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SUMMARY

This work was designed aiming to study the possibility of producing a forage hybrid between teosinte (*Euchleana mexicana*) and maize (*Zea mays* L.). To achieve this main purpose the present investigation concerned mainly with the evaluation of five teosinte parental lines P_1 (Guatemala), P_2 (Balsas), P_3 (Shandweel), P4 (Demiatta) and P_5 (Sakha) and four maize- as testers- genotypes P_6 (Inbred line 7), P_7 (Inbred) line 34, P_8 (Inbred line 63) and P_9 (T.W.C 352) and their 20 F_1's crosses; throughout the genetical evaluation of them among their forage yield traits at cutting, silage and the chemical characteristics as well.

The genetical evaluation of the present investigated materials were conducted according to line x tester analysis which suggested by **Kempthorane (1957)**.

The line x tester experiment was carried out during the three summer growing seasons 2004, 2005 and 2006. The lines and testers plants were, grown and crossed in the first and the second seasons (2004 and 2005). In the third season (2006) the experiment was designed in a randomized complete block with three replications to evaluate the nine parents (5Lines and 4 Testers) and their twenty F_1 hybrids at the Experimental Farm, Sakha Agricultural Research Station, Agriculture Research Center.

The studied characters in this work were:

a. Plant height (cm).
b. Stem diameter (cm).
c. Number of stems/plant.
d. Leaf area plant DC^2.
e. Fresh leaf/stem ratio.
f. Dry leaf/stem ratio.
g. Fresh forage yield kg/plant.
h. Dry matter percentage.
i- Dry forage yield kg/plant.

As well as total fresh and total dry forage yield in both the 1^{st} and the 2^{nd} cut.

While, at silage stage the characters studied were:

a. Plant height (cm).
b. Stem diameter (cm).
c. Fresh forage yield kg/plant.
d. Dry matter percentage.
e. Dry forage yield kg/plant.

Chemical composition percentages for dry matter basis at the first, the second cuts and at silage stage for Crude protein (CP%), Either Extract Fast (EE%), Crude fiber (CF%), Nitrogen-free- extract (NFE%), Ash (Ash %).

The results of the present investigation could be summarized and presented in the following topics.

1- Analysis of variance
2- Mean performances
3- Heterosis
4- Combining ability
5- Proportional contributions
6- Gene action
7- Heritability

1. Analysis of variance:

a. Plant height:

Variance due to genotypes, parents, crosses, parents vs. crosses, lines and testers were highly significant at the first, at the second cuts and at silage stage, except parents at the second cut and lines at the firs cut which was insignificant while line x tester interactions were insignificant at the two cuts and at silage stage.

b. Stem diameter:

The analysis of variance exhibited highly significant variance among genotypes, parents, crosses, parent vs. crosses and testers for stem diameter trait, at the first, the second cuts and at silage stage, except parents at the second cut which was insignificant,. While, lines and line x tester interaction which were insignificant at the two cuts and silage stage.

c. Number of stems per plant:

Analysis of variance showed that, genotypes, parents, crosses, parent vs. crosses and testers showed highly significant differences for stem number at the two cuts, except P vs. C and parents at the first and the second cut, respectively,.

d. Leaf area per plant (DC^2):

Analysis of variance indicated that all sources of variation were highly significant for leaf area/ plant at the two cuts, except, lines at the first cut had significant, while line x tester interaction at the two cuts, line and parents at the second cut which, were insignificant.

e. Fresh leaf/stem ratio:

Analysis of variance showed that all sources of variation were highly significant at the two cuts, except, line x tester showed significant at the firs cut, lines at the two cuts showed insignificant, parents and line x tester showed insignificant at the second cut.

f. Dry leaf/stem ratio:

Analysis of variance indicated that all sources of variation were highly significant at the two cuts, except, line x tester showed significant at the second cut, lines at the two cuts and insignificant at the first cut, while, lines at the two cuts and parent at the second cut showed insignificant.

g. Fresh forage yield:

The analysis of variance exhibited highly significant different for all sources of variation for fresh forage yield per plant at the two cuts, total yield and at silage stage, except lines at silage stage had was insignificant.

h. Dry matter percentage:

Analysis of variance indicated to highly significant variance for all sources of variation at the first, the second cuts and at silage stage, except line x tester at the two cuts and at silage, while parents, P. vs. C. and lines showed insignificant at the second cut, while parent and lines showed insignificant at silage.

i. Dry forage yield:

Analysis of variance showed that variances were highly significant for all sources of variation for dry forage yield at the two cuts, total yield and at silage stage, except lines and parents at the second cut had insignificant, while lines at the first cut, total yield and at silage stage had significant.

