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# Performance Evaluation and Adaptability Study of Hybrid Maize (Zea Mays) in the Highlands of Eastern Hararghe, Ethiopia

*Zeleke Legesse[1*], Jifara Gudeta[1], Fikadu Tadesse[1] and Alemayehu Biri[2]*

[1]*Fadis Agricultural Research Center, P.O.Box: 904, Harar, Ethiopia*

[2]*Fiche Agricultural Research Center, Oromia, Ethiopia*

## Abstract

Maize is one of a major crop in Ethiopia in production, consumption and income generation for both resource constrained men and women. Although, productivity of maize in Ethiopia is showing increment in recent years however productivity in Eastern Hararghe is still low 24.06 qt/ha compared to the national and regional average. The experiment was conducted at high-land areas of East Hararghe namely Kurfa chele and Meta districts in 2018/19 and 2019/20 cropping seasons. The study was done with the objectives of to evaluate the performance of hybrid maize varieties for their adaptability, stability, high yielder and to recommend variety/ies for the study areas and similar agro-ecologies. The experiment was conducted with randomly complete block design with three replications. The analysis of variance revealed the significance variation of hybrid maize varieties for the traits evaluated. The variety SPRH (145.3) had the earliest in maturity which is not significant different from varieties, SBRH, Shonee, Damote, BH-140 and BH-146 with a mean values of 146.6, 147.2, 148.3, 149.2 and 149.6 days respectively. Damote variety had the highest grain yield (54.62 qt ha-1), while BH-547 had the lowest grain yield (36.47 Qt ha-1). The second and third varieties for grain yield was recorded from SPRH1 and Shone which was not significant from the highest grain yield (Damote). Thus, it can be concluded that hybrid maize varieties Damote and SPRH resulted in best results in terms of yield and yielding component across the study area. Therefore, for sustainable maize production in the study area these varieties had been recommended and need to be demonstrated with local varieties to users along with their improved production packages.

## Keywords

Grain yield, Hybrid maize, Variety evaluation

## Introduction

Maize (*Zea mays* L) is one of the most important cereals broadly adapted worldwide [1]. It is largely produced in Western, Central, Southern and Eastern parts of Ethiopia. Maize is widely grown in most parts of the world over a wide range of environmental conditions ranging between 480 latitude North to about 400 South latitude all over the world [2]. Maize, which is originated from South America, is first introduced in Ethiopia in the 1thto 17$^{th}$ Century [3]. However, it is increasingly becoming more important than most of the indigenous crops of the country and has been widely accepted in several ways, namely for human consumption, as feed grain, fodder crop and for many industrial purposes.

The popularity of maize in Ethiopia is partly because of its high value as a food crop as well as the growing demand for the Stover as animal fodder and source of fuel for rural families [4]. Although, productivity of maize in Ethiopia is showing increment in recent years however productivity in Eastern Hararghe is still low 24.06 qt/ha compared to the national and regional average of Oromia 32.54 and 33.19 quintal/ha respectively [5].

In maize farming system of Eastern Ethiopia, especially Eastern Hararghe farmers traditionally use local variety of maize, for production and productivity for a long period of time. Lack of insufficient knowledge and awareness of farmers on the production and benefits of these new and high yielding varieties with good agronomic practice is a leading constraint. Identification of adaptable variety minimizes the magnitude

***Corresponding author:** Zeleke Legesse, Fadis Agricultural Research Center, P.O. Box: 904, Harar, Ethiopia

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of scale or rank shift of their performance across or specific environment [6-8].

Hence, it is important to test adaptability of these medium to early maturing maize varieties the highlands of eastern Hararghe. Thus, study was conducted to compare the performance of commercial varieties for their adaptability, stability and to recommend a suitable one for the local maize growers of eastern Hararghe, highlands of Ethiopia and similar agro-ecologies.

