

Evaluation of variability in Some Local Genotypes of Maize (*Zea mays* L) under rain fed at Damazin Research Station, Blue Nile State

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Abstract Estimation of the genetic variability among 18 local genotypes of Maize (*Zea mays* L) was recorded. In a genotype X tester fashion, 16 genotypes were crossed with low testers. All the 32 F₁ genotype and their 18 parents were sown for two seasons (2007/08 and 2008/09), in summer (Autum). The results in season 2007/08 indicated highly significant differences for Number of leaves / plant while significant for the--- character--- day's to 50% tasselling, stem diameter, leaf area, Cob bareness% Cob diameter, Cob weight, yield/ plant and yield (t/ha). On the other hands in season 2008/09, a highly significant differences were shown for three characters (day's to 50% tasselling, Cob diameter and yield t/ha), while significant for six characters (stem diameter, Number of leaves/Plant, leaf area, Cob bareness%, Cob weight and yield per plant).

Keywords Maize, Hybrid, Yield and Damazin Area

1. Introduction

Maize (*Zea mays* L) ranks as one of the worlds' three most important cereal crop. It is cultivated in wider range of environments than wheat and rice because of its greater adaptability (Koutsika and Sotiriou, 1999). Currently, its global production area is about 140 million hectares, of which approximately 96 million hectares in the developing countries. Although 68% of the world maize area is in developing countries, 46% of the world's maize production of 602 million tons (FAO, 2003) is produced in other area. Low average yields in the tropics are responsible for the wide gap between the global share of area and of production (Heisey and Edmeades, 1999 and Pingali and Pandey, 2000).

Drought and low N₂ stresses are factors most frequently limiting maize production in the tropics (Edmeades et al., 1997; Banziger et al., 1999b and Vasal et al., 1997; 1999).

The objective of the study is to evaluate 50 local maize genotypes from Blue Nile State for yield and yield components.

2. Materials and Methods

This trial was carried out in summer (Autum of 2007 and 2008) for two seasons at Damazin Research Station Farm, Blue Nile State (11° 57. 460N, lat. and 34° - 13.547 E. long). The genetic materials used in this study (Table 1) consisted of 50 local maize, using a Randomized Complete Block Design (RCBD) with four replications. Each block (replicate) was divided into plots, to which the hybrids and their parents were assigned randomly. The plot sizes were four rows of 4 meters length 70 Cm spacing between rows and 20 Cm between hills. Planting rate was made as three seeds / hole. These were then thinned to one plant / hole after two weeks from sowing. Sowing practiced was on 12th of July in season 2007 and 14th of July 2008. Weeding was carried out when needed. One row at each side of the plot was treated as a boarder row to avoid the inter row competitions. Ten randomly selected plants from the middle of the two rows of each plot were used to record the data on the following: Days to 50% tasselling, stem diameter, Number of leaves| plant, leaf area, Cob bareness%, Cob diameter, Cob weight, yield| plant and yield /(t/ha). The collected data were analyzed based on individual and combined analysis of variance. The procedure described by Gomez and Gomez (1984) were used to estimate the individual and combined analysis of variance.

Table 1. 50 local maize (genetic materials) used in the study

Genotype code	Pedigree	Type
1	M ₄₅	Tester
2	H ₁	Tester
3	B ₁	Local (lines)
4	B ₂	Local (lines)
5	B ₃	Local (lines)
6	B ₄	Local (lines)
7	B ₅	Local (lines)
8	D ₁	Local (lines)
9	D ₂	Local (lines)
10	D ₃	Local (lines)
11	D ₄	Local (lines)
12	D ₅	Local (lines)
13	D ₆	Local (lines)
14	R ₁	Local (lines)
15	R ₂	Local (lines)
16	R ₃	Local (lines)
17	R ₄	Local (lines)
18	R ₅	Local (lines)
F ₁ Hybrids		
19	B ₁ × M ₄₅	Local
20	B ₂ × M ₄₅	Local
21	B ₃ × M ₄₅	Local
22	B ₄ × M ₄₅	Local
23	B ₅ × M ₄₅	Local
24	B ₁ × H ₁	Local
25	B ₂ × H ₁	Local
26	B ₃ × H ₁	Local
27	B ₄ × H ₁	Local
28	B ₅ × H ₁	Local
29	D ₁ × M ₄₅	Local
30	D ₂ × M ₄₅	Local
31	D ₃ × M ₄₅	Local
32	D ₄ × M ₄₅	Local
33	D ₅ × M ₄₅	Local
34	D ₆ × M ₄₅	Local
35	D ₁ × H ₁	Local
36	D ₂ × H ₁	Local

