Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.16, No.1, 2025

Performance Evaluation of Sunflower (*Helianthus annuus)* Varieties under Irrigation Condition in Low land Areas of South Omo Zone, Southern Ethiopia

Temesgen Jerjero*

Department of plant breeding ,Southern Agricultural Research Institute, Jinka Agricultural Research Center, P.O. Box 96, Jinka , Ethiopia

Abstract
Sunflower (Helianthus annuus L.) is one of the world's most important oilseed crops together with oil palm (Elaeis guineensis Jacq.), soybean (Glycine max (L.) and rapeseed (Brassica napus L.). However, in south Omo Zone the yield of this crop is limited mainly due to lack of improved sunflower varieties. This field experiment was conducted during 2021/22 and 2022/23 main cropping season to evaluate and recommending high yielder sunflower variety for yield production at Benna-Tesemay and Selamago District in South Omo Zone, Southern Ethiopia. The experiment involves three improved varieties (Russian Black, Oissa, Ayehu) and Local check. The experiment was conducted using randomized complete block design (RCBD) with four replications. The varieties were planted in rows with 4 m width and 4m length (16m^2) along five rows per plot, 75cm between rows and 25cm between plants. Data were collected on days to maturity, plant height, head diameter, head per plant, primary braches per plant, grain yield and thousand seed weight and the collected data were subjected to analysis of variance using SAS software. The combined analysis of variance was done after homogeneity test for yield and yield related traits for locations. The combined mean squares for the treatments were significant (P< 0.05) for Days to maturity, primary braches, head per plant, head diameter and grain yield. However, there is none significant difference (P>0.05) for plant height and thousand seed weight .From the evaluated varieties, the maximum combined mean grain yield was recorded from varieties, Russian Black (2110.8kg ha-1) and Oissa (1861.8 kg ha-1) while, the minimum combined mean grain yield was recorded to local variety (1290.4kg ha-1) . It couled be concluded that varieties Russian Black (2110.8kg ha-1) and Oisa (1861.8 kg ha-1) can be demonstrated and popularized as well as important for the target area and similar agro-ecologies.
Key words: *Grain yield, location, performance, Sunflower, varieties*
DOI: 10.7176/JNSR/16-1-01
Publication date: January 30th 2025

INTRODUCTION

Sunflower (*Halianthus annuus* L.) is one of the most important oil seed crops of the world (Bakht *et al.,* 2010). It is a wide spread oilseed crop of the world and it is almost grown in all continents. Europe, America and Australia accounts for 80% of the total production of the world whereas Asia contributes to 18% and the rest 2% from Africa (Damodaran and Hege, 2010). The domesticated sunflower was introduced from North America into Europe in the sixteenth century by the early Spanish explorer (Musa-Khalifani et al.2021) where the crop utilized as a garden ornamental. Evidences suggested that sunflower was introduced to the North Horn of Africa including Ethiopia by the Italians some 160 years ago. Sunflower is one of the most important oil crops and preferable source of edible oil in worldwide including of Ethiopia. Besides its primary use in human consumption sunflower oil has a wide range of applications and can be used as a supplement in the chemical industry as well as in the pharmaceutical industry. Sunflower meal, a side product from oil extraction, is rich source of protein and it is efficiently utilized when blended with meal of soybean for use in the livestock feeding (Seiler and Jan, 2010). Sunflower oil is also a rich source of (64%) of linoleic acid, which helps in washing out cholesterol deposition in the coronary arteries of the heart and good for heart disease (MOANR, 2016).Sunflower is categorized as a low to medium drought sensitive crop. The drought-tolerant nature can be attributed to its extensive root system, which can extract water and nutrients to a depth of 3m. Sunflower is grown in many semi-arid regions of the world. It is tolerant of both low and high temperatures but more tolerant to low temperatures (Demirer et al., 2004). Optimum temperatures for growth are 21.3 to 26°c, but a wider range of temperatures (18 to 35°c) show little effect on productivity. Extremely high temperatures have been shown to lower oil percentage, seed fill and germination (Elsheikh, 2015). Sunflower was grown on about 6,738.00 ha in Ethiopia from which about 7,953.72 tons are produced in the year 2017, with the average regional

