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Observation and Yield Trial on Drought Tolerant Maize Varities at, Arbaminch, SNNPR, Ethiopia

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Abstract
This study was aimed at selecting varities that fit better for lowland maize production area. Seven improved lowland maize varieties along with standard check (BH-540) were tested at Arbaminch Agricultural Research Center's sub station, South Ethiopia for two consecutive years. Randomized complete block design with three replications was used. Seeds were sown on a plot size of 3m x 5m in rows of four per plot at a spacing of 75 cm between rows and 25 cm between plants. Analysis of variance revealed no significant differences ($p<0.05$) between varieties for grain yield for 2014 and 2015 cropping seasons except for M-5, which was lowest yielder in both seasons. Four varieties (M-4, BH-540, Gibe-2, and M-7) were showed above mean performance during 2014 and 2015 cropping seasons. Combined analysis of variance over 2014 and 2015 cropping seasons revealed significance effect of varities for all traits except for cob number. The effect of season by variety had no effect for all traits studied. It would be highly recommended to use all tested varieties except M-5, until another studies carried out around and similar areas.
Keywords: variety, observation, trial and drought

1. Introduction

Maize (*Zea mays* L) is one of the most important cereal crops in Ethiopia, ranking second in area coverage and first in total production (CSA, 2014/15). Availability of limited number of drought tolerant maize varieties was the main factor for low production in low-moisture stress areas of the country in general and southern Ethiopia in particular (wedajo *et al.,* 2015).

It is an important field crop in terms of area coverage, production and utilization for food and feed purposes. In south Ethiopia, maize is the first crop both in area coverage (310,243.28 hectare) and production (9,998,685.25 quintal) (CSA, 2014/15). Gamo Gofa zone is leading maize producer both in area coverage (57,268.03 quintal) and production (1,961,088.81 quintal) in south Ethiopia. It is the most extensively cultivated food crops and main source of calorie in western, southern and eastern part of Ethiopian (Mosisa *et al.*, 2001). With the introduction of high yielding open pollinated varieties, and the increasing local demand, the importance of the crop may increase even further. The low yield in this area is mainly not only lack of improved varieties but also attributed to recurrent drought. Varities released for low land area of Ethiopia can be used for production based on rainfall conditions in the study area.

Lack of insufficient knowledge and awareness of farmers on the production and benefits of these new and early maturing varieties with good agronomic practice is a leading constraint. Identification of adaptable variety minimizes the magnitude of scale or rank shift of their performance across or specific environment. Hence, it is important to introduce drought tolerant maize varieties to the target area for improved maize production and productivity. Therefore, this study was initiated with the objective of selecting best performing drought tolerant maize variety/ies.

2. Material and Methods

2.1. Description of the experimental site

The experiment was conducted for two consecutive years (2014&2015) at Arbaminch Agricultural Research Center's sub-station, south Ethiopia. Arbaminch is located at latitude of 06°06' north and longitude of 37°35' south with altitude of 1216 m. a. s. l. in lowlands. The district receives average annual rain fall of 1000.00 mm; the minimum and maximum air temperature of 16-37°C, respectively.

2.2. Experimental materials and design

The treatments consisted of eight released low land maize varieties from Melkassa agricultural research center for lowland maize producing agro ecologies of the country. The experiment was laid out as a RCBD design with three replications in a plot size of 3 m × 5 m and the management practices were undertaken as per the recommendation. Seeds were planted in rows at a rate of 25 kg/ha in a plot consisting of four row each of 5 m long and 3 m wide. The inter row spacing was 0.75m, while the intra row spacing was 0.25m, giving population density of 53,333 plants per hectare. Plots and blocks were at the distances of 1m and 1.5m apart, respectively.

2.3. Data collection

The middle two rows were used for data collection and harvested at maturity. Individual plant base data as well

as plot base data were collected on different traits. Data collected on individual plant basis from five randomly selected plants were, cob number, ear height and cob length. Data collected on plot basis were days to maturity, days to silking days to tasseling and grain yield (kg/ha).

2.4. Statistical data analysis

Analysis of variance was carried out by using Genstat 16th edition software for the parameters studied following the standard procedures. The level of significance used in 'F' and't' test was P=0.05. Mean separation was conducted by using least significant difference.

