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ESTIMATION OF GENE ACTION, COMBINING ABILITY, HETEROSIS AND HERITABILITY IN MAIZE BY USING LINE × TESTER METHOD UNDER TWO OF NITROGEN LEVELS.

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ABSTRACT

The experiment was carried out at the field of College of Agriculture at the University of Duhok during the spring season of 2010. Eleven inbred lines of maize, had been selected, eight of them were used as a line (males), (ZP 204, ZP 301, ZP 595, ZP 670, ZP 430, ZP 505, un 44652, ZP 735) and the reminder used as testers (females), (ZP 197, ZP 607 and ZP 707) to estimate gene action, specific and general combining ability, heterosis and heritability for yield and its components under two nitrogen fertilizer levels (135 and 275 Kg N/ha). The results showed significant positive heterosis for most studied characters of hybrids under two nitrogen levels. The better hybrids for grain yield were (ZP 607 × ZP 505) and (ZP 707 × ZP 204). The line ZP 505 showed the heights positive GCA effect of grain yield. Heritability in broad sense was high for all studied characters while heritability in narrow sense was high for ear height under both nitrogen levels and number of rows / ear under value nitrogen level only. The additive variance was more than dominance variance for all characters except 100 grain weight (g) and ear length (cm) under (135 Kg N). The average degree of dominance was greater than one for all characters. The results of this study can enhance the use of promising inbred lines in a programme focused on developing hybrid that efficiently can take up and use nitrogen.

Keyword: Gene action, Heritability, Nitrogen levels

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INTRODUCTION

The most commonly soil order that is dominance in Semmel region at Dohuk province is vertisols it's a good natural fertility at the same time, it responds for adding chemical fertilizers. Therefore this soil is a good productivity, but the leaching process may causes deficiency of nutrient elements at root zone of field crops.

Nitrogen deficiency is one of the most important stresses affecting maize production (lafltt and Banziger, 1995). The yield of maize require high addition chemical fertilizers, mainly nitrogen, thus a maize cultivar with genetic potential to use nitrogen efficiently could produce economically in poor soil with low levels of fertilizer application or high yields with better in puts of fertilizers due to its capacity to utilize nitrogen efficiently. (Pollmer *et al.,*1979 and Moll *et al.,* 1982) the variation in the capacity of maize genotypes to take up nitrogen from soil and to utilize plant nitrogen for grain production has been widely reported efficient and in efficient maize hybrids respond differently to the nutrient supply in the soil (Eito *et al.,* 2002). Genetic variation in response to nitrogen supply of inbred lines which response by many workers and it appears to be possible to develop hybrids to low nitrogen in soil (Balko and Russel, 1980). In most breeding programs one of main objective is to indentify inbred lines with productive potential and high combining ability for hybrid production that expresses high heterotic levels for grain yield. Maize cultivars present different behavior when grown in low levels of nitrogen and show different nitrogen partition and biomass in the plant, especially in terms of nitrogen removed from the vegetative tissues (Ta and Wieland, 1992). Some morphological and physiological responses of maize when deficiency conditions are shown through plant height low efficiency in light interception increment in nitrogen mobilization to grain and reduction in nitrogen concentration in the plant (Muchow and Sinclaif, 1994), with respect to genetic parameters to related nitrogen use efficiency, dominance effects had the great contribution to the observed genetic variance (Clark and Duncan., 1991). The genetic variation due to general combining ability was greatly related to nitrogen plant structure (productivity and dry matter), indicating that differences among crosses could be attributed to additive gene effects (Rizzi et al., 1993).

The objective of this study was to evaluate gene action, heterosis and heritability for yield and its components by using line × tester method under two levels of nitrogen.

MATERIAL AND METHODS

Eleven inbred lines of maize were selected, eight of them used as a line (males), (1) ZP 204 (2), ZP 30, (3) ZP 670, (4) ZP 430,(5) ZP 505, (6) un 44652, (7) ZP 735 and the reminder used as testers (female) (A) ZP 197, (B) ZP 607 and (C) ZP 707. The genotypes were sown during on April 2009, each genotype was planted in row with 4 m length, spacing 75 and 25 cm between and within rows, respectively. All recommended cultural practices and operation were done as recommended. Crossing among genotypes was done by line × tester according to Kemphorne methods (1957). The 24 hybrid, eight parental line and three testers were sown at the same field experiment during the spring season 2010. A Randomize Complete Block Design with three replications was applied, using (135) kg N/ha in the first experiment and (275) kg N/ha in the second experiment before anthesis stage. The data were recorded on plant height (cm), ear length (cm), 100 grain weight (g), no of rows/ear, ear length (cm) yield/plant (g) and estimated the nitrogen in grains. The data of each level analyzed individually using RCBD/design according to (Al-Rawi and Khalf – Allah, 1980). Duncan Multiple Range Test was used to compare the means of genotypes. The genetic analysis was based on Kempthorn, (1957) to determined the variance of general and specific combining ability, additive, dominance and environmental variance, average degree of dominance, heritability in broad and narrow sense, expected genetic advance in absolute and percentage and heterosis estimated as a deviation of F_1 from the mid parents values.

