Original Research Article||

Performance evaluation of improved maize (*Zea mays* L.) varieties in Debub Ari District, Southwestern Ethiopia

Mihiretu Muluneh[1], Temesgen Jerjero[1] and Atlaw Eshebel[1]

[1]*Department of plant breeding, Southern Agricultural Research Institute, Jinka Agricultural Research Center, P.O. Box-96, Jinka, Ethiopia*

Abstract

A field experiment involving seven improved and one local maize variety was carried out in Debub Ari District during the 2018 to 2020 main cropping seasons to identify the best-performing variety for the midland areas of the South Omo Zone. The midland maize varieties included in the field experiment were seven improved varieties (SBRH, SPRH, Gibe-2, Gibe-3, BH546, BH547, BH548) and a local check. Growth parameters and yield and yield components were recorded and analyzed. The analysis of variance results showed significant variations among the maize varieties for all the tested traits. The longest plant height (258.67 cm) was observed for the variety SBRH but is at par with all the other varieties except the shortest (203.5) for GIBE-2. The highest ear length (26.5 cm) obtained from the variety BH548, while the lowest (21.5 cm) was from the local check. The highest hundred seed weight (39.85g) was obtained from the variety BH547, whereas the SPRH variety with 32 (g) is the least. The highest grain yield (8428.2 kg ha^{-1}) was recorded for the improved variety BH546 whereas, 6064 (kg ha^{-1}) for the local check was the least. In this study, yield advantages of 28.05% and 19.21% were obtained from the improved maize varieties BH546 and BH547, respectively, performing way better than the local check. Therefore, it can be concluded that the use of improved maize varieties, such as BH546 or BH547, is recommended and could be suitable for midland maize production in the study area, although further testing is needed to support the recommendation.

Key words: Growth parameters, grain yield, mid land maize, variety

Original submission: November 25, 2021; **Revised submission**: February 4, 2022; **Published online**: April 30, 2022
***Corresponding author's address:** Temesgen Jerjero, Email *temejer@gmail.com*
Author(s): Mihiretu: *mihiretum2007@gmail.com*; Atlaw Eshebel*: atlaweshbel243@gmail.com;*

INTRODUCTION

Cereal production is the livelihood for millions of households in Ethiopia and is the largest sub-sector within the country's agriculture, far surpassing all others in terms of rural employment, agricultural land use, calorie intake, and contribution to national income (Shahidur, 2010). Maize (*Zea mays* L., 2n=20) is an important cereal crop belonging to the tribe *Maydeae*, of the grass family, *Poaceae*, genus *Zea* and species *mays* (Piperno and Flannery, 2001). Maize accounts for 15-56% of the total daily calories of people in developing countries in sub-Saharan Africa. Maize is currently produced on nearly 100 million hectares in 125 developing sub-Saharan African countries and is among the three most widely grown crops in 75% of those countries (FAOSTAT, 2010). The crop is largely produced in Western, Central, Southern and Eastern parts of Ethiopia. In 2014/2015, cropping seasons 2,114,876 hectares of land was covered with maize with an estimated production not less than 72350 ton (CSA, 2015). In Ethiopia, maize is produced primarily for food, especially in major maize-producing regions, and is a staple food for low-income groups. Maize is consumed as injera' porridge, bread and *nefro*. It is also consumed roasted or boiled as vegetables at sweet stage. In addition, it is used to prepare *Tella* and *Arekie* (local beverages). The leaf and stalk are used for animal feed and dried stalk and cob are major fuels for the rural community. Maize is also used as industrial raw material for oil and glucose production (MARD, 2014). Maize holds a unique and exceptional position in world agriculture as food, feed for livestock, and as a source of diverse, industrially important products. Maize grains have great nutritional value as they contain 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3.0% sugar and 1.7% ash. It is also used in the manufacturing of starch, corn flakes, alcohol, salad oil, soap, varnishes, paints, printing, and similar products (Ahmed, 2000). Maize is one of the most important cereal crops in midland areas of the southern region in general and in midland areas of the South Omo zonal administration in particular. Its production is common in midland areas of South Omo zone, especially in Debub Ari district. Even though the crop is important in the target area, some factors constrained the productivity of maize in the target areas. Advancing the improvement of crop productivity in different localities can be achieved, through testing the adaptability of crop technologies. Keeping this in view; the present study was conducted to evaluate the performance of recently released midland maize varieties for their adaptability.

