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Evaluating the Yield Performance of Released Sesame Varieties in Western Tigray, Northern Ethiopia

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

The experiment was conducted in western Tigray in Humera and Dansha (Kebabo) area during the main growing season of 2016 under rain fed condition with the aim of evaluating and identifying the well performing and high yielder sesame variety. The experiment consisted of nine varieties laid down in randomized complete block design (RCBD) with three replications, Result of the combined analysis showed highly significant ($p<0.01$) difference among the varieties in days to flowering, days to maturity, number of branches per plant, number of pods per plant, thousand seeds weight and grain yield. Among the nine sesame varieties the highest mean grain yield was recorded on Setit-2 (1111.89 kg ha^{-1}), Setit-1 (1070.58 kg ha^{-1}), Humera-1(976.42 kg ha^{-1}) and local check (970.20 kg ha^{-1}) followed by Adi (755.42 kg ha^{-1}) whereas the lowest mean grain yield was recorded on Borkena (548.67 kg ha^{-1}), BaHa - Zeyit (548.69 kg ha^{-1}) followed by BaHa- Necho (616.28 kg ha^{-1}) and Gonder-1 (683.09 kg ha^{-1}). This indicated that the verities released by Humera Agricultural Research Center and the local check (Hirhir) were highly performed in Humera. Therefore, even though they were statically similar; Setit-2 was recently released and it can be concluded that variety Setit-2 well performed and can be recommended for the growers in the study area.

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Keywords: Sesame; variety; yield; adaptability.

1. INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest cultivated plants in the world and it belongs to the family *Pedaliacea*. It is the most important ancient oilseeds crop known to mankind. The crop is grown in the tropical and subtropical countries [1]. India and China are the world's largest producers of sesame, followed by Myanmar, Sudan, Uganda, Ethiopia, Nigeria, Tanzania, Pakistan and Paraguay [2]. Ethiopia is one of the major producers of sesame in sub-Saharan Africa, and Ethiopian sesame is among the highest quality in the world. Tigray, Amhara, Benshangul Assosa, Gambella, Oromia, Somalia and SNNP regions are the main producing regions in Ethiopia [3].

The majority production of sesame occurs in the northern and northwestern parts of Ethiopia, which borders with Sudan and Eritrea and it is the white gold crop, with the second most exported crop in the world market after coffee [4]. Especially the seed produced in western Tigray (Humera type) is highly competent in the world market by its desirable qualities in terms of color, taste and aroma [5]. In western Tigray the crop produces by smallholders (own less than 10 ha of land), and commercial farmers (own more than 10 ha of land) and their average production per household is about 62 quintals [6].

In Ethiopia, the national average productivity of sesame was about 8.52 quintals/ha [7], 7.57 and 7.35 quintals/ha [8]. But in according to the [6] report the productivity of sesame in 2013/14 production season in Humera and Metema areas was 3.29 and 3.57 quintals/ha respectively. This indicates that the productivity of sesame in Humera area was far below the national average. This is mainly due to the low adoption of recommended technologies such as improved sesame seeds, full recommendation of fertilizer, utilization of chemical insecticides and different agronomic practices in sesame growing areas [9]. In addition the low productivity of sesame in the Western Tigray might be due to the cultivation of Sesame at low soil fertility, poor crop management practices, the occurrence of different diseases and insect pests and the use of low yielding Sesame varieties. Therefore, this research was conducted to evaluate and select well performing and high yielder variety/ies to increase the production and productivity of sesame.

2. MATERIALS AND METHODS

2.1 Description of the Experimental Site

The experiment was conducted at Humera Agricultural Research Center on station and Dansha (Kebabo) area during the main growing season of 2016. Humera is located 600 km west of Mekelle at an altitude 604 m.a.s.l and at 14°06′N latitude and 38°31′E longitudes. The agro-ecology of the region is described as a hot to warm semiarid plain sub agro-ecology. The maximum temperature varies from 33^{0}C in May to 42^{0}C in April while minimum temperature varies from 17.5^{0}C in August to 22.5^{0}C in July. The annual rainfall ranges from 400-650 mm which lasts from June to September. The dominant soil type of Humera Agricultural Research Center is chromic vertisol black in color characterized by very deep clay texture [10]. Dansha (Kebabo) is located at about 1439 km far fromAddis Ababa via the Mekelle road and 135 km south of Humera. It is located at geographic coordinate 25°12′16″ N latitude and 15°10′23″ E longitude and at an altitude 690 m.a.s.l. The mean annual temperature is 28.7^{o}C and it has vertisol soil type. The average annual rainfall varies from 850-1400 mm [11].