3. Results and Discussion

The analysis of variance (ANOVA) for each season was conducted in order to check the presence of significance differences among the genotypes and the results are presented under Table 1 and 2. Combined analysis of variance was also conducted to test the effect of seasons on the performance of varities for different traits (Table 3). Analysis of variance for a season revealed significant (P<0.05) differences for the parameters studied except for cob number during 2014 and cob number, days to tasseling and grain yield during 2015 cropping season. The combined analysis of variance over seasons showed significant (P<0.05) mean squares of varities for all traits except for cob number (Table 3). This indicated the presence of significant variations among genotypes and the genotypes had inconsistent performance over the tested seasons for the studied traits. Solomon *et al*. (2008), Wende (2013) and Workie *et al*. (2013) in maize and Yayis *et al*.(2014) in field pea also reported the significant effect of genotype, on yield and some other yield related traits. The interaction of variety x season was non significant for all traits. Non significant effect of variety x seasons indicated that there was no significant effect of consecutive seasons on the performances of studied traits.

Table 1. Mean squares of analysis of variance for yield and other traits of eight maize varieties grown during 2014 cropping season

Source of variation	DF	Cl	CN	DM	DS	DT	EH	GY
Replication	2	6.792	0.00042	99.1	4.67	25.04	195.2	114.87
Varieties	7	17.786*	0.03565ns	723.6**	90.00**	80.95*	854.0**	97.40*
Residuals	14	4.982	0.03565	110.3	13.00	39.90	253.9	95.16
Total	23							

*, ** significant and non significant at P≤ 0.05 and P≤ 0.01 respectively, ns non significant at P≤ 0.05 CL= Cob length, CN= cob number, DE=, DS=days to emergency, DT =days to tasseling, EH=ear height, GY=grain yield

Table 2. Mean squares of analysis of variance for yield and other traits of eight maize varieties grown during 2015 cropping season

Source of variation	DF	Cl	CN	DM	DS	DT	EH	GY
Replication	2	4.625ns	0.00042Ns	30.1	5.54	26.04	190.8	82.74
Varieties	7	17.881*	0.03565ns	593.9*	88.52*	69.95ns	825.4**	96.46ns
Residuals	14	6.292	0.03565	124.4	14.73	43.38	235.8	92.92
Total	23							

*, ** significant and non significant at P≤ 0.05 and P≤ 0.01 respectively, ns non significant at P≤ 0.05 CL= Cob length, CN= cob number, DE=, DS=days to emergency, DT =days to tasseling, EH=ear height, GY=grain yield

Table 3. Mean squares of combined analysis of variance for yield and other traits of eight maize varieties grown during 2014 and 2015 cropping season

Source of variation	DF	Cl	CN	DM	DS	DT	EH	GY
Replication	2	2.10	0.00083	117.2	9.19	51.06	1.68	195.05
Varieties	7	6.71**	0.07131NS	1310.0*	178.16**	149.83**	7.34*	192.21*
Season	1	0.06NS	0.00NS	12.0NS	1.02NS	0.02NS	1.0	1.47
Season X Varieties	7	0.04NS	0.00NS	7.5NS	0.35Ns	1.07NS	0.5NS	1.65NS
Residuals	30	5.283	0.03328	110.3	13.01	38.86	228.6	87.94
Total	47							

The mean performance of varities for grain yield for each season is presented under Table 3 and 4. The varities had mean grain yield of 4410 kg/ha. The highest mean grain yield was obtained from M-4, M-7, Gibe-2 and BH-540 (5580 kg/ha, 4733 kg/ha, 4727kg/ha and 4553 kg/ha with out significant difference among the four varities during 2014 and 2015 cropping seasons, and the lowest from M-1 and M-5 (3390 kg/ha and 3867kg/ha) for both seasons respectively. Moreover, performances of genotypes were not consistent across seasons.

The varities had significant differences for all studied traits except for cob number during 2014 and cob number and days to tasseling during 2015 cropping season. Overall, the variation in plant height, days to

tasseling, days to silking, days to maturity and grain yield observed are due to differences among the variety. Earliest days to tassling were recorded for M1Q, M-5 and M-2 varieties with 39.00, 43.33 and 48.00 days, respectively during 2014 cropping season with out significant difference between the three and for M1Q, M-5, M-7, M-2 and M-4 with 39.67, 43.33, 51.00, 48.00 and 50.33 days respectively during 2015 cropping season with out significant difference between the five while Gibe -2 and BH 140 were late maturing with 130.0 and 138.3 days respectively during 2014 and 130.0 and 141.5 days respectively during 2015 cropping season.

