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Research Article

Determination of Appropriate Maize (*Zea mays* L.) Spacing for Moisture Stress Areas of Borana Zone, Southern Oromia

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Abstract

Plant density is one of the factor that affect maize yield and yield related traits. However, most of appropriate agronomic practices and requirements of maize have been studied and determined, there is limited information on plant population and row arrangement in study area. Therefore, this study was conducted to investigate the effects of intra and inter-row spacing on growth, yield components and grain yield of maize, and to identify economically acceptable maize intra and inter-row spacing in Yabello district. A factorial combination of the three intra-rows spacing (20, 25 and 30 cm) and four inter-row spacing (55, 65, 75 and 85 cm) were laid out in a Randomized Complete Block Design with three replications. The analysis of variance revealed that inter-row spacing highly significant ($P< 0.01$) affected most parameters, except cob diameter, ear length, and the number of rows per cob. The highest number of cobs per plant (1.61) and number of seeds per row (28.87) were observed at 65 cm inter-row spacing. Intra-row spacing significantly affected the number of cobs per plant and the hundred-seed weight. The highest values for both were observed at 30 cm intra-row spacing, with 1.6 cobs per plant and 30.75 g for hundred-seed weight. Furthermore, the interaction between inter and intra-row spacing significantly influenced the days to flowering and grain yield. The highest grain yield (4037.57 kg ha^{-1}) was achieved with the 65 cm $\times$ 30 cm combination, while the lowest grain yield (2222.52 kg ha^{-1}) was obtained from the combination of 30 cm intra-row and 85 cm inter-row spacing. Economic analysis showed the highest net benefit (100, 906.7 ETB ha^{-1}) from the combination of 30 cm intra-row and 65 cm inter-row spacing. Therefore, based on economic analysis it can be concluded that spacing combinations of 65 x 30 cm responded favorably in attaining higher grain yield for Melkassa-1 maize variety production in the moisture stress area of Borana zone and similar agro ecologies.

Keywords

Analysis of Variance, Grain Yield, Intra-Row Spacing, Inter-Row Spacing

1. Introduction

Maize is an annual crop of the family *Poaceae*, commonly known as the grass family and is a key source of food and livelihood for millions of people in many countries of the world [4]. It is regarded as one of the key strategic cereal crops for food security in both Ethiopia and globally. It is the world's leading and most versatile crops having wider adaptability. Globally, maize is known as the "queen of cereals" because it has the highest genetic yield potential among the cereals. Maize (*Zea mays* L.) has a critical nutritional role to play in human as it is the third important cereal crop globally after wheat and rice with regards to cultivation area, total production and consumption. Maize grain has greater nutri-

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tional value as it contains 72% carbohydrate, 8.8% protein, 2.15% fiber and 2.33% ash [6].

Maize is ranks second, after wheat in hectare coverage (187, 959, 116 ha) and first in total production (1, 060, 107, 470 MT) and productivity (5.64 t ha^{-1}) [15]. It is cultivated in a wide range of altitudes, moisture regimes, soil types and terrains, mainly by smallholder crop producers, which comprise 80 percent of the total population, in all regional states. Though maize is widely grown in Ethiopia, only three regional states contribute to 94% of the total annual production. These regions are Oromia (60%), Amhara (21.6%) and SNNP (12.55%). Thus, the trend of the National maize production was totally dependent on the production field of the three regions. In Ethiopia, maize has gained popularity as a staple crop, with consistent growth in both production area and yield over the years [10]. During the 2017 Meher season, approximately 10.9 million farmers cultivated maize across 2.1 million hectares, making it the country's leading cereal crop [9]. According to [9], around 108, 384.8 tons of maize were harvested from approximately 33, 951 hectares during the same season, with an average yield of 3.2 tons per hectare.

Among all the factors, which affect the corn yield remarkably, plant Density is one of the most important ones and due to its genetic potential, corn yield is different under various plant populations [1]. Optimal inter- and intra-row spacing is influenced by factors such as soil fertility, moisture availability, crop characteristics, and weed pressure [4]. Most of the farmers in Borana have been using different spacing from 50 to 60 cm inter row spacing and 20 to 30 cm intra row spacing even for tall and late maturing varieties (personal observation). This variation in spacing needs to be studied to improve yield of maize in study area. However, in this study area there was no research conducted regarding the effect of inter and intra row spacing on yield and yield components of maize variety. Therefore, the objectives of the study was to investigate the effects of intra and inter-row spacing on growth, yield components and grain yield of maize, and to identify economically acceptable maize intra and inter-row spacing in Yabello, Borana zone.

