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EVALUATED OF ANALYSIS OF VARIANCE, MEAN PERFORMANCE AND HETEROSIS FOR SOME AGRONOMIC TRAITS OF SEVEN INBRED LINES AND THEIR F_1 CROSSES OF YELLOW MAIZE

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ABSTRACT

The field experiment was performed during two successive summer seasons 2022 and 2023 at the experimental farm Faculty of Agricultural, Moshtohor, Banha University. Seven diverse maize inbred lines (line 635 (P_1), line 524 (P_2), line 423 (P_3), line 231 (P_4), line 418 (P_5), line 200 (P_6) and line 202 (P_7)). The lines were obtained from Faculty of Agricultural Moshtohor, Banha University, Egypt. To estimate of analysis of variance, mean performance and heterosis for plant height, ear height, flag leave area, stem diameter, number of leaves/plant, ear weight, number of ear/plant, ear length, ear diameter, number of rows/ear, number of kernels/row, cub weight, 100-kernel weight, kernel weight/ear and kernel yield/plant.

The results showed *highly difference significant between the genotypes for all studies traits. The mean of square due to parents were highly significant for all studies traits except the kernel yield/ plant trait. Moreover, analysis of variance due to crosses was highly significant for all studies traits. While mean of square due to P vas F1s were highly deference significant for all studies traits except ear diameter (cm). The mean performance of seven lines and their F1 crosses for kernel yield/plant (g) it ranged from 31.7 to 67.0 (g) for parents, as well as it changed from 91.27to 405.5 (g) for crosses. The parents P2, P4 and the crosses (P1 xP6), (P2 x P4), (P2 x P6), and (P2 x P7), were given the highest values for kernel yield/plant. The present data of hetrosis for kernel yield/plant showed positive and highly significant heterosis over MP by all crosses except three crosses were positive and significant this crosses (P2 x P5), (P3 x P6) and (P6 x P7) . Moreover, heterosis was positive and highly significant heterosis relative to BP evaluated by all crosses. The results were indicating effectiveness selection in this respect.*

Conclusively, *the significantly of the studied traits indicated the presence of adequate genetic variability in the used genetic material. Mean Performance one of the most importance statistical analysis is the mean performance of tested material is which should be presented to identify the genetic variability existing among these material.*

Key words: Maize, Analysis of variance, mean performance and heterosis.

INTRODUCTION

Maizef or corn *Zea mays* L. (corn), is the most abundantly produced cereal in the world. It is grown in every continent except Antarctica. White, yellow, and red are the most common cultivated maize types. The white and yellow varieties are preferred by most people depending on the region. The global maize area (for dry grain) amounts to 197 M ha **FAO Stat, (2021).** It is an established and important human food crop in a number of countries, especially in SSA, Latin America, and a few countries in Asia, where maize consumed as human food contributes over 20% of food calories **Shiferaw *et al*., (2011**).

In Egypt, it is used as human food, livestock and poultry feed as well as a row material for industrial products such as oil and starch **Ali and Abdelaal (2020)**. Maize production in 2023 in Egypt was estimated at a near‑average level of 7.1 million tons **(FAO 2024). El-Shamy (2023),** in Egypt the maize is one of the most important strategic crops, because it is a food crop for humans and animals, and it is also used in many food industries, in addition to being one of the main imported crops, as the value of its imports represents about 13% of the total value of agricultural imports, so the government seeks to increase the total production of maize through horizontal expansion by increasing the cultivated area, or vertical expansion by increasing productivity. One solution for this is the development of a hybrid variety with higher yields and broader environment adaptability **Kinfe *etal*., (2017)**. The first step to achieve these highly desirable characteristics of hybrid varieties is the development of promising inbred lines.

The identification of parental lines that perform superior hybrids is the most costly and time consuming phase in maize hybrid development. Performance of maize lines does not predict the performance of maize hybrids for kernel yields **Hallauer *et al*., (2010).**

Nada (2023) showed negative or positive and highly significant of heterosis over BP for plant height, ear height. number of rows/ear , hundred grain weight, shelling percentage and Grain yield of plant traits.

Tejaswini *et al*. (2023) revealed that Heterosis studies in maize ten hybrids recorded significantly positive standard heterosis while, ten hybrids recorded significantly negative standard heterosis for plant height. For ear girth, better-parent heterosis ranged from -21.18% (PFSR-73×PFSR-127) to 17.95% (BML-10×ML-14). Better-parent heterosis for number of kernel rows / ear ranged from -27.61% (MGC-49×BPDT-5009) to 16.67% (ML-14×PFSR-92). Five hybrids recorded significantly positive heterosis over the better parent for the trait. Better-parent heterosis for number of kernels/ row varied from -39.60% (ML14×BPDT-5009) to 50.70% (PFSR-73×PFSR-92) for number of kernels/row. Better-parent heterosis for grain yield/plant ranged from -55.52% (MGC-49×BPDT-5009) to 44.65% (PFSR-73×ML-14).