Table 4. Mean grain yield (kg/ha) of eight maize varities grown at grown during 2014 cropping season

Varities	Cl	CN	DM	DS	DT	EH	GY
M1Q	15.67b	1.00	101.7c	49.33b	39.00c	58.33bc	3227cb
M-5	20.00a	1.00	111.7bc	47.00b	43.33bc	51.67c	3840cb
M6Q	20.33a	1.00	106.7c	59.33a	52.00ab	74.33bc	4133abc
M-7	20.67a	1.00	111.7bc	59.00a	51.00ab	71.67bc	4667abc
Gibe-2	22.33a	1.00	130.0bc	62.33a	55.33a	89.33ab	4747abc
M-2	22.33a	1.00	113.3bc	59.67	48.00abc	75.67bc	4400abc
BH-540	23.00a	1.00	144.7a	57.00a	50.33ab	104.33a	4587abc
M-4	23.00a	1.00	97.3c	59.67a	50.33ab	85.33abc	5620a
CV	10.70	17.1	9.2	6.40	13.0	20.9	21.0
Grand Mean	20.92	1.00	114.6	56.70	48.7	76.3	4403
LSD	3.91	NS	18.39	6.31	11.06	27.91	1708

CL= Cob length, CN= cob number, DE=, DS=days to emergency, DT =days to tasseling, EH=ear height, GY=grain yield and DM= days to maturity

Table 5. Mean grain yield (kg/ha) of 8 maize varities grown at grown during 2015 cropping season

Varities	Cl	CN	DM	DS	DT	EH	GY
M1Q	15.33a	1.00	100.01a	50.00 a	39.67a	57.67a	3553
M-5	20b	1.00	111.7ab	47.00 a	43.33 ab	51.67 a	3893
M6Q	20.33b	1.00	106.7a	59.33 b	52.00b	74.33 ab	3913
M-7	20.67b	1.00	111.7ab	59.00 b	51.00 ab	71.67ab	4800
Gibe-2	22.33b	1.00	130.0bc	62.67 b	53.67b	89.33 bc	4707
M-2	22b	1.00	113.3ab	59.67 b	48.00ab	75.67 ab	4413
BH-540	22b	1.00	138.3c	58.33 b	51.67b	102.67 c	4520
M-4	23b	1.000	97.3a	59.67 b	50.33ab	85.33 bc	5540
CV	12.1	17.0	9.8	6.7	13.5	20.2	20.9
Grand Mean	20.75	1.00	113.6	56.96	48.7	76.0	4430
LSD	4.393	NS	19.5	6.722	NS	26.89	NS

CL= Cob length, CN= cob number, DE=, DS=days to emergency, DT =days to tasseling, EH=ear height, GY=grain yield and DM= days to maturity

Table 6. Combined mean grain yield (kg/ha) of 8 maize varities grown at grown during 2014 and 2015 cropping season

Varities	Cl	CN	DM	DS	DT	EH	GY
M1Q	15.50 c	1.00	100.8cd	49.67 c	39.33c	58.00 cd	3390c
M-5	20.00 b	1.00	111.7 bc	47.00 c	43.33 bc	51.67 d	3867c
M6Q	20.33ab	1.00	106.7bcd	59.33ab	52.00a	74.33 bc	4023abc
M-7	20.67ab	1.00	111.7 bc	59.00ab	51.00a	71.67bc	4733abc
Gibe-2	22.33ab	1.00	130.0 a	62.50 a	54.50a	89.33 ab	4727 abc
M-2	22.33ab	1.00	113.3b	59.67ab	48.00 ab	75.67 bc	4407abc
BH-540	22.50ab	1.00	141.5a	57.67 b	51.00a	103.50 a	4553 abc
M-4	23.00 a	1.00	97.3d	59.67ab	50.33ab	85.33 b	5580a
CV	11.0	16.5	9.2	6.3	12.8	19.8	20.2
Grand Mean	20.83	1.00	114.1	56.81	48.69	76.2	4410
LSD		NS	17.52	6.015	10.395	25.21	1554

4. Conclusion and Recommendation

Eight OPV maize varieties M1Q, M-5, M6Q, M-7, Gibe-2, M-2, BH-540, and M-4 with BH-540 as a standard check were evaluated. Thus, it can be concluded that maize varieties M-4, BH-540, Gibe-2, and M-7 resulted in best results in terms of yield. Therefore, for sustainable maize production in the study area these four varities could be recommended. These varieties need to be demonstrated to users with their improved production

packages.

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