2. Material and Methods

2.1. Description of the Study Area

The experiment was carried out at Yabello Pastoral and dryland Agricultural research center on station for three consecutive years. The site is situated at about 04°52´49´´ latitude and 038°08´55´´longitude at 1656 meters above sea level. The area has annual mean minimum and maximum temperature of 13.5 and 23.7 ℃, respectively. The soil type of the experimental area is characterized as well drained sandy loam with a pH value of 7.03. The major annual crops grown in study area are Teff, maize, common bean and wheat.

2.2. Treatments and Experimental Design

The experiment consists two factors, namely three levels of intra row spacing (20, 25 and 30 cm), and four levels of inter row spacing (55, 65, 75, and 85 cm). The 3 x 4 treatment combinations were laid out in a Randomized Complete Block Design (RCBD) in factorial arrangement replicated three times. The gross size of each plot was 4.5 m × 3 m (13.5 m^2). The outermost row on both sides of each plot was considered border plants and was not used for data collection to avoid border effects. Adapted Melkasa-1 maize variety was used as test crop. This variety was selected based on better performance, early maturity and adaptability to the agro ecology of the study area. Melkassa-1 was characterized by short, early mature, yellow seed color and tolerant to moisture stress with yield potential of 4 t ha^{-1} at research field.

2.3. Experimental Procedures and Field Managements

The experimental field was ploughed and disked by tractor and pulverized to a fine tilth by hand digging. All agronomic and other crop management practices were applied as per the recommendations. The whole of blended NPS fertilizer was applied uniformly to all experimental plots during planting at the rate of 46 kg P_2O_5 ha^{-1} and UREA was applied in split form i.e, half Urea fertilizers was applied at sowing and the remaining half of urea was applied at the knee stage with a rate of 46% of N ha^{-1}. The spacing between blocks and plots was 1.5m and 1m, respectively.

2.4. Data Collection and Measurements

2.4.1. Phenological and Growth Parameters

Days to flowering was recorded as the days from planting to the date on which 50% of plants on the net plot produced at least their first flower. Days to physiological maturity was recorded as the number of days from planting to the stage when 90% of the plants in a plot reached physiological maturity. Plant height was measured as the height (cm) of five randomly taken plants from the ground level to the tip of the plant at the time of physiological maturity from the net plot area and the means were recorded as plant height.

2.4.2. Yield and Yield Components

Ear height, cob length and cob diameter were measured from five randomly selected plants from the middle rows. Similarly, the number of cobs per plant, number of rows per cob and number of seeds per row were counted from five randomly selected plants, and expressed as an average for each plot. Hundred seed weight was determined by taking the weight of 100 randomly sampled seeds from the total harvest from each net plot area and the weight was adjusted to 10% moisture level. Finally, yield per plot was measured from the net plot area and the weight was converted to kg ha^{-1}.

2.5. Data Analysis

All collected parameters were subjected to analysis of variance using of SAS computer software to test the significance of the treatments. Whenever the effects of the treatments were found to be significant, the means were compared using LSD test at 5% level of significance.

2.6. Partial Budget Analysis

The economically acceptable treatment (s) were determined by partial budget analysis to estimate the gross value of the grain yield by using the adjusted yield [11] at the market value of the grain during the cropping period. Only total costs that varied (TCV) were used to compute costs. Current prices of maize seed was considered as a variable. To estimate the economic parameters, 35 and 28 ETB kg^{-1} was used as the cost incurred for purchasing of seed at sowing time and market price value of maize grain yield at harvesting time, respectively. However, other fixed costs like cost of land preparation, field management, harvest, transportation, and storage were assumed to be equal for all and not included in the analysis. Treatment net benefits (NB) and TCV were compared using dominance analysis. Marginal rate of return, which refers to net income obtained by incurring a unit cost of seed, was calculated by dividing the net increase in yield of maize due to the application of each seed rate.

