yield performance and economic profitability of improved sesame varieties under farmers' circumstances.

MATERIALS AND METHODS

Description of the Study Areas

The study was conducted in Dabo Hana and Bure districts (Figure 1) of Buno Bedele and Ilu Aba Bor zones respectively in the 2023 main cropping season. Dabo Hana is among the districts of Buno Bedele zone. The district is bounded by Bedele district on the South, Dega and Mako districts on the West, Chewaka and Leka dulecha on the North, Chora on the Southwest, by Jima Arjo on the East and Northeast. The administrative town of this district is Kone. The district is situated 521 km away from Addis Ababa the capital city of Ethiopia and 38 km away from Bedele town. The district is located at 8°30' 21" to 8°43' 29" N latitude and 36°5'27" to 36°26' 19"E longitude with an average elevation of 1190-2323 m.a.s.l and average maximum and minimum annual temperature of 28°C and 11°C respectively. The annual rainfall ranges from 900-2200mm. There is a mixed farming system where maize and sorghum are the dominant cereal crops and sesame has gone out of production due to a lack of improved variety coupled with its labor-intensive crop in the district.

Bure district is among the districts of Ilu Ababor zone. The district is bordered on the south by Nono, on the west by Kelem Welega zone, on the northeast by Metu, and the southwest by Gembela Region. The administrative center of the district is Bure which is located 683 km away from the capital city of the country and 80 km away from Metu town. Bure district is located at an average elevation of 1730 m.a.s.l and located at 08° 16' 59" N (latitude) and 035° 6' 0" E (longitude). It is characterized by a warm climate with average

maximum and minimum annual temperatures of 31.66°C and 10°C respectively. The annual average rainfall is about 2000 mm. The economy of the area is based on a mix of crop and livestock production systems among which hot paper, sorghum, common bean, sesame, and horticulture are the dominant crops.