Therefore, the main objectives of this study were studied the performance of some maize lines and their F_1crosses and the hybrid strength of some maize lines and their F_1crosses.

MATERIAL AND METHODS

1- Material and experimental design:

The field experiment was performed during two successive summer seasons 2022 and 2023 at the experimental farm Faculty of Agricultural, Moshtohor, Banha University. Seven diverse maize inbred linesi.e. (line 635 (P_1), line 524 (P_2), line 423 (P_3), line 231 (P_4), line 418 (P_5), line 200 (P_6) and line 202 (P_7)). These lines were obtained from Faculty of Agricultural Moshtohor, Banha Univeresity, Egypt. The origin of the seven maize lines are presented in Table (1).

Table (1):The origin and name of the seven maize lines under this study

Number	Name	Origin
P_1	Line 635	Egypt (Moshtohor)
P_2	Line 524	Egypt (Moshtohor)
P_3	Line 423	Egypt (Moshtohor)
P_4	Line 231	Egypt (Moshtohor)
P_5	Line 418	Egypt (Moshtohor)
P_6	Line 200	Egypt (Moshtohor)
P_7	Line 202	Egypt (Moshtohor)

The lines were sown in the first season 2022 at 30 may. All possible parental combinations, excluding reciprocates were made among the seven parental lines to produce twenty-one crosses. Necessary precations were adopted during the crossing operations to avoid contaminations of the genetic material. The seed of the twenty-one hybrids along with seven lines parents were grown in second summer season 2023 and evaluated under all recommend practices for maize productions were applied from sowing till harvesting. Using randomized complete block design in three replications. The experimental plot consist six rows 6 m., long and 70 cm for width and inter between plant distances was kept 20 cm.

2- The following data were recorded individual plant basis:

A. Plant growth and morphological traits:

Plant height (cm), ear height (cm), stem diameter (cm), number of green leaves /plant and flag leave area (cm^2**).**

B. Kernel yield and its Contributing:

Eear length (cm), ear diameter (cm), cub weight (g), number of rows/ear, number of ears/plants, ear weight (g), number of kernels/rows, 100-kernel weight , kernel weight/ear and kernel yield/plant.

3- Diallel analysis:

The collected data were subjected to the standard analysis of variance of the randomized complete blocks design according to **Snedecor and Cochran (1994)**.

3-1. *Heterosis assessment:*

a- Heterosis over the mid-parental value (Relative heterosis)

$$H.MP= \frac{F1-MP}{F1} \times 100$$

Where : F1 and MP are the average performance of the F1 and the mid-parental values, respectively.

b- Heterosis over better parent (heterobeltiosis)

$$H.BP= \frac{F1-BP}{F1} \times 100$$

Were BP is the average performance of the better parents

The significant of heterosis was estimated using the following formula:

RESULT AND DISCUSSION

A. Analysis of variance:

The present data in Tables (2, 3 and 4), shown the mean of square for seven maize lines and their F_1 crosses for plant height, ear height, flag leave area, stem diameter, number of leaves/plant, ear weight, number of ear/plant, ear length, ear diameter, number of rows/ear, number of kernels/row, cub weight, 100-kernel weight, kernel weight/ear and kernel yield/plant. The results showed highly difference significant between the genotypes for all studies traits. The significantly of the studied traits indicated the presence of adequate genetic variability in the used genetic material. These results are in agreement with finding of **Al-Wardy (2017), Ejigu *et al*., (2017) , Jakhar *et al*. (2017), Rehap *et al*. (2021) and Nada (2023)**

The mean of square due to parents were highly significant for all studies traits except the kernels yield/ plant trait. Moreover, analysis of variance due to crosses were highly significant for all studies traits. While mean of square due to P vas F_1s were highly deference significant for all studies traits except ear diameter (cm). These results are in agreement with finding of **Tesfaye and Sime (2021)** observed that the analysis of variance showed there is highly significant variation between the hybrids for all the traits considered.

Table (2). Mean of square for some morphological traits in 7 inbreed lines and their F_1 crosses.

SO V	df	Plant height (cm)	Ear height (cm)	Stem diameter (cm)	Number of green leaves/plant	Flag leaf area (cm2)
Rep.	**2**	10.78	7.96	0.07	0.27	85.73
Genotypes	**27**	2902.83**	843.45**	0.33**	6.13**	59031.11**
Parental	**6**	11535.98**	2760.55**	1.29**	43.59**	74199.50**
Crosses	**20**	20796.19**	5602.33**	1.93**	64.80**	188058.36**
P vas F1s	**1**	41316.61**	8943.94**	1.22**	99.38**	951328.36**
Error	**54**	9.57	6.21	0.06	0.43	142.11
Total	**83**					