3. Result and Discussion

3.1. Analysis of Variance

The analysis of variance revealed that the main effect of Inter row spacing had a significant effect on almost all parameters except cob diameter, ear length and number of row per cob. Likewise, the main effect of intra row spacing was significantly affected number of cob per plant, hundred seed weight and grain yield. On the other hand, the interaction effect of both inter and intra row spacing had a significant effect on days to flowering and grain yield of Melkassa-1 Maize variety (Table 1).

Table 1. *Mean square of ANOVA for phenological and growth parameters, yield, and yield components of maize as affected by Intra-row and inter-row spacing.*

Source	FD	MD	PH (cm)	EH (cm)	NCPP	CD	EL (cm)	NSPR	NRPC	HSW (g)	GY (Kg/ha)
Year	1.565	5.9	31.03	111.31	0.13*	2.034*	44.87**	10.06*	0.58	54.43***	18679.49*
Rep	2.843	2.79	55.61	34.17	0.052	0.459	0.41	0.33	0.71	2.51	2676.79
Inter (A)	46.14**	675**	110.57*	110.93	0.23**	0.752	2.93	28.89**	0.63	37.72**	14589794**
Intra (B)	7.065	7.954	26.164	78.65	0.245**	0.514	0.0.032	6.7	1.86	25.25***	1182872**
A*B	14.72**	2.46	22.48	66.92	0.067	0.844	1.51	5.58	0.31	0.687	398327**
Error	2.56	5.73	32.6	55.302	0.04	0.48	1.19	3.031	0.74	3.125	5222
Mean	51.54	74.29	163.72	55.01	1.53	3.852	22.37	28.96	13.49	29.79	3115.5
CV (%)	3.1	3.22	3.49	13.52	12.81	17.99	4.87	6.013	6.35	5.93	2.32

Key: CV= coefficient of variation, *=significantly different at 5%, **=significantly different at 1%, DF= days to flowering, MD= days to physiological maturity, PH=plant height, EH=Ear height, NCPP=number of cob per plant, CD=cob diameter, EL=ear length, NSPR=number of seed per row, NRPC=number of row per com, HSW=hundred seed weight, GY grain yield.

3.2. Effect of Inter and Intra Row Spacing on Phenology and Growth Parameters of Maize

Days to flowering: Analysis of variance revealed that days to flowering was highly significantly (P<0.01) affected by main effects of inter row spacing and interaction of both inter and intra row spacing, whereas main effects of intra row spacing was not significant (Table 1).

The mean number of days required for flowering ranged between 50 and 55.56 for the interaction of both inter- and intra-row spacing. The earliest days to flowering (50 days) were recorded from the interaction of 65 cm inter-row with 20 cm intra-row spacing, while the longest days to flowering (55.56 days) were recorded from the interaction of 85 cm inter-row with 30 cm intra-row spacing. The results indicated that days to flowering increased as the inter- and intra-row spacing of maize increased. The significant difference in days to flowering might be attributed to increased plant density, leading to competitive stress factors such as light interception, nutrient uptake efficiency, and water availability, which promote earlier reproductive development under crowded conditions. Similarly, [7] reported that higher plant density delayed days to flowering.

Table 2. *Main effects of inter and intra row spacing on Days to flowering of maize.*

Inter row Spacing (cm)	Intra row spacing (cm)		
	20 cm	25 cm	30 cm
55 cm	50.78 [cd]	51.67 [bc]	50.11 [d]
65 cm	50 [d]	50.33 [cd]	50.11 [d]
75 cm	51.44 [bcd]	52.33 [b]	52.33 [b]
85 cm	52.44 [b]	51.33 [bcd]	55.56 [a]
LSD (5%)	1.50		
CV (%)	3.10		

Where, LSD =least of significance difference, CV= coefficient of variation.

Days to Physiological maturity: Analysis of variance revealed that Inter row spacing had a highly significant ($P< 0.01$) effect on days to maturity, but main effects of intra row spacing and the interaction effect of inter row and intra row spacing were not significant (Table 1).

The highest mean value for days to physiological maturity (80.59 days) was recorded from 85 cm inter row spacing; however, the minimum days to physiological maturity (69.52 days) was recorded from 55 cm inter row spacing. The increase in days to maturity of maize at the highest inter-row spacing might be due to the reduced competition for resources (light, nutrients, water) allowing for optimal growth conditions, which leads individual plants at wider spacing (85 cm) to take longer before reaching physiological maturity compared with those planted closer together. Similar findings were reported by [16], who observed that wider inter-row spacing in maize delayed physiological maturity due to reduced resource competition, leading to more optimal plant growth.

