

Adaptation Study of Sesame (*Sesamum indicum* L.) Varieties in Buno Bedele and Ilu Ababor zones, South-western Oromia

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ABSTRACT

Aim: The aim of the study was to evaluate and select well adapted sesame varieties for the study area and similar agro ecologies.

Materials and Methods: Eight (8) improved sesame varieties were tested at Bure in Ilu Ababor Zone and Dabo in Buno Bedele Zone districts during main cropping seasons using Randomized Complete Block Design (RCBD) with three replications. An important data like Days to heading, Plant height, Capsule length and Grain yield were recorded and mean performances of these traits were evaluated using Genstat 18th edition software.

Results: The results showed significant differences among sesame varieties for grain yield and yield related traits. The combined analysis of grain yield over the two districts was non-significant. Therefore, it is necessary to recommend specifically for each districts. Grain yield of the sesame varieties at Bure district varied from 15.46qt ha⁻¹ for variety Dicho, to 13.61qt ha⁻¹ for variety Yale. The maximum yield was obtained from Dicho variety (15.46qt ha⁻¹) followed by Yale variety (13.61qt ha⁻¹). Therefore, these two varieties were recommended to be demonstrated under farmers' field for further scaling up. Grain yield of the sesame varieties at Dabohana district at dahe sub site varied from 15.46qt ha⁻¹ for variety Hagalo, to 20.05qt ha⁻¹ for variety Obsa. The maximum yield was obtained from Hagalo variety (20.05qt ha⁻¹) followed by Obsa variety (18.01qt ha⁻¹).

Conclusion: It was concluded that Dicho (15.46 qt/ha), Yale (13.61 qt/ha), Hagalo (20.05 qt/ha) and Obsa (18.01 qt/ha) were the best varieties showed the highest yield of the tested varieties as well as higher yielder than other improved varieties tested.

Keywords: Adaptability, Sesame, Varieties, Yield related

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Introduction

Sesame (*Sesamum indicum* L., 2n=26) grouped under the family Pedaliaceae; is probably the most ancient oil seed known and used by man (Kafiriti and Deckers, 2001; Reddy, 2006). It is called 'Queen of oil seeds' due to its high quality polyunsaturated stable fatty acid, which restrains oxidative rancidity (Reddy, 2006, Gururajan, *et al.*, Balasubramanian&Palaniappal, 2011); it is also stable due to the natural antioxidants sesamol and sesamolol that reduce the rate of oxidation (Terefe, *et al.*, 2012). *Sesamum indicum* L. is a member of the Pedaliaceae family is an erect annual herb commonly known as sesame, benni seed or simsim.

It is one of the oldest and most traditional oilseed crops, valued for its high-quality seed oil. According to recent archeological findings, sesame cultivation was derived from wild populations native to South Asia, and its cultivation was established in South Asia from the time of the Harappan civilization and spread west to Mesopotamia before 2000 B.C. (Fuller, 2003). Despite other claims, it was first cultivated in Africa and later taken to India at a very early date (Alegbejo *et al.*, 2003; Purseglove, 1969). Tunde- Akintunde *et al.* (2012) suggested that sesame was the main oil crop grown by the Indus Valley Civilization and was likely transferred to Mesopotamia around 2500 B.C. The Assyrians used its oil for different purposes such as food, salves (ointments), and medicine, while Hindus believed it to be sacred. Sesame is also known as the "queen of oilseeds," but it is actually an orphan crop. Little research into sesame has been undertaken and, hence, it is not a crop mandated by any international crop research institute

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(Bedigian and Harlan, 1986; Bhat et al., 1999), despite being cultivated in both tropical and temperate zones of Africa, Asia, Latin America, and some parts of the southern United States (Bedigian, 2010d; IPGRI and NBPGR, 2004). Sesame is adaptable to a range of soil types, although it performs well in well-drained, fertile soils of medium texture (typically sandy loam) at neutral pH. Generally, sesame is a short-day plant that may grow in long-day areas. Depending upon light intensity and day period in various regions, sesame has produced genotypes with different photoperiod requirements. Some cultivars among the other oilseed field crops, sesame (*Sesamum indicum* L.) is one of the important crops in the world for edible oil production. It is produced mainly in India, Myanmar, China, Sudan, Ethiopia, Uganda, Nigeria, Paraguay, Niger, Tanzania, Thailand, Pakistan, and Turkey (Anonymous, 2010). Sesame has an important role in human nutrition. Most of the sesame seeds are used for oil extraction and the rest are used for edible purpose.