*and ** = Significant at 0.05 and 0.01 levels of probability, respectively

Table (3). Mean of square for some yield attributes traits in 7 inbreed lines and their F_1 crosses

SO V	df	Ear weight (g)	Number of ears /plant	Ear length/cm	Ear diameter/cm	Number of rows/ear
Rep.	**2**	18.23	0.04	1.56	0.25	1.86
Genotypes	**27**	3888.76**	0.79**	12.96**	0.97**	19.29**
Parental	**6**	2372.99**	0.55**	76.78**	6.22**	48.33**
Crosses	**20**	12551.91**	1.85**	131.54**	6.49**	112.82**
P vas F1s	**1**	68494.85**	4.17**	164.82**	0.21	289.29**
Error	**54**	3.43	0.12	0.55	0.12	1.61
Total	**83**					

*and ** = Significant at 0.05 and 0.01 levels of probability, respectively

B. *Mean performance*:

One of the most importance statistical analysis is the mean performance of tested material, which should be presented to identify the genetic variability existing among these material for plant height, ear height, flag leave area, stem diameter, number of leaves/plant, ear weight, number of ear/plant, ear length, ear diameter, number of rows/ear, number of kernels/row, cub weight, 100-kernel weight, kernel weight/ear and kernel yield/plant.

Table (4). Mean of square for kernel yield and its components trait in 7 inbreed lines and their F_1 crosses.

SOV	df	Number of kernels/row	Cob weight/g	100-kernels weight	Kernel weight/ear	Kernel yield/plant
Rep.	**2**	0.23	12.73	2.67	41.24	106.49
Genotypes	**27**	163.50**	139.81**	88.37**	3317.56**	22376.62**
Parental	**6**	184.89**	241.08**	292.35**	1667.85**	1706.91
Crosses	**20**	520.51**	446.12**	615.01**	8785.87**	35174.43**
P vas F1s	**1**	2298.10**	362.02**	788.39**	59392.22**	243792.90**
Error	**54**	**4.55**	**1.17**	**1.31**	**5.27**	**1125.62**
Total	**83**					

*and ** = Significant at 0.05 and 0.01 levels of probability, respectively

Plant height is one of the most importance goals of maize breeding programs. Therefore, corn breeders should be select short maize plants that are resistant to lodging and suitable for mechanical harvesting. The mean performance of plant height for parents and their F_1 crosses are given in **Table (5).** Plant height ranged from 125.5to 190.0 cm for parental Lines and from 153.5 to 237.5 cm for F_1 crosses. The parents P_1 and P_2 and F_1 crosses (P_1×P_5), (P_1×P_6), (P_2×P_5) and (P_2×P_3) were the shortest genotypes. It was observed that parent P_6 and cross (P_5×P_7) were the tallest genotypes. These results indicate that genes controlling plant height were transmitted from the parents to the F_1 progeny. **Mousa *et al*., (2014)** showed that mean performance of 21 crosses and two checks Sc_{10} and Sc_{128} for ten studied traits over locations. great variation were found among the F_1 crosses for all traits, from 253.0 to 294.5 cm for plant height. The mean performance of ear height for parents and their F_1 crosses ear height ranged from 57.5 to 91.3 cm for parental and from 76.8 to 122.8 cm for F_1 crosses. The parents P_1 and P_2 and F_1 crosses (P_1×P_6), (P_1×P_7), (P_2×P_5) and (P_2×P_7) and (P_3×P_7)were the shortest genotypes. It was observed that parent P_6 and cross (P_3×P_5) were the tallest genotypes. These results indicate that genes controlling plant height were transmitted from the parents to the F_1 progeny. In addition **Zare *et. al*., (2011)**. Stem diameter is one of the most important measurements that plant breeders must take into consideration, as increasing stem diameter leads to stem stiffness and resistance to lodging. The mean performance of stem diameter it ranged from 1 to 2 cm for parents and changed from 1.4 to 2.6 cm for F_1 crosses. The parents P_4, P_6 and P_7 as well as crosses (P_2×P_6), (P_3×P_7), (P_4 x P_7) and (P_5 X P_7) were given highest values for stem diameter. **Nada (2023)** reported that the largest stem diameter the crosses P1×P3 (3.6 cm), and P3×P4 (3.5 cm). The mean performance of number of green leaves/plant for parents and their F_1 crosses. it ranged from 7.7 to 11.0 for parents and changed from 11.3 to 13.5 cm for F_1 crosses. The

Table 5. Mean performance for some morphological traits in 7 inbreed lines and their F_1 crosses.

