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# Adaptability Study of Released Sesame (*Sesamum indicum* L.) Varieties in West Hararghe Zone, Oromia National State, Ethiopia

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## Abstract

Sesame (*Sesamum indicum* L.) is an annual crop and one of the important oil crops of the world. The experiment was conducted at Daro lebu district (on Milqaye FTC), and Mieso district (Melkasa sub site) in 2018 main cropping season. The objective of the study was to evaluate and select well adapted sesame varieties with high yielder and resistant to major insect pest and disease in west Hararghe Zone. The treatments involved were six released sesame varieties and one standard check (Adi) was used for this study. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and the plot size was 2.4m X 3m areas which contain six rows of sesame in spacing of 40cm X 10cm between rows and plants respectively. Each variety was sown at seed rate of 5 kg $ha^{-1}$ by row planting without any fertilizer application. The result from combined mean analysis of variance revealed that significant ($P \leq 0.05$) difference among varieties for days to flowering, days to maturity, disease score, number of seed per capsule, thousand seed weight and grain yield across location. However, statistically non-significance difference shown on plant height, pest score, and number of capsule per plant among tested varieties. The grain yields of tested varieties were ranged from 392kg $ha^{-1}$ (Abasena) to 591kg $ha^{-1}$ (Bha Necho). The variety Bha Necho was recorded superior grain yield 5.91qt/ha followed by variety Bha Zeyit 570kg $ha^{-1}$ among tested varieties. The combined mean grain yield of Bha Necho and Bha Zeyit varieties were 48.7% & 41.8% yield advantage over standard check (Adi), respectively. Therefore, these two varieties were selected and recommended for further demonstration to study area and similar agro ecologies.

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## Keywords

Adaptation, Sesame, Yield, Varieties.

## Introduction

Sesame (*Sesamum indicum* L) belongs to the genus Sesamum, order Tubiflorae and family pedaliaceae and is a diploid species with 2n = 2x = 26 chromosomes. It is an annual self-pollinating plant with an erect, pubescent, branching stem, and 0.60 to 1.20 m tall. The leaves are ovate to lanceolate or oblong while the lower leaves are trilobed and sometimes ternate and the upper leaves are undivided, irregularly serrate and pointed (Felter and Lloyd, 1898: cited in Morris, 2002). The fruit is an oblong, mucronate, pubescent capsule containing numerous small, oval, and yellow, white, red, brown, or black seeds (Morris 2002; Geremew *et al.*, 2012).

Sesame is an annual crop and one of the important oil crops of the world and belongs to the order Tubiflorae and family Pedaliaceae cultivated for seed (Raikwar &

Srivastva, 2013). It was one of the first oil seeds from which oil was extracted by the ancient Hindus, which was used for certain ritual purposes (Arnon, 1972). Seegeler (1983) reported that it is an ancient oilseed, first recorded as a crop in Babylon and Assyria before 2050 BC. Among the other oilseed field crops, sesame is known 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 nextto coffee (Fiseha *et al.,* 2019) 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%) (Annonymous, 2015). In Ethiopia grows almost all regions of the country with an altitude of less than 2000m above sea level (Yebiyo, 1985; Adefris *et al.*, 2011) and is a well-established crop in Amhara, Tigray, and Afar and Oromia regions. Reports on peasant holdings in sesame showed that 89.95% (2466503.09 tons) of the Ethiopian sesame produce comes from Amhara (48.84%), Tigray (24.52%) and Oromia (16.59%) regions (CSA, 2015). The total sesame production area and quintals were reported for National, Regional (Oromia) about 337,926.82ha (267,866,546kg) and 2,170.25ha (1,299,662kg) over last year post harvest estimate respectively (CSA, 2016). National (793kg $ha^{-1}$) and regional (599kg $ha^{-1}$) average yield of sesame produced reported (CSA, 2016).

In Ethiopia, sesame grows well in the lowlands either as sole crop or intercropped with millet or sorghum (Haile *et al.,* 2004). Sesame oil and seed are put to great variety of uses. The oil, besides as a cooking medium, is also used for anointing the body. The oil cake which is rich in calcium is used as feed. The seed is used in the preparation of different foods (stew called wet, a source for porridge, snacks, flavoring, sweets and beverages) (Adefris *et al.,* 2011). It is used as a source of food; eaten as raw, either roasted or parched, or as blended oil in the form of different sweets (Weiss, 1971). The seeds are rich source of oil, protein, calcium, phosphorus and oxalic acid (Caliskan *et al.,* 2004). Low yield had been 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).