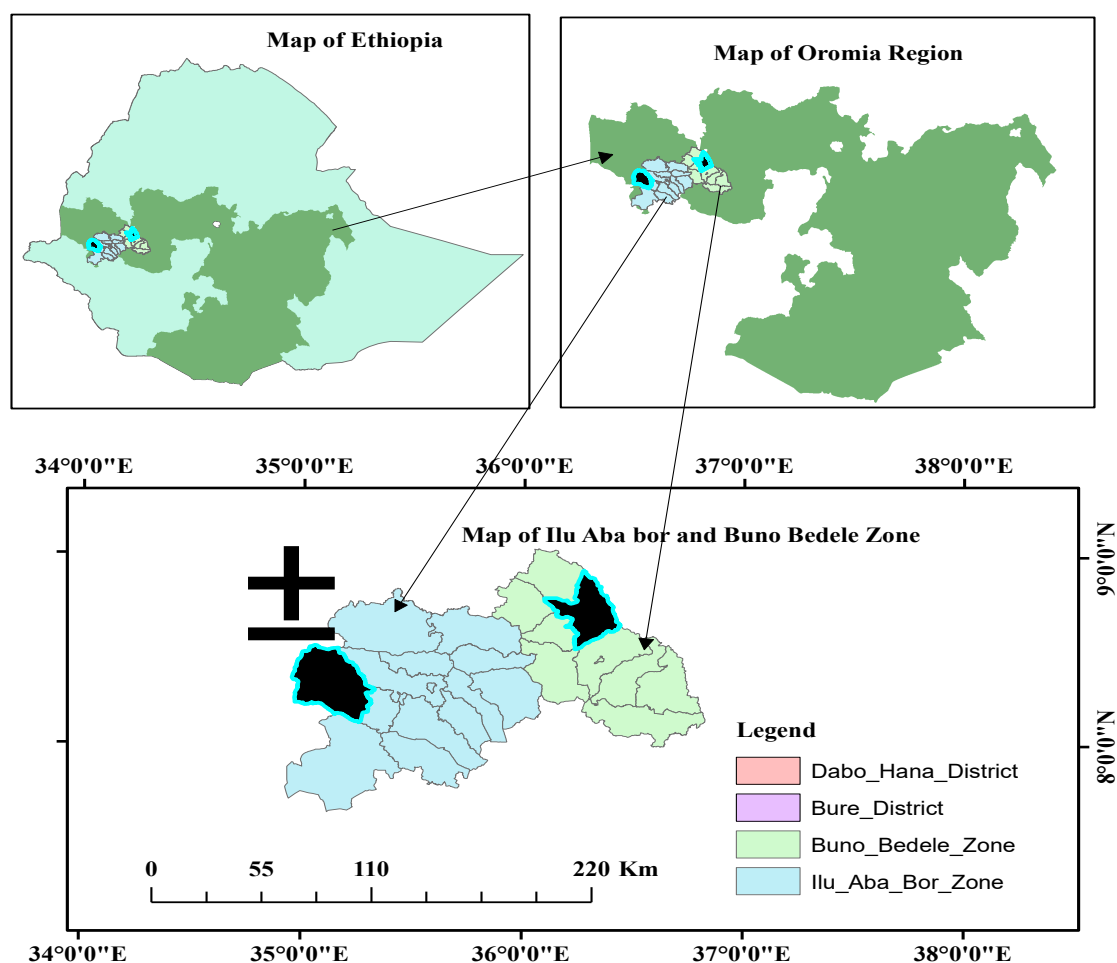


Fig. 1. Map of the study areas

Site and Farmer Selection

Dabo Hana and Bure districts were selected due to their suitable environment for sesame production and previous adaptation trial implementations. Based on sesame production potential and road availability, four kebeles (Lilo Saxo, Daye, Obo Miriga, and Toli Cheka) were selected and a total of ten interested experimental farmers were selected in collaboration with respective kebeles Development Agents (DAs). The two Bedele Agricultural Research sub-sites namely Daye and Bure were also used as sesame demonstration sites. Farmers' Research Group (FRG) approach was followed to enhance variety dissemination. Accordingly, one Farmers' Research Group was established in each kebeles using the experimental farmers as a point of reference. The established FRG consisted of a total of 55 farmers where the issue of gender disaggregation is considered (46 male and 9 female).

Materials and Research Design

The experiment was carried out on a total of twelve demonstration sites that were, ten interested experimental farmers' fields, and two research sub-sites. A single demonstration site of 10 m x 30 m was used and replicated across twelve sites. Four improved sesame

varieties namely Hagalo and Obsa in Dabo Hana district and Dichu and Yale varieties in Bure district were used based on specific adaptation trial recommendations [12]. One local sesame variety that has identical traits within the recommended improved varieties was used for comparison to convince farmers. For this study, each sesame variety was planted on a single demonstration plot of 10 m x 10 m by following the recommended agronomic practices including a seed rate of 5 kg ha⁻¹, a spacing of 40 cm between rows, and 10 cm between plants, NPS rate of 100 kg ha⁻¹ all at planting and 50 kg ha⁻¹ of urea at vegetative stage were used. The same weed management/hand weeding was used for each demonstration site.

Technology Promotion Approach

Training and experience sharing between the experiment hosting farmers and other FRG members through mini-field day were used as technology promotion events with the aim to facilitate further scaling up of improved sesame varieties. Accordingly, training was provided to FRG members and other stakeholders on improved sesame varieties, its yield advantage over the local variety, its management practices and future dissemination approach.

Data Collection

Both quantitative and qualitative data were collected. The collected quantitative data like yield, cost incurred, profit gained, and number of participants on the training were collected using data collection sheets, whereas qualitative data such as experiment hosting farmers, other FRG members and stakeholders' preferences and feedback towards the improved sesame varieties were also recorded via checklist.

Yield Advantage

The yield advantage of improved sesame variety over the local one is calculated by the following formula.

$$\text{Yield advantage in \%} = \frac{\text{Yield of improved variety} - \text{Yield of Local variety}}{\text{Yield of Local variety}} \times 100$$

Eqn. 1

Variety Preference Ranking

The variety preference ranking was conducted using group discussions with FRG members. All FRG members were facilitated to set their selection criteria and then select the preferred sesame variety at its maturity stage.

Method of Data Analysis

The collected quantitative data were entered into SPSS software version 20 and analyzed using descriptive statistics and one way ANOVA. The qualitative data like stakeholders' varietal preferences were analyzed using matrix ranking in accordance with the given value [13] and whereas their feedback were narrated. The cost incurred and benefit obtained was computed using partial budget analysis.

RESULTS AND DISCUSSION

Technology Promotion Approach

Training is organized to transfer information that brings about semi-permanent change in the areas of skills, knowledge, and attitudes toward specific jobs. In line with this, training was provided to different categories of stakeholders on the full-package-based production of improved sesame production, the concept of farmers' research group, and their roles in improved variety dissemination. Hence, a total of 82 (70 male and 12 female) stakeholders participated in the training (Table 1). At the end of the training, they provide constructive feedback on means of further improving sesame variety dissemination.