2.2 Experimental Materials

Nine varieties including the newly released sesame varieties (Setit-1, Humera-1, Setit-2, Hirhir (local), Adi, Gonder-1, Borkena, BaHa-Nechoand BaHa-Zeyit were collected from Humera Agricultural Research Center, Werer Agricultural Research Center, Gonder Agricultural Research Center, Sirinka Agricultural Research Center and Haramaya University.

2.3 Experimental Design and Field Management

The nine varieties were planted at the two Research sites to evaluate their adaptation and yield performance. The experiment was laid down in randomized complete block design (RCBD) with three replications. Individual plots had a size of 5 meters row length and 2 meters width with inter and intra row spacing of 40 cm and 10 cm respectively. The recommended crop management practices were followed uniformly for all plots.

2.4 Data Collected

Five representative plants were selected randomly from each plot and tagged. Data such as plant height, number of branches per plant, number of capsule per plant, number of seeds per capsule and yield data were recorded from the randomly selected 5 plants and finally mean of the 5 plants were taken for each parameter. Yield data was taken from the 3 central rows of the plot and it was converted in to hectares. The recommended crop management practices were followed uniformly for all plots.

2.5 Statistical Data Analysis

The field experimental data were subjected to ANOVA using SAS software 9.2 versions and means comparison were made using Tukey'stest at 5% probability level. Correlation analysis was also made using Pearson correlation coefficient.

3. RESULTS AND DISCUSSION

3.1 Evaluation of the Yield and Yield Parameters of Sesame Varieties

Result of the analysis of variance for individual location indicated that, there was a significant variation among all the traits of the varieties except plant height, number of pods per plant and number of seeds per pod at Humera and plant height and length of pod bearing zone at Dansha. The mean value for grain yield of the varieties ranged from 777.90 kg $ha^{-1}$for BaHa-Necho to 1547.40kg $ha^{-1}$for setit-2 with an average yield of 1134.56kg ha^{-1} at Humera while, at Dansha the mean value of grain yield ranged from 319.44kg ha^{-1} for Borkena to 676.39 for Setit-2 at Dansha with an average yield of 502.01kg ha^{-1} and the grain yield was higher at Humera than Dansha (Table 1 and 2).

Besides, the result of the combined analysis in yield and yield components of sesame varieties of the experiment across the two locations showed highly significant ($p<0.01$) differences among the varieties in all traits except plant height, length of pod bearing zone and number of seeds per pods (Table 3). Significant variations were obtained due to location for all of the traits, except number of branches per plant and number of pods per plants. Significant effect due to variety x location was also showed significant variations for all traits except plant height and length of pod bearing zone.

According to days to flowering varieties; BaHa-Zeyit (49.17), BaHa-Necho (47.83), Borkena (46.83) and Goder-1 (46.50) had longer days to flowering whereas varieties Humera-1 (38.83), Setit-1 (39.50), Setit-2 (40.83), Adi (40.83) and Hirhir (40.83) had scored shortest days to flowering. This result was similar with [12] who reported that the varieties Setit-2, Setit-1 and Humera-1 had shortest days to flowering as compared with the other varieties. Variations in the number of days to 50% flowering may result from genetic variations in the variety's responses to various environmental factors [13]. Similarly [14] also reported that days to 50% flowering was affected by cultivars and locations. Significant variations were observed on days to flowering among tested Sesame varieties [15,16,17].

Regarding days to maturity; the only variety Setit-2 (83.33) had shortest days to physiological maturity while varieties BaHa-Necho (96.67) and BaHa-Zeyit (97.00) had longer days to physiological maturity. This effect might be due to the genetic variation among sesame varieties and their response to the environmental resources which made them to respond differently in days to flowering and physiological maturity. According to Tewoderos and Bekelech [12] report varieties Setit-2 and Setit-3 had scored the shortest days to physiological maturity. Significant variations were also observed on days to maturity among the tested Sesame varieties [16,15].