RESULTS AND DISCUSSION

Analysis of variance showed highly significant difference between genotypes under both nitrogen levels (table 1). The mean performance of parent testers and hybrids for all characters under both nitrogen levels are presented in table (2). The maximum plant height (157 cm) was recorded in parent 5 & hybrid (A×2) (164 cm) under (135) & 275 kg/ha, respectively. Highest ear height (88.3 cm) & hybrid (B × 4) (97.3 cm) under both nitrogen levels while the maximum 100 grain weight (g) was recorded in parent 5 (29.59 g) & hybrid (B×6) under level 273 kg/ha. The highest

No. of rows / ear obtained was (16.6) in parent 3 & hybrid (C×3) (20) under the both nitrogen level respectively. The result proved that parent 3 (19.33) & hybrid (C×3) gave the highest value for ear length under (135) & (275) kg/ha. The highest yield per plant in (g) was recorded for parent (3) (79.87 g), (126.12 g) and hybrid (B×6) (124.36 g), (157.44 g) under both nitrogen levels while the result indicated that the largest nitrogen grain reached (4.44 g) and hybrid (B×5) (3.11 g), (5.70 g) under (135) and (275) kgN/ha.

Estimates of general combining abilities effect for the parents and testers were presented in table (3). The genotype (tester C) was the best combiner for the no.of rows/ear and ear/length, parent 4 for the ear height and N in grain, parent 6 for 100 grain weight and grain yield/plant under both nitrogen levels, while other genotypes varied in these effect among nitrogen levels. It's worthy; we can say that the tester C was the best combiner for the most characters under both nitrogen levels.

Table (4) showed that the specific combining abilities estimated the highest positive S.C.A effect for yield / plant was found in crosses (C×3) and (B×8) under N_1 level while under N_2 level the highest positive S.C.A. effect was found in crosses (C×3) and (A×1) in any way the S.C.A. effects for yield were larger under low N level, they consider that these effects were more important under low high than N a variability. For ear length the cross (A×1) gave high S.C.A effect for this trait under N_1 and N_2. Level while in No. of rows / ear the same cross gave high positive S.C.A under N_1 level but under N_2 level the cross (B×8) gave high positive S.C.A affect . For 100 grain weight, the cross (A×2) gave the highest positive S.C.A effect and N_1 and N_2 level for plant height and ear height (cm) the crosses (B×7) and (C×5) gave high positive S.C.A effect under N_1 level whereas the crosses (A×2) and (C×8) gave high positive S.C.A effect under N_2 level. For nitrogen in grain the cross (A×7) under N_1 level gave positive S.C.A. effect while the cross (C×7) gave positive S.C.A. effect under N_2 level. Similar results in maize have been reported by Al-Savie (2005), Derera *et al.* (2007), Mohammdi *et al.* (2008) and Rather *et al.* (2009).

Table, (5) shows of additive, dominance, and environment variance, average degree of dominance, heritability in broad and narrow sense and genetic advance for the studied characters under N1 level compare with N2 level except plant height, ear height and No. of rows/ear), and also the value of dominant gene effect in the genetic control of these characters. These results supported by the values of the average degree of dominance which are more than one for same characters. High heritability in narrow sense was reported for No. of rows / ear and ear height under N_1 level and medium for all characters under N_2 level, whereas low heritability in narrow sense was observed for nitrogen, in grain only. High heritability in broad sense was observed for all characters under N_1 and N_2 level except nitrogen in grain under N_1 and N_2 level. This result point out that high heritability values and a high percentage of genetic advance indicated scope for improvement of these characters by direct selection. The present finding thus supported the results of Deletic *et al* (2005), Hamed (2008), Cook and Hallader, (2008) and Najeeb *et al.* (2009).

Table (6) reveals the estimation of heterosis for the studied characters significantly positive heterosis in favorable direction over mid parent was observed for the most crosses under N_1 and N_2 level, The crosses (B×6) , (B×8), (C×1), (C×6), (B×7) were superior significantly at level 1 % of positive heterosis in desirable direction for grain yield / plant. For ear length the crosses (B×7) and (C×5) gave high value of heterosis and reached 4.16 and 3.83)under N_1 level while the crosses (C×6) and (C×4) gave him value of heterosis which was 6.79 and 5.08, respectively under N_2 level. For the No. of rows / ear the cross (C×3) showed positive heterosis and the value of heterosis scored 4.66 and 5.00 under N_1 and N_2 level, respectively. The cross (A×2) obtained high positive heterosis in desirable direction for 100 grain weight and reached 5.94 and 11.11 under N_1 and N_2 level for plant height the most crosses was reported significantly positive heterosis at level 1%, the (B×2) and (C×6) were superior than the other crosses and the value reached 31.66 and 45.33, respectively, under N_1 and N_2 level, while the cross (C×5) and (C×1) were scored 29.5 and 29.50. For (N) in grain, the cross (B×5) was the best cross in desirable direction at level 1 % and was 0.75 and 1.44. These results are in accordance with these, Chungji *et al.* (2006), Lee *et al,* (2006) and Dawod *et al*. (2009).

