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International Journal of Current Research
Vol. 9, Issue, 10, pp.59069-59072, October, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EVALUATION OF ADAPTABILITY AND YIELD PERFORMANCE OF MAIZE (*ZEA MAYS* L) VARIETIES AT BURE DISTRICT OF ILUABABOR ZONE, SOUTH WESTERN ETHIOPIA

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ARTICLE INFO

Article History:
Received 11th July, 2017
Received in revised form
08th August, 2017
Accepted 16th September, 2017
Published online 31st October, 2017

Key words:

Adaptation,
Evaluation,
Improved varieties,
Yield.

ABSTRACT

The experiment was conducted on farm at Bure district of IluAbabor Zone, south westrn Ethiopia, to evaluate the adaptability and yield performance of improved maize varieties during 2016 of main cropping season. The treatment consisted of nine improved varieties namely BH661, BH547, BH546, Limu, G2, G3, MH140, MHQ138, M6Q and a Local cultivar were planted on (4.5m x 2.5m) plots at spacing of 75cm x 25cm. The experiment was laid in RCBD with three replications. Data on plant height, Number of ear plant^{-1}, cob length, cob diameter, number of row cob^{-1}, number of grain row^{-1}, 1000 grain weight and grain yield were recorded. The analysis of variance showed that there were highly significant ($P<0.01$) differences among varieties for grain yield and other parameters considered except number of row cob^{-1}. The highest number of gain row $^{-1}$ (40.94) was recorded in variety BH546. BH661 variety had maximum cob length of 21.13 cm. The highest plant height of 2.90 cm was noted in local cultivar. The variety BH547 gave the highest grain yield (10459 kg ha^{-1}). Thus, variety BH547 was superior in terms of yield as well as in other important yield components. It is, therefore suggested that BH547 could be recommended for production in Bure district and similar agro-climatic conditions of south western Ethiopia.

Citation: Legesu Girshe, Alum Abera and Tajudin Sultan, 2017. "Evaluation of adaptability and yield performance of maize (*Zea mays* L) varieties at bure district of iluababor zone, south western ethiopia", *International Journal of Current Research*, 9, (10), 59069-59072.

INTRODUCTION

Maize (*Zea mays*) is one of the most important cereals broadly adapted worldwide (Christian *et al.,* 2012). In Ethiopia, maize grows from moisture stress areas to high rainfall areas and from lowlands to the highlands. It is largely produced in Western, Central, Southern and Eastern parts of Ethiopia. In 2014/2015, cropping season 2,114,876.10 hectares of land was covered with maize with an estimated production not less than 72,349,551.02 quintals (CSA, 2014/2015). In Ethiopia maize is produced for food, especially, in major maize producing regions mainly for low-income groups. Maize is consumed as "Injera," Porridge, Bread and "Nefro." It is also consumed roasted or boiled as vegetables at green stage. The leaf and stalk are used for animal feed and dried stalk & cob are used for fuel. It is also used as industrial raw material for oil & glucose production (MARD, 2014). The total annual production and productivity of maize in Ethiopia exceeds all other cereals (23.24% of 13.7 Million tons), and second after tef (*Eragrostis tef*) in area coverage (16.12% of the 8.7 000 000 ha) (Mosisa *et al.,* 2007). It is an important field crop in terms of area coverage, production and utilization for food and feed purposes. However, maize varieties mostly grown in the highlands at an altitude ranging from 1,700 to 2,400 mas of Ethiopia are local cultivars with poor agronomic practices (Beyene *et al.,* 2005). With the introduction of the hybrid seeds and the high yielding open pollinated varieties, and the increasing local demand, the importance of the crop may increase even further (Mosisa *et al.,* 2007). Maize is currently grown across 13 agro-ecological zones, which together cover about 90 percent of the country. Moreover, it is an increasingly popular crop in Ethiopia: The area covered by improved maize varieties grew from five percent of total area under maize cultivation in 1997 to 20 percent in 2006 (CSA, 2006). Despite the country continuous increase in the land coverage, production and demand for maize; the average maize yield in Ethiopia as well as in south western part is low because of different factors of which use of unimproved variety a great role. Variability in genetic potential among varieties is a major component of variable yield. Olakajo and Iken (2001) reported that maize varieties produce significantly different yields at different locations. Olaoye (2009) emphasized the need to evaluate maize varieties in various agro-ecological zones for their adaptation, yield potential and disease reactions. Therefore, improved varieties released elsewhere, testing for adaptation in the new similar agro ecologies are important to make use of varieties. Several maize varieties have been released by EIAR Centers to the growers in Ethiopia for different agro ecological zone. However, adaptation trial and