37	D ₃ × H ₁	Local
38	D ₄ × H ₁	Local
39	D ₅ × H ₁	Local
40	D ₆ × H ₁	Local
41	R ₁ × M ₄₅	Local
42	R ₂ × M ₄₅	Local
43	R ₃ × M ₄₅	Local
44	R ₄ × M ₄₅	Local
45	R ₅ × M ₄₅	Local
46	R ₁ × H ₁	Local
47	R ₂ × H ₁	Local
48	R ₃ × H ₁	Local
49	R ₄ × H ₁	Local
50	R ₅ × H ₁	Local

3. Results & Discussion

3.1. Days to 50% Tasselling

There was highly significant differences ($p \leq .01$) among the evaluated maize genotypes, in days to 50% tasselling---- in second season while significant in first season (Table 2). The genotype X tester analysis of variance (Table 3) showed highly significant differences for crosses in second and non-significant for genotypes and tester, and location in first season ----. The combined analysis of variance Table (4) showed highly significant differences for genotype and non-significant for season X genotypes (SXG). The earliest genotype was D₄ (54.4 day) during the first season and the Latest--- were M₄₅ X D₃ (61.1 day), while in the second season, the latest one were M₄₅ X D₃ (61.1 day), and in the 2nd season the earliest were H₁ X R₃ (54.8 day) and H₁ X R₂ (60.4 day) is the latest one. The overall mean days to 50% tasselling was 57.8% in both seasons. During the first season, the earliest genotype was R₅ (54.7 day) during the first season and H₁ X R₁ (60.4 days) were the latest. In the second season, D₅ (54.9 day) were the earliest and H₁ X R₂ (61.8 day) was the latest one. The overall mean days to 50% tasselling were 57.2 and 58.0 days in the first and the second season respectively. The coefficient of variations was 2.121% in the first season and 3.93 in the second season.

Table 2. Mean square from analysis of variances for different characters in fifty maize genotypes evaluated during season 2007/2008 at Blue Nile State.

Character	Genotype	
	Mean squares	
Day to 50% tasselling	22.1*	18.3**
Stem diameter (Cm)	20.7*	18.4*
Leaf/ plant	3.1**	2.7*
Leaf/ area(Cm ²)	16086.1*	121023.3*
Cob parents	0.9*	0.8*
Cob diameter(Cm)	0.3*	0.2**
Cob weight(g)	927.6*	811.4*
yield/ plant	2162.1*	2045.3*
yield ton/ ha	6.1*	5.8**

*= Significant

** = Highly significant

NS= Non significant

Table 3. Mean squares from the analysis of variance for some morphological characters in fertility maize genotype evaluated Damazin season 2007

Characters	Crosses d.f=31	Lines d.f=15	Tester d.f=1	Lines x tester d.f=15	Error d.f=147
Day to 50% tasselling	11.57**	14.04ns	2.20ns	9.72ns	6.10
Stem diameter	0.43**	0.49ns	0.02ns	0.40**	0.07
Leaf/ plant	5.22**	6.02ns	1.40ns	4.67**	0.63
Leaf/ area	15798.90**	12330.88ns	78.75ns	20314.92**	1628.35
Cob parens	1.64**	2.88**	0.43ns	0.47**	0.15
Cob diameter	0.52**	0.52ns	4.69ns	0.25*	0.12
Cob weight	561.45**	553.83ns	2349.55*	449.87**	21.12
yield/ plant	108.15**	144.42ns	5.61ns	78.72**	8.29
yield ton/ ha	2.59**	2.27ns	3.03ns	2.88**	0.17

*= Significant

** = Highly significant

NS= Non significant

Table 4. Mean squares from the analysis of variance for some morphological characters in 50 maize genotype evaluated Damazin season 2008