It is grown primarily for its oil-rich seeds. The sesame seed is rich in good quality edible oil (up to 60%) and protein (up to 25%) (Brar and Ahuja, 1979). The oil is in demand in the food industry because of its excellent cooking quality, flavor, and stability. The world production is estimated at 3.66 million tones with Asia and Africa producing 2.55 million tons (Anon, 2008).

Oil crops are the second largest source of foreign exchange earnings after coffee (FAO, 2012) and sesame is the main oilseed crop in terms of production value. In 2010, Ethiopia was considered the second main exporter of sesame seeds in the world, behind India (FAOSTAT, 2012). Ethiopia sesame is grown chiefly for export (more than 95%) and direct consumption (5%) (Anonymous, 2015). In Ethiopia grows almost all regions of the country with an altitude of less than 2000m above sea level (Yebiyo, 1985; Adefriset al., 2011) and is a well-established crop in Amhara, Tigray, Afar and Oromia regions. Reports on peasant holdings in sesame showed that 2626541.89qt of the Ethiopian sesame produce comes from Amhara 1,360,998.39qt, Tigray 811,042.39qt and Oromia 247,134.28qt regions (CSA, 2020). The total sesame production area and quintals were reported for National, Regional (Oromia) about 375,119.95ha (2626541.89qt) and 36,492.24ha (247,134.28qt)

over last year post harvest estimate respectively (CSA, 2020). National (7qt/ha) and regional (6.77qt/ha) average yield of sesame produced reported (CSA, 2020). Low yield is attributed to cultivation of low yielding dehiscent varieties with low harvest index values, significant yield loss during threshing and lack of agricultural inputs such as improved varieties, fertilizers and other agro-chemicals (Ashri, 1994, 1998; Weiss, 2000; Uzun and Cagirgam, 2006). Even if sesame is the most important oil crop and enrich with different mineral elements and vitamins, the production and productivity of the crop is below average because of different production constraints (lack of farmer's awareness, lack of improved variety(s) that adapted to their environment, inadequate supply of seed and other agricultural input). For that reason, this study was initiated to improve the production and productivity of sesame by evaluating and selecting high yield sesame variety (s) for sesame growing districts of Ilu Ababor and Buno Bedele Zone. Therefore, the study was initiated with the objective to evaluate and select best adapted sesame varieties for high yielder and diseases and insect tolerant for the study areas of Bure and Dabo Hana districts and other similar agro ecology

Materials and Methods

The experiment was conducted at Dabo Hana district (Dhaye sub-site) in BunoBedele and Bure district during main cropping seasons.

Bure District

Bure is one of Southwest of Ethiopia located in Illubabor Zone of Oromia Region. The district is bordered on the south by Nono, on the west by KelemWelega Zone, on the north east by Metu, and on the Southwest by Gembela Region. The administrative center of this district is Bure. The district is located 683 km away from the capital city of the country and 80 km away from Ilu Aba Bora Zone. The district is located at an average elevation 1730 m.a.s.l and located at 08°17'to 08°18'55.4" N latitude and 035°6'to 035°31'1.6" E longitude. It is generally characterized by warm climate with a mean annual maximum temperature of 89°F (31.66°C) and a mean annual minimum temperature of 50°F (10°C.) The driest season lasts between June and September, while the coldest month being November. The annual rainfall ranges from 2000 mm. The soil of the area is characterized as an old soil called Nito soils.

The economy of the area is based on mixed cropping system and livestock rearing agricultural production system among which dominant crops are Coffee, Hot paper, sorghum and haricot bean, sesame and also horticultural crops.