In western Hararghe about 8,336.38 was produced by 76,672.00 household during 2016 cropping season (CSA, 2016). According to zonal agricultural office sesame production is largely produced by Anchar, Doba, Mi'eso, Hawi-gudina, low land of Darolebu and Oda bultum districts. Despite the area is suitable for sesame production but due to lack improved varieties, biotic and abiotic factors productions are declining time to time. From the above mentioned problems lack of improved variety is very serious question of target area producers. Therefore, this activity was initiated to evaluate the performance of recently released varieties of sesame in terms of high grain yield and tolerant to disease in the study area.

## Materials and Methods

### Description of the study sites

The field experiment was conducted at Daro lebu and Mieso districts in west Hararghe Zone during 2018 main cropping season. Milkaye FTC from Daro Labu district and Melkasa sub site from mieso district were selected and Adaptabilitystudies of improved Sesame varieties were conducted. Daro Lebu lies to the east of Addis Ababa on 446 km and south of Chiro town, the capital of the zone, at a distance of 115 km. The area has bimodal type of rain fall distribution of short rainy season Winter lasts from mid- February to April whereas the long rainy season Summer is from June to September with annual rainfall ranging from 900-1300mm (average annual rainfall of 1094mm) and ambient temperature of the district varies from 14 to 26$^{o}$C with an average of 20$^{o}$C (Climate data obtained from Mechara Metrological Station). The nature of rain fall is very erratic and unpredictable causing tremendous erosion. The major soil type of the area is sandy clay loam which is reddish in color (Report on farming system of Daro Lebu districts, Mechara Agricultural Research Center, unpublished data).

Mieso is located at 304km to East of Addis Ababa and 25km to West of Chiro. It is bordered by Doba district in East direction, Afar Region in West, Chiro district in South and Somali Region in North. The district has an area of 257,344 ha. It is located at the latitude of 9°13'59.99" and longitude of 40°45'0". The altitude of the district on average is 1332 m.a.s.l. with maximum and minimum temperature of 37$^0$C and 25$^0$C, respectively. The annual rainfall of the district ranges from 500mm to 700mm (Jima and Birhanu, 2017)

## Treatments and Experimental Design

Six released sesame varieties namely: Bha Necho, Bha Zeyit, Dicho, Chalesa, Obsa, and Aba-sena varieties and one standard check (Adi) were used for this study. These varieties were selected based on average yield performance and agro ecological adaptation. The varieties were obtained from Bako Agricultural Research center and Haramaya University. The experiment was laid out in RCBD with three replications and the plot size was 2.4m X 3mareas which contain six rows of sesame in spacing of 40cm X 10cm between rows and plants respectively. The spacing between plots and blocks was0.5m and 1m respectively. Each variety was sown at seed rate of 5 kg ha$^{-1}$ by row planting without any fertilizer application. All other trial management activity was carried out as necessary.

## Data collection

## Phenological Parameters

Phenological parameters such as days to flowering (days), days to maturity (days) and plant height (cm) were recorded. Days to flowering was recorded by counting the number of days after flowering when 50% of the plants per plot had the first open flower. Days to maturity was recorded when 90% of capsules were physiologically matured per plot. Plant height at maturity (PH) (cm): this growth parameter is the stature of the plants in centimeter (cm) from the ground up to the top of the plants.

## Grain Yield and Yield Components

Four central rows were harvested for determination of grain yield. Five plants were randomly selected from the four central rows to determine yield and yield components, which consisted of number of capsule per plant and number of seeds per capsule. Capsule number per plant was determined by counting capsules of the five randomly selected plants while number of seeds per capsule was recorded by counting the total number of seeds in a capsule from randomly sampled capsules taken from the five randomly selected plants. Thousand seed weight (gram) (TSW): the average weight of 1000 seeds randomly collected from the harvested grain yield in grams and Grain yield (kg/ha): the total grain yield (kg/ha) harvested from the net plot area.

## Statistical Analysis

All the agronomic data were recorded and being subjected to analysis using the R Computer software. Mean separation was carried out using for testing Least Significant Difference (LSD) test at 5% probability level.

## Results and Discussion

The analysis of variance shows that, there were significant ($P<0.05$) difference among varieties in days to maturity, plant height, disease (bacterial blight), number of seed per capsule, thousand seed weight and grain yield. However, statistically non-significance difference was observed on days to flowering, pest score and number of capsule per plant among tested varieties.