The number of branches per plant was found to be significantly ($p<0.001$) affected by sesame varieties. The highest number of branches per plant was recorded on varieties; BaHa-Necho (3.80), Adi (3.70), Borkena (3.38) and BaHa-Necho (3.20) while the smallest number of branches per plant was observed on Setit-2 (2.17), Gonder-1 (2.57), Humera-1 (2.60) and the local check (2.43). The variation may be due to the variation in genetic composition of the varieties. These results were in line with [18,19] who reported that the number of branches change due to the varieties. Similarly [12] stated that the genetic compositions might be the fundamental cause of the variation in the number of branches among them; as a result, characteristics may differ in their genetic responses for the formation of branches. In addition the difference in the number of branches of the cultivar was related to the genetic nature of the variety [20]. The number of branches per plant was also significantly influenced by crop varieties [21, 22,23].

Table 1. Yield and yield components of sesame varieties at humera

Variety name	DF	DM	PHT	LPBZ	NB	NPPP	NSPP	1000SW	Yield (kg/ha)
Adi	40.00^{b}	90.33^{cd}	165.07	84.93^{ab}	3.47^{ab}	66.73	59.53	3.00^{ab}	1206.90^{ab}
Baha-Necho	51.00^{a}	98.00^{a}	159.53	63.40^{ab}	3.47^{ab}	65.33	67.60	2.50^{b}	779.80^{b}
Baha-zeyit	51.00^{a}	97.33^{ab}	152.20	74.27^{ab}	3.20^{ab}	58.90	62.67	2.50^{b}	777.90^{b}
Borkena	49.00^{a}	90.33^{cd}	152.60	58.27^{b}	3.03^{ab}	53.73	69.20	2.50^{b}	821.80^{b}
Gonder-1	49.00^{a}	95.00^{abc}	159.20	68.40^{ab}	3.80^{a}	57.87	35.07	2.33^{b}	898.90^{b}
Hirhir(Local)	39.67^{b}	92.33^{bcd}	154.80	73.00^{ab}	2.67^{ab}	65.67	62.40	3.33^{a}	1316.70^{ab}
Humera-1	39.00^{b}	92.00^{cd}	142.27	75.60^{ab}	2.27^{ab}	60.80	59.63	3.33^{a}	1338.70^{ab}
Setit-1	39.33^{b}	93.00^{abcd}	162.73	92.33^{a}	2.77^{ab}	66.87	63.67	3.33^{a}	1522.80^{a}
Setit-2	41.33^{b}	88.33^{d}	160.13	85.20^{ab}	1.93^{b}	69.47	67.47	2.50^{b}	1547.40^{a}
VAR	***	***	NS	**	**	NS	NS	***	***
L.S.D(±)	5.26	5.14	NS	29.41	1.56	25.28	NS	0.70	599.72
Grand mean	44.37	92.96	156.50	75.04	2.96	62.82	64.10	2.82	1134.56
CV (%)	4.08	1.90	10.91	13.49	18.19	13.86	12.14	8.55	18.20

Means followed by same letter(s) with in a column are not significantly different at 5% level of significance, NS= not significant, DF=number of days to flowering, DM= number of days to maturity, PHT=plant height, LPBZ=length of pod bearing zone, NBP= number of branches per plant, NPPP= number of pods per plant, NSPP= number of seeds per plant, 100SW=hundred seed weight, GY= grain yield, VAR= variety, LSD= least significance difference, CV (%) = coefficient of variation