Table 1. *Training Participants*

Participant categories	Sex		Total
	Male	Female	
Farmers	46	9	55
DAs	9	3	12
Woreda Agricultural Experts (SMS)	12	0	12
Others	3	0	3
Total	70	12	82

Source: Data result and own computation, 2023

Farmers' Preference and Selection Criteria of Sesame Varieties

Farmers' participation in the variety selection process has a paramount role in improved variety adoption and its further dissemination. To this end, the discussion was held with FRG members by letting them set their own sesame varietal selection criteria. Accordingly, tolerance to disease and shattering, early maturity, pod length, and high yield were the identified selection criteria for best sesame varieties by the farmers (Table 2). Using the Likert scale of 1-5, (1 being very poor, 2 was poor, 3 was good, 4 was very good and 5 was excellent) the varieties were ranked from the viewpoints of farmers. The result showed that Hagalo and Dichu varieties were preferred by the farmers by getting the highest mean scores of 5 and 4.6 in Dabo Hana and Bure districts respectively.

Table 2. *Farmers' preference and selection criteria of sesame varieties by simple score ranking (1-5)*

Farmers Criteria	Farmers' sesame preferences per the districts					
	Dabo Hana			Bure		
	Hagalo	Obsa	Local	Dichu	Yale	Local
Tolerance to disease	5	4	2	4	4	2
Early maturity	5	5	2	5	5	2
Pod length	5	5	3	5	4	3
Tolerance to shattering	5	4	3	4	3	3
High yield	5	3	4	5	3	4
Overall score	25	21	14	23	19	14
Mean score	5	4.2	2.8	4.6	3.8	2.8
Rank	I	II	III	I	II	III

Source: Farmers' preference data result and own computations 2023

The reasons behind farmers' mostly preferred Hagalo and Dicho varieties are illustrated in Table 3.

Table 3. Reason for the preference of sesame varieties

Districts	Sesame varieties	Rank	Reason for farmers' preference
Dabo Hana	Hagalo	1 st	Very good in terms of disease and shattering tolerance, early maturity, pod length, and high yield.
	Obsa	2 nd	Very good in terms of early maturity and pod length, whereas good in disease and shattering tolerance, but medium in yield.
	Local	3 rd	Good in terms of yield and medium in pod length and shattering tolerance but poor in terms of disease tolerance and early maturity.
Bure	Dicho	1 st	Very good in terms of early maturity, pod length, and high yield but good in disease and shattering tolerance.
	Yale	2 nd	Very good in terms of early maturity, good in disease tolerance and pod length, whereas medium in shattering and yield.
	Local	3 rd	Good in terms of yield and medium in pod length and shattering tolerance but poor in terms of disease tolerance and early maturity.

Source: Farmers' preference data result and own computations 2023

Yield Performance of the Demonstrated Varieties

The below tables (Tables 4 and 5) shows the mean yield performance, analysis of variance and yield advantage of the demonstrated sesame varieties replicated across twelve demonstration sites in Dabo Hana and Bure districts. Before performing analysis of variance, each six one way ANOVA assumptions were checked and the results indicated that, both dependent and independent variables were fulfilled the criteria.

The simple descriptive result revealed that the mean yields of 987.80, 575.00, and 673.62 kg ha⁻¹ were obtained from Hagalo, Obsa, and local sesame varieties respectively at Dabo Hana district whereas the mean yield of 762.23, 442.07 and 493.34 kg ha⁻¹ were obtained from Dicho, Yale and local variety respectively in Bure district. Even though the demonstrated sesame variety was different within the district; the maximum mean yield was obtained from Hagalo followed by Dicho variety. The analysis of variance among the mean yield of the demonstrated sesame varieties shows that there was a statistically significant yield difference ($P < 0.05$) between the varieties in both districts. About 46.6 and 54.5% of yield advancement were obtained from Hagalo at Dabo Hana and Dicho variety at Bure district over the local variety as indicated in Table 6.

The current result was in line with the findings of Lule and Mengistu [14] who reported that, on the farmers' field the average grain yield for Obsa and Dicho were 868.8 and 810.6 kg ha⁻¹ respectively during variety registration. Gebremichael [15] also stated as the improved sesame varieties mean yields were ranged from 300 to 1000 kg ha⁻¹ under rain-fed and 1000 to 2400 kg ha⁻¹ under irrigation.