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information of the varieties to Illu Ababor zone in particular Bure district has not been tested and needs to be worked out. Moreover, no one identify the best variety for increasing the production of maize. Indiscriminately, growers cultivate local cultivar of maize which is not high yielder. Keeping this in view, the present study was conducted to evaluate the adaptability of improved maize varieties and select the best high yielding variety/ies for maize growers of Bure district of south western Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

The field experiment was conducted on farm at Bure district of IluAbabor Zone, south westrn Ethiopia in 2016 of main cropping season. Bure is located at 8°17'N latitude and 35°6' E longitude with an altitude of 1694 m.a.s.l. It has a moist climate with an average maximum and minimum temperature of 26°C and 20°C respectively, and an average annual precipitation of about 1500 mm.

Experimental Material

The experimental material consisted of nine improved maize varieties namely BH661, BH547, BH546, Limu, G2, G3, MH138, MH140, M6Q and one local check. The improved maize varieties were obtained from Bako and Melkasa Agricultural Research Center, Ethiopia. A recommended dose of phosphorus in the form of Triple Super Phosphate (46% P_2O_5) at the time of sowing and Urea (46% N) as a source of nitrogen were applied for all plots.

Experimental Design and Treatments

The Varieties were planted during the main rainy season in a well prepared soil under randomized complete block design with three replications. Plot size was kept at 4.5m long and 2.5m wide having row to row and plant to plant distance of 75 and 25 cm, respectively. Sowing was done with the help of hand dibbling, two seeds per hill were planted, which were thinned to one plant per hill at 4-5 leaf stage. Fertilizer in the form of Urea and DAP was applied at the rate of 100kg ha-1, respectively. Urea was applied in split form. Standard cultural practices were followed from sowing till harvesting during the entire crop season.

Data collection and Analysis

Data was recorded on ten plants from each plot for yield and yield related traits viz: plant height (cm), Number of ear plant $^{-1}$, cob length, cob diameter (cm), number of row cob^{-1}, number of grain row^{-1}, 1000 grain weight (gm) and grain yield (kg ha^{-1}). The data were subjected to the analysis of variance (ANOVA) using Statistical Analysis System (SAS) computer software Version 9.2 (SAS Institute, 2008). Significant means were separated using the least significant difference at 5% probability level.

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) showed that there were highly significant differences among the varieties in all the parameters except in the number of row per cob which showed no significant differences among the varieties (Table 1).

Plant height (m)

Different varieties of maize had highly significant (P<0.01) different in plant height (Table 1). The highest plant height was recorded in plot received local cultivar (2.90 m) followed by B661 (2.52 m) and BH547 (2.30 m), which were statistically significant difference among each other and the remaining plots which received different varieties. On the other hand, the lowest height was recorded form the plot containing M6Q (1.64 m) variety, which was also significantly different from the rest plots (Table 2). The difference in plant height among the varieties may be due to the variation in genotype of the varieties and their interaction with the environment. Hussain *et al*. (2011) showed significant difference for plant height among the genotype of maize varieties. Revilla *et al.* (2000) also reported differential pattern of maize varieties for plant height due to genotype and environment interaction.

Number of ears per plant

The analysis of variance showed highly significant (p<0.01) differences in the number of ear per plant among the different maize varieties (Table 1). The variety BH547 produced maximum number of ears per plant (1.57), while that of M6Q variety produced minimum number of ears per plant (1.00). Similar genetic variations were observed by Demalesh and Yasin (2016) among different varieties.

Cob Length (cm)

Data regarding cob length revealed highly significant differences among the studied varieties (Table 1). According to the mean values of variety BH661 had maximum cob length (21.13 cm) while the variety M6Q showed minimum cob length with the value of 16.40 cm (Table 2). The difference in cob length may resulted in the variability among genotype. Significant genetic differences for morphological parameter for maize genotypes were also reported by (Ihsan *et al.,* 2005).

