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Performance Evaluation of Maize Hybrids for Yield Characteristics Under Drought Stress Condition of Southern Tigray Region

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Abstract: Eight released maize varieties with one local check were tested at Ofla in randomized complete block design with three replications during 2014 main rainy season. The experiment was conducted to test the adaptability of improved high land hybrid maize varieties and select the best high yielding maize hybrid varieties for the target area. The treatments consisted of one open pollinated maize variety (Gibe-1) and six hybrid maize varieties (Hora, Jibat, Argane, BH-140, BH661, Wanchi) and one local check were evaluated at Ofla sites. Hybrid maize varieties were planted with 0.75 m and 0.25 m between row and between plants respectively. Urea and DAP were used as a source of Nitrogen and Phosperos at recommended rate of application. The analysis of variance showed highly significant difference ($p<0.01$) for plant height (cm) and days to maturity. While, days to male flower, days to female flower, ear height (cm), thousand seed weight (g), grain yield and yield per cob showed significantly difference ($p<0.05$). Wonchi variety was obtained the best results in terms of yield and yielding component and local check maize varieties did not performed well in terms of yield and yielding component as compared to hybrids. Therefore, for sustainable maize production Wonchi could be recommended. This variety need to be addressed to farmers and users with improved production packages.

Keywords: Hybrid Maize, Grain Yield, Ofla, Wonchi

1. Introduction

Maize (*Zea mays* L.) is one of the most important crops in the world and it is the third most important crop next to wheat and rice. It is the primary source of food in developing countries and provides 60% of human nutrition together with rice and wheat [1].

Ethiopia is commonly producing maize in the lowlands, the mid-land and the highland agro-ecologies. Inter mes of area coverage, production and utilization and feed purposes maize is vital crop [2]. Maize is also the most widely cultivated crops and main source of food in western, southern and eastern part of Ethiopia [3]. More than 40% of the total maize growing area is located in low-moisture stress areas, where as it contributes less than 20% to the total annual production. Availability of drought tolerant hybrid maize varieties cultivated for few farmers was the main factor for instability and low production in low-moisture stress areas of the country [4].

In northern Ethiopia maize farming system is more tradition especially production and consumption. The major constraint of maize production in the study area is Disease, moisture stress, lack of knowledge and awareness. Identification of adaptable variety minimizes the magnitude of rank shift of their performance across or specific environment [5, 6]. Thus, the present study was conducted to evaluate the performance of hybrid maize varieties for their adaptability and high yielder and to recommend a suitable one for the local maize growers of southern Tigray of Ethiopia and similar agro-ecologies.

2. Methodology

2.1. Description of the Experimental Site

The experiment was conducted in southern Tigray region, at Ofla research site (12° 41'50" N; 39° 42'08" E; with

altitude of 2578m) during 2014/15 main season. The mean annual rainfall is 565mm and average temperature during growing season was 18.7°C. The dominant soil type of the site is clay loam with pH of 7.8-8.2.

2.2. Experimental Materials and Design

An experiment was conducted in 2014/15 main rainy season at Ofla research site. The treatments consisted were eight released varieties from different research centers for different maize producing agro ecologies of the country. One was open pollinated maize variety (Gibe-1) and six hybrid maize varieties (Hora, Jibat, Argane, Wonchi, BH-661, BH-140) and one local check. The experiment was laid out RCBD design with three replications in a plot size of 3 m × 4 m and the management practices were considered as per the recommendation. Seeds were planted in rows with two seeds per hill at a rate of 25 kg/ha. The inter row spacing was 0.75 m, while the intra row spacing was 0.25 m. Plots and blocks were at the distances of 1 m and 1.5 m apart, respectively. Fertilizers were applied at the rate of DAP 100 and Urea 100 kg/ha. Urea was applied in split (half at planting and half at knee height). Weed control was carried out after three weeks of planting.

2.3. Data Collection

Data were collected on major phonological, growth, yield and yield related traits as described below.

2.3.1. Phonological and Growth Data

Days to male flowering (DMF): was calculated by counting the number of days from the first days of sowing to initiate male flowering to the date when 50% of the plants tassled or flowered.

Days to female flowering (DFF): This was recorded as the number of days from planting to 50% of the plants in a plot produced 2-3 cm long silk.

Days to Maturity (DM): was recorded as number of days from planting to 90% of the plants in the plot reached physiological maturity or black layer formation.

Plant Height (PH): was recorded by measuring the height of the plant from the ground level to the top of the tassle from the five randomly selected plants per plot.

Ear Height (EH): Ear height of from five randomly taken plants from harvestable row was measured from base of the plant to the upper most useful ear bearing.