The productivity of inbred lines, testers and crosses were different and were dependent under nitrogen levels. The highest SCA estimated were detected for the cross, between line ZP – 301 and tester ZP – 301 and tester ZP – 607, some lines and hybrids identified in this study showed to be promising in GCA and SCA so that you put this inbred lines in plant breeding program.

Table (1) Mean squares for studied characters under two levels of nitrogen.

SOV	df	Plant height (cm)		ear height (cm)		100 grain weight (g)		No. of rows / ear	
		N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
Replication	2	124.2	77.06	142.0	102.63	0.28	2.08	0.49	1.02
Genotypes	34	514.8**	779.94**	456.1**	341.96**	71.2**	61.80**	9.83**	15.24**
Parents	10	564.2**	898.87**	556.3**	315.88**	80.1**	82.78	2.7**	3.49**
Par. vs crosses	1	2400.9**	9375.41**	1222.3**	2777.80**	213.7**	0.12	29.6**	70.30**
Crosses	23	411.3**	354.52**	379.2**	247.40**	61.2**	55.37	12.00**	17.96**
Lines	7	543.7**	416.98**	731.8**	493.77**	37.1**	36.48	8.10**	2.50**
Testers	2	886.7**	770.38**	57.9**	102.12**	180.2**	104.57	54.00**	102.72**
LXT	14	277.3**	263.88**	248.7**	144.96**	56.3**	57.78	7.90**	13.57**
Error	68	5.57	7.05	6.2	4.64	0.1	0.34	0.25	0.75

SOV	Df	Ear length (cm)		Grain yield / plant (g)		N. in grain (g)	
		N_1	N_2	N_1	166.31	N_1	N_2
Replication	2	0.35	0.32	6.35	4467.54**	0.09	0.73
Genotypes	34	12.70**	19.86**	4106.62**	650.49**	0.13**	0.68**
Parents	10	8.63**	6.93**	2525.15**	47685.95**	0.08**	0.22
Par. vs crosses	1	0.35	77.11**	8042.96**	4248.06**	0.01	0.02
Crosses	23	15.11**	23.00**	4623.07**	2865.67**	0.15**	0.90**
Lines	7	8.29**	7.70**	2942.50**	13257.86**	0.12**	0.64**
Testers	2	56.31**	110.62**	9008.21**	3652.14**	0.19**	1.80**
LXT	14	12.64**	18.13**	4836.89**	119.73	0.17	0.90**
Error	68	0.51	1.25	15.54	166.31	3.64	6.47

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Table (2): Mean performance and statistical significance for studied characters in genotypes (testers, parents and hybrids) under two levels of nitrogen.