MATERIALS AND METHODS

Description of the Study Area

The experiment was conducted at Aykamer kebele in Debub Ari District during the main cropping seasons (July to November 2018 to 2020) under rained conditions. The study site is located at an altitude of 1645 meters above sea level (masl) with geographical coordinates of longitude 036°34’ 35.0’’ E and latitude 05°54’ 97.4” N. The location is found north at eastern direction 18 km from Jinka town (principal city of the south Omo Zone). The study site has a bi-modal rainfall pattern with the shorter rainy season from March-May and the longest rainy season from August through November. The total annual rainfall is 1852.2± 250.7 mm. The annual mean minimum and maximum temperatures are 15.5±0.9°C and 18.7 ± 1.4°C, respectively.

Treatments and Experimental Design

The experiment was executed by using seven improved and one local maize variety. Field experiment was laid out in a randomized complete block design (RCBD) with three replications. The experimental field was well prepared by plowing three times as conventional tillage practice. Sowing was done by row with two seeds per hole at 0.75 m between rows and 0.25 cm between plants within rows. The seeds were planted immediately after the onset of the main rainy season ensuring an adequate soil moisture level for good germination and seedling development. NPS and urea fertilizers were applied at the rate of 100 kg ha^{-1} and 200 kg ha^{-1}, respectively. NPS fertilizer was applied once at planting time, while urea was applied in split, half at planting and the remaining half at knee height. Weed management practices were done three times based on the recommendations. Pests were controlled using recommended chemicals, harvesting was manually done. Hundred seed count was done by seed counter machine (grain seed counter machine) and grain yield and hundred seed weight were measured by sensitive weighing balance.

Data Collection

Data was recorded on five plants from each plot for yield related traits viz; plant height (cm), ear height (cm) and ear length. The grain yield (kg ha^{-1}) and 100 grains weight (g) were calculated for the entire plot.

Data Analysis

The collected data (plant height, ear height, ear length, grain yield and hundred seed weight) were subjected to Analysis of variances (ANOVA) using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS) software (SAS Institute 2002). Significant differences between and among treatment means were delineated by using LSD (least significance difference at 5% level of significance)

RESULTS AND DISCUSSION

The result showed that there were significant differences among the tested varieties for all the studied traits (Table 1). Among the tested varieties, the maximum plant height was recorded for SBRC (258.67 cm) and the minimum plant height was corresponded to Gibe -2 (203.5 cm). The result from the present study agreed with the report of Tahir et al. (2008), who reported that plant height is genetically as well as environmentally controlled. The maximum and the minimum ear height were recorded for BH547 and BH548, respectively. These results get sufficient validation from the findings of Nazir, (2010) and Sahibzada, (2011). Moreover, the maximum and the minimum ear length were recorded for BH546 and local check, respectively. As presented in Table 1, significant differences were observed for grain yield among different varieties used in this study. BH546 and BH547 showed higher grain yield (8428 kg ha^{-1} and 7506 kg ha^{-1}), respectively. The local variety produced lower grain yield (6064 kg ha^{-1}) than the other tested varieties. Grain yield ranged from 6064 (kg ha^{-1}) for the local check to 8428 (kg ha^{-1}) for the improved variety - BH546. In this study, yield advantages of 28.05% and 19.21% were obtained from the improved maize varieties: BH546 and BH547, respectively over the local check. It was noted that the improved midland maize varieties: BH546 and BH547were the best performing cultivars than the other varieties under study in the study area.

Table 1. The combined mean square value for growth parameters, yield and yield components of maize affected by variety at Ayikamer Keble in Debube Ari District during 2018 and 2019

SOV	DF	PH	EL	EL	HSW	GY
Variety (v)	7	1730**	578.559***	10.559***	39.35***	293425***
Replication (R)	2	ns	ns	ns	ns	ns
Year (Yr)	1	29205***	ns	ns	ns	ns
Variety X Year (VxYr)	7	ns	9.2837	ns	ns	ns

Note: DF =degree of freedom, SOV = source of variation, PH= plant height, EL = ear length, EH= ear height, HSW = hundred seed weight, GY= grain yield, ns = non- significant. significant at 0.05, ** significant at 0.01 and *** significant at 0.001 level of significance*

Table 2. The combined mean value of yield and yield components of maize varieties at Ayikamer Kebele, in Debub Ari district, during 2018 to 2020.