Characters	Crosses d.f=31	Lines d.f=15	Tester d.f=1	Lines x tester d.f=15	Error d.f=147
Day to 50% tasselling	9.92*	13.36ns	3.51ns	6.90ns	6.03
Stem diameter	0.39**	0.32ns	0.20ns	0.47**	0.08
Leaf/ plant	5.48**	5.05ns	0.01ns	6.28**	1.10
Leaf/ area	11158.35**	12169.95ns	23620.51ns	9315.94**	1581.27
Cob parens	1.64**	2.88**	0.43ns	0.47**	0.15
Cob diameter	0.52**	0.52ns	4.69**	0.25*	0.12
Cob weight	561.45**	553.83ns	2349.55*	449.87**	21.12
yield/ plant	108.15**	144.42ns	5.61ns	78.72**	8.29
yield ton/ ha	3.33**	1.46ns	58.19**	1.54**	0.24

*= Significant

** = Highly significant

NS= Non significant

Table 5. Mean square from the combined analysis of variance for some morphological character in 50 maize genotypes evaluated Damazin for two seasons 2007/2008

Source of variation	Day to 50% tasselling	Stem diameter (cm)	Leaf/ plant	Leaf/ area (cm ²)	Cob bareness (%)	Cob diameter (cm)	Cob weight (g)	yield/ plant (g)	yield ton/ ha
Rep/ yrs d.fb	4.29	-	-	4968.43	0.04	0.20	32.87	28.16	0.24
Season (s)dsl	0.67 ^{ns}	-	-	30923.22 ^{**}	0.00 ^{ns}	0.00 ^{ns}	0.00 ^{ns}	0.00 ^{ns}	4.62 ^{**}
Genotype(G) f44	20.82 ^{**}	-	-	26366.11 ^{**}	2.84 ^{**}	0.97 ^{**}	1362.16 [*]	378.77 ^{**}	3.85 ^{**}
Sx G.df49	1.30 ^{ns}	-	-	2358.76 [*]	0.00 ^{ns}	0.00 ^{ns}	0.00 ^{ns}	0.00 ^{ns}	4.53 ^{**}
Pooled 279 error ds	6.07	-	-	1604.81	0.15	0.12	21.12	8.29	0.20

*= Significant

** = Highly significant

NS= Non significant

3.2. Stem Diameter

The genotype X tester analysis of variance recorded highly significant differences for crosses in both seasons and locations, but for genotypes and tester non-significant differences was obtained in both seasons. The combined analysis of variance Table (4) showed significant differences, for seasons, genotypes, and non-signification for genotypes X seasons, The largest stem diameter were M₄₅ X B₁ (3.1 Cm) in the first season and the smallest genotype were R₄ (1.6 Cm) in the second season, the M₄₅ X B₁ (3.0 Cm) and the lowest one were detected by the genotype M₄₅ X B₅ (1.7 Cm), with the overall mean of stem diameter of 2.1 and 2.2 Cm in the first and second season respectively, and the coefficient of variation of 12.766% in the first season and 13.01% in the second season.

3.3. Number of Leave Per Plant

Individual analysis of variance revealed significant differences, and indicated that the significant difference

among the genotype in first season and highly significant differences in second season (Table 2). The genotype X tester analysis of variance (Table 3) showed highly significant differences for the crosses in both seasons and locations. Non significant differences were showed for genotype and testers in both seasons and location, while highly significant differences were recorded for genotype X tetter in both seasons and location. The combined analysis of variance showed highly significant for season, genotype and season genotype in location (Table 4). The highest number of leaves /plant was reported by genotype B₂ (15.2) as shown in Table (6) and the lowest leaves per plant by genotype M X B₂ (11.0) in the first season, while in the second season the highest leaves per plant was reported by genotype B₂ (14.9) and the lowest one was given by genotype M₄₅ X D₄ (11.2), with the overall mean number of leaves per plant as 13.0 in the first season and 13.1 in the second one with the coefficient of variation of 6.09% and 7.99% in the first and second season, respectively.