Dabo Hana District

Dabo Hana is one of the districts in BunoBede Zone, Oromia Regional State Southwest part of Ethiopia. The district is bordered on the south by chora, on the west by Cawaka, on the north by Nekemte, and on the east by Bedele. The administrative center of this district is kone. The district is located 521 km away from the capital city of the country and 38 km away from Bedele Town of Buno Bedele Zone. The district is located at an average elevation 1190-2223 m.a.s.l and 8°30' 21' N-8° 43'29' N latitude and 36° 5'27' E-36° 36'19' E longitude. It is generally characterized by warm climate with a mean annual maximum temperature of 28°C and a mean annual minimum temperature of 11°C. The driest season lasts between December and January, while the coldest month being December. The annual rainfall ranges from 900 mm-2200mm. The soil of the area is characterized as an old soil called Nit soils. The economy of the area is based on mixed cropping system and livestock rearing agricultural production system among which dominant crops is maize, sorghum and coffee and also horticultural crops like hot paper.

Experimental Materials and Design

Eight (8) improved sesame varieties were brought from Mechara Agricultural Research Center and Bako Agricultural Research Center and evaluated as experimental materials (Table 1). These materials were randomly assigned to the experimental block and the experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The spacing between blocks and plots was 1m and 0.5m, respectively. The gross size of each plot was 7.2m² (2.4m x 3m) having six rows with a row-to-row spacing of 40cm and 10cm between plant. The total area of the experimental field was 253m² (27.5m x 9.2m). Planting was done by rows planting with a seed rate of 5kg ha⁻¹. NPS fertilizer was applied at the rate of 100kg ha⁻¹ (72g per plot) at the time of planting.

Data collected

Days to flowering: Days to flowering was calculated from days of emergence to the days 50% flowering on the plot

Days to maturity (DM): Days to maturity was calculated from days of emergence to the days 50% reach physiological maturity

Plant height (PH) (cm): plant height was taken from five plants in each plot sesame peak flowering time

Capsule zone length: It was measured from the node of the first capsule to the location of the node that contained the last capsule at maturity

Number of capsules per plant: number of capsules per plant was taken from five plants in each plot

Number of seed per capsules: number of seed per plant was taken from three capsules per plant (upper, middle and lower capsules) from five plants in each plot.

Yield (g/plot): yield data was taken from sample plot and converted in to qt/ha.

Data Analysis: Genstat 18th edition software was used to analyze all the collected data from individual farmers and the combined data over locations. Mean separations was carried out using least significant difference (LSD) at 5% probability level.

Table 1. Description of the sesame varieties used in the experiment

S.No.	Varieties	Altitude (m.a.s.l)	Year of Release	Maintainer
1	Chalasa	1350-1650	2013	BARC
2	Obsa	1250-1650	2010	BARC
3	Dicho	1250-1650	2010	BARC
4	Hagalo	1300-1650	2019	BARC
5	Yale	1300-1650	2019	BARC
6	BaHazeit	560-1650	2016	HU
7	BaHanecho	560-1650	2016	HU
8	Walini	1250-1450	2017	BARC

Results and Discussion

Analysis of variance revealed that there was a highly significant variation among the tested varieties ($P < 0.001$). The results of ANOVA for each locations revealed significant ($P < 0.05$) variation for seed yield at D/Hana and Bure districts separately (Table 2 and 3). The results of ANOVA for seed yield pooled data showed non-significance differences among the tested varieties. Therefore, it is an important and necessary to conduct analysis separately for seed yield for both locations.