## Materials and Methods

### Treatments and experimental design

The experiment was conducted for two consecutive growing years (2018/19 and 2019/20) at the highland areas of Eastern Hararghe. The experiment was conducted at three sites of Meta (two sites) and Kurfa chele districts on farmers' fields. A total of eight recently released hybrid maize varieties namely; Damote, SPRH1, SBRH1, BH-661, Shone, BH-546, BH-547 and BH- 140 were used as experimental materials to evaluate the agronomic performance to the study areas. The experiment was laid out as a RCBD design with three replications in a plot size of 3 m × 4 m. Seeds were planted in rows with two seeds per hill at a rate of 25 kg/ha in a plot consisting of four row each of 4 m long and 3 m wide and seedlings were thinned into one plant with spacing of 0.25 m and 0.75 m between plant and rows respectively (Table 1).

Fertilizers were applied at the rate of 100/100 kg/ha NPS/Urea. Urea was applied in split (half at planting and the other half at knee height). First weed control was carried out after three weeks of planting after 21 days of planting and other management practices were undertaken as per the recommendation for maize production.

Data were collected on both individual plant base and plot base data on five important traits like days to 50% tasseling. Days to 50% silking, days to physiological maturity, plant height and grain yield per hectare. Days to 50% tasseling, days to 50% silking, days to physiological maturity and grain yield per hectare were collected on plot base and plant height was collected from individual plant base (five randomly selected plants). The data collected from the experiment had been subjected to statistical analysis using GENSTAT 18$^{th}$ edition software and least significance difference (LSD) was used to compare treatment mean differences at the probability level of $\alpha = 0.05$. Additionally, AMMI and GGE Bi plot had been done to determine performance and stability of tested varieties over environments and year.

**Table 1:** Lists of improved hybrid maize varieties used as experimental materials.

| Name of Varieties | Year of released | Organization/ center released |
|---|---|---|
| BH-140 | 1988 | BARC/EIAR |
| Damote | 2015 | Du Pont Pioneer |
| Shone | 2006 | Du Pont Pioneer |
| BH-547 | 2013 | BARC/EIAR |
| BH-546 | 2013 | BARC/EIAR |
| BH-660 | 1993 | BARC/EIAR |
| SPRH1 | 2015 | BARC/EIAR |
| SBRH1 | 2015 | BARC/EIAR |

## Results and Discussion

The analysis of variance revealed that significant ($P < 0.05$) differences in the parameters studied of all maize varieties over location and yea. The mean square data indicated that hybrid maize varieties differ significantly in days to tasseling (DT), days to silking (DS) grain yield per hectares whereas, highly significant difference ($P < 0.001$) for days to physiological maturity (DM) and plant height (m) (Table 2).

Analysis of variance revealed that significance difference was observed for all traits evaluated among the varieties tested across location and year (Table 3). The varieties were ranged from 88.67 to 95.67 in days to tasseling and 97.7 to 108 in days to silking. The earliest in days to tasseling was recorded from the variety SPRH1 (88.67 days) followed by Shone, SBRH1, Damote and BH-140 which were statistically not significant and BH-661 takes the longer time to tasseling with a values of 95.67 days. The variation in days to tasseling may due to genetic materials of the evaluated varieties.

The present result revealed that the height of plant was highly significantly affected due to various maize varieties (Table 3). The tallest plants were observed in BH-661 (2.203 m) followed by Shone and BH-546 with height of 1.982 and 1.924 m, respectively whereas, the shortest plant height was recorded from the variety SPRH (1.743 m) followed by SBRH (1.746 m). Analysis of the data revealed significant variations

**Table 2:** Mean squares from analysis of variance (ANOVA) of measured phonological and agronomic traits of hybrid maize.

| | | Mean square | | | | |
|---|---|---|---|---|---|---|
| **S.V** | **d.f.** | **DT** | **DS** | **DM** | **PH-m** | **GYLD-Qt-ha** |
| Rep stratum | 2 | 2.042 | 0.31 | 10.18 | 0.04443 | 691 |
| Variety | 7 | 2.34$^{*}$ | 3.27$^{*}$ | 65.27$^{**}$ | 0.19827$^{**}$ | 33332$^{*}$ |
| Error | 46 | 8.613 | 9.03 | 11.85 | 0.0196 | 11116 |
| Mean | | 92.42 | 101.71 | 149 | 1.9 | 43.55 |
| CV | | 3.2 | 3 | 2.3 | 7.4 | 24.2 |