2.3.2. Yield and Yield Related Traits

Ear length (EL): was recorded by measuring the length of cobs per plant from the five randomly selected plants per plot.

Grain Yield (GY): Grain yield per plot was converted to grain yield in t/ha after adjusting to 12.5% moisture.

Hundred seed weight (HSW): was recorded by counting hundred grain /seeds and then recording the weight of hundred seeds /grains in grams.

Yield per Cob (YPC): was recorded by counting the number of grains within one cob from the five randomly selected cobs.

2.4. Statistical Data Analysis

Analysis of variance for the design was carried out using SAS 9.4 software. The level of significance used in 'F' test was P=0.05. When the treatment effects were found to be significant, the means were separated using the Fisher's protected least significant.

3. Results and Discussion

The analysis of variance (ANOVA) for different plant traits recorded is given in (Table 1). The analysis of variance showed that highly significantly difference ($p<0.01$) for plant height (cm) and days to maturity, while days to male flower, days to female flower, ear height (cm), thousand seed weight (g), grain yield and yield per cob showed significantly difference ($p<0.05$). These indicated the presence of sufficient amount of variability in hybrid maize varieties for the tested traits. Even though number of cobs and ear length showed non significantly difference among the maize varieties. Similar results were reported by [7, 10].

3.1. Days to Male Flowering (Days)

All the varieties showed significant difference for days to male flowering (Table 1). Among the tested hybrid maize varieties, BH-661 had the longest days to male flowering (117.66 days) followed by Gibe-1 (115.00 days) and BH-140 (114.00 days) which is late maturing, while the shortest days to male flowering were recorded at Hora (103.66 days) and (103.33 days). Hussain M [8] reported similar results of maize varieties for days to male flowering (Table 2).

3.2. Days to Female Flowering

Significant differences were recorded among evaluated hybrid maize varieties for Days to female flowering (Table 1). BH-661 (124.33 days) and BH-140 (125.33 days) took longer days to silking, Whereas the shortest days to female flowering was recorded from Hora (114.33 days), Wonchi (113.00 days) and local check (112.00 days) for silking (Table 2).

3.3. Days to Maturity

Phenological traits showed significant difference among maize hybrid varieties in which BH-661 (191.66 days), Gibe-1 (192.00 days) and Jibat (189.33 days) showed the longest days to maturity. Whereas, Hora (156.00 days) and Wonchi (159.33 days) were recorded the shortest days to maturity (Table 2).

3.4. Plant Height (cm)

All the varieties showed significant difference for plant height (Table 2). Among the tested varieties, BH661 had the highest plant height (202.66 cm) followed by Gibe-1 (186.00 cm), while the shortest plants of 140 cm were recorded from Argene. [9] reported similar results of maize varieties for plant height.

3.5. Ear Height (cm)

The difference in ear height (cm) in this study was found non- significant owing to the genetic variation among the evaluated maize varieties. Even though, BH661 had the maximum ear height (83.66cm) followed by Gibe-1 (79.6cm). While the shortest ear height was recorded for Wonchi (57.66 cm) and Argane (60.66cm). These results got sufficient confirmation with the findings of [11, 12].

3.6. Number of Cobs Per Plant

Non-significant differences were recorded among evaluated maize varieties for their number of cobs per plant (Table 2). Variety (Jibat) gives the maximum number of cobs per plant (1.6), while the minimum number of cobs per plant was recorded from Wonchi (1.2) followed by local cheek (1.06). Similar results also reported by [13].

3.7. Hundred Seed Weight (HSW)

The result of HSW significantly differs among the varieties (Table 2). The maximum values for HSW were obtained from BH-661 (35 g), Wonchi (35.00g), Argane (34.66) and Gibe-1 (34.33g) while the minimum value was obtained from Varity local cheek (29.3g). Similar result corroborated with result reported by [14].

3.8. Grain Yield (t/ha)

Significant differences were obtained for grain yield among different varieties used in this trial. Maize variety BH-140 showed higher grain yield (8.681 t/ha), while variety local cheek produced lower grain yield (4.969 t/ha). Similar result corroborated with result reported by Akbar *et al*. (2009) who evaluated and identified high yielding maize varieties among different varieties tested.

3.9. Ear Length (cm)

Among the improved hybrid maize varieties evaluated for their adaptability at Ofla research site., the longest ear length was obtained from Wonchi (23.53cm) followed by BH661 (23.06cm), While the shortest ear length was recorded from Argane (19.40cm) and non- significantly different from others (Table 2).