Cob Diameter (cm)

The statistical analysis showed highly significant (p<0.01) differences in the diameter of cob among the different maize varieties (Table 1). The mean comparison showed that the highest cob diameter (5.60 cm) was resulted from plot which received BH547, which was statistically in parity with cob diameter of BH661 and B546 varieties. The lowest cob diameter (4.66 cm) was recorded from plot received MHQ138 variety, which was none significant different from plot received local cultivar, MH140, M6Q, and G3 varieties. The variation in cob diameter may be due to genetic composition of the varieties and the environmental factor associated with it. This result gets sufficient validation from the findings of Nazir *et al*. (2010).

Number or row per cob

The mean comparison showed that the highest number of row per cob was resulted from plot which received BH547 (15.23), which was statistically significant different from plot received BH546, BH661, Limu, G2, G3, MHQ138, MH140, M6Q and local cultivar. The minimum number of row per cob was counted from plots which received local cultivar (12.86) (Table 2). The variation of number of row per cob may be due to genetic potential of the varieties. Tamer (2010) concluded that significant differences of various traits were found among the maize cultivars tested.

obtained from plot sown M6Q, which was statistically not significant different from plot sown local cultivar, G2, Limu, MHQ138, and MH140 varieties (Table 2).

Table 1. Mean squares of ANOVA for analysis of variance showing mean squares of number of different traits of maize varieties

Source of variation	DF	PH(cm)	EPP(cm)	CL(cm)	CD(cm)	NRC	NGR	TGW(gm)	GY(kg/ha)
Rep	2	0.03	0.03	0.59	0.11	0.03	2.62	555.80	146106.44
Treatment	9	0.38**	0.04**	6.77**	0.21**	1.36ns	32.66**	5592.86**	5379661.06*
Error	30	0.01	0.01	0.53	0.03	0.78	3.56	1009.75	1744671.34

Where; DF = degrees of freedom; PH=Plant height; EPP= Number of ear plant^{-1}; CL= cob length; CD= Cob diameter; NRC=Number of row cob^{-1}, NGR= Number of grain row^{-1}; TGW=Thousand grain weight; GY= Grain yield; ns, * and ** implies non significant, significant and highly significance differences at 5% & 1% level of probability, respectively.

Table 2. Mean of grain yield and other growth and yield parameters of maize varieties at Bure, in 2016 main cropping season

Treatment/ varieties	Plant height (m)	Ear plant^{-1}	Cob length (cm)	Cob diameter (cm)	Row cob^{-1}	Grain row^{-1}	1000 grain weight (gm)	Grain yield (kg/ha)
Local	2.90a	1.04b	19.07cd	4.95cde	12.86b	34.68b	286.81d	8480abcd
BH547	2.30c	1.57a	20.47ab	5.60a	15.23a	38.90a	420.04a	10459a
BH661	2.52b	1.37b	21.13a	5.31ab	13.24b	39.09a	357.71b	10165ab
G2	1.82ef	1.37b	18.53de	5.05bcd	12.94b	33.53bc	322.97cbd	7463cd
G3	2.10cd	1.19b	19.57bcd	5.01bcde	13.29b	33.59bc	346.25bc	8259bcd
BH546	2.15c	1.37b	20.40ab	5.30ab	13.53b	40.94a	343.26bc	9195abc
MHQ138	1.93df	1.17c	17.33ef	4.66e	13.70b	33.06bc	286.43d	6941d
Limu	2.11cd	1.17c	20.20abc	5.16bc	13.49b	38.25a	301.48cd	8271bcd
MH140	2.13dc	1.04c	18.40de	4.99bcde	13.79b	31.26c	315.92bcd	7330cd
M6Q	1.64f	1.00c	16.40f	4.80de	13.60b	31.33c	276.91d	6382d
CV (%)	5.74	10.23	3.82	4.03	6.18	5.31	9.53	15.18
LSD (5%)	0.21	0.19	1.25	0.35	1.43	3.17	52.89	2144.1

Means in the column followed by the same letter(s) are not significantly different at 5% level of significance. LSD (0.05) = Least Significant Difference at 5% level; and CV (%) = coefficient of variation in percent.