Variety	PH (cm)	EH (cm)	EL (cm)	GY (kg/ha)	HSW (g)
SBRH	258.7^{a}	126.16^{a}	24.66^{b}	6710^{bc}	39.00^{a}
GIBE-2	203.5^{c}	104.5^{bc}	23.00^{c}	64510^{c}	37.00^{abc}
BH547	239.8^{ab}	130.83^{a}	22.33^{cd}	7506^{b}	39.85^{a}
GIBE-3	239.7^{ab}	122.16^{ab}	22.83^{cd}	6167^{c}	36.25^{bc}
BH546	245.2^{a}	120.5^{ab}	25.50^{ab}	8428^{a}	37.91^{ab}
BH548	222.6^{bc}	101.83^{c}	26.50^{a}	6424^{c}	34.16^{cd}
G-3	239.7^{ab}	122.16^{ab}	22.83^{cd}	67617^{c}	36.25^{bc}
Local	248.8^{ab}	125.50^{a}	21.50^{d}	6064^{c}	38.00^{ab}
CV	7.86	12.94	5.17	10.59	7.26
LSD (5%)	21.97	18.03	1.43	849.5	3.15

Note: Means with the same letters within the columns are not significantly different at $p<0.05$; PH = plant height (cm), EH = ear height (cm), EL = ear length (cm), HSW = hundred seed weight (g), GY = grain yield (kg ha^{-1})

The significant differences among varieties indicates the presence of variability for grain yield among the tested entries. This finding is in agreement with the reports of Wedajo and Hussein (2015), who indicated that there were significant differences observed among the maize varieties for grain yield. Similar results were reported by Ahmed et al. (2000), who evaluated and identified high yielding maize varieties among different genotypes tested. From the tested varieties in the present study, higher hundred seeds weight (37.91 g) and (39.85 g) were recorded for the improved midland maize varieties (BH546 and BH547, respectively). On the other hand, the minimum hundred seed weight (32g) was noted for the SPRH line.

CONCLUSIONS

The experiment was carried out using seven improved midland maize varieties and one local check in randomized complete block design (RCBD) with three replications during 2018 to 2020 main cropping seasons. According to the study results, all the studied growth parameters, yield components and grain yield were significantly affected by varieties. Higher performances in terms of seeds weight were exhibited by the improved midland maize varieties: BH547 and BH546. Similarly higher grain yields (kg ha^{-1}), were recorded for BH546 and BH547 Based on the combined mean performances the two varieties (BH546 and BH547) were significantly higher than that of the standard local check (BH140). Therefore, it can be concluded that use of the improved maize varieties of BH546 and BH547 would be recommended for demonstration and popularization for production in the target area and other places with similar agroecology.

CONFLICTS OF INTEREST

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

ACKNOWLEDGEMENTS

The authors would like to thank South Agricultural Research Institute (SARI) for financial support and Jinka Agricultural Research Center for facilitation during the field work and report writing periods.

REFERENCES

Ahmed, N., Waheed, A. and Hamid, F. S. 2000. Performance of maize cultivar under late sowing conditions. Pakistan J. Biol. Sci., 3(12): 2098-2100.

CSA (Central Statistical Agency of the Federal Democratic Republic of Ethiopia). 2015. Agricultural Sample Survey, 2014/15. Report on Area and production of major crops (Private Peasant Holdings, meher season). Statistical Bulletin 278. Vol. I, Addis Ababa, Ethiopia

FAOSTAT. 2010. Food and Agricultural Organization of the United Nations [online].

MARD (Ministry of Agriculture and Rural Development). 2014. Animal and Plant Health Regulatory Directorate. Crop Variety Registry issue no.17. Addis Ababa, Ethiopia.

Nazir, H., Zaman, Q., Amjad, M. and Aziz, N.A. 2010. Response of maize varieties under agro ecological conditions of Dera Ismail khan. J. Agric. Res., 48(1): 59-63.

Piperno, D. R. and Flannery, K. V. 2001. The earliest archaeological maize (Zea mays L.) from High land Mexico: new acceleration mass spectrometry dates and their implications. Proceedings of national academy of sciences, 98: 2101-2103. Pakistan. Pak J Life Soc Sci, 2008, 6:

Shahidur, R. 2010. Staple Food Prices in Ethiopia. International Food Policy Research Institute, Addis Ababa, Ethiopia.

Sahibzada, Q. A., Khan S., Ghaffar M., and Ahmad F. 2011. Agricultural Research Station,Baffa, Mansehra, KPK, Pakistan. Genetic Diversity Analysis for Yield and Other Parameters in Maize (*Zea mays* L.) Genotypes.Asian Journal of Agricultural Sciences, 3(5): 385-388.

Tahir, M., Tanveer, A., Ali, A., Abbas, M. and Wasaya, A. 2008. Comparative yield performance of different maize (Zea mays L.) hybrids under local conditions of Faisalabad-Pakistan. Pak J Life Soc Sci., 6(2): 118-120.

Wedajo, G., and Hussein M. 2015, July). Study on adaptability and stability of drought tolerant maize varieties in drought prone areas of South Omo Zone, SNNPRS. International Journal of Research in Agriculture and Forestry, 2(I7).