yield of 1.18t ha-1 (CSA, 2017). However, the country grain yield is far less than the attainable yield (2.5 to 3.5 t ha-1) under good management conditions at farmers field (MOANR, 2016). Low yield of sunflower is attributed to several production constraints which include lack of improved varieties, poor crop management practices, moisture stresses, low soil fertility, diseases and insect pests (Farahvash et al., 2011). Sunflower is becoming a high potential crop in Southern region and in and South Omo Zone Therefore, to increase the production potential area for sunflower production evaluating and promoting high yielder sunflower varieties are a paramount importance. So, this study is crucial to select and recommend the best high yielding sunflower varieties for the area and small scale holder farmers to produce this crop in the future which will support in food security and income generation.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted in two Districts at Bena- Tesemay and Selamgo District during the main cropping seasons from 2021 to 2022/23 under irrigation condition. Bena- Tesemay (Woyito) was located South Omo Zone in Southern Nations, Nationalities and People's Regional State. It is situated between 5°01' and 5°73' North latitude & 36°38' and 37°07' East longitude with altitude of 588 meter above sea level. The rainfall distribution of the area is bimodal with main rainy season extends from January to May and the second cropping season, from July to October. It receives annual average rainfall of 876.3 mm and the monthly average minimum and maximum temperatures of 18.2 and 37.3°C, respectively (Awoke and Anteneh (2022).

Selamago District which located South Omo Zone in Southern Nations, Nationalities and People's Regional State and located between 5°32′–6°46′ North latitude and 35°89′–36°45′ East longitude and its elevation ranges from 370 – 500 m.a.s.l. The annual rain fall of study area is 889.94mm and the average maximum and minimum air temperature of study area is 36oc and 22.91oc respectively. Soil types of the study area dominated by clay texture which may hold water for a long time (Dilnesaw et al., 2019).

Experimental Design and Treatments

The experiment involves three improved varieties (Russian Black, Oissa, Ayehu) and one local cultivar were used for this experimental study. The experiment was conducted using randomized complete block design (RCBD) with four replications. The varieties were planted in rows with 4 m width and 4m length ($16m^2$) along five rows per plot, 75cm between rows and 25cm between plants. Important agronomic practices were applied equally to all the entries at their proper time of application.

Data Collection

The following growth, yield and yield related traits such as days to maturity, plant height, , head diameter, head per plant, primary braches per plant, grain yield and thousand seed weight were collected.

Data analysis

The collected data were subjected to analysis of variance in a randomized complete block design (RCBD) using SAS software version 9.2 (SAS, 2008) with a generalized linear model (GLM) procedure. Means were separated using least significant differences (LSD) test at 5% level of significance. Homogeneity of error mean square between the two sites was tested by the F-test on variance ratio.

Results and Discussion

Analysis of variance

The Combined analysis of variance for both locations was carried out after homogeneity of error variances was tested and all of the traits showed homogeneous error variances (Table 3). Having this knowledge, combined analysis of variance were performed and presented in Table 3. The mean squares obtained in combined analysis of variance were used to separate varieties effects, location and their interactions. The mean squares from the combined analysis of variance over the two locations for varieties showed statistically significant ($P \leq 0.05$) for days to maturity, Primary branches per plant , number of head per plant, head diameter and Grain yield. While none significant for plant height and thousand seed weight (Table 3). The mean squares from the combined analysis of variance over the two locations for locations showed statistically significant ($P \leq 0.05$) for plant

height , Grain yield and thousand seed weight ,while none significant for days to maturity, primary branches per plant , head per plant and head diameter . Main effects of varieties and location as well as their interactions had significant effect on head per plant and thousand seed weight and none significantly (P>0.05) effects on days to physiological maturity , plant height primary branches per plant head diameter and grain yield .

The presence of significant differences among the tested varieties might be due to the existence dissimilarity in genetic composition among them, for that fact characters may be differ in their genetic properties. Besides, environmental influences might be the possible causes of their significant differences or both. This finding result was agreed with the research finding of Awoke and Anteneh (2022) who reported that, there were presences of significant differences among the tested sun flower varieties.

Growth parameters

The combined analysis of variance as shown in Table 3 indicates the main effects of varieties and location as well as their interactions had no significantly (P>0.05) effects on days to maturity, plant height, Primary branches ,head diameter and grain yield . However, the main effects of varieties and location as well as their interactions had significantly (P <0.05) on number of head per plant and thousand seed weight.

Days to maturity: The analysis of variance as shown in table 3 indicates the main effects of varieties had significant effect and location had none significant effect while location and variety their interactions had none significantly (P >0.05) effects on the days of maturity duration.