Genotypes	Plant height (cm)	Ear height (cm)	Stem diameter (cm)	Number of green leaves/plant	Flag leaf area (cm^2)
Line 635 (P_1)	125.0	61.3	1.0	8.0	327.7
Line 524 (P_2)	133.7	57.5	1.4	7.7	318.8
Line 423 (P_3)	160.0	70.0	1.4	10.3	239.5
Line 231 (P_4)	153.7	77.5	1.7	10.5	376.9
Line 418 (P_5)	139.4	82.5	1.5	11.0	360.7
Line 200 (P_6)	190.0	91.3	2.0	9.7	507.7
Line 202 (P_7)	162.5	72.5	1.7	8.3	339.0
P1 x P2	210.7	91.8	1.7	12.7	587.9
P1 x P3	193.7	82.5	1.8	12.5	538.1
P1 x P4	220.0	92.5	1.6	11.3	684.6
P1 x P5	153.5	105.6	1.5	11.3	444.3
P1 x P6	177.5	76.8	1.8	12.0	494.7
P1 x P7	200.0	92.5	1.8	11.7	598.5
P2 x P3	180.1	108.1	1.4	11.0	558.5
P2 x P4	210.0	108.7	1.7	10.3	660.5
P2 x P5	177.5	77.5	1.6	12.0	561.5
P2 x P6	223.7	120.0	2.6	12.3	782.7
P2 x P7	184.5	78.7	1.6	11.3	485.5
P3 x P4	210.0	106.3	1.4	12.7	496.2
P3 x P5	235.0	122.8	1.6	11.5	671.3
P3 x P6	184.4	77.5	1.8	11.7	648.5
P3 x P7	230.7	92.8	2.1	12.7	535.2
P4 x P5	210.6	100.0	1.6	13.5	512.0
P4 x P6	211.4	103.1	2.0	11.7	570.5
P4 x P7	219.4	108.7	2.5	11.3	661.8
P5 X P6	190.0	102.5	1.7	12.0	619.1
P5 X P7	237.5	103.1	2.0	11.3	784.4
P6 x P7	208.3	86.3	1.7	12.5	675.9
Mean	**190.5**	**91.1**	**1.7**	**11.2**	**537.2**
l. S. D $_{0.05}$	**5.028**	**4.047**	**0.382**	**1.063**	**19.369**
L.S.D $_{0.01}$	**6.670**	**5.370**	**0.506**	**1.410**	**25.696**

parents P_5 followed byP_4 as well as crosses ($P_4 \times P_5$), (P_1 x P_2), (P_1 x P_3) and (P_3 x P_4) were given highest values for number of green/plant. Flag leave area contributed directly and in directly with great grain yield variation, the present data show significant difference among the seven parents and their F_1 crosses, the mean performance for flag leave area ranged from 239.5 to 507.7 cm^2 for parents. Moreover, for F_1 crosses it ranged from 444.3 to 784.4 cm^2. The parent P_6 and crosses (P_5 X P_7) (P_2 x P_6), and (P_1x P_4) were given highest values for flag leave area cm^2.

The mean performance of seven lines and their F_1 crosses for ear length presented in **Table (6),** it ranged from 10 to 14.7 cm for parents, as well as it changed from 13.03to 19.0 cm for crosses. The parent P_2 and the crosses (P_4 x P_6), (P_5 X P_7), (P_1 X P_2), (P_3 x P_7) were given the highest values for ear length cm. but the parent P_3 and cross (P_6 X P_7) were given lowest values for this trait. The mean performance for ear diameter it ranged from 2.7 to 4.2 cm for parents, as well as it changed from 2.2 to 4.3 cm for crosses. The parent P_1 and the crosses, (P_2 x P_4), (P_3 x P_4) and (P_5 x P_6) were given the highest values for ear diameter cm. but the parent P_6 and cross (P_2 X P_3) were given lowest values for this trait. The mean performance for cub weight trait ranged from 14.3 to 27.7 cm for parents, as well as it changed from 11.4 to 39.7 cm for crosses. The parent P_7 and the crosses, (P_2 x P_4), (P_2 x P_5), (P_4 x P_5), (P_4 x P_6), (P_4 x P_7) and (P_5 x P_7) were given the highest values for cub weight. But the parent P_5 and cross (P_3 x P_6) were given lowest values for this trait.

The mean performance of seven lines and their F_1 crosses for number of rows/ear it ranged from 8.00 to 12.00 for parents, as well as it changed from 10.7 to 18 rows for crosses. The parent P_6 and the crosses (P_1 x P_5), (P_1 x P_6), (P_2 x P_3), (P_2 x P_4), (P_3 x P_4), (P_3 x P_7) (P_4 x P_7) and (P_5 x P_7), were given the highest values for number of rows/ear. But the parent P_4 and cross (P_2 x P_6) were given lowest values for this trait. The mean performance of seven lines and their F_1 crosses for ear weight (g) it ranged from 57.0 to 83.3 (g) for parents, as well as it changed from 106.3 to 197.0 (g) for crosses. The parent P_2 and the crosses (P_1 x P_7), (P_2 x P_4), (P_2 x P_6), (P_2 x P_7), (P_4 x P_5) and (P_5 x P_7), were given the highest values for ear weight. But the parent P_1 and cross (P_1 x P_3) were given lowest values for this trait. The results are agreement with reported by **Nada (2023)**.