Table 2. Yield and yield components of sesame varieties at Dansha

Variety name	DF	DM	PHT	LPBZ	NB	NPPP	NSPP	1000 SW (g)	yield (kg/ha)
Adi	41.67^{ab}	88.67^{ab}	127.00	76.00	3.93^{a}	66.87^{a}	53.47^{abc}	2.50^{ab}	337.22^{c}
Baha-Necho	44.67^{ab}	95.33^{ab}	120.00	62.33	4.13 ^{a}	67.47^{a}	67.33^{a}	2.03^{b}	467.22^{bc}
Baha-zeyit	47.33^{a}	96.67^{a}	132.47	58.33	3.20^{abc}	46.93^{ab}	63.87^{ab}	2.03^{b}	452.78^{bc}
Borkena	44.67^{ab}	94.00^{ab}	107.20	70.93	3.73^{ab}	59.23^{a}	45.20^{bc}	2.40^{ab}	319.44^{c}
Gonder-1	44.00^{ab}	94.33^{ab}	116.70	49.47	1.33^{d}	29.47^{b}	54.60^{abc}	2.17^{ab}	408.83^{c}
Hirhir(Local)	42.00^{ab}	88.33^{ab}	110.70	59.27	2.20^{cd}	55.6^{a}	54.60^{abc}	2.50^{ab}	623.72^{ab}
Humera-1	38.67^{b}	91.00^{ab}	119.50	64.67	2.93^{abc}	56.07^{a}	59.40^{abc}	2.50^{ab}	614.17^{ab}
Setit-1	39.67^{b}	87.00^{bc}	108.40	58.67	3.13^{abc}	61.67^{a}	58.80^{abc}	2.67^{a}	618.33^{ab}
Setit-2	40.33^{b}	78.33^{c}	116.13	57.93	2.40^{bcd}	68.9 ^{a}	41.27^{c}	2.17^{ab}	676.39^{a}
VAR	**	***	NS	NS	***	***	***	***	***
L.S.D(±)	4.05	9.52	NS	NS	1.41	22.61	19.48	0.50	179.16
Grand mean	42.56	89.67	117.58	61.96	3.00	56.91	55.40	2.33	502.01
CV (%)	5.55	3.24	9.40	16.66	16.20	13.68	12.11	7.46	13.29

Means followed by same letter(s) with in a column are not significantly different at 5% level of significance, NS= not significant, DF=number of days to flowering, DM= number of days to maturity, PHT=plant height, LPBZ=length of pod bearing zone, NBP= number of branches per plant, NPPP= number of pods per plant, NSPP= number of seeds per plant, 100SW=hundred seed weight, GY= grain yield, VAR= variety, LSD= least significance difference, CV (%) = coefficient of variation

Table 3. Yield and yield components of sesame varieties

Variety name	DF	DM	PHT (cm)	LPBZ (cm)	NBP	NPPP	NSPP	1000sw	GY(kg/ha)
Adi	40.83[b]	89.50[c]	146.03	80.47	3.70[a]	66.80[ab]	56.50	2.75[ab]	755.42[b]
BaHa-Necho	47.83[a]	96.67[a]	139.77	62.87	3.80[a]	66.40[ab]	67.47	2.27[c]	616.28[bc]
BaHa-zeyit	49.17[a]	97.00[a]	142.33	66.30	3.20[ab]	52.92[bc]	63.27	2.27[c]	548.69[c]
Borkena	46.83[a]	92.17[abc]	129.90	64.60	3.38[ab]	56.48[abc]	57.20	2.45[bc]	548.67[c]
Gonder-1	46.50 [a]	94.67[ab]	137.97	58.93	2.57[bc]	43.67[c]	59.83	2.25[c]	683.09[bc]
Hirhir(Local)	40.83[b]	90.33[bc]	132.77	66.13	2.43[bc]	60.63[ab]	58.50	2.92[a]	970.20[a]
Humera-1	38.83[b]	91.50[bc]	130.90	70.13	2.60[bc]	58.43[abc]	59.37	2.92[a]	976.42[a]
Setit-1	39.50[b]	90.00[bc]	135.57	75.50	2.95[abc]	64.27[ab]	61.23	3.00[a]	1070.58[a]
Setit-2	40.83[b]	83.33[d]	138.13	71.57	2.17[c]	69.18[a]	54.37	2.33[c]	1111.89[a]
LOC	**	***	***	***	NS	NS	***	***	***
VAR	***	***	NS	NS	***	***	NS	***	***
LOC* VAR	***	***	NS	NS	***	**	**	**	***
L.S.D(±)	3.92	5.02	28.73	21.84	0.95	15.33	13.85	0.39	183.53
Grand mean	43.46	91.69	137.04	68.50	2.98	59.86	59.75	2.57	809.03
CV (%)	4.72	2.86	10.97	16.69	16.71	13.41	12.14	8.00	11.87

Means followed by same letter(s) with in a column are not significantly different at 5% level of significance, DF=number of days to flowering, DM= number of days to maturity, PHT=plant height, LPBZ=length of pod bearing zone, NBP= number of branches per plant, NPPP= number of pods per plant, NSPP= number of seeds per plant, 100SW=hundred seed weight, GY= grain yield, LOC= location, VAR= variety, LSD= least significance difference, CV (%) = coefficient of variation