Table 6. Means of the different character in 50 maize genotype evaluated Blue Nile in season 2007 at Damazin

Genotype	Days to 50% Tasseling	Stem diameter (CM)	Number of leaves /plant	leaf area (cm)	Cob Barness	Cob diameter (cm)	Cob weight (cm)	yield per plant(g)	yield t/h
M45	57.0	2.0	12.7	374.1	1.9	4.2	116.1	98.4	4.1
H1	57.0	1.9	11.5	392.6	1.7	3.8	112.7	106.0	4.8
B1	55.6	2.3	13.5	408.7	1.5	3.8	120.0	84.8	4.1
B2	61.4	2.2	15.2	302.4	1.4	4.6	107.8	84.3	4.0
B3	56.7	2.2	12.7	269.4	1.9	3.5	95.6	99.0	3.9
B4	57.2	1.9	13.2	275.4	1.4	3.6	125.1	86.5	4.2
B5	56.3	2.3	12.3	307.2	1.7	4.5	113.9	81.2	4.3
D1	56.8	2.1	13.7	422.2	1.6	4.1	118.0	76.6	4.0
D2	58.9	2.8	14.7	377.1	1.7	4.1	119.8	83.3	4.4
D3	56.7	1.9	13.6	292.9	1.7	4.3	112.4	85.2	4.3
D4	54.4	1.8	12.7	405.6	2.4	3.7	94.3	81.2	4.7
D5	55.2	2.3	12.6	355.0	2.2	4.2	98.0	77.3	4.0
D6	57.7	2.0	11.7	407.0	1.7	3.6	95.1	76.7	5.3
R1	55.9	1.9	14.8	227.0	1.5	3.8	87.9	75.3	2.0
R2	56.9	1.8	11.8	325.6	2.2	3.9	85.2	78.9	4.1
R3	56.0	1.8	12.4	190.2	1.6	4.0	118.8	85.8	4.1
R4	57.7	1.6	13.9	368.9	2.4	3.6	111.2	88.9	4.2
R5	59.8	2.2	15.1	338.0	2.5	3.7	100.4	83.9	4.0
M45XB1	60.6	3.1	11.0	302.3	2.7	4.1	93.4	83.4	3.9
M45XB2	56.3	2.2	14.1	479.3	1.5	3.9	95.8	81.2	3.4
M45XB3	59.0	2.5	13.4	351.4	2.7	4.3	118.9	74.0	3.4
M45XB4	58.7	1.9	13.5	294.8	3.1	3.9	105.7	83.3	3.4

M45XB5	57.3	1.7	13.3	391.0	1.8	3.8	102.4	82.9	3.7
M45XD1	57.7	2.2	11.1	360.7	1.9	4.4	96.0	81.7	4.1
M45XD2	57.4	2.2	12.7	234.1	1.6	4.4	100.0	82.4	4.5
M45XD3	61.8	1.8	13.6	326.9	1.9	3.9	103.6	80.9	5.3
M45XD4	55.8	2.1	11.4	241.8	2.9	3.4	99.6	79.0	4.2
M45XD5	60.3	1.9	13.1	256.2	2.1	4.0	105.3	79.8	3.3
M45XD6	58.5	1.7	11.8	382.5	3.1	3.9	88.1	77.1	4.0
M45XR1	57.3	1.7	11.2	361.7	2.6	4.5	95.9	80.0	4.1
M45XR2	57.6	2.1	14.8	329.3	2.1	3.8	95.9	82.3	4.9
M45XR3	56.3	2.6	13.8	229.6	1.9	4.0	94.9	74.7	5.0
M45XR4	56.5	1.9	12.1	330.3	2.5	4.2	93.9	81.3	3.5
M45XR5	59.4	2.4	14.2	403.3	3.6	3.9	116.1	83.0	3.1
H1XB1	56.9	2.3	13.6	384.7	2.6	3.1	106.1	84.1	3.2
H1XB2	60.1	2.3	13.5	347.9	1.7	3.7	108.4	84.9	4.6
H1XB3	61.0	2.4	11.8	356.1	3.9	3.5	87.2	56.6	5.4
H1XB4	59.6	1.9	12.8	279.7	2.9	3.6	75.6	76.5	4.5
H1XB5	60.7	2.2	11.2	269.2	1.9	2.9	87.1	75.9	5.3
H1XD1	59.2	2.0	11.9	215.4	1.4	3.4	84.7	81.5	4.7
H1XD2	58.3	2.5	14.3	273.9	1.6	4.0	86.3	82.1	4.8
H1XD3	57.7	1.9	14.1	307.2	1.5	3.8	105.9	84.0	3.2
H1XD4	56.0	2.3	14.9	422.2	2.4	3.3	113.4	82.5	6.1
H1XD5	60.5	2.6	12.5	377.1	2.2	4.0	94.5	79.6	3.6
H1XD6	57.2	1.9	11.9	292.9	2.8	3.7	85.8	84.2	3.4
H1XR1	56.6	1.9	12.7	405.6	2.7	4.1	69.2	83.2	3.7
H1XR2	60.0	1.7	14.2	384.7	1.6	3.7	75.0	77.6	5.2
H1XR3	56.1	1.7	14.1	347.9	2.3	3.4	82.0	83.4	3.3
H1XR4	57.0	2.2	12.4	356.1	2.1	4.0	100.8	79.7	3.3
H1XR5	57.9	2.1	12.7	279.7	2.8	3.9	106.3	84.5	4.3
Overall means	57.8	2.1	13.0	332.3	2.1	3.9	100.1	82.0	4.1
C.V%	4.27	12.66	6.09	12.14	17.85	9.12	4.59	3.51	9.87