Table 4. Yield performance of the improved and local sesame varieties in kg ha⁻¹ in the study areas

Districts	Sesame varieties	N	Minimum	Maximum	Mean	Std. Deviation
Dabo Hana	Hagalo	5	756.70	1261.10	987.80	184.70
	Obsa	5	388.90	950.00	575.00	228.00
	Local	5	516.70	911.10	673.62	147.04
Bure	Dicho	7	552.20	1435.60	762.23	304.20
	Yale	7	303.30	566.70	442.07	78.46
	Local	7	435.60	661.10	493.34	79.97

Table 5. Analysis of variance for mean yield of the demonstrated sesame varieties

Districts	Yield of sesame	Sum of Squares	df	Mean Square	F	Sig.
Dabo Hana	Between Groups	464731.361	2	232365.681	6.471	.012
	Within Groups	430888.828	12	35907.402		
Bure	Between Groups	414000.727	2	207000.363	5.909	.011
	Within Groups	630512.006	18	35028.445		

$$\text{Yield advantage \%} = \frac{\text{Yield of improved sorghum variety} - \text{yield of local variety}}{\text{Yield of local variety}} \times 100$$

Eqn. 2

Table 6. The yield advantage of improved sesame varieties over the local one

Districts	Sesame varieties	Mean yield (kg ha ⁻¹)	Yield difference (kg ha ⁻¹)	Yield advantage (%)
Dabo Hana	Hagalo	987.80	314.18	46.6
	Obsa	575.00		
	Local	673.62		
Bure	Dicho	762.23	268.89	54.5
	Yale	442.07		
	Local	493.34		

Source: Own computation 2023

Economic Analysis

Economic analysis was performed to examine the economic profitability of the varieties. Partial budget was used to calculate costs that vary and the net benefits for each sesame variety whereas the marginal analysis is to examine just how the net benefits increase as the amount invested increases. Accordingly, the seed cost of improved sesame varieties (Hagalo, Obsa, Dicho, and Yale) was 11 ETB kg⁻¹ whereas 10 ETB kg⁻¹ for local varieties at planting time, but the farm gate price of both improved and local sesame varieties were the same (15.5 ETB kg⁻¹) at thrashing time of 2023.

Table 7. Cost-benefit analysis of the demonstrated sesame varieties

Parameters	Sesame varieties per the districts					
	Dabo Hana			Bure		
	Hagalo	Obsa	Local	Dicho	Yale	Local
Yield kg ha ⁻¹ (Y)	987.8	575.0	673.6	762.2	442.1	493.3
Sale Price ETB kg ⁻¹ (P)	15.5	15.5	15.5	15.5	15.5	15.5
Total Revenue (TR=YxP)	15310.9	8912.5	10441.1	11814.6	6852.1	7646.8
Variable costs						
Seed cost (ETB kg ⁻¹)	11	11	10	11	11	10
Fertilizers NPS (ETB kg ⁻¹)	39.9	39.9	39.9	39.9	39.9	39.9
Urea (ETB kg ⁻¹)	41.6	41.6	41.6	41.6	41.6	41.6
TVC	92.6	92.6	91.6	92.6	92.6	91.6
Net benefits (NB = TR-TVC)	15218.3	8819.9	10349.5	11721.9	6759.5	7555.2
Marginal rate of return (MRR = $\Delta TR/\Delta TVC$)	4869.8	-1528.6		4167.8	-794.7	

Source: Data result and own computation 2023

As indicated in Table 7, the highest net benefit was obtained from the Hagalo variety with 4870% at Dabo Hana, and from Dicho variety with a 4168% marginal rate of return at the Bure district. This implies farmers can recover all the incurred costs and gain an extra 48.7 and 41.7 ETB ha⁻¹ for every 1 ETB ha⁻¹ on average they invested when using Hagalo and Dicho varieties, respectively. Therefore, the use of Dano variety is economically acceptable in the study area. Unexpectedly, the benefit gained from Obsa and Yale was below the local sesame variety due to the low yield obtained as they were shattered and attacked by diseases at the maturity stage.

CONCLUSION

Four improved sesame varieties were demonstrated along with local variety across ten farmers' fields and two research sub-sites. The highest grain yield, yield advantage and net benefit were obtained from Hagalo in Dabo Hana district and Dicho variety in Bure district. As a result, Hagalo and Dicho varieties were preferred by the farmers and other stakeholders in Dabo Hana and Bure districts respectively. Based on these findings, Hagalo and Dicho varieties were recommended for further scaling up in the study districts and other similar agroecologies.

Acknowledgment. The authors would like to thank Oromia Agricultural Research Institute (IQQO) for financial support and all Bedele Agricultural Research Center (BeARC) researchers and supportive staffs for the accomplishment of this research activity.

Conflicts of Interest. The authors declare that there are no conflicts of interest regarding the publication of this research activity.

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