Table 3. *Main effects inter and intra row spacing on days to physiological maturity, plant height and ear height of maize.*

Inter row spacing	MD	PH (cm)	EH (cm)
85	80.59 [a]	161.91 [b]	55.93 [ab]
75	75.89 [b]	162.73 [b]	57.36 [a]
55	69.52 [d]	166.55 [a]	53.92 [ab]
65	71.15 [c]	163.69 [ab]	52.82 [b]
LSD (5%)	1.29	3.09	4.02
Intra row spacing			
30	74.81	164.125	53.38
25	74.17	162.74	55.36
20	73.89	164.29	56.28
LSD (5%)	NS	NS	NS
CV (%)	3.22	3.49	13.52

Where, LSD =least of significance difference, CV= coefficient of variation, MD=days to physiological maturity, PH= plant height, EH=Ear height.

Plant height: Analysis of variance revealed that Inter row spacing had a significant ($P< 0.05$) effect on days to maturity, but main effects of intra row spacing and the two-factor interaction was not significant (Table 1).

The tallest plant height (166.55 cm and 163.69 cm) was obtained from 55 cm and 65 cm inter row spacing, whereas the shortest plant height (161.91 cm) was recorded from 85 cm inter row spacing. The result showed that plant height increased at lowest inter row spacing. This might be due to their competition among plants for light more intensely. Similarly, [5] noted that the increase in plant height under the narrowest spacing could be attributed to intense competition among plants for light. Likewise, [8] also reported that the longer plant height was recorded from narrow plant spacing; while the shortest plant height from wide this is may be due to nutrients competition.

Ear Height: Analysis of variance revealed that main effects of inter row, intra row spacing and their interaction had non-significant effect on ear height (Table 1).

3.3. Effect of Inter and Intra Row Spacing on Yield and Yield Components of Maize

Number of Cob per Plant and Cob Diameter: The analysis of variance indicated that both inter- and intra-row spacing had a highly significant effect ($P < 0.01$) on the number of cobs per plant, while the interaction between the two factors was not significant. On the other hand, neither both main effects nor interaction of both factor was significantly affected the cob diameter of maize (Table 1).

The highest number of cobs per plant (1.61) was recorded at 65 cm inter-row spacing, which was statistically similar to the results observed at 75 cm and 85 cm inter-row spacing. Regarding the main effects of intra-row spacing, the highest mean number of cobs per plant was achieved at 30 cm spacing, while the lowest was observed at 20 cm spacing. The results indicated that the number of cobs per plant increased with wider intra-row spacing. This improvement could be attributed to enhanced resource availability, reduced competition for light, improved pollination efficiency, better plant health, and the potential to fully express the plant's genetic capacity. Supporting this finding, [3] reported a higher number of ears per plant at wider intra-row spacing. Similarly, [13] observed significant variations in the number of kernels per ear across different intra-row spacing, likely due to reduced intra-plant competition in widely spaced plants compared to closely spaced ones.

Table 4. *Main effects inter and intra row spacing on yield components of maize.*

Inter row spacing (cm)	NCPP	CD	EL (cm)	NSPR	NRPC	HSW (g)
85	1.51 [ab]	3.86	22.39	29.67 [a]	13.27	31.5 [a]
75	1.593 [a]	4.05	22.83	29.76 [a]	13.52	29.27 [b]
55	1.41 [b]	3.64	22.07	27.52 [b]	13.62	28.81 [b]
65	1.61 [a]	3.85	22.2	28.87 [a]	13.56	29.57 [b]
LSD (5%)	0.106	NS	NS	0.941	NS	0.956
Intra row spacing (cm)						
30	1.6 [a]	3.83	22.38	29.45	13.23	30.75 [a]
25	1.55 [a]	3.74	22.34	28.66	13.59	29.38 [b]
20	1.4 [b]	3.98	22.4	28.75	13.66	29.24 [b]
LSD (5%)	0.092	ns	ns	ns	ns	0.83
CV (%)	12.81	17.99	4.87	6.01	6.35	5.93

Where, LSD =least of significance difference, CV= coefficient of variation, ns=non-significant, NCPP=number of cobs per plant, CD=cob diameter, EL=ear length, NSPR=number of seed per row, NRPC=number of row per cob and HSW= hundred seed weight.