From the evaluated varieties the combined mean performance on days to maturity was statistically significant had significant different but numerically they have no significant difference on maturity durations.

Plant height: The analysis of variance as shown in table 3 indicates the main effects of varieties had none significant effect and location had significant effect while location and variety interactions had none significantly (P >0.05) effects on the plant height length. From the combined mean value, Russian black had tallest plant height (216.67 cm) and Oissa had shortest height (193.10 cm). This result was similar with the research finding of Awoke and Anteneh (2022) who reported that, main effects of varieties and location as well as their interactions had no significantly (P>0.05) effects on days to physiological maturity and plant height.

Yield and yield components

Number of primary branches per plant: The analysis of variance as shown in table 3 indicates the main effects of varieties had significant effect and location had none significant effect while location and variety their interactions had none significantly (P >0.05) effects on the number of primary branches per plant (Table 3). From the combined mean value, the maximum number of primary branches per plant was recorded to local variety (12.75) and the improved varieties had only mother plant they have no branches (Table 4).

Number of heads per plant: The analysis of variance as shown in table 3 indicates the main effects of varieties and location as well as their interactions had significantly (P <0.05) effects on heads per plant (Table 3). From the combined mean value, the maximum number of head per plant was recorded to local variety (12.85) (Table 4).

Heads diameter (cm) : In this study, the analysis of variance showed that, the main effects of varieties and location as well as their interactions had none significantly (P >0.05) effects on heads diameter (Table 3). From the combined result improved varieties had statistically similar head diameter , the large head diameter was recorded to Oissa (23.72 cm) and local variety had shortest head diameter (19.05 cm) (Table 4). This result was in agreement with Awoke and Anteneh (2022) who reported that Oissa variety had maximum head diameter at woito and Dasench also similar results reported by Elsheikh (2015) who found a significantly difference among sunflower varieties.

Grain yield (kg ha-1)

Results combined analysis of variance of the current study showed the main effects of variety and location had significant (P<0.05) effect and while their interactions had none significantly effects on grain yield. The maximum grain yield (2110.8 kg ha-1) and (1861.8 kg ha-1) was recorded to Russian Black and Oissa varieties, respectively and the lowest grain yield (1290.4 kg ha-1) was recorded to local variety. The possible reason for the observed the significance difference among tested varieties might be due to existence dissimilarity in genetic

composition among them, for that fact characters may be differ in their genetic properties. Moreover, environmental influences might be the possible causes of their significant differences or both. This current work was similar result with the finding of Awoke and Anteneh (2022) who reported that R. Black and Oissa variety had maximum grain yield than local variety. Similar results was reported by the result of this study is in agreement with the research finding of Elsheikh (2015) who observed a significantly difference among sunflower varieties. Similarly, Jocković et al. (2019) who studied on evaluate of sunflower varieties found that, a significantly difference on grain yield of different sunflower varieties.

Thousand Seeds weight (g): The combined analysis of variance showed that the main effects of varieties had none significant effect and location had significant effect while, variety and location as well as their interaction had significance ($P<0.05$) effects on thousand Seeds weight. Even though there was no statistically different among tested varieties on thousand Seeds weight. The highest of thousand Seeds weight (62.43g) was recorded for variety Russian Black and the lowest of thousand seeds weight (53.90) was recorded to local variety (Table 4). This result is in line with Natalija et al, (2015) who obtained minimum and maximum values for 1000 seed weight on different sunflower varieties and similar finding was reported by Awoke and Anteneh (2022) who reported that R. Black and Oissa variety had maximum thousand Seeds weight yield than local variety.

Table1. The mean value of growth, yield and yield related traits in Benna- Tsemay District in 2021/22

Variety	DM	PH (cm)	PB	HD (cm)	H/P	YD (kg/ha)	TSW (g)
Ayehu	102^{ab}	202.25	0^{b}	24.25^{a}	0^{b}	1571.6^{c}	47.17^{a}
Oissa	106^{a}	188.25	0^{b}	22.9^{ab}	0^{b}	1841.5^{b}	51.87^{a}
R.balack	105^{ab}	210.75	0^{b}	23.35^{a}	0^{b}	2001.3^{a}	49.87^{a}
Local	103^{b}	190.65	12.0^{a}	19.6^{b}	12^{a}	1205.5^{d}	29.55^{b}
CV (%)	2	8.1	7	10.4	3.5	5.92	14.82
LSD 5%	3.65	NS	2.79	3.74	2.39	156.69	10.576