2. The mean performances:

a.b. Plant height and Stem diameter:

Mean performances displayed that testers were taller and thicker than lines. Most of the F_1 crosses were exceeded their corresponding parents for plant height and stem diameter. The better lines were Demiatta, Sakha and Shandweel, while the better testers were Inbred line 34 and T.W.C. 352, at the two cuts and at silage stage.

c,d. Number of stem and leaf area per plant:

Mean performance denoted that lines were more than testers in number of sterm and leaf area per plant at the two cuts. The best line was Shandweel for leaf area, while Demiatta, Balsas and Sakha were better for stem number/ plant at the two cuts. The better testers were Inbred line 34 and T.W.C. 352 for the leaf area and stem number/plant. The hybrids were lower than lines for tillering but more in leaf area.

e,f. Fresh and dry leaf/stem ratio:

The data indicated that lines were more leafy than testers. Crosses were more than testers for fresh and dry leaf/stem ratio at the first cut, while lines more leafy than crosses for fresh at first cut only. Crosses were more than their parents at the second cut for fresh and dry leaf/stem ratio. The better lines were Demiatta and Sakha, while the better testers were Inbred line 34 and T.W.C. 352.

g. Fresh forage yields:

Mean performances displayed that the testers were higher for fresh forage yield kg/plant than lines at the first cut, while at silage stage, lines were higher for fresh forage yield than testers. Lines at the second cut were higher for fresh forage yield than the first cut. The better line was Sakha at the two cuts and total fresh forage yield, while T.W.C. 352 was the best tester. The crosses were great higher than parents for fresh forage yield at the two cuts, total yield and at silage stage. The better crosses were Demiatta x Inbred line 34, Shandweel x Inbred line 34 and Sakha x T.W.C. 352 at the two cuts and total yield (the highest one have 2.750 kg/plant^{-1}). While, the better crosses at silage stage for fresh forage yield were Shandweel x T.W.C. 352 (7.670 kg/P), Shandweel x Inbred line 34 (7.530 kg/P), Demiatta x T.W.C. 352 (7.47 kg/P), Guatemala x T.W.C. 352 (7.4 kg/P) and Balsas x T.W.C. 352 (7.17 kg/P).

h,i. Dry matter percentage and dry forage yield:

The data indicated that lines were higher for dry matter percentage at the first cut and at silage stage than testers. The crosses were more than parents for dry matter percentage at the second cut and at silage stage.

The lines were higher than testers for dry forage yield per plant at the first cut, total yield and at silage stage. The crosses were great higher in dry forage yield per plant than the parents at the two cuts, total yield and at silage stage. The better crosses for dry forage yield per plant were Demiatta x Inbred line 34 and Sakha x T.W.C. 352 at the two cuts and total yield which were 0.573 and 0.54 kg/plant, respectively. While, at silage stage, the better crosses were Demiatta x T.W.C. 352 (1.76 kg/P), Shandweel x T.W.C. 352 (1.74 kg/P), Shandweel x Inbred line 34 (1.72 kg/P) and Guatemala x T.W.C. 352 (1.70 kg/plant).

3. Heterosis:

Relatively to teosinte parents for all traits.

a- **Plant height:** Highly significant positive (desirable) heterosis relatively to teosinte parent were obtained for the first, the second cuts and at silage stage except the crosses which contained the tester inbred line 63 at the second cut. The crosses Guatemala x T.W.C. 352, Demiatta x Inbred line 34, Shandweel x Inbred line 34 and Guatemala x Inbred line 34 were the taller crosses.

b- **Stem diameter:** Positive highly significant heterosis (desirable) values over teosinte parent were found at two cuts and at silage stage except the crosses which contained the tester inbred line 63 at the second cut. The thicker crosses were Demiatta x Inbred line 34, Shandweel x T.W.C. 352 and Shandweel x Inbred line 34.

c- **Number of stems per plant:** Highly significant negative heterosis (unuseful) values over teosinte parent (high parent) were at the first and at the second cut.

d- **Leaf area/plant:** Highly significant positive heterosis (desirable) values over teosinte parent were found at the two cuts were.