3.4. Leaf Area (Cm²)

The individual analysis of variance for leaf area indicated significant differences among the evaluated genotypes at location in both seasons (Table 2). The mean square for genotype X tester analysis showed highly significant differences for crosses at location, season. Non-significant for genotypes and testers were detected in both years and location (Table 3). On the other hand, the combined analysis recorded highly significant differences for genotypes X tester in both seasons and location. The combined analysis of variance showed (table 7) highly significant differences for season, genotypes, and seasons X genotypes. Maximum leaf area were recorded by genotype M₄₅ X B₂ (479.3 Cm), while the minimum one were given by the genotype R₁(190.2Cm) in the first season, but in the second season, the maximum leaf area were recorded by genotype M₄₅ X B₂ (453.2cm) and the minimum one were recorded by genotype R₃(192.4), with the overall mean leaf area of 332.3 Cm² in the first season and 314.7 Cm² in the second one. The coefficient of variation was 12.14% in the first season and 12.64% in the second season.

Table 7. Means of the different character in 50 maize genotype evaluated Blue Nile in season 2008 at Damazin

Genotype	Days to 50% Tasseling	Stem diameter (Cm)	No. of leave\ plant	leaf area (Cm)	Cob Barnes	Cob diameter (cm)	Cob weight (cm)	yield /plant (g)	yield t/h
M45	57.4	2.0	12.9	358.7	1.9	4.2	116.1	98.4	6.1
H1	59.0	1.9	12.2	342.5	1.7	3.8	112.7	106.0	5.5
B1	56.7	2.3	13.6	375.1	1.5	3.8	120.0	84.8	6.7
B2	61.2	2.2	14.9	301.1	1.4	4.6	107.8	84.3	6.5
B3	56.6	2.4	13.2	272.9	1.9	3.5	95.6	99.0	5.7
B4	58.2	2.3	13.1	257.9	1.4	3.6	125.1	86.5	4.2
B5	57.4	2.5	12.5	292.1	1.7	4.5	113.9	81.2	5.4
D1	57.2	2.3	13.4	422.2	1.6	4.1	118.0	76.6	4.0
D2	59.0	2.7	14.9	356.4	1.7	4.1	119.8	83.3	4.4
D3	57.6	1.8	13.6	320.2	1.7	4.3	112.4	85.2	4.3
D4	55.3	1.8	12.6	386.8	2.4	3.7	94.3	81.2	4.7
D5	55.2	2.3	12.7	355.0	2.2	4.2	98.0	77.3	5.2
D6	57.8	2.0	11.7	408.6	1.7	3.6	95.1	76.7	5.3
R1	56.2	1.9	14.6	231.2	1.5	3.8	87.9	75.3	6.3
R2	57.5	1.8	11.7	324.1	2.2	3.9	85.2	78.9	4.1
R3	56.4	1.8	12.6	192.4	1.6	4.0	118.8	85.8	4.1
R4	60.1	1.8	13.9	362.0	2.4	3.6	111.2	88.9	4.2
R5	58.6	2.2	14.7	336.0	2.5	3.7	100.4	83.9	4.0
M45XB1	59.7	3.0	12.1	303.8	2.7	4.1	93.4	83.4	3.9
M45XB2	56.1	2.1	14.5	453.2	1.5	3.9	95.8	81.2	3.4
M45XB3	58.3	2.5	13.8	349.3	2.7	4.3	118.9	74.0	3.4
M45XB4	58.0	2.0	13.3	289.6	3.1	3.9	105.7	83.3	3.4
M45XB5	56.8	1.7	15.3	382.3	1.8	3.8	102.4	82.9	3.7
M45XD1	58.3	2.2	11.4	354.6	1.9	4.4	96.0	81.7	4.1
M45XD2	57.4	2.1	12.4	229.2	1.6	4.4	100.0	82.4	4.5
M45XD3	60.9	2.0	13.6	326.9	1.9	3.9	103.6	80.9	5.3
M45XD4	55.9	2.2	11.2	233.1	2.9	3.4	99.6	79.0	4.2
M45XD5	59.5	2.1	13.4	265.6	2.1	4.0	105.3	79.8	3.3
M45XD6	58.3	1.8	11.8	346.7	3.1	3.9	88.1	77.1	3.8
M45XR1	57.1	1.9	11.2	344.8	2.6	4.5	95.9	80.0	4.1
M45XR2	57.5	2.3	14.6	298.9	2.1	3.8	95.9	82.3	4.9
M45XR3	55.4	2.8	13.9	240.9	1.9	4.0	94.9	74.7	5.0
M45XR4	56.0	2.1	12.1	331.6	2.5	4.2	93.9	81.3	3.5
M45XR5	57.7	2.5	14.3	387.1	3.6	3.9	116.1	83.0	3.1
H1XB1	57.1	2.3	13.7	372.9	2.6	3.1	106.1	84.1	3.2
H1XB2	59.8	2.4	13.6	347.8	1.7	3.7	108.4	84.9	2.4