Note: Means with the same letters within the columns are not significantly different at p<0.05. DM =days to maturity, PH =plant height, PB= Primary branches, HD= head diameter, H/P number of head per plant, GY =Grain yield, TSW =Thousand seed weight, Varity = Variety and Ns = none significance

Table2. The mean value of growth, yield and yield related traits in Selamago District in 2022/23

Variety	DM	PH (cm)	PB	HD (cm)	H/P	YD (kg/ha)	TSW (g)
Ayehu	108.50^{b}	222.90	0^{b}	24.20	1.60^{b}	1726.7^{b}	63.00
Oissa	107.00^{b}	197.95	0^{b}	24.55	1.00^{a}	1882.0^{b}	69.63
R.balack	109.75^{b}	222.60	0^{b}	24.0	1.00^{b}	2220.4^{a}	75.00
Local	123.75^{a}	221.55	13^{a}	18.50	11.70^{a}	1375.32^{c}	78.25
CV (%)	4.47	11.95	5.09	17.59	28.84	7.92	12.74
LSD 5%	8.03	Ns	3.57	Ns	41.33	170.65	Ns

Note: Means with the same letters within the columns are not significantly different at p<0.05. DM =days to maturity, PH =plant height, PB= Primary branches, HD= head diameter, H/P number of head per plant, GY =Grain yield, TSW =Thousand seed weight, Trt = treatment and ns = none significance

Table 3. Mean square values of traits of sunflower varieties over location during 2021/22 and 2022/23

SV	DF	DM	PH	PB/P	H/P	HD	GY	TSW
Rep	3	19.66 ^{ns}	550.31^{ns}	1.46^{ns}	0.695^{ns}	3.34^{ns}	8390^{ns}	31.53^{ns}
loc	1	1.26^{ns}	2671.80 *	1.12^{ns}	1.44ns	0.72^{ns}	170833*	5768.72*
Variety	3	19.91*	849.75^{ns}	321.00*	276.28*	47.190*	965689*	140.19^{ns}
Var*Loc	3	4.25^{ns}	186.56^{ns}	0.458^{ns}	3.28*	2.71^{ns}	11411^{ns}	456.35*
			Mean square of Errors (MES)					
Bena Tesmay	-	5.2222	257.40	3.056	2.247	5.4944	9595	43.718
Selamgo	-	6.83333	667.596	5.007	1.217	6.1256	11381	64.077
F= max	-	1.3 ^{ns}	2.6 ^{ns}	1.64 ^{ns}	1.85 ^{ns}	1.11 ^{ns}	1.18 ^{ns}	1.47 ^{ns}

*Note: DM =days to maturity, PH =plant height, PB= Primary branches, HD= head diameter, H/P number of head per plant, GY =Grain yield, TSW =Thousand seed weight, Var= varieties, SV= source of variance, Loc= location, *= significance and ns = none significance*

Table4. The combined mean value of growth, yield and yield related traits in Bena-Tesemay and Selamago District

Variety	DM	PH (cm)	PB	HD (cm)	H/P	YD (kg/ha)	TSW(g)
Ayehu	102.62^{b}	212.58^{ab}	0.25^{b}	24.22^{a}	1.30^{b}	1649.1^{c}	55.08
Oissa	106.13^{a}	193.10^{b}	0.00^{b}	23.72^{a}	1.00^{b}	1861.8^{b}	60.75
R.balack	104.25^{ab}	216.67^{a}	0.00^{b}	23.70^{a}	1.0^{b}	2110.8^{a}	62.43
Local	103.00^{b}	206.10^{ab}	12.75^{a}	19.05^{b}	12.85^{a}	1290.4^{d}	53.90
CV (%)	2.19	10.68	3.71	14.96	3.75	5.62	20.63
LSD 5%	2.31	21.93	3.57	3.32	41.33	101.57	ns

Note: Means with the same letters within the columns are not significantly different at p<0.05. DM =days to maturity, PH =plant height, PB= Primary branches, HD= head diameter, H/P number of head per plant, GY =Grain yield, TSW =Thousand seed weight, Trt = treatment and ns = none significance

Conclusion and Recommendation

Sunflower is one of the four most important oilseeds in the world. Because of its high quality of oil about 90% of the total production of oil is used for human consumption. In Ethiopia noug, linseed, Ethiopian mustard and cotton are the primary source for oil millers. Although sunflower is not widely grown in Ethiopia and in the target areas this was mainly due to shortage of improved varieties. This field experiment was conducted to evaluate and recommend sunflower varieties for grain yield production at Benna –Tesemay and Selamago District in South Omo Zone, Southern Ethiopia. The experiment contains three improved varieties namely Russian black, Oissa, Ahyehu and local. The experiment was conducted using randomized complete block design with four replications. Data were collected on days to maturity, plant height, and heads per plant, primary braches per plant, head diameter, grain yield and thousand seed weight and subjected to analysis of variance using SAS software program.