e.f- **Fresh and dry leaf/stem ratio:** Highly significant and negative (unuseful) heterosis values at the first cut for fresh leaf/stem ratio, found and hybrids relative to the tester inbred line 63 for dry leaf stem ratio highly significant negative (undesirable) heterosis values for hybrids relative to tester in bred line 63 at the first cut, while at the second cut all hybrids had highly significant positive heterosis (desirable) except hybrids relative to tester inbred line 63 had insignificant. The better crosses were Guatemala x T.W.C. 352, Shandweel x T.W.C. 352 and Demiatta x T.W.C. 352 for fresh and dry leaf/stem ratio at the second cut relative to teosinte parents.

g- **Fresh forage yield:** Highly significant positive (desirable) heterosis values over teosinte parents for fresh forage yield at the first, the second cuts, the total yield and at silage stage. The following crosses were developed the higher values of heterosis relative to teosinte parents i.e., Demiatta x Inbred line 34, Guatemala x T.W.C. 352, Guatemala x Inbred line 34 and Shandweel x T.W.C. 352 for the first, the second cuts and total yield. While, the crosses involved Balsas, Guatemala, Demiatta and Shandweel x T.W.C. 352 were the best at silage stage.

h- **Dry matter percentage:** Highly significant and negative (undesirable) heterosis values for dry matter percentage at the first cut relative to teosinte parents. While, at the second cut, the cross Sakha x Inbred line 34 gave highly significant positive (desirable) heterosis value. At the silage stage all crosses showed highly significant positive (desirable) heterosis values except crosses involved tester Inbred line 63 which showed significant negative and insignificant heterosis. The better crosses showed, Sakha x Inbred line 7, Shandweel x Inbred line 7 and Guatemala x Inbred line 34.

i- **Dry forage yield:** Highly significant and positive (desirable) heterosis values relatively to teosinte parents showed at the first, the second cuts, total yield and at silage stage, except, most crosses involved tester inbred line 63 at the second cut showed insignificant. The better crosses were, Balsas x T.W.C. 352 at the first cut and at silage stage, while, Shandweel x Inbred line 34 and Demiatta x Inbred line 34 at the second cut and total yield, respectively.

4. Combining ability:

4.1. Combining ability variances:

- The estimates of general and specific combining ability variances denoted that σ^2GCA were larger in magnitude than corresponding σ^2SCAones, for most traits at the two cuts, total yield and at silage stage, while some traits showed σ^2SCA were larger than σ^2GCA. This finding indicated that additive types of gene action played a major role in the inheritance of the most traits and both additive and non-additive types of gene action were involved in the inheritance of forage yield.

4.2. Combining ability effects:

a. Plant height: The line Demiatta, tester T.W.C. 352 and tester Inbred line 34, were good combiner at the first and the second cut. While line Shandweel and all testers except Inbred line 63 were the best combiner at silage stage. However, estimation of S.C.A. effects showed that the best crosses were Demiatta x Inbred line 34 at the two cuts, and Balsas x Inbred line 7 or Inbred line 34 at the silage stage.

b. Stem diameter: The line Sakha, tester T.W.C. 352 and Inbred line 34 were good combiner at the two cuts, while line Shandweel and all testers except Inbred line 63 were good combiners at silage stage. However, the crosses revealed good S.C.A. effects were Demiatta x Inbred line 34 and

Balsas x Inbred line 34 at the two cuts, respectively, as well as, Demiatta x Inbred line 7, Guatemala x Inbred line 34 and Sakha x T.W.C. 352 at the silage stage.

c. Number of stem/plant: The line Demiatta, tester Inbred line 34 were good combiners at the two cuts. While the crosses Guatemala x Inbred line 63 Sakha x Inbred line 63, Demiatta x Inbred line 34 and Demiatta x line 7 found the highly S.C.A. effect at the two cuts.

d. Leaf area/plant: The line Shandweel at the first cut and Guatemala at the second cut, as well as, testers T.W.C. 352 and Inbred line 34 at the first cut showed the better GCA effects, while all testers except Inbred line 63 at the second cut, were good combiner for leaf area/plant. However, the highest crosses for S.C.A. effects were Shandweel x Inbred line 34, Guatemala x Inbred line 7 and Sakha x Inbred line 63 at the two cuts.

e.f. Leaf/stem ratio: The line Demiatta and all testers except Inbred line 63 were good combiners at the two cuts for fresh and dry leaf/ stem ratio. However, the highest crosses for S.C.A. effects were Demiatta x Inbred line 34 and Sakha x T.W.C. 352 at the two cuts, as well as, Balsas x Inbred line 34 at the second cut for fresh leaf/stem ratio. While for dry leaf/stem ratio, the crosses Guatemala x Inbred line 63 and Balsas x Inbred line 34 at the first cut, and Sakha x T.W.C. 352, Balsas x Inbred line 34, Demiatta x Inbred line 34,