The present data in **Table (7)** show the mean performance of seven lines and their F_1 crosses for number of ears/plant, the mean performance it ranged from 1.0 to 1.3 (ear) for parents, as well as it changed from 1.00 to 2.9 (ear) for crosses. The parent P_7 and the crosses (P_1 x P_2), (P_2 x P_4), (P_2 x P_6), (P_2 x P_7) and (P_4 x P_6), were given the highest values for number of ears/plant. The mean performance of seven lines and their F_1 crosses for number of

Table 6. Mean performance for some ear traits in 7 inbreed lines and their F_1 crosses.

Genotypes	Ear length/cm	Ear diameter/cm	Cub weight/g	Number of rows/ear	Ear weight (g)
Line 635 (P_1)	12.7	4.2	25.3	10.7	57.0
Line 524 (P_2)	14.7	3.7	16.3	8.0	83.3
Line 423 (P_3)	10.0	2.8	17.3	8.7	64.3
Line 231 (P_4)	13.7	4.1	15.2	8.0	76.3
Line 418 (P_5)	11.0	3.2	14.3	10.7	74.7
Line 200 (P_6)	12.7	2.7	16.8	12.0	68.7
Line 202 (P_7)	13.3	3.5	27.7	10.0	65.3
P1 x P2	17.7	2.7	18.5	12.0	107.0
P1 x P3	16.7	3.8	27.3	12.7	106.3
P1 x P4	14.77	3.13	16.90	12.67	119.0
P1 x P5	14.7	3.6	20.0	14.0	132.3
P1 x P6	16.7	3.3	17.6	14.7	138.0
P1 x P7	15.4	3.6	21.7	13.3	152.3
P2 x P3	14.0	2.2	18.2	14.7	130.3
P2 x P4	15.0	4.3	28.9	15.3	171.7
P2 x P5	16.3	2.6	29.0	14.0	115.0
P2 x P6	15.7	2.9	18.7	10.7	162.5
P2 x P7	16.3	3.6	22.8	12.7	151.3
P3 x P4	13.7	4.2	17.0	16.0	131.5
P3 x P5	15.7	2.9	24.5	13.3	113.0
P3 x P6	14.7	3.0	11.4	13.3	103.3
P3 x P7	17.3	3.3	26.3	14.7	143.0
P4 x P5	15.7	2.3	35.8	14.0	163.7
P4 x P6	19.0	3.7	30.3	13.3	123.3
P4 x P7	15.5	3.7	30.7	18.0	135.7
P5 X P6	15.7	4.0	19.3	12.7	141.2
P5 X P7	18.7	3.3	39.7	18.0	197.0
P6 x P7	13.03	3.83	25.05	14.00	116.3
Mean	**15.0**	**3.4**	**22.6**	**12.9**	**119.4**
l. S. D $_{0.05}$	**1.204**	**0.563**	**1.759**	**2.062**	**3.008**
L.S.D $_{0.01}$	**1.597**	**0.746**	**2.333**	**2.735**	**3.991**

Table 7. Mean performance for yield and its components traits in 7 inbreed lines and their F_1 crosses.

Genotypes	Number of ear/plant	Number of kernels/row	100-kernel weight/g	Kernel weight/ear	Kernel yield/plant
Line 635 (P_1)	1.0	17.0	30.0	31.7	31.7
Line 524 (P_2)	1.0	17.7	24.3	67.0	67.0
Line 423 (P_3)	1.0	14.0	25.0	47.0	47.0
Line 231 (P_4)	1.0	15.3	23.7	61.2	61.2
Line 418 (P_5)	1.0	12.7	21.0	60.3	60.3
Line 200 (P_6)	1.2	23.0	26.3	51.8	60.8
Line 202 (P_7)	1.3	23.0	22.8	34.7	47.0
P1 x P2	2.3	32.0	27.9	88.5	206.7
P1 x P3	1.7	25.0	40.3	79.0	131.3
P1 x P4	1.03	32.00	24.97	102.10	102.10
P1 x P5	1.5	24.0	31.9	113.3	169.5
P1 x P6	1.8	23.07	26.4	120.4	220.6
P1 x P7	1.0	29.7	30.1	130.7	130.7
P2 x P3	1.8	34.0	31.1	112.2	205.3
P2 x P4	2.0	25.0	34.7	142.8	285.5
P2 x P5	1.3	29.0	37.0	86.0	112.7
P2 x P6	2.9	32.0	35.6	141.7	405.5
P2 x P7	2.3	32.0	25.8	128.5	299.3
P3 x P4	1.7	22.0	26.7	114.5	191.2
P3 x P5	1.7	34.0	39.0	88.5	152.9
P3 x P6	1.0	24.0	24.8	91.9	91.9
P3 x P7	1.7	24.0	37.3	116.7	194.2
P4 x P5	1.1	23.7	34.1	127.8	127.8
P4 x P6	2.0	37.7	26.8	93.0	186.0
P4 x P7	1.1	40.0	35.7	105.0	115.4
P5 X P6	1.3	34.3	31.1	121.9	162.9
P5 X P7	1.0	37.7	36.7	155.0	155.0
P6 x P7	1.0	26.67	30.33	91.27	91.27
Mean	**1.5**	**26.6**	**30.0**	**96.6**	**146.9**
l. S. D $_{0.05}$	**0.557**	**3.465**	**1.861**	**3.730**	**54.513**
L.S.D $_{0.01}$	**0.740**	**4.597**	**2.469**	**4.948**	**72.319**