$^{*}$and $^{**}$represent statistically significant differences at 0.05 and 0.01 probability levels, respectively; DT: Days to 50% Tasseling; DS: Days to 50% Silking; DM: Days to Physiological Maturity; PH: Plant Height and GYLD: Grain Yield in Quintal per Hectare

**Table 3:** Combined mean of yield and other traits of hybrid maize tested across years and locations during 2018/19 and 2019/20 cropping season.

| Variety | DT | DS | DM | PH (m) | GYLD_Qt_ha |
|---|---|---|---|---|---|
| BH-140 | 93.33abc | 98.7a | 149.2 abc | 1.898 b | 36.84 cd |
| BH-546 | 95bc | 102.7a | 149.7 abc | 1.924 b | 41.59 bcd |
| BH-547 | 94.67bc | 102a | 151.6 bc | 1.871 bc | 36.47 d |
| BH-661 | 95.67c | 108b | 153.6 c | 2.203 a | 40.37 bcd |
| Damote | 91.33abc | 100.3a | 148.3 ab | 1.876 bc | 54.62 a |
| SBRH1 | 90.33ab | 97.7a | 146.6 a | 1.746 c | 44.07 bcd |
| Shonee | 90.33ab | 101.7a | 147.2 ab | 1.982 b | 46.81 abc |
| SPRH1 | 88.67a | 102.7a | 145.3 a | 1.743 c | 47.65 ab |
| **LSD (5%)** | **5.139** | **5.262** | **4.5** | **0.15** | **17.33** |
| **CV%** | **3.2** | **3.00** | **3.2** | **8.2** | **24.2** |

NB: Means with the same letter was not significant and means with different letters are significant; DM: Days to Physiological Maturity; PH (m): Plant Height in Meter and GYLD_Qt_ha: Grain Yield in Quintal Per Hectares

among the tested varieties of maize for days to physiological maturity. The variety SPRH (88.67 days) recorded the earliest in days to anthesis where no significance difference between the varieties; Shonee, SBRH, Damote and BH-140. However, maize variety BH-661 recorded the latest in days to anthesis. Similarly, variety SPRH (145.3) had the earliest in maturity which is not significant different from varieties, SBRH, Shonee, Damote, BH-140 and BH-146 with a mean values of 146.6, 147.2, 148.3, 149.2 and 149.6 days respectively.

In present investigations grain yield was found to be highly significant (Table 3). Accordingly, the variety, Damote had the highest grain yield (54.62 qt $ha^{-1}$), while BH-547 had the lowest grain yield (36.47 Qt $ha^{-1}$). The second and third varieties for grain yield was recorded from SPRH1 and Shone which was not significant from the highest grain yield (Damote). The possible reason for the observed differences could be variation in their genetic make-up. This study is in line with those of Mosisa and Habtamu [9], who evaluated different improved maize varieties and reported that mean grain yield across environments varied from 4300 to 7300 kg $ha^{-1}$.

## Conclusion and Recommendation

Using improved varieties of hybrid maize could make an important contribution to increase agricultural production and productivity in areas like eastern Hararghe where there is low practice of using improved technologies such as improved crop varieties. To this end, the use of improved hybrid maize technologies such as improved varieties could be one of the alternatives to improve productivity by small farmers. During the field implementation, eight improved Hybrid maize varieties were used. According to the results of analysis of variance, all of the agronomic traits evaluated were revealed significant statistical variation. Hybrid maize variety Damote, SPRH and Shonee gave the highest grain yield of all the test varieties respectively, while BH-547, BH-140 and BH-661 varieties showed the smallest grain yield respectively.

Thus, it can be concluded that hybrid maize varieties Damote and SPRH resulted in best results in terms of yield and yielding component across the study area. Therefore, for sustainable maize production in the study area these varieties had been recommended and need to be demonstrated with local varieties to users along with their improved production packages.

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