Number of grain per row

The analysis of variance showed highly significant ($p<0.01$) differences in the number of grain per row among the different maize varieties (Table 1). The highest number of grain per row was recorded from plot which had BH546 which was statistically not significant different with BH547, BH661, and Limu varieties. BH546 variety had got 40.94 number grains per cob which was significant different from G2, G3, MHQ138, MH140, local and M6Q varieties. Number of grain per cob obtained from local cultivar was 34.68 which was statistically in parity with G2, G3, and MHQ138 varieties. The minimum number grain per cob is 31.26 obtained from MH140 variety, which was statistically not significant different from M6Q, MHQ138, G2 and G3 varieties (Table 2). The variation of number of grain per row may be due to genetic potential of the varieties and environmental factors. Hussain *et al.* (2011) and Workie *et al*. (2013) observed that the total output of the crop (yield), is dependent on the planting material genetic potential.

1000 Grain weight (g)

Data pertaining 1000-grain weight of the 10 genotypes were highly significant (($P<0.01$) different among each other (Table 1). The analysis of variance revealed statistically significant ($P<0.01$) difference in 1000 grain weight among the different varieties of maize (Appendix Table 1). The mean comparison of 1000 grain weight for the different varieties was different ranging from 276.9 to420.04 gram. The maximum weight for 1000grain weight resulted from BH547 (420.04 gm) variety, which was statistically significant different form all the remaining varieties. The second highest 1000 grain yield resulted from BH661 (357.71gm) which was statistically not significant different from BH546, MH140, G2 and G3 varieties. The minimum 1000 grain weight (276.9 gm) The variation in 1000 grain weight among the varieties may attribute to variation in the genetic makeup of the studied varieties. In support of this finding, different researchers have reported significant amount of variability in different maize populations studied. Daniel (2012) tested 20 varieties and found 1000 grain weight vary genotype to genotype. This result is also in the same range (weight of 1000 grain) with the result reported by releasing organization, Ethiopian agriculture research institute, Bako and Melkasa agricultural research center. Significant genetic differences for morphological parameter for maize genotypes were also reported by (Ihsan *et al.,* 2005).

Grain yield (kg/ha)

The analysis of variance indicated significant ($P<0.05$) grain yield differences among the various varieties of maize (Table 1). The average maize grain yield for the various variety treatments ranged from 6382 to 10459 kg/ha. The highest grain yield (10459 kg/ha) was obtained from plot sown BH547 variety followed by BH661 (10165kg/ha) and BH546, were statistically in parity with each others. However, the yield recorded from plot sown BH547 was significant different from the yield recorded from plot sown G2, G3, Limu, MHq138, MH140 and M6Q varieties. On the other hand, the yield obtained from M6Q variety (6382kg/ha) was none significant different from the yield obtained from local cultivar, G2, G3, Limu, MHQ138, MH140 and M6Q varieties (Table 2). Grain yield variation might be due to the various genetic backgrounds of these varieties and their response to agro-ecology of the experimental area. This is accordance with Daniel (2012) significant differences were revealed for grain yield among different genotypes. The finding was also in line with the work by Demelash and Yasin (2016) showed significant differences for grain yield among the genotypes. This result is also agreed with CSA (2012) which reported that maize varieties have potential of 9000-12000 kg ha-1 on research field and 6000-8000 kg ha-1 on farmer's field. Similar result was reported by Souza *et al.* (2002) who evaluated and identified high yielding maize varieties among different genotypes tested. Akbar *et al*. (2009) also reported significant differences among maize cultivars for grain yield.

Conclusion and Recommendations

Based on the result of this study, it could be concluded that the variety BH547 superior in terms of yield as well as in other important yield components. It is, therefore suggested that BH547 could be recommended for production in Bure district and similar agro-climatic conditions of south western Ethiopia. This variety need to be demonstrated with local cultivars to users along with their improved production packages. It is also suggested that this variety should be tested across the various ecology of south western Ethiopia. The present study showed considerable amount of variation among the tested varieties which could be manipulated for further improvement in maize breeding.

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