kernels/row it ranged from 12.7 to 23.00 (kernels) for parents, as well as it changed from 22.0 to 40.0 (kernel) for crosses. The parents P_6, P_7 and the crosses (P_1 x P_2), (P_1 xP_4), (P_2 x P_3), (P_2 x P_6), (P_2 x P_7), (P_3 x P_5), (P_4 x P_6), (P_4

x P_7), (P_5 x P_6) and (P_5 x P_7) were given the highest values for number of kernels/row. But the parent P_5 and cross (P_3 x P_4) were given lowest values for this trait. The mean performance for 100-kernel weight (g) it ranged from 21.00 to 30.00 (g) for parents, as well as it changed from 24.8 to 40.3 (g) for crosses. The parents P_1, P_6 and the crosses (P_1 xP_3), (P_1 x P_5), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_3 x P_5), (P_3 x P_7), (P_4 x P_5), (P_4 x P_7) and (P_5 x P_7) were given the highest values for 100-kernel weight. But the parent P_5 and cross (P_3 x P_6) were given lowest values for this trait. The mean performance kernels weight/ear (g) it ranged from 31.7 to 67.0 (g) for parents, as well as it changed from 79.0 to 155.0 (g) for crosses. The parents P_2, P_4 and the crosses (P_1 xP_7), (P_2 x P_4), (P_2 x P_6) and (P_5 x P_7), were given the highest values for kernels weight/ear. But the parent P_1 and cross (P_1 x P_3) were given lowest values for this trait. The mean performance of seven lines and their F_1 crosses for kernels yield/plant (g) it ranged from 31.7 to 67.0 (g) for parents, as well as it changed from 91.27 to 405.5 (g) for crosses. The parents P_2, P_4 and the crosses (P_1 xP_6), (P_2 x P_4), (P_2 x P_6), and (P_2 x P_7), were given the highest values for kernels yield/plant. But the parent P_1 and cross (P_6 x P_7) were given lowest values for this trait.

The results indicating effectiveness of selection in these respects. **Mukhlif *et al*., (2021)** showed that the significant differences in the days to 50% silking, plant height, number of ears/plant number of kernels/row), 300 kernel weight distinguished by its superiority in the trait of plant height, number of ears / plant and kernel yield plant. The inbred line in 300 grain weight and pure line in the trait of number of grains/rows the cross (5×7) was the best hybrid in traits, with 300 grain weight and plant kernel yield.

C. Hetrosis and heterobilitosis, %:

The results for plant height in **Table (8),** the all crosses showed positive and highly significant heterosis over MP. Moreover heterosis were positive and highly significant heterosis relative to better parent recorded by crosses (P_1 x P_2), (P_1 x P_3), (P_1 x P_4), (P_1 x P_5), (P_1 x P_7), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_7), (P_4 x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 X P_7) and (P_6 X P_7). Moreover the result for ear height, showed positive and highly significant heterosis over MP by crosses (P_1 x P_2), (P_1 x P_3), (P_1 x P_4), (P_1 x P_5), (P_1 x P_7), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_7), (P_4 x P_5), (P_4 x P_6), (P_4 x P_7),(P_5 X P_6), (P_5 X P_7) and (P_6 X P_7). Meanwhile heterosis were positive and highly significant heterosis relative to better parent recorded by crosses (P_1 x P_2), (P_1 x P_3), (P_1 x P_4), (P_1 x P_5), (P_1x P_7), (P_2 x P_3), (P_2 x P_4), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_7), (P_4 x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 X P_6) and (P_5 X P_7).