Traits	Plant height (cm)		Ear height (cm)		100 grain weight (g)		No. of rows / ear		ear length (cm)		grain yield / plant(g)		N. in grain (g)	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
A	110.0 n	126.6 mn	75.0 J	73.3 Hi	11.2 qr	11.2 qr	14.6 g-i	15.3 de	15.50 e-h	16.16 de	48.03 l-p	70.64 n	2.30 d-g	3.53 j-m
B	110.0 n	111.6 n	74.6 gh	81.6 e-g	22.6 cd	22.7 cd	13.3 Ji	14.0 f	18.83 i-g	16.66 cd	51.75 l-p	78.57 g	2.37 c-g	4.08 e-k
C	110.0 n	149.0 de	67.6 klm	70.0 K	15.2 mn	19.6 i	14.0 F	14.6 g-i	14.33 e-h	17.33 cd	74.59 g-j	89.23 g-k	2.62 a-f	3.64 J-m
1	116.6 m	117.3 pq	49.3 o	53.3 O	20.7 gf	21.7 ed	14.0 F	16.7 e-f	14.33 e-h	15.33 cd	27.52 m	44.08 m-p	2.45 a-f	4.27 J-m
2	120.0 Lm	126.6 mn	48.3 o	63.3 N	10.2 s	16.5 L	14.6 F	16.6 e-f	14.50 i-k	15.33 d-f	30.08 m	63.02 J-n	2.41 a-f	3.98 f-g
3	136.6 h-j	145.0 ef	77.6 fg	80.0 i-h	15.3 mn	20.3 gin	15.3 Fgn	16.6 def	18.66 ab	19.33 ab	79.87 f-j	126.12 c	2.78 a-c	4.32 b-f
4	132.3 jkl	136.6 i	67.6 kl	72.3 hij	12.7 op	20.7 g	14.0 F	14.0 f	13.33 n-l	13.66 f-i	45.53 lk	57.20 k-o	2.65 a-f	4.07 d-k
5	157.0 b	163.3 ab	57.0 n	88.3 bc	13.6 no	29.5 a	14.0 F	14.0 f	14.33 i-k	14.66 d-g	45.32 lk	67.87 J-l	2.35 c-g	4.44 b-e
6	116.0 m	118.3 pq	65.6 k-m	65.6 k-m	20.2 c	25.3 a	14.6 g-i	16.0 cd	13.41 f-i	14.66 i-k	40.47 op	45.74 lk	2.57 a-f	4.19 c-h
7	131.6 kl	137.3 i	88.3 bc	87.3 bc	22.7 d	23.2 bc	14.0 f	15.3 g-h	14.50 i-k	14.16 e-h	42.72 n-p	47.47 l-k	2.60 a-f	3.87 f-g
8	118.0 lm	128.3 lm	78.0 fg	83.0 e-f	14.4 p	14.4 p	14.0 F	14.0 f	14.00 n-l	14.70 d-g	35.23 p	61.70 i	2.73 a-e	4.06 e-k
A×1	138.0 g-i	150.0 de	76.6 h-j	83.0 de	17.1 k	19.5 hi	16.0 cd	16.6 e-f	16.0 ef	19.33 ab	90.76 f	113.80 de	2.35 c-g	3.29 m
A×2	152.6 cd	165.6 a	77.6 g-j	84.3 Cd	19.8 n	22.0 de	14.0 f	17.3 c-e	14.66 i-k	18.33 bc	73.36 h	93.20 f-h	2.30 d-g	3.48 j-m
A×3	121.6 l	121.6 l	83.0 def	88.0 bc	10.2 ut	12.0 pq	14.0 F	14.0 f	13.00 l-o	13.00 g-i	50.53 jk	63.15 k-n	2.77 a-d	4.40 b-f
A×4	123.0 no	131.6 J	87.3 cd	96.6 A	12.0 r	15.2 k-m	14.0 f	14.0 f	13.33 n-l	14.00 e-i	38.50 op	40.16 l	2.62 a-f	4.00 e-k
A×5	138.0 g-i	142.6 f-h	79.3 l-j	83.0 de	12.9 q	15.1 lm	16.0 cd	16.0 cd	12.50 o	12.00 i	60.16 i	73.51 n-k	2.70 a-f	4.71 bc
A×6	131.6 6 kl	138.3 3 hi	81.0 e-h	88.33 bc	15.36 m-o	17.45 J	14.0 F	14.6 g-i	14.50 i-k	15.5 def	71.63 n	93.84 fg	2.32 c-f	4.05 d-l
A×7	126.6 6 mn	126.6 6 k	69.3 3 J	70.0 i-k	8.0 V	8.3 t	12.0 g	12.0 J	12.3 hi	12.6 on	28.6 m	42.96 n-p	2.85 Ab	3.48 l-m
A×8	140.0 gh	143.7 fg	74.7 J	77.7 Fg	10.5 t	13.1 o	14.0 f	14.6 g-i	13.3 f-i	13.8 j-n	75.5 gn	96.75 ef	2.85 ab	3.70 j-g
C×6	135.0 h-k	158.3 c	82.3 ef	88.3 bc	21.86 ed	21.66 d-f	18.66 B	17.33 c-e	18.83 ab	20.66 a	127.3 c	144.9 ab	2.55 a-f	4.05 e-l
C×7	124.0 no	138.3 hi	69.0 k	69.3 j-l	23.28 bc	23.61 c	18.0 B	20.0 a	18.33 ab	19.0 ab	112.0 d	129.5 b-d	2.19 ab	4.64 b-d
C×8	137.6 hi	158.3 c	79.0 f-j	97.3 A	14.8 po	15.3 kl	15.33 De	16.66 def	16.66 i-k	14.50 def	40.17 l	86.3 f-i	2.36 c-g	3.44 lm
Mean	137.4	139.9	74.6	80.5	17.1	17.7	15.4	16.05	15.32	16.41	73.65	86.46	2.51	4.07
C.V	1.71	1.89	3.3	2.67	1.95	3.32	3.31	5.40	4.67	6.81	5.35	12.65	9.25	7.58

Continued …….

Table (2): Mean performance and statistical significance for studied characters in genotypes (testers, parents and hybrids) under two levels of nitrogen.