There was a significant ($p<0.05$) variation among the interaction of varieties x location in number of pods per plant. Among the nine sesame varieties; the highest mean number of pods per plant was recorded on Setit-2 (69.18), Adi (66.80), BaHa-Necho (66.40), Setit-1(64.27) and the local check (60.63) whereas the lowest number of pods per plant was recorded on Gonder-1 (43.67) and BaHa-Zeyit (52.92). This variation may be due to the genetic variability of the sesame varieties. Similarly, number of capsules per plant also varied significantly among the varieties [17,24]. The number of capsules per plant was significantly influenced by varieties [22,25,26]. Similar reports also written by [19,27,28] who stated that significant differences among sesame varieties in the number of capsules per plant was recorded due to the genetic difference of the varieties.

There was also a significant ($p=0.03$) variation in the interaction effect in thousand seeds weight. Varieties Setit-1 (3.00 g), Humera-1 (2.92g) and local check (2.92g) gave the highest thousand seeds weight followed by Adi (2.75g) while varieties BaHa-Necho (2.27g), BaHa-Zeyit (2.27g), Gonder-1(2.25 g) and Setit-2 (2.33 g) were produce lighter seeds. This result may be due to the genetic variation of the sesame verities. This finding is in agreement with [28] who stated that the variation was due to the genetic makeup of the variety. Similarly; [29] reported that thousand seed weight was affected by sesame varieties.

3.2 Grain Yield (kg/ha)

Among the nine sesame varieties the highest mean grain yield was recorded on Setit-2 (1111.89 kg ha^{-1}), Setit-1 (1070.58 kg ha^{-1}), Humera-1(976.42 kg ha^{-1}) and local check (970.20 kg ha^{-1}) followed by Adi (755.42 kg ha^{-1}) whereas the lowest mean grain yield was recorded on Borkena (548.67 kg ha^{-1}), BaHa-Zeyit (548.69 kg ha^{-1}) followed by BaHa- Necho (616.28 kg ha^{-1}) and Gonder-1 (683.09 kg ha^{-1}). The result of analysis showed that the highest mean grain yield was recorded on verities released by Humera Agricultural Research Center and the local check (Hirhir). This might be due to their better adaptation to the environment and high yield potential of the varieties. This result is in conformity with [17] who stated that the increase in yield in GT-10 variety was due to varietal and genetic difference as well as environmental factors. The high yielding cultivars like GT-2, GT-10 and GT-1 had stable performance over the environment with broad adaptability [30]. Highly significant differences were observed among the genotypes, environment and their interaction; the differential response of the genotypes in varying environments and stability analysis was required to determine the stability [31]. Seed yield was also significantly influenced by genotypes, environment, and genotype by environment interaction [32,33,34]. Similar findings were also found by [12] who stated that the varieties; Humera-1, Setit-1 and Setit-3 were recorded the highest seed production in qu/ha. Seed yield was significantly influenced by sesame varieties [14,22,25]. Grain yield was affected by genetic variation among the sesame genotypes [35,15,36]. In addition [37] reported that the highly significant differences among sesame varieties for seed yield was indicated the presence of adequate variability among the varieties. The possible reason for the yield difference was due to the variation in genetic properties of the varieties; Moreover, environmental influences might be the possible causes of their significant differences or both [19].

4. CONCLUSION AND RECOMMENDATION

The study was conducted to evaluate the performance of released sesame varieties for growth and yield. The results for analysis of variance showed that there were highly significant differences among the varieties for all traits except plant height, length of pod bearing zone and number of seeds per pods. The highest mean grain yield was recorded on Setit-2 (1111.89 kg ha^{-1}), Setit-1 (1070.58 kg ha^{-1}), Humera-1(976.42 kg ha^{-1}) and local check (970.20 kg ha^{-1}). This indicated that the verities released by Humera Agricultural Research Center and the local check (Hirhir) were highly performed in the study area. Therefore, even though they were statically similar; Setit-2 was recently released and it can be concluded that variety Setit-2 well performed and can be recommended for the growers in the study area. Finally, this study is of paramount importance to identify the best performing and high yielder varieties, and this study also forwards for sesame researchers to carry out different researches up on collecting and developing of new varieties other than those released sesame varieties in Humera.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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