From the combined results of this study the maximum grain yield (2110.8 kg ha-1) and (1861.8 kg ha-1) was recorded to Russian Black and Oissa varieties, respectively and the lowest grain yield (1290.4 kg ha-1) was recorded to local variety respectively. Therefore, it can be concluded that variety Russian Black followed by Oissa variety well performed and could be recommended for the private investors, postural and agro postural, Farmers and growers in the study area.

Conflicts of interest

Authors declare that there were no conflicts of interest regarding the publication of this paper.

Acknowledgements
The authors would like to thanks South Agricultural Research Institute (SARI) for financial support and Jinka

Agricultural Research Center, Crop Research Directorate staff members for their technical support and facilitation during the field works.

References

Awoke T and Anteneh T. 2022. Evaluation of Sunflower (*Helianthus annuus* L.) Varieties for Growth, Yield and Yield Components under Irrigation at Lowland Area of South Omo Zone, Southern Ethiopia. *Journal of Agriculture and Aquaculture* 4(2).

Bakht, J., Shafi, M., Yousaf, M. and Khan, M.A., 2010. Effect of irrigation on physiology and yield of sunflower hybrids. *Pak. J. Bot*, *42*(2), pp.1317-1326.

CSA (Central Statistical Agency). (2017). Report on area and production of crops (private peasant holdings 'Meher' season) 2016/2017. Addis Ababa Ethiopia, the FDRE statistical bulletin, Statistical Bulletin 584, Addis Ababa Ethiopia, Vol. I.Pp. 1-122.

Damodaram, T. and Hegde, D.M., 2010. Oilseeds situation, a statistical compendium, Directorate of Oilseed Research Hydrabad.

Demirer, T., Ozer, I., Kocturk, O.M. and Er, A.Y., 2004. Effect of different leaf fertilizers on yield and quality in sunflower (Helianthus annuus L.). *Pakistan Journal of Biological Sciences*, *7*(3), pp.384-388.

Dilnesaw, Z., Ebrahim, M., Getnet, B., Fanjana, F., Dechassa, F., Mequaninnet, Y., Hagose, H., Alemaw, G., Adane, A., Negi, T. and Getaneh, A., 2019. Evaluation of rice (Oryza sativa L.) variety adaptation performance at Omo Kuraz sugar development project Salamago district South Omo Zone, SNNPR state, Ethiopia. *Int. J. Adv. Res. Biol. Sci*, *6*(5), pp.78-85.

Elsheikh, E.R.A., 2015. *Water productivity of sunflower under different irrigation regimes on Gezira clay soil, Sudan*. Wageningen University and Research.

Farahvash, F., Mirshekari, B. and Seyahjani, E.A., 2011. Effects of water deficit on some traits of three sunflower cultivars. *Middle East Journal of Scientific Research*, *9*(5), pp.584-587.

Hu, J., Seiler, G. and Kole, C. eds., 2010. *Genetics, genomics and breeding of sunflower*. CRC Press .

Jocković, M., Cvejić, S., Jocić, S., Marjanović-Jeromela, A., Miladinović, D., Jocković, B., Miklič, V. and Radić, V., 2019. Evaluation of sunflower hybrids in multi-environment trial (MET). *Turkish Journal of Field Crops*, *24*(2), pp.202-210.

MOANR (Ministry of Agriculture and Natural Resources). (2016). Plant variety release, protection and seed quality control directorate. Addis Abeba, Ethiopia.

Musa-Khalifani, K., Darvishzaeh, R., Abrinbana, M. and Alipour, H., 2021. Unraveling genotype-isolate interaction in sunflower (Helianthus annuus L.)-Sclerotinia pathosystem using GGE biplot method. *Journal of Plant Physiology and Breeding*, *11*(1), pp.109-121.

SAS, (2008). User's guide SAS/STAT® version 9.2. SAS Institute, Cary, NC.