The grain yields of tested varieties were ranged from 457kg ha$^{-1}$ (Aba-sena) to 725kg ha$^{-1}$ (Bha Zeyit). Bha Zeyit Variety (725kg ha$^{-1}$) was recorded superior grain yield followed by variety Bha Necho (707kg ha$^{-1)}$ among tested varieties. On the other hand, lowest grain yield was recorded by Aba sena (457kg ha$^{-1}$) at Milqaye FTC(Table-1)

At Mieso sub site there was significant ($P\leq0.05$) difference among varieties in days to flowering, days to maturity, plant height, thousand seed weight and grain yield but non-significant difference observed for disease (bacterial blight), pest score, number of capsule per plant, and number of seed per capsule with evaluated varieties. The grain yields of tested varieties were ranged from 305kg ha$^{-1}$ (Obsa) to 467kg ha$^{-1}$ (Bha Necho). Bha Necho (467kg ha$^{-1}$) was recorded superior grain yield followed by variety Bha Zeyit (416kg ha$^{-1)}$ among tested varieties. On the other hand, lowest grain yield was recorded by Obsa (305kg ha$^{-1}$) (Table-2)

**Table.1** Mean grain yield and agronomic traits of sesame varieties on Milkaye FTC in2018

| Variety | DF | DM | PH | BB | PS | NCPP | NSPC | THSW | GYD(in kg) | GYD AD% |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bha Zeyit** | 54.66 | 99.6b | 99.3c | 1.33ab | 1 | 100.66 | 69.33b | 4.80a | 725a | 49.50% |
| **Bha Necho** | 55.33 | 98b | 116ab | 1.00b | 1 | 84.66 | 70.66a | 5.83a | 707a | 45.80% |
| **Chalesa** | 55.33 | 95.6b | 106.6bc | 1.33ab | 1 | 78.33 | 63.66ab | 4.36ab | 563b | 16.08% |
| **Decho** | 54.33 | 97.6b | 104.6c | 1.33ab | 1 | 83.33 | 60.66 | 4.06ab | 563b | 16.08% |
| **Obsa** | 55 | 96.3b | 105.6 | 1.33ab | 1 | 95.33 | 62ab | 4.03ab | 512b | 5.56% |
| **Adi** | 55.6 | 121.66a | 120.3a | 2.00ab | 1 | 76.66 | 54.66b | 3.13b | 485b | |
| **Aba-sena** | 56 | 1130a | 107bc | 2.33a | 1 | 88.66 | 56b | 5.50a | 457b | |
| **Mean** | 55.19 | 103.14 | 108.5 | 1.52 | 1 | 86.8 | 62.42 | 4.53 | 568 | |
| **LSD** | 3.22ns | 9.01*** | 10.28* | 1.12* | 2.06ns | 27.1ns | 11.63* | 2.12* | 129** | |
| **CV%** | 3.31 | 4.95 | 5.37 | 42.03 | 1.16 | 17.7 | 10.56 | 26.56 | 12.9 | |

DF=days to flowering, DM=Days to maturity, PH= plant height (cm), *BB=Bacterial blight*,PS=Pest Score (1-5), NCPP= Number of capsule Per Plant, NSPC=Number of Seed Per capsule, THSW=Thousand Seed Weight (g) and GY= Grain Yield (qt/ha).

**Table.2** Mean grain yield and agronomic traits of sesame varieties on Mieso sub site FTC in 2018

| Variety | DF | DM | PH(cm) | BB | PS | NCPP | NSPC | THSW(g) | GY(kg ha$^{-1)}$ | YD AD% |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bha Necho** | 51.33b | 99.33b | 84.33abc | 1 | 1 | 42.33 | 63 | 4.60ab | 467a | 46.4 |
| **Bha Zeyit** | 51.66b | 100.66b | 92.00a | 1.66 | 1 | 33.33 | 73.66 | 4.86a | 416b | 30.4 |
| **Decho** | 50.00b | 98.66b | 89.66ab | 1 | 1 | 38 | 68 | 2.86b | 374bc | 17.24 |
| **Chalesa** | 53.00ab | 102.00b | 87.00abc | 1 | 1 | 42.66 | 75.33 | 3.26ab | 328cd | 2.82 |
| **Aba-sena** | 55.66a | 109.33a | 79.00bc | 1.33 | 1 | 33.66 | 61 | 4.06ab | 328cd | |
| **Adi** | 50.33b | 107.66a | 78.66c | 1.66 | 1 | 38 | 63 | 3.53ab | 319d | |
| **Obsa** | 52.66ab | 98.33b | 77.00c | 1 | 1 | 30.66 | 66.66 | 3.53ab | 305d | |
| **Mean** | 52.09 | 102.28 | 83.95 | 1.23 | 1 | 36.95 | 67.23 | 3.81 | 362 | |
| **LSD** | 3.46* | 4.78*** | 10.69* | 0.67ns | 2.06ns | 24.96ns | 14.82ns | 1.85* | 0.46*** | |
| **CV%** | 3.77 | 2.65 | 7.22 | 31.1 | 1.16 | 38.3 | 12.49 | 27.49 | 7.21 | |

DF=days to flowering, DM=Days to maturity, PH= plant height (cm), *BB=Bacterial blight*,PS=Pest Score (1-5), NCPP= Number of capsule Per Plant, NSPC=Number of Seed Per capsule, THSW=Thousand Seed Weight (g) and GY= Grain Yield (qu/ha)