The results for stem diameter showed positive and highly significant heterosis over MP by crosses (P_1 x P_2), (P_1 x P_3), (P_2 x P_6), (P_3 x P_7), (P_4 x P_7) and (P_5 X P_7). As well as heterosis were positive and highly significant heterosis relative to better parent recorded by crosses (P_1 x P_2), (P_1 x P_3), (P_2 x P_5), (P_2 x P_6), (P_3 x P_7), (P_4 x P_7) and (P_5 X P_7). The result for flag leave area showed positive and highly significant heterosis over MP by all crosses. Meanwhile heterosis were positive and highly significant heterobilitosis relative to better parent recorded by all crosses (P_1 x P_6). The result for number of green leaves/plant showed positive and highly significant heterosis over MP by all crosses. Moreover, heterosis were positive and highly significant heterosis relative to better parent recorded by all crosses except (P_1 x P_5), (P_2 x P_4) and (P_5 X P_7). The results were agreement with reported by **Kamal *et al.*, (2023), Nada (2023), Tejaswini *et al*., (2023), Mishra *et al*., (2024) and Waghmare *et al*., (2024)**

The present data for ear weight (g) in **Table (9),** show positive and highly significant heterosis over MP by all crosses. Also, heterosis was positive and highly significant heterobilitosis relative to better parent recorded by all crosses. The result of number of ears/plant showed positive and highly significant heterosis over MP by crosses (P_1 x P_2), (P_1 x P_3), (P_1 x P_6), (P_2 x P_3), (P_2 x P_4), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5) and (P_4 x P_6). Meanwhile heterosis were positive and highly significant heterosis relative to BP evaluated by crosses (P_1 x P_2), (P_1 x P_3), (P_1 x P_5), (P_2 x P_3), (P_2 x P_4), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_7) and (P_4 x P_6). The result of hetrosis for ear length in Table (9), showed positive and highly significant heterosis over MP by crosses(P_1 x P_2), (P_1 x P_3), (P_1 x P_4), (P_1 x P_5), (P_1 x P_6), (P_1 x P_7), (P_2 x P_3), (P_2 x P_5), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_6), (P_3 x P_7), (P_4x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 x P_6) and (P_5 x P_7). Meanwhile heterosis were positive and highly significant heterosis relative to BP obtained by crosses (P_1 x P_2), (P_1 x P_3), (P_1 x P_4), (P_1 x P_5), (P_1 x P_6), (P_1 x P_7), (P_2 x P_5), (P_2 x P_6), (P_2 x P_7), (P_3 x P_5), (P_3 x P_6), (P_3 x P_7), (P_4x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 x P_6) and (P_5 x P_7). The result of hetrosis for ear diameter, showed positive and highly significant heterosis over MP by crosses (P_3 x P_4), (P_5 x P_6) and (P_6 x P_7). Meanwhile heterosis were positive and highly significant heterosis relative to BP recorded by crosses (P_5 x P_6) and (P_6 x P_7). The result of hetrosis for cub weight recorded the positive and highly significant heterosis over MP by crosses (P_1 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_3 x P_5), (P_3 x P_7), (P_4x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 x P_6), (P_5 x P_7) and (P_6 x P_7). Moreover, heterosis were positive and highly significant heterosis relative to BP evaluated by crosses (P_1 x P_2), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_3 x P_5), (P_4x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 x P_6) and (P_5 x P_7). The results were agreement with reported by ***Tejaswini et al*., (2023), Mishra *et al*., (2024) and Waghmare *et al*., (2024).**

The present data of hetrosis for number of rows/ear **in Table (10),** showed positive and highly significant heterosis over MP by all crosses except two crosses (P_2 x P_6) and (P_5 x P_6). Meanwhile heterosis were positive and highly significant heterosis relative to BP evaluated by all crosses except the one cross (P_2 x P_6). The hetrosis over MP by for number of kernels/row showed positive and highly significant the all crosses. While heterosis were positive and highly significant heterosis relative to BP evaluated by all crosses except the one cross (P_1 x P_6), (P_3 x P_6) and (P_3 x P_7) were the positive and non-significant heterosis relative to BP. The result of hetrosis for 100-kernel weight showed positive and highly significant heterosis over MP by crosses (P_1 x P_3), (P_1 x P_5), (P_1 x P_7), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_7), (P_4x P_5), (P_4 x P_6), (P_4 x P_7), (P_5 x P_6), (P_5 x P_7) and (P_6 x P_7). Meanwhile heterosis were positive and highly significant heterosis relative to BP evaluated by crosses (P_1 x P_3), (P_1 x P_5), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_6), (P_2 x P_7), (P_3 x P_4), (P_3 x P_5), (P_3 x P_7), (P_4x P_5), (P_4 x P_7), (P_5 x P_6), (P_5 x P_7) and (P_6 x P_7). Moreover the data of hetrosis for kernel weight/ear recorded positive and highly significant heterosis over MP by all crosses. Moreover, heterosis were positive and highly significant heterosis relative to BP evaluated by all crosses. The present data of hetrosis for kernel yield/plant showed positive and highly significant heterosis over MP by all crosses except three crosses were positive and significant this crosses (P_2 x P_5), (P_3 x P_6) and (P_6 x P_7). Moreover, heterosis were positive and highly significant heterosis relative to BP evaluated by all crosses. The results were garment with reported by **Kamal *et al.*, (2023), Nada (2023), Tejaswini et *al.*, (2023), Mishra *et al.*, (2024) and Waghmare *et al.*, (2024)** inundation **Abdel-Moneam *et al.*, *(*2024)** observed that the greatest cross combinations were eight crosses for kernel yield/plant. Nine single crosses manifested positive and highly significant heterosis over mid and better parents (ranged from 193.95% for cross Inb. 103 X Inb. 309 to 865.36% for cross Inb. 27 X Inb. 103 over mid parent and from 115.70% for cross Inb. 103 x Inb. 309 to 686.13% for cross Inb. 48 x Inb. 103 over better parent) for grain yield/plant.