Ear length and Number of seed per row: The Analysis of variance revealed that main effect of inter row, intra row spacing and their interaction were non-significantly affected ear length and number seed per row, except main effect of inter row spacing significantly ($P<0.01$) affected number of seed per row (Table 1).

The highest number of seed per row (28.87) was obtained from 65 cm inter row spacing; whereas the lowest seed number per row was recorded from 55 cm inter row spacing. This might be due to moderate inter row spacing of 65 cm led to optimal conditions for balanced resource allocation nutrient uptake was increased without excessive competition hindering growth potential. In line with this finding, [14] also reported that main effect of inter-row spacing was significantly affected the number of grains per row of hybrid maize in west Gojjam zone.

Hundred seed weight (g): The results of analysis of variance showed that the main effects of Inter and Intra row spacing were significantly ($P< 0.01$) affected hundred seed weight; however, their interaction was not significant (Table 1).

The highest hundred seed weight was obtained from 85 cm inter row spacing; whereas the lowest hundred seed weight was recorded from 55 cm inter row spacing. On the other hand, the highest and lowest hundred seed weight was recorded from 30 cm and 20 cm intra row spacing respectively. This result indicated that the hundred seed weight was increased as inter and intra row spacing was increased and vice versa. This might be due to increased inter and intra row spacing reduces competition for resources like light, water and nutrients, resulting in larger and heavier seeds thereby increasing the hundred seed weight. Similarly, [12] also reported increased inter and intra row spacing reduces competition for resources like light, water and nutrients, resulting in larger and heavier seeds thereby increasing the hundred seed weight.

Grain Yield

Analysis of variance showed that Grain yield of maize was highly significantly ($P<0.01$) affected by interaction effects of both inter and Intra row spacing, as well as main effects of inter and intra row spacing. Consistent with this finding, [12] repoted that both the main effects of inter- and intra-row spacing, as well as their interaction, had a highly significant impact ($P < 0.01$) on grain yield (Table 1).

Accordingly, the highest grain yield (4037.57 kgha^{-1}) was obtained in combination of 65 cm × 30 cm which is statistically similar with combination of (75 cm x 25 cm), while the lowest grain yield (2222.52 kgha^{-1}) was obtained at wider inter and widest intra row spacing combination (85 cm × 30 cm) (Table 5). This might be primarily due to optimal plant density that enhances resource allocation, improves conditions favorable for growth, and maximizes competitive advantages among plants without causing excessive stress. Conversely, wider spacing like (85 cm x 30 cm) result in lower yields due to reduced plant population density. Previous research findings also indicated that plants grown on wider spacing absorb more nutrients and solar radiation for improved photosynthesis and hence produce better grain yield on an individual basis but yield per unit area reduced due to a thin or low plant stand [2, 11].

Table 5. *Interaction effects of Inter and Intra row spacing on yield of maize.*

Inter row spacing (cm)	Intra row spacing (cm)		
	20	**25**	**30**
55	2320.41 [h]	2534.22 [g]	2907.19 [f]
65	3420.05 [e]	3699.35 [c]	4037.57 [a]
75	3568.35 [d]	3981.37 [a]	3778.58 [b]
85	2319.56 [h]	2596.88 [g]	2222.52 [i]
LSD (5%)	67.66		
CV (%)	2.32		

3.4. Partial Budget Analysis

The economic analysis was conducted using the methodology described by [17]. The average yield of maize obtained from each treatment was used as the basis for the economic analysis. As a result, (Table 6) displays the estimated net benefits for each of the 12 treatments. The interaction of 30 cm intra-row spacing and 65 cm inter-row spacing produced the highest net benefit (100, 906.7 ETB ha^{-1}), whereas the lowest net benefit (55, 377 ETB ha^{-1}) was obtained from the interaction of 30 cm intra-row spacing and 85 cm inter-row spacing (Table 6). The marginal rate of returns for un-dominated treatments is presented in Table 7. The minimum acceptable marginal rate of return will fall between 50% and 100% as suggested by [17]. Considering both net benefit and the acceptable marginal rate of return, 30 cm intra-row spacing with 65 cm inter-row spacing are recommended for maize production.