H1XB3	60.1	2.4	12.0	361.0	3.9	3.5	87.2	56.6	1.8
H1XB4	58.3	2.0	13.0	276.0	2.9	3.6	75.6	76.5	2.0
H1XB5	60.0	2.4	11.3	270.9	1.9	2.9	87.1	75.9	2.0
H1XD1	58.6	2.1	11.8	208.4	1.4	3.4	84.7	81.5	2.1
H1XD2	57.4	2.4	14.3	268.9	1.6	4.0	86.3	82.1	2.4
H1XD3	58.1	2.1	13.9	302.1	1.5	3.8	105.9	84.0	3.2
H1XD4	56.2	2.4	14.9	293.6	2.4	3.3	113.4	82.5	3.1
H1XD5	60.0	2.7	12.1	276.5	2.2	4.0	94.5	79.6	3.2
H1XD6	57.1	2.8	11.9	282.3	2.8	3.7	85.8	84.2	3.4
H1XR1	56.7	1.9	12.8	272.5	2.7	4.1	69.2	83.2	2.6
H1XR2	60.4	2.0	14.1	283.2	1.6	3.7	75.0	77.6	2.1
H1XR3	54.8	1.9	13.8	312.8	2.3	3.4	82.0	83.4	2.3
H1XR4	56.5	2.3	12.6	274.6	2.1	4.0	100.8	79.7	3.3
H1XR5	57.0	2.4	12.8	299.3	2.8	3.9	106.3	84.5	2.9
Overall means	57.8	2.2	13.1	314.7	2.1	3.9	100.1	82.0	3.9
C.V%	4.25	13.01	7.99	12.64	17.85	9.12	4.59	3.51	12.48

3.5. Cob Bareness%

In the two seasons at location, significant differences in percent of cob bareness percentage were detected among the different genotype, which showed highly significant differences for the crosses in both seasons and location, significant for line and tester in both seasons and location, while highly significant differences were detected for genotype X tester, in both seasons and location (Table 3). The combined analysis of variance (table 7) showed highly significant differences for seasons, genotype and seasons X genotype in both seasons and locations as shown in Table (4). The higher percentage of cob bareness were observed by $H_1 \times B_3$ (3.9%) and the lowest one were recorded by $H_1 \times D_1$ (1.4%) in first season, while in the second season the highest one were given by genotype $H_1 \times B_3$ (3.9%) and the lowest one were given by genotype $H_1 \times D_3$ (1.4%).The overall mean for this character was 2.1% in both seasons, and the coefficient of variation of was 17.985 in both seasons.