Table 2. Analysis of variance ANOVA of 8 sesame varieties for grain yield in qt ha⁻¹ in Bure district in 2022 cropping season

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F value	Pr (>F)
Replications	2	34.09	17.05	11.72	
Treatments	7	122.21	17.46	12.00	<.001
Residuals	14	20.37	1.46		
Total	23	176.69			

Table 3. Analysis of variance ANOVA of 8 sesame varieties for grain yield in qt ha⁻¹ in Dabo Hana in 2022 cropping season

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F value	Pr (>F)
Replications	2	1.48	0.74	0.08	
Treatments	7	83.13	11.88	1.32	0.01
Residuals	14	126.25	9.02		
Total	23	210.86			

Grain yield is also a vital of prime importance and of special interest to a sesame breeder. Accordingly, highly significant variability was observed among varieties for grain yield qt ha⁻¹, which ranged from 8.52 qt ha⁻¹ to 15.46qt ha⁻¹ with the mean value of 11.99qt ha⁻¹ result at Bure District in Tolicheka Keble were recorded. Depending on the mean performances, varieties such as Dicho and Yale had mean performances higher than the grand mean while lower yielder were obtained from BaHanecho (8.52qt ha⁻¹) and BaHazeit (8.61qt ha⁻¹). Accordingly, highly significant variability was observed among varieties for grain yield kg ha⁻¹, which ranged from 14.35 qt ha⁻¹ to 20.05qt ha⁻¹ with the mean value of 17.20qt ha⁻¹ result at Dabo District in Dhaye sub site were recorded. Similar findings were observed by Desawi et al (2014).

Depending on the mean performances, varieties such as Hagalo, Obsa and Yale had mean performances higher than the grand mean while lower yielder were obtained from Walin (14.35qt ha⁻¹) and BaHanecho (14.68qt ha⁻¹). Analysis of variance (ANOVA) revealed significant difference ($P < 0.05$) among the eight (8) sesame varieties in phenological traits such as plant height, capsules length, Number of capsule per plant, Number of seed per capsule and Grain yields (Table 4 and 5). Yasin and Genene (2017) also reported significant variation in seed yield among sesame varieties and many similar studies have indicated that sesame varieties were significantly different in yield components (Ray et al., 2009).

Plant height: Varieties differed significantly ($P < 0.05$) for plant height, which varied from 100.41 to 100.27 cm (Table 4). Highest plant height (100.41 cm) was recorded in variety Yale and the lowest plant height was recorded in

BaHazeit (100.27) variety. El-Bramawy (2006) also corroborated similar findings.

Capsule zone length: Varieties differed significantly ($P < 0.05$) for capsule length, which varied from 3.00 to 2.44cm (Table 4). Highest capsule length (3.00 cm) was recorded in variety Chalasa, Obsa, BaHanecho, and Walin and the lowest capsule length was recorded in Hagalo (2.44cm) variety.

Number of capsules per plant: Varieties differed significantly ($P < 0.05$) for number of capsule per plant, which varied from 159 to 70 (Table 4). Highest number of capsule per plant (159) was recorded in variety BaHanecho, and the lowest number of capsule per plant was recorded in BaHazeit (70) variety. Hika et al (2014) also advocated similar results of sesame.

Number of seed per capsules: Varieties differed significantly ($P < 0.05$) for number of seed per capsule, which varied from 71.33 to 59 (Table 4). Highest number of seed per capsule (71.33) was recorded in variety Dicho, and the lowest number of seed per capsule was recorded in BaHazeit (59) variety. Similar findings were also reported by Salunkhe and Desai (1986).

Days to physiological maturity: Varieties differed significantly ($P < 0.01$) for number of days to physiological maturity ranging from 102.3 to 120 days with mean of all varieties 111.15 (Table 5). Variety Chalasa was earliest to physiologically mature at 102.3 days changing color of leaves and capsule from green to yellow of 90% of the plants from the sowing. At this stage, the grains are fully developed and lose connection for the supply of photosynthetic assimilates nutrients and water from the tissues of the ovary of the mother plants. The other earlier maturing variety was Obsa taking 120 days. Uzun and Cagiran (2006) also advocated similar findings.