**Table.3** The combined mean source of sesame varieties on grain yield and yield component over two locations (Milkaye FTC and Mieso sub site) in 2018

| Variety | DF | DM | PH(cm) | BB | PS | NCPP | NSPC | THSW(g) | GY((kg ha$^{-1}$)) | YLD AD% |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bha Necho** | 53.33b | 98.66b | 100.16 | 1.00b | 1 | 63 | 66.83ab | 5.21a | 598a | 48.75 |
| **Bha Zeyit** | 53.16b | 100.16b | 95.66 | 1.50ab | 1 | 67 | 71.50a | 4.83ab | 570a | 41.8 |
| **Decho** | 52.16b | 98.16b | 97.16 | 1.16b | 1 | 60.66 | 64.33ab | 3.46c | 452b | 12.4 |
| **Chalesa** | 54.16ab | 98.83b | 96.83 | 1.16b | 1 | 60.5 | 69.50a | 3.81bc | 445b | 10.7 |
| **Obsa** | 53.83ab | 97.33b | 91.33 | 1.16b | 1 | 63 | 64.33ab | 3.78c | 408bb | 1.24 |
| **Adi** | 53.00b | 114.66a | 99.5 | 1.83a | 1 | 57.33 | 55.83b | 3.33c | 402b | |
| **Aba-sena** | 55.83a | 111.16a | 93 | 1.83a | 1 | 61.16 | 58.50b | 4.78ab | 392b | |
| **Mean** | 53.64 | 102.71 | 96.23 | 1.38 | 1 | 61.88 | 64.83 | 4.17 | 467 | |
| **LSD** | 2.03** | 6.29** | 10.15ns | 0.64* | 4.08ns | 16.78ns | 8.85* | 1.25* | 0.73*** | |
| **CV%** | 3.2 | 5.17 | 8.9 | 39.56 | 3.44 | 22.9 | 11.52 | 25.31 | 13 | |

DF=days to flowering, DM=Days to maturity, PH= plant height (cm), BB=Bacterial blight, PS=Pest Score (1-5), NCPP= Number of capsule Per Plant, NSPC=Number of Seed Per capsule, THSW=Thousand Seed Weight (g) and GY= Grain Yield (qt/ha)

The result from combined mean analysis of variance revealed that significant ($P \leq 0.05$) difference among varieties for days to flowering, days to maturity, disease (bacterial blight), number of seed per capsule, thousand seed weight and grain yield across location. However, statistically non-significance difference shown on plant height, pest score, and number of capsule per plant among tested varieties (table 3).

The grain yields of tested varieties were ranged from 392kg ha$^{-1}$ (Abasena) to 591kg ha$^{-1}$ (Bha Necho). Bha Necho was recorded superior grain yield 591 kgha$^{-1}$ followed by variety Bha Zeyit 570kg ha$^{-1}$ among tested varieties. On the other hand, lowest grain yield was recorded by Aba-sena (392kg ha$^{-1}$). The combined mean data across locations indicated that Bha Necho and Bha Zeyit varieties were performed better than the standard check (Adi) and other tested varieties (Table-3). This result is supported by the finding of Fiseha *et al.,* (2019), who reported that the highest grain yield was obtained from the variety which is well adapted to the growing environment.

The combined mean grain yield of Bha Necho and Bha Zeyit varieties were 48.7% & 41.8% yield advantage over standard check (Adi) respectively (table-3). These varieties were well performed across all locations. However all varieties were shown grain yield reduction at Mieso sub site as compared to Milkaye (Table 1 and 2). This yield reduction was might occurred due to environmental factor not due to genetic factor, and the nature of rain fall at study area is very erratic and unpredictable causing tremendous erosion during this growing season. (Fiseha *et al.,* 2019) reported that this might be because there was optimum and evenly distributed rainfall during this growing season. Variety Bha Zeyit and Bha Necho had the highest mean number of capsule per plant 67 and 63 respectively and thousand seed weight 4.81and 5.21 respectively while Chalesa and Adi showed the lowest mean number of capsule per plant 60.5 and 57.33respectively.

## Recommendation

Evaluation of different varieties under different environment is crucial to determine their responses. In line with this, seven (7) sesame varieties were studied at two locations representing Low-land agro-ecologies of west Hararghe zone in 2018 cropping season with the objective to evaluate and select adaptable, high yielding,

early maturing, and diseases resistant varieties. The result of the experiment showed that a significant difference for both individual and combined mean effects for most traits. Grain yield was an important character to be considered for variety selection to address the objective of the conducted activity. For this reason, two improved varieties i.e. BhaNecho, and BhaZeyit were showed better performance for most of the studied characters including grain yield as well as higher yield advantage than standard check**.** Therefore, these two varieties were selected and recommended to be demonstrated on farmers' field for further scaling up.

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