3.6. Cob Diameter (Cm)

Table (2) indicated that Individual analysis of variance were significant for cob diameter among the evaluated genotype in first season while it was highly significant in second season. The mean squares for genotype X tester analysis showed highly significant differences for crosses in first season and location while highly significant for line and the taster were detected in second season and location (Table 3). On the other hand highly significant differences for genotype X tester in both seasons and location were recorded . The combined analysis of variance showed highly

significant differences for seasons, genotypes, and genotype X seasons in location as revealed in Table (4). The cob diameter ranged from 2.9 Cm for genotype $H_1 \times B_5$ to 4.6 Cm for genotype B_2 in both seasons. The overall mean of cob diameter of 3.5 Cm in both seasons, and the coefficient of variation was 9.12% in both seasons.

3.7. Cob Weight (gm)

The individual analysis of variance for cob weight indicated significant differences among the evaluated genotypes at location and in both seasons (Table 2). The mean squares for genotype X tester analysis (table 6) showed highly significant differences for crosses at location and season as shown in Table (3). Non significant differences were detected for genotype in both seasons and location, while the tester showed significant differences in first season. The combined analysis of variance showed no significant for seasons, highly significant for genotypes and seasons X genotypes (Table 4). On the other hand ,non- significant differences were recorded for season in location. In the first season the cob weight ranged from 75g for $H_1 \times R_2$ to 120 g for B_1 . The heaviest genotype was B_1 (120.0g), but the lightest one was $H_1 \times R_2$ (75.0 g), while in the second season the heaviest cob weight ranged from 75g for $H_1 \times R_2$ to 125.1g for--- B_4 ---- and the lightest one was $H_1 \times R_2$ (75.0 g) with the overall mean of cob weight as100.1g in the first season and 101.2g in the second season with the coefficient of variation as 4.59% in both seasons.

3.8. Yield per Plant (G)

The individual analysis of variance for yield per plant

indicated significant differences among the evaluated genotypes in location and season (Table 2). The genotype X tester analysis of variance showed highly significant differences for crosses in both season and location, while non-significant were recorded for genotypes and tester in both seasons and location. On the other hand, highly significant differences were recorded for genotype X tester in both seasons and location (Table 3). The combined analysis of variance showed highly significant differences for seasons, genotypes, season X genotype (Table 4). The yield/plant ranged from 56.5 g for genotype H₁ X B₃ to highest 106 g for genotype H₁ in both seasons, with an overall mean yield/plant as 82 g in both seasons and the coefficient of variation was 3.51% in both seasons.

3.9. Grain Yield (t/ha)

The individual analysis of variance showed significant differences among the evaluated genotypes for this trait at location and seasons (Table 2). The genotype X tester analysis of variance showed highly significant differences for crosses in both season and location, while non-significant differences for genotypes in both seasons and location. On the other hand, the testers showed highly significant differences in second season (Table 3). Combined analysis of variance showed highly significant differences for seasons, genotypes, X season in both seasons as shown in Table (4). In the first season, the yield ranged from 2.0 t/ha for R₁ to 6.7 t/ha for H₁ X D₄, while during the second season, the yield ranged from 1.8 t/ha for H₁ X B₃ to 6.7 t/ha for M₄₅ X D₃, with the overall mean --- yield of 4.1 and 3.9 t/ha in the first season and second seasons, respectively. The coefficient of variation was 9.987% in the first season and 12.48% in second one.

4. Conclusion

- a- a wide range of phenotypic variability was detected among the evaluated genotypes at the end of the two seasons for most of the traits studied. This variability can be exploited in the improvement of this crop.
- b- The significance ($p > 0.05$) of years, seasons, and the interactions of years and seasons, years with genotypes, seasons with genotypes and years with genotypes indicated the importance of genotypes X environment interaction. Nevertheless, evaluation over more seasons and years is essential.
- c- A great amount of variability as measured by the range of means and the coefficient of variations was

expressed by the different characters which were also illustrated.

- d- In combining ability analysis mean squares due to lines were larger than that due to testers for most of the characters indicating that variation in general in combining ability effects was mainly due to variation among lines.
- e- Portioning of mean square of crosses to lines and lines to testers interactions revealed significant differences for line X testers for all characters indicating the existence of variation among the crosses.

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