Table 1. *The mean squares of different sources of variations.*

SOV	DF	DMF	DFF	MD	PH	EH	NC	EL	GY	HSW	YPC
VAR	7	94.57*	81.37*	625.08**	2156**	668.8*	0.079^{ns}	8.12^{ns}	438.53*	14.79*	1834.74*
ERROR	16	19	16.53	96.33	140.37	109.45	0.045	3.84	154.4	4.94	388.33
CV		4	3.45	5.57	7.4	16	16.42	9.28	16.39	6.65	13.86

SOV=source of variations, DF=Degree of freedom, DMF=Days to male flowering, DFF=Days to female flowering, MD=Days to maturity, PH=Plant height, EH=ear height, NC=Number of cobs per plant, EL=Ear length, GY=Grain yield, HSW=Hundred seed weight, YPC=Yield per cob.

Table 2. *The mean comparisons of grain yield and other phonological parameters of hybrid maize at Ofla.*

Varieties	DMF	DFF	MD	PH	EH	GY	HSW	YPC
BH-661	117.66^{a}	124.33^{a}	191.00^{a}	202.66^{a}	83.66^{a}	84.04^{a}	35.00^{a}	164.73^{a}
Hora	103.66^{c}	114.33^{c}	156.00^{c}	155.66^{bc}	65.00^{bc}	76.89^{a}	34.26^{ab}	133.00^{a}
Wonchi	105.33^{bc}	113.00^{c}	159.33^{c}	145.33^{bc}	57.66^{c}	85.22^{a}	35.00^{a}	162.20^{ab}
Local check	103.33^{c}	112.00^{c}	167.00^{bc}	116.00^{d}	36.00^{d}	49.69^{b}	29.30^{c}	98.40^{c}
Argane	112.00^{ab}	116.33^{bc}	172.00^{bc}	140.00^{c}	60.00^{c}	69.20^{ab}	34.66^{a}	120.53^{bc}
BH-140	114.00^{a}	125.33^{a}	181.00^{ab}	162.66^{b}	73.66^{abc}	86.81^{a}	30.46^{bc}	164.13^{a}
Gibe-1	115.66^{a}	122.00^{ab}	192.00^{a}	186.00^{a}	79.66^{ab}	79.63^{a}	34.33^{a}	160.73^{a}
Jibat	112.33^{ab}	116.33^{bc}	189.33^{a}	157.33^{bc}	66.66^{abc}	77.99^{a}	34.26^{ab}	133.47^{ab}

SOV=source of variations, DF=Degree of freedom, DMF=Days to male flowering, DFF=Days to female flowering, MD=Days to maturity, PH=Plant height, EH=ear height, NC=Number of cobs per plant, EL=Ear length, GY=Grain yield, HSW=Hundred seed weight, YPC=Yield per cob.

Table 3. *Simple linear correlation coefficient between pairs of all traits in maize hybrids.*

DFF	MD	PH	EH	NC	EL	GY	HSW	YPC	
DFF	1.00000								
MD	0.56281	1.00000							
PH	0.50180	0.50542	1.00000						
EH	0.39105	0.43201	0.86779	1.00000					
NC	-0.07678	0.07234	0.17839	0.38770	1.00000				
EL	0.03349	-0.02612	0.46225	0.43310	-0.01734	1.00000			
GY	0.10482	0.18368	0.52982	0.60663	0.43991	0.35621	1.00000		
HSW	-0.18918	-0.00047	0.46518	0.41198	0.20367	0.22528	0.54659	1.00000	
YPC	0.33722	0.18881	0.69721	0.63520	0.24622	0.61114	0.72414	0.39690	1.00000

DMF=Days to male flowering, DFF=Days to female flowering, MD=Days to maturity, PH=Plant height, EH=ear height, NC=Number of cobs per plant, EL=Ear length, GY=Grain yield, HSW=Hundred seed weight, YPC=Yield per cob.

3.10. Correlation Coefficient

The results of simple linear correlation coefficients between all pairs of traits as shown in table 3 reveals grain yield had positive and significant association with plant height (r=0.52), ear height (r=0.60), number of cobs per plant (r=0.43) and ear length (0.35).

4. Conclusion and Recommendation

One OPV maize variety (Gibe-1) and six hybrid maize varieties (Hora, Jibat, BH140, BH660 Argane, Wanchi) with one local check were evaluated. Thus, it can be concluded that hybrid maize variety wonchi resulted in best performance in terms of yield and yielding component and local check maize variety was not best performed in terms of yield and yielding component as compared to hybrids. Therefore, for sustainable maize production in the study area Wonchi could be recommended. This variety need to be demonstrated with local varieties for users along with their improved production packages.

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