Table 6. *Partial budget analysis for the effects of Inter and intra-row spacing on grain yield of Maize.*

Intra* Inter	Av. Yield (kg ha^{-1})	Adj. GY (kg ha^{-1})	Seed (kgha^{-1})	TVC	Gross Return (ETB ha^{-1})	Net Benefit (ETBha^{-1})	Dominance Analysis
30*85	2222.52	2000.27	18	630	56007.56	55377.56	
30*75	3778.58	3400.72	21	735	95220.16	94485.16	
25*85	2596.88	2337.19	22	770	65441.32	64671.32	D
30*65	4037.57	3633.81	24	840	101746.7	100906.7	
25*75	3981.37	3583.23	25	875	100330.4	99455.44	D
20*85	2319.56	2087.6	28	980	58452.8	57472.8	D
30*55	2907.19	2616.47	28	980	73261.16	72281.16	D
25*65	3699.35	3329.42	29	1015	93223.76	92208.76	D
20*75	3568.35	3211.52	31	1085	89922.56	88837.56	D
25*55	2534.22	2280.8	34	1190	63862.4	62672.4	D
20*65	3420.05	3078.05	36	1260	86185.4	84925.4	D
20*55	2320.41	2088.37	43	1505	58474.36	56969.36	D

Key: D=Dominated, ETB= Ethiopian birr, Kg=Kilogram TVC=Total variable cost, Cost of seed at time of sowing per kg = 35 Birr, Cost of grain at time of harvesting per kg = 28 ETB.

Table 7. *Calculated net benefits, and marginal rate of return for un-dominated treatments.*

Intra*Inter	TVC	MC	NB (ETBha^{-1})	MB (ETBha^{-1})	MRR (%)
30*85	630		55377.56		
30*75	735	105	94485.16	39107.6	372.45
30*65	840	105	100906.7	6421.52	61.16

Key: TVC = Total variable cost; MC= marginal cost, NB=net benefit MB= marginal benefit, MRR= marginal ret of return, ETB= Ethiopian birr.

4. Conclusion and Recommendations

The lack of optimum plant population is a major factor limiting maize yield in the study area. Ensuring proper plant density can increase seed yield, though the optimum intra- and inter-row spacing depends on factors such as soil fertility, moisture, crop nature, and weed levels. Therefore, this study was conducted to investigate the effects of intra- and inter-row spacing on maize growth, yield components, and grain yield. Three intra-row spacing (20, 25, and 30 cm) and four inter-row spacing (55, 65, 75, and 85 cm) were tested in a factorial Randomized complete block design using the Melkassa-1 maize variety. The results revealed that inter-row spacing significantly affected most parameters, except cob diameter, ear length, and the number of rows per cob. The highest number of cobs per plant (1.61) was observed at 65 cm inter-row spacing, which was comparable to the 75 cm and 85 cm inter-row spacing. The highest number of seeds per row (28.87) was found at 65 cm inter-row spacing, while the lowest was observed at 55 cm. Intra-row spacing significantly affected the number of cobs per plant and the hundred-seed weight. The highest values for both were observed at 30 cm intra-row spacing, with 1.6 cobs per plant and 30.75 g for hundred-seed weight. Furthermore, the interaction between inter- and intra-row spacing significantly influenced the days to flowering and grain yield. The earliest flowering (50 days) occurred with the combination of 65 cm inter-row and 20 cm intra-row spacing, while the latest flowering (55.56 days) occurred with the combination of 85 cm inter-row and 30 cm intra-row spacing. The highest grain yield (4037.57 kg ha^{-1}) was achieved with the 65 cm × 30 cm combination, while the lowest grain yield (2222.52 kg ha^{-1}) was obtained from the combination of 30 cm intra-row and 85 cm inter-row spacing. Economic analysis showed the highest net benefit (100, 906.7 ETB ha^{-1}) from the combination of 30 cm intra-row and 65 cm inter-row spacing. Therefore, the 65 cm × 30 cm spacing is recommended for maize production in the Borana lowlands and similar agro-ecologies for the Melkassa-1 maize variety.

Abbreviations

ETB	Ethiopian Birr
CSA	Central Statistical Agency
ANOVA	Analysis of Variance
LSD	Least Significance Difference
CIMMYT	International Maize and Wheat Improvement Center

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Conflicts of Interest

The authors declare no conflicts of interest.

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