Table 4. Mean yield related traits and grain yield per hectare of Sesame varieties at Bure District at Tolichakebele in 2021/22 years

Varieties	DM	PH (cm)	CL (cm)	NC/P	NS/C	Qt/ha
Chalasa	122.3	1.35ab	3.00a	124.0ab	66.00ab	11.39cd
Obsa	122.3	1.32ab	3.00a	123.7ab	62.00ab	13.38abc
Dicho	122.7	1.38ab	2.62ab	117.0ab	71.33a	15.46a
Hagalo	122.0	1.37ab	2.44b	149.7a	69.33ab	11.20d
Yale	122.7	1.41a	2.77ab	116.7ab	64.00ab	13.61ab
BaHazeit	122.7	1.27b	2.54ab	70.0b	59.00b	8.61e
BaHanecho	123.6	1.34ab	3.00a	159.0a	63.67ab	8.52e
Walini	123.7	1.29ab	3.00a	107.0ab	70.0a	12.13bcd
GM	122.67	1.34	2.8	120.9	65.67	11.79
LSD 5%	2.82	0.138	0.55	66	10.8	2.11
CV%	1.3	5.9	11.2	31.2	9.4	10.2
P-value	NS	*	*	*	*	*

DM= Days to Maturities, PH= Plant height (cm), CL= Capsule length (cm), NCPP= Number of Capsule per plant, GM= Grand mean and CV= Coefficient of variation, *=significant at P<0.05 level, NS= Non-significant

Table 5. Mean yield related traits and grain yield per hectare of Sesame varieties at Dabo Hana District at Dahe sub site in 2021/22 years

Varieties	DM (days)	PH (cm)	CL (cm)	NC/P	NS/C	Qt/ha
Chalasa	102.3d	153.6a	3.33	106.9	87.33	15.97ab
Obsa	120.0a	152.0a	3.00	158.6	73.56	18.01ab
Dicho	113.3ab	153.9a	2.88	145.8	78.22	17.27ab
Hagalo	109.3bc	158.2a	3.11	117.9	77.44	20.05a
Yale	114.0ab	133.3b	2.77	119.7	76.11	17.36ab
BaHazeit	109.7bc	148.4b	2.77	137.2	84.89	14.68b
BaHanecho	105.0cd	159.9a	3.00	223.9	81.11	14.68b
Walini	109.0bcd	146.4ab	3.00	143.6	85.89	14.35b
GM	110.33	150.72	2.99	144.19	80.57	16.55
LSD 5%	6.96	15.44	0.85	118.32	14.85	5.25
CV%	3.6	5.9	16.3	46.9	10.5	18.1
P-value	*	*	NS	NS	NS	*

DM= Days to Maturities, PH= Plant height (cm), CL= Capsule length (cm), NCPP= Number of Capsule per plant, GM= Grand mean and CV= Coefficient of variation, *=significant at P<0.05 level, NS= Non-significant

Plant height: Varieties differed significantly (P<0.05) for plant height, which varied from 159.9 to 133 cm (Table 5). Highest plant height (159.9 cm) was recorded in variety BaHanecho and the lowest plant height was recorded in Yale (133) variety. Terefe et al (2012) also corroborated similar findings of sesame varieties

Conclusions

Studying varietal response to different environment is very crucial for plant breeding programmes where there is a diverse natural, environmental, climatic and soil variability are existing. In line with this, a total of 8 sesame varieties were studied at Bure and Dabo Hana districts on different site.

The result of the experiment showed that sesame varieties were showed a significant differences both at individual site' level. Different

varieties are responded differently at specific locations. The seed yields of varieties were inconsistent performance at both locations which shows the environmental influence on the varieties. Generally, at Bure district Dicho (15.46 qt/ha) and Yale (13.61 qt/ha) and at Dabo Hana District; Hagalo (20.05 qt/ha) and Obsa (18.01 qt/ha) were the best varieties that showed the highest yielder of the tested varieties as well as higher yielder than other improved varieties tested. Therefore, Dicho and Yale are the two varieties recommended for Bure district and other similar agro ecologies of Ilu Ababor Zones and Hagalo and Obsa are the two varieties recommended for Dabo Hana district and other similar agro ecologies of Buno Bedele Zone to be demonstrated on farmers' field for further scaling up.

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