Shandweel x Inbred line 34 and Guatemala x Inbred line 7, at the second cut showed suitable S.C.A. effects.

g. Fresh forage yield: The line Demiatta and all testers except Inbred line 63 were good combiners for fresh forage yield at the two cuts and total yield. While the line Shandweel and testers T.W.C. 352 and Inbred line 34 were good combiners at silage stage. The highest crosses for S.C.A. effects were Demiatta x Inbred line 34 at the two cuts and total yield, as well as, Sakha x T.W.C. 352 and Balsas x Inbred line 63 at the total yield. While, the cross Shandweel x Inbred line 34 have the highest SCA effects at silage stage.

h. Dry matter percentage: The line Demiatta and tester T.W.C. 352 were good combiners at the two cuts, while line Sakha and all testers except Inbred line 63 were good combiners at silage stage. The highest crosses for S.C.A. effects were Sakha x Inbred line 7 and Demiatta x Inbred line 34 at the first cut, Sakha x Inbred line 34 at the second cut, and Sakha x Inbred line 63 and Shandweel x Inbred line 7 at silage stage.

i. Dry forage yield: The line Demiatta and testers Inbred line 34 and T.W.C. 352 were good combiners at the two cuts and total dry forage yield. While the line Shandweel and tester T.W.C. 352 were good combiners at the silage stage. The highest crosses for S.C.A. effects were Demiatta x Inbred line 34 and Sakha x T.W.C. 352 at the two cuts and total dry

forage yield, while at silage stage it was the cross Sakha x Inbred line 7.

5. Proportional contributions:

Estimation of proportion contributions showed that the testers contribution were great higher than line and line x tester interaction contributions for all characters. The proportional contribution values of line x tester interaction were higher than lines for all characters except for plant height at the two cuts and at silage stage, and for dry matter percentage at the first cut in where the line contribution were higher than line x tester.

6. Gene action:

The additive genetic variances were higher than non-additive genetic variances for most characters at the two cuts and total forage yield, and at silage stage, indicating that the additive genes controling these traits. While the non-additive genetic variances were higher than additive genetic variances, showing that non-additive genes were responsible in the inheritance of leaf area at the first cut, dry leaf/stem ratio at the second cut, and dry forage yield at the first cut, total forage yield.

7. Heritability:

The estimates of heritability displayed that heritability in narrow sense equal heritability in broad sense at silage stage in plant height, stem diameter and dry matter percentage, also number of stem/ plant at the two cuts and leaf area per plant at the second cut. The heritability in narrow sense have high values for plant height at the two cuts, fresh leaf/ stem ratio at the second cut, fresh yield at the two cuts and total yield, dry matter percentage at the first cut and dry yield at the second cut, indicated that additive genetic variance played a major role in the inheritance of this traits. While, heritability in narrow sense for stem diameter, leaf area/ plant and dry yield at the first cut, indicated that non-additive genetic variance played a major role in the inheritance of this traits.

Chemical traits

1. Analysis of variance:

Variances due to genotypes, parents, crosses, parent vs. crosses lines, testers and line vs. tester were highly significant for most chemical traits, at the two cuts and at silage stage.

2. The mean performance of genotypes:

Mean performances revealed that teosinte were more than maize parents for some chemical traits and maize were more than teosinte parents for another chemical traits and exchanged from cuts to silage. The teosinte parents were higher than maize parent for crude protein percentage (CP%) at the first cut, while at silage stage TWC 352 was the highest of CP% (8.60%). The crosses exceeded their parents for CP%, wherease, Sakha x Inbred line 7 (8.46%), Demiatta x Inbred line 34 (7.53%) and Demiatta x Inbred line 7 (11.90%) were the highest at the first, the second cut and at silage respectively. Ether extract (EE%) showed that teosinte parents had higher than maize parents, EE% ranged from 4.73% to 2.49% and from 5.63% to 2.90% at the first cut and at silage, respectively. crosses exceded their parents for EE% at the second cut and at silage, the highest crosses for EE% were Balsas x T.W.C. 352 (5.53%) at the first cut and Sakha x T.W.C. 352 at the second cut and at silage (7.08%) and (8.80%) respectively. Crude fiber percentage (CF%) showed teosinte parents had lower value at the first cut while higher value at silage than maize parents, the