Traits	Plant height (cm)		Ear height (cm)		100 grain weight (g)		No. of rows / ear		Ear length (cm)		Grain yield / plant(gm)		N. in grain(g)	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
B×1	132.33 j-l	139.00 g-i	76.33 iJ	78.00 fg	15.16 no	17.20 j	13.3 ji	14.0 f	12.8 no	15.5 def	42.63 l	50.82 lp	2.29 ef	4.09 e-g
B×2	149.66 de	150.00 de	75.33 j	82.33 de	9.66 u	10.96 rs	14.0 f	14.0 hi	14.3 h-l	14.3 e-h	42.63 l	64.10 J-m	2.49 af	4.81 b
B×3	135.0 i-k	143.3 fg	85.0 c-e	88.3 bc	12.06 r	16.20 k	16.0 Cd	15.33 f-h	14.16 h-l	16.0 de	23.93 m	37.59 op	2.25 gf	4.12 c-i
B×4	142.3 fg	146.66 ef	92.3 ab	97.3 a	24.43 b*	24.15 b	14.0 f	14.0 hi	14.23 i-k	15.33 def	52.8 J	94.46 e-g	2.59 a-f	4.13 c-i
B×5	157.6 b	160.3 bc	82.6 e-f	88.3 bc	15.06 h-o	17.50 J	18.0 b*	17.33 c-e	16.25 de	19.00 ab	91.9 f	137.72 ab	3.11 a	5.70 a
B×6	137.3 hi	146.0 ef	64.0 ml	69.3 j-l	20.88 gf	25.16 q	16.0 cd	16.0 e-f	16.0 ef	19.00 ab	124.36 c	157.44 a	2.52 a-f	4.42 b-e
B×7	146.0 ef	156.6 cd	62.3 m	64.3 mn	17.25 k	19.50 hi	16.00 cd	18.0 b-d	18.33 bc	19.66 ab	125.4 c	132.1 bcd	2.38 a-f	3.79 f-g
B×8	136.0 h-k	143.3 fg	83.3 def	87.3 bc	19.21 i	21.55 ef	18.0 b	20.0 a	16.66 de	19.16 ab	123.2 c	140.0 ab	2.41 a-f	4.05 d-k
C×1	140.0 gh	153.3 d	52.3 o	90.0 b	15.58 kl	17.80 j	14.66 ef	20.00 a	14.0 j-h	19.66 ab	71.20 n	148.1 ab	2.45 a-f	4.17 d-h
C×2	146.6 ef	153.0 cd	51.6 o	87.0 bc	19.18 i	19.41 hi	15.33 de	19.33 ab	14.33 h-l	19.66 ab	44.57 lk	137.33 ab	2.53 a-f	4.38 b-f
C×3	155.0 bc	145.0 ef	87.3 cd	95.0 a	14.70 po	19.68 hi	20.00 a	20.0 a	19.66 a	19.83 ab	120.5 c	134.1 bc	2.24 gf	3.89 f-e k-g
C×4	145.0 ef	158.3 b	87.0 cd	82.3 de	15.86 m	20.50 gh	18.0 b	19.33 ab	15.66 e-g	19.0 ab	98.4 e	95.4 ef	2.64 a-f	3.65 J-m
C×5	164.0 a	164.0 a	79.3 ef	93.0 a	13.76 r	21.38 ef	18.0 b	18.66 a-c	19.66 a	18.66 ab	14.01 b	116.0 cd	2.35 a-f	3.35 m
C×6	135.0 h-k	158.3 c	82.3 ef	88.3 bc	21.86 ed	21.66 d-f	18.66 b	17.33 c-e	18.83 ab	20.66 a	127.3 c	144.9 ab	2.55 a-f	4.05 e-l
C×7	124.0 no	138.3 hi	69.0 k	69.3 j-l	23.28 bc	23.61 c	18.0 b	20.0 a	18.33 ab	19.0 ab	112.0 d	129.5 b-d	2.19 ab	4.64 b-d
C×8	137.6 hi	158.3 c	79.0 f-j	97.3 a	14.76 po	15.33 kl	15.33 de	16.66 def	16.66 i-k	14.50 def	40.17 L	86.3 f-i	2.36 c-g	3.44 Lm
Mean	137.4	139.86	74.6	80.47	17.1	17.69	15.39	16.05	15.32	16.41	73.65	86.46	2.51	4.07
C.V	1.71	1.89	3.3	2.67	1.95	3.32	3.31	5.40	4.67	6.81	5.35	12.65	9.25	7.58

Table (3): Estimation of GCA effects of testers and inbred lines for studied characters under two levels of Nitrogen.

Inbred and tester	Plant height (cm)		Ear height (cm)		100 grain weight (g)		No. of rows / ear	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
A	-6.65	-6.22	1.09	-0.04	-2.95	-2.39	-1.50	-1.69
B	1.38	1.36	0.68	-2.04	0.51	1.39	0.00	-0.61
C	5.26	4.86	-1.77	2.08	2.44	1.00	1.50	2.30
SE(gi)	1.92	2.16	2.03	1.76	0.27	0.48	0.41	0.70
1	-3.80	1.18	-8.54	-0.29	0.49	-0.06	-0.86	0.05
2	11.08	7.73	-8.76	0.59	0.01	-0.26	-1.30	0.27
3	-3.47	-9.59	8.34	6.59	-3.87	-1.75	0.91	-0.16
4	0.62	-5.15	11.90	8.15	1.27	2.23	-0.41	-0.83
5	12.63	9.40	8.01	-0.40	0.24	-2.28	1.58	0.72
6	-5.80	1.29	-1.20	-1.95	3.16	3.70	0.47	-0.61
7	-8.47	-7.04	-11.76	-16.06	0.09	-0.67	-0.41	0.05
8	-2.80	2.18	2.01	3.37	-1.39	-0.89	0.02	0.50
SE (gi–gi)	1.92	2.16	2.03	1.76	0.27	0.48	0.41	0.70

Continued …….

Inbred and tester	Ear length (cm)		Grain yield / plant (g)		N. in grain (g)	
	N_1	N_2	N_1	N_2	N_1	N_2
A	-1.55	-2.26	-18.73	-23.92	0.08	-0.18
B	0.04	0.25	-1.21	0.87	0.00	0.31
C	1.50	2.00	19.95	23.05	-0.09	-0.12
SE(gi)	0.58	0.91	3.21	8.93	0.18	0.25
1	-1.08	1.17	-11.37	3.34	-0.14	-0.22
2	-0.92	0.45	-26.71	-2.68	-0.06	0.15
3	0.24	-0.71	-0.58	-22.62	-0.08	0.06
4	-0.95	-0.80	-15.80	-24.77	0.11	-0.14
5	0.77	-0.43	17.81	8.17	0.21	0.51
6	1.07	0.01	28.20	31.16	-0.04	0.09
7	1.24	1.31	9.06	0.16	-0.03	-0.10
8	-0.36	-0.99	-0.60	6.78	0.03	-0.34
SE (gi–gi)	0.58	0.91	3.21	8.93	0.18	0.25

Table (4): Estimated of S.C.A effect of crosses for studied characters under two nitrogen levels.