Conclusion

The significantly of the studied traits indicated the presence of adequate genetic variability in the used genetic material. Mean Performance one of the most importance statistical analysis is the mean performance of tested material is which should be presented to identify the genetic variability existing among these material**.**

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تقييم تحليل التباين ومتوسط الأداء وقوة الهجين لبعض الصفات الزراعية في سبعة سلالات والهجن الناتجة في الجيل الاول من الذرة الصفراء

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أجريت التجربة الحقلية خلال موسمين متتاليين ٢٠٢٢ و ٢٠٢٣ في المزرعة البحثية بكلية الزراعة بمشتهر جامعة بنها. استخدم سبعة سلالات ذرة صفراء متجانسة متنوعة (السلالة ٦٣٥ (P1)، السلالة ٥٢٤ (P2)، السلالة ٤٢٣ (P3)، السلالة ٢٣١ (P4)، السلالة ٤١٨ (P5)، السلالة ٢٠٠ (P6) والسلالة ٢٠٢ (P7)). تم الحصول على السلالات من كلية الزراعة بمشتهر جامعة بنها، مصر. تم إجراء جميع التهجينات الممكنة باستثناء العكسية بين السلالات السبعة لإنتاج واحد وعشرين هجينا. تم اتخاذ الاحتياطات اللازمة أثناء عمليات التهجين لتجنب تلوث المادة الوراثية. تم زراعة بذور الواحد والعشرون هجينًا بالاضافة الى الاباء في الموسم الثاني ٢٠٢٣ وتم تقييمها وفقًا لجميع الممارسات الزراعية الموصى بها لإنتاج الذرة من الزراعة و حتى الحصاد. باستخدام تصميم القطاعات كاملة العشوائية في ثلاث مكررات، لتقدير تحليل التباين ومتوسط الأداء وقوة الهجين لصفات ارتفاع النبات وارتفاع الكوز ومساحة ورقة العلم وقطر الساق وعدد الأوراق / نبات ووزن الكوز وعدد الكيزان / نبات وطول الكوز وقطر الكوز وعدد الصفوف / كوز وعدد الحبوب / الصف ووزن القولحة ووزن ١٠٠ حبة ووزن الحبوب / كوز ومحصول الحبوب / نبات.

أهم النتائج

١- أظهرت نتائج تحليل التباين اختلافًات عالية المعنوية بين جميع التراكيب الوراثية لجميع صفات الدراسة. كان متوسط مجموع مربعات الآباء ذات دلالة احصائية عالية المعنوية لجميع صفات الدراسة باستثناء صفة محصول الحبوب / النبات. علاوة على ذلك، كان تحليل التباين للهجن عالي المعنوية لجميع صفات الدراسة. في حين كان تحليل التباين للهجن مقابل الاباء P vas F1s ذات معنوية عالية لجميع صفات الدراسة باستثناء قطر الكوز (سم).

٢- تراوح متوسط أداء السبعة آباء والهجن الناتجة منها في الجيل الاول لمحصول الحبوب/نبات (جم) من ٣١.٧ إلى ٦٧.٠ (جم) للآباء، كما تغير من ٩١.٢٧ إلى ٤٠٥.٥ (جم) للهجن. وقد سجل الابوين P2 وP4 والهجن (P1 xP6) و(P2 x P4) و(P2 x P6) و(P2 x P7) أعلى القيم لمحصول الحبوب/نبات. ويمكن انتخابها في الاجيال التالية لتحسين المحصول ومكوناته.

٣- وأظهرت البيانات الحالية لقوة الهجين لصفة محصول الحبوب/نبات موجبة عالية المعنوية على أساس متوسط الاباء لجميع الهجن باستثناء ثلاثة هجن (P2 x P5) و(P3 x P6) و(P6 x P7). علاوة على ذلك، كانت قوة الهجين على اساس الاب الافضل موجبة وعالية المعنوية لجميع الهجن..

التوصية: إن الفروق ذات الدلالة الاحصائية بين جميع الصفات تحت الدراسة تشير الى الاختلافات الوراثية بين التراكيب الوراثية المستخدمة . كما إن متوسط الأداء هو أحد أهم التحليلات الإحصائية للتراكيب الوراثية المستخدمة للاختيار بينها في برامج التهجين لتحسين الذرة الشامية.