values of CF% ranged from 21.40% to 16.67% at the first cut, while from 33.40% to 29.50% at silage. the crosses exceded their parents for CF% at the two cuts and at silage, which ranged from 25.20% to 22.83% at the first cut, from 22.40% to 20.60% at the second cut and from 36.40% to 34.20% at silage. Nitrogen free extract percentage (NFE%) values indicated that maize parents had higher than teosinte parents at silage, the values ranged from 61.91% to 57.78% at the first cut and from 49.88% to 42.01% at silage. the crosses were lower value than their parents at the two cuts and silage, the values ranged from 52.94% to 49.97% at the first cut, from 57.06% to 51.39% at the second cut and from 38.59% to 32.77% at silage. Ash content (Ash%) showed teosinte parents higher than maize parents at the first cut and at silage except T.W.C. 352 at the firs cut the values ranged from 11.47% to 8.70% at the first cut and from 11.06% to 9.20% at silage. Crosses had value ranged from 13.38% to 10.90% at the first cut, from 12.20% to 9.80% at the second cut and from 12.26% to 9.26% at silage.

3. Heterosis:

Positive highly significant (desirable) heterosis relatively to teosinte parents were obtained for CP% of all crosses at the first cut and at silage stage and most crosses at the second cut. The highest values were from the crosses Demiatta x Inbred line 34 and Sakha x T.W.C. 352 at the first cut, Sakha x T.W.C. 352, Sakha x Inbred line 7 and Demiatta x Inbred line 34 at the second cut and Demiatta x Inbred line 7; Shandwell x Inbred line 7 and Balsas x Inbred li9ne 34 at silage stage.

For EE%, most crosses at the second cut and all crosses at silage stage showed highly significant and significant positive (desirable) heterotic effects, the highest cross was Sakha x T.W.C. 352.

For CF%, all crosses gave highly significant positive heterotic effect at the two cuts and at silage stage.

For NFE%, highly significant negative (undesirable) heterotic effects for all crosses at the two cuts and at silage stage were obtained.

For Ash %, most crosses at the second cut showed highly significant positive heterotic effect, while at silage stage some crosses were of highly significant positive heterosis.

4. Combining ability:

4.1. Combining ability variances:

The estimates of general and specific combining ability variance indicated that σ^2SCA were larger in magnitude than corresponding σ^2GCA ones, for most chemical traits at the two cuts and at silage stage, σ^2GCA was larger than σ^2SCA for CP% at the two cuts. This finding indicated that non-additive types of gene action played a major role in the inheritance of the most traits and additive types of gene action were of major role in the inheritance of CP% at the two cuts.

4.2. Combining ability effects:

Estimation of general combining ability effects denoted that the lines Guatemala had highly significant positive GCA effects for CF% and NFE%, Balsas for CF% and Ash%, Shandweel for Ash%, Demiatta for NFE% and CP% and Sakha for Ash% and EE%.

While the testers which showed highly significant positive GCA effects were Inbred line 7 for Ash%, CP% and NFE%, Inbred line 34 for CP% and Ash%, Inbred line 63 for NFE% and T.W.C. 352 for CP%, CF% and EE%. The good combiners were the line Demiatta and the tester T.W.C. 352 followed by Inbred line 34.

The crosses Shandweel x Inbred line 34 and Balsas x Inbred line 7 exhibited the best SCA effects for CP%. Also the crosses Balsas x T.W.C. 352, Demiatta x T.W.C. 352 were better in SCA for EE%. While, Balsas x Inbred line 7 had the best SCA effects for NFE%.

5. Proportional contributions:

Estimation of proportion contributions showed that the testers were higher than lines and line x tester for CP% and CF%, while line x tester interaction were higher than lines and testers for EE%, NFE% and Ash%.

6. Gene action.

The results indicated that the additive gene effect played a major role in the genetic expression of CP%, at the two cuts, while at silage stage the non-additive gene effect played a major role in the genetic expression of this trait. Mean while, non-additive genetic variance (σ^2D) were larger than the additive genetic variance (σ^2A) with respect to EE%, CF%, NFE% and Ash% at the first, the second cuts and at silage stage, except EE% at the second cut.

7. Heritability:

Estimation of heritability for chemical traits indicated that heritability in broad sense equal heritability in narrow sense for CP% and EE% at the second cut, indicated that all genetic variance due to additive genetic variance for this traits.

H^2n have high value for CP% at the first cut while H^2n equal zero for EE% at the first cut and Ash% at the second cut indicated that all genetic due to non-additive genetic variance. Estimated H^2n revealed that most chemical traits at the two cuts and silage showed that non-additive genetic variance played a major role in the inheritance of this traits.