Hybrids	Plant height (cm)		Ear height (cm)		100 grain weight (g)		No. of rows / ear	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
A × 1	8.09	8.77	7.12	-0.62	3.39	4.21	2.61	1.69
A × 2	7.20	17.88	8.34	-0.18	6.54	6.92	1.05	2.13
A × 3	-8.90	-8.77	-2.76	-2.18	0.79	-1.56	-1.16	-0.75
A × 4	-11.34	-3.22	-2.65	4.59	-2.37	-2.35	0.16	-0.08
A × 5	-8.34	-6.77	-6.76	-0.51	-0.59	1.99	0.16	0.36
A × 6	3.43	-3.00	4.12	6.37	-1.04	-1.57	-0.72	0.36
A × 7	1.09	-6.33	-1.98	2.15	-5.30	-6.30	-1.82	-2.97
A × 8	8.76	1.44	-5.73	-9.62	-1.40	-1.34	-0.27	-0.75
B × 1	-5.94	-9.80	7.20	-3.62	-2.04	-1.14	-0.88	-2.72
B × 2	-3.16	-5.69	6.43	-0.18	-7.06	-7.88	-0.44	-2.27
B × 3	-3.61	5.30	-1.01	-0.18	-0.77	-1.15	-0.66	-0.50
B × 4	-0.38	4.19	2.76	7.26	6.44	2.80	-1.33	-1.16
B × 5	2.94	3.30	-3.01	6.81	-1.89	0.66	0.66	0.61
B × 6	1.05	-2.91	-12.45	-10.62	1.00	2.34	-0.22	0.61
B × 7	12.28	12.08	-3.56	-1.51	0.43	1.06	0.66	1.94
B × 8	-3.27	-6.47	3.65	2.04	3.89	3.32	2.22	3.50
C × 1	-2.15	1.02	-14.33	4.25	-1.34	-3.06	-1.72	1.02
C × 2	-4.04	-12.19	-14.77	0.36	0.51	0.96	-0.61	0.13
C × 3	12.51	3.47	3.77	2.36	-0.01	2.72	1.83	1.25
C × 4	11.73	-0.97	-0.11	-11.86	-4.05	0.45	1.16	1.25
C × 5	5.40	3.47	9.77	-6.30	2.48	-2.66	0.83	-0.97
C × 6	-4.48	5.91	8.33	4.25	0.04	-0.76	0.94	-0.97
C × 7	-13.48	-5.75	5.55	-0.63	4.86	5.24	1.16	1.02
C × 8	-5.48	5.02	1.77	7.58	-2.49	-1.90	-1.94	-2.75
SE (sij)	1.92	2.16	2.03	1.76	0.38	0.67	0.41	0.70

Continued …….

Table (4): Estimated of S.C.A effect of crosses for studied characters under two nitrogen levels.

Hybrid	Ear length (cm)		Grain yield / plant (g)		N. in grain (g)	
	N_1	N_2	N_1	N_2	N_1	N_2
A × 1	3.27	3.43	41.30	33.48	-0.09	-0.37
A × 2	1.77	3.15	37.24	18.91	-0.23	-0.55
A × 3	1.05	-1.01	-9.72	8.80	0.25	0.44
A × 4	0.47	0.15	-4.87	-13.68	-0.08	0.25
A × 5	-2.08	-2.29	-18.48	-11.62	-0.11	0.31
A × 6	-0.38	-0.62	-17.40	-14.29	-0.23	0.06
A × 7	-2.38	-2.40	-41.30	-34.61	0.28	-0.30
A × 8	0.38	-0.40	13.26	13.00	0.21	0.15
B × 1	-1.49	-2.92	-24.35	-54.29	-0.07	-0.07
B × 2	-0.15	-3.36	-9.00	-34.98	0.05	0.26
B × 3	-1.49	-0.53	-53.84	-41.59	-0.16	-0.33
B × 4	-0.22	-1.03	-9.75	17.47	-0.03	-0.10
B × 5	0.06	2.18	-4.27	27.78	0.39	0.79
B × 6	-0.49	0.35	17.80	24.51	0.05	-0.06
B × 7	2.17	2.40	37.93	29.67	-0.09	-0.49
B × 8	1.61	2.90	45.48	31.42	-0.12	0.01
C × 1	-1.78	-0.50	-16.94	20.80	0.17	0.44
C × 2	-1.61	0.21	-28.23	16.06	-0.18	0.28
C × 3	2.54	1.54	63.57	32.79	-0.08	-0.11
C × 4	-0.25	0.88	14.63	-3.78	0.11	-0.15
C × 5	2.02	0.10	22.76	-16.16	-0.28	-1.11
C × 6	0.88	0.27	-0.39	-10.21	0.17	0.01
C × 7	0.21	-0.01	3.37	4.93	-0.19	0.79
C × 8	-2.00	-2.50	-58.74	-44.43	-0.08	-0.15
SE (sij)	0.58	0.91	3.21	8.93	0.18	0.25

Table (5): Estimation of genetic parameters for studied characters under two nitrogen levels.

Variance	Plant height		Ear height		100 grain weight		No. of rows / ear	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
$^2\sigma A$	96.50	77.35	82.78	58.40	11.61	8.35	3.11	4.44
SEA	27.30±	22.26±	20.02±	14.43±	3.62±	2.49±	1.00±	1.57±
$^2\sigma D$	90.58	85.60	80.85	46.77	18.74	19.14	2.56	4.27
SED	32.68±	31.10±	29.31±	17.08±	6.64±	6.81±	0.93±	1.60±
$^2\sigma E$	5.57	7.08	6.19	4.65	0.11	0.36	0.25	0.75
SED	0.94±	1.19±	1.04±	0.78±	0.01±	0.05±	0.04±	0.12±
å	1.37	1.48	1.39	1.26	1.79	2.14	1.28	1.38
h.n.s	0.50	0.45	0.48	0.53	0.38	0.30	0.52	0.46
h.b.s	0.97	0.95	0.96	0.95	0.99	0.98	0.95	0.92
GA	12.23	10.44	11.18	9.80	3.70	2.78	2.25	2.54
GA% of	8.90	7.46	14.97	12.18	21.56	15.75	14.62	15.82
Mean	137.45	139.86	74.67	80.47	17.17	17.69	15.39	16.05

Continued …….

Table (5): Estimation of genetic parameters for studied characters under two nitrogen levels.

Variance	Ear length(cm)		Grain yield / plant(g)		N. in grain(g)	
	N_1	N_2	N_1	N_2	N_1	N_2
σ^2A	3.18	5.27	699.91	852.52	0.01	0.13
SEA	1.04±	1.83±	209.76±	270.36±	0.01±	0.04±
σ^2D	4.04	5.62	1607.11	1177.47	0.03	0.27
SED	1.49±	2.13±	570.03±	430.46±	0.02±	0.10±
σ^2E	0.51	1.25	15.54	119.73	0.05	0.09
SED	0.08±	0.21±	2.62±	20.23±	0.01±	0.01
å	1.59	1.46	2.14	1.66	2.14	2.02
h.n.s	0.41	0.43	0.30	0.39	0.12	0.26
h.b.s	0.93	0.89	0.99	0.94	0.49	0.80
GA	2.01	2.66	25.56	32.36	0.07	0.37
GA% of mean	13.15	16.22	34.70	37.42	2.85	8.12
Mean	15.32	16.41	73.65	86.46	2.52	4.06

σ^2A = Additive genetic variance; σ^2D = Dominance genetic variance; σ^2E = Environment variance; $\bar{a}$ = Average degree of dominance; $h_{.n.s}$ heritability narrow sense; $h_{.b.s}$ heritability in broad sense ; GA = Genetic advance .

Table (6): Heterosis relative to mid – parent for studied characters under two level of nitrogen.

Hybrid	Plant height (cm)		Ear height (cm)		100 grain weight (g)		No. of rows / ear	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
A×1	16.33**	36.66**	14.50**	19.66**	0.67	3.35**	1.33*	1.00
A×2	25.66**	50.66**	16.00**	16.00**	5.94**	11.11**	-1.00	1.66
A×3	-10.00**	-5.83*	6.16*	12.83**	-3.10**	-3.90**	-2.00**	-1.00
A×4	-6.16*	8.33**	16.00**	23.83**	-3.85**	3.06**	-0.66	-0.33
A×5	-3.66	6.00*	13.33**	2.16	-7.47	2.48**	1.33*	1.66
A×6	9.16**	25.33**	10.66**	18.83**	-1.80**	-0.95	-1.66**	0.00
A×7	-2.5	3.00	-17.33**	-10.33	-8.65**	-8.99**	-2.66**	-3.00**
A×8	12.50**	29.50**	-4.33**	2.00	-24.00**	0.09	-0.66	0.33
B×1	18.66**	24.83**	10.83**	14.00**	-6.53**	-3.77**	0.00	-1.66
B×2	31.66**	33.83**	10.33**	13.33**	-9.43**	-5.46**	-0.33	-1.00
B×3	11.66**	15.00**	4.16	12.16**	-6.44**	-5.27**	0.66	1.00
B×4	21.16**	22.50**	17.16**	23.83**	3.20**	6.45**	0.00	0.33
B×5	24.00**	22.83**	13.33**	6.83**	-10.55**	-0.16	4.00**	3.66**
B×6	23.16**	32.16**	-9.66**	-0.83	-1.52**	1.20**	1.00	2.00**
B×7	25.16**	28.16**	-22.66**	-16.66**	-4.67**	-3.39**	2.00**	3.66**
B×8	16.83**	28.33**	1.00	11.00**	1.12**	2.99**	4.00**	6.33**
C×1	6.83**	40.00**	-7.33**	29.50**	-0.85*	-4.41*	0.66	4.33**
C×2	15.16**	31.66**	-7.33**	21.50**	3.12**	4.65**	1.00	3.66**
C×3	12.16**	17.50**	12.33**	22.33**	-0.70*	-0.11	4.66**	5.00**
C×4	17.16**	21.66**	18.16**	12.33**	-2.31**	4.47**	4.00**	5.00**
C×5	10.83**	27.33**	29.50**	1.33	-1.19**	-2.67**	4.00**	4.33**
C×6	20.00**	45.33**	14.50**	21.66**	2.49**	-0.62	3.66**	2.66**
C×7	-16.33**	14.66**	-10.16	-8.16**	4.73**	2.05**	4.00**	5.00**

C×8	-1.00	44.16**	2.50	24.16**	-0.28	-1.03	1.33**	2.33**

Continued …….

Table (6): Heterosis relative to mid – parent for studied characters under two level of nitrogen.

Hybrid	Ear length (cm)		Grain yield / plant (g)		N. in grain (g)	
	N_1	N_2	N_1	N_2	N_1	N_2
A×1	0.58	3.83**	67.74**	41.68**	-0.02	-0.60
A×2	-0.33	2.58*	37.67**	21.00**	-0.05	-0.27
A×3	-4.41**	-4.41**	-0.80	-47.85**	0.22	0.47
A×4	-1.08	-0.91	-14.12	-17.92**	0.14	0.19
A×5	-2.41**	-3.41**	15.56	2.18	0.37	0.72
A×6	-0.58	0.70	49.58**	13.43**	-0.11	0.19
A×7	-2.33**	-2.83*	-2.41	-30.45**	0.39	-0.22
A×8	-0.91	-2.10	55.12**	7.32	0.32	-0.09
B×1	-2.25**	-0.25	2.90	-10.41*	-0.12	-0.07
B×2	-0.33	-1.66	6.71	-11.69**	0.10	0.78
B×3	-2.91**	-1.66	-28.26*	-78.41**	-0.32	-0.07
B×4	0.15	0.16	39.98**	-9.25*	-0.07	0.06
B×5	1.66*	3.33**	77.90**	29.94**	0.75	1.44**
B×6	1.25	3.95**	111.33**	62.20**	0.04	0.28
B×7	4.16**	4.25**	84.81**	62.34**	-0.10	-0.18
B×8	2.25**	3.48**	96.48**	53.09**	-0.13	-0.02
C×1	-2.33**	5.08**	88.76**	12.83**	-0.09	0.21
C×2	-1.58*	4.83**	68.52**	-15.08	0.01	0.57
C×3	1.33	3.33**	56.88**	54.84**	-0.46	-0.09
C×4	0.33	5.00**	29.48**	30.97**	0.01	-0.21
C×5	3.83**	4.16**	44.72**	72.82**	-0.14	-0.69
C×6	2.83**	6.79**	87.36*	59.84**	0.04	0.13
C×7	2.41**	4.75**	70.83**	43.61**	-0.43	0.87
C×8	-1.16	0.98	31.38*	-35.29**	-0.31	-0.40

*, ** significant difference at level 0.05 and 0.01, respectively.

تقدير الفعل الجيني وقابلية الائتلاف وقوة الهجين ونسب التوريث في الذرة الصفراء باستعمال طريقة السلالة × الفاحص تحت مستويين من النايتروجين

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الخلاصة

طبقت التجربة في حقل كلية الزراعة/ جامعة دهوك للموسم الربيعي لعام 2010. انتخبت احدى عشر سلالة من الذرة الصفراء، ثمانية منها استخدمت امهات وهي (zp204 ، zp301 ، zp 595، zp670 ، zp430 ، zp505 ، un44652 ، zp735) والباقي استخدمت كفواحص (اباء) وهي (zp197 ، zp607 ، zp707) لتقدير الفعل الجيني وقابلية الائتلاف العامة والخاصة وقوة الهجين ونسبة التوريث للحاصل ومكوناته تحت مستويين من السماد النايتروجيني.

اظهرت النتائج قوة هجين بالاتجاه الموجب لمعظم صفات الهجن تحت المستويين من النايتروجين وكانا افضل هجينين لحاصل الحبوب هما الهجينان (zp505 × zp607) و (zp204 × zp707) ، كما اظهرت السلالة zp505 قابلية ائتلاف عامة عالية وموجبة لحاصل الحبوب. اما قابلية التوريث بالمعنى الواسع فكانت

عالية لجميع الصفات في حين كانت نسبة التوريث بالمعنى الضيق عالية لارتفاع العرنوص تحت المستويين من النايتروجين بينما اظهرت صفة عدد الصفوف للعرنوص قابلية ائتلاف خاصة تحت المستوى الاول للنايتروجين، كان التباين الاضافي اكبر من التباين السيادي لكل الصفات باستثناء وزن 100 حبة وطول العرنوص تحت المستوى 135كغم /N/هـ، كان معدل درجة السيادة اكثر من واحد لكل الصفات المدروسة. ان نتائج هذه الدراسة يمكن ان تعزز من استعمال هذه السلالات المتفوقة في برامج التربية لانتاج هجن ذات كفاءة عالية في التمثيل النايتروجيني.
كلمات الدالة: الفعل الجنيني ، التباين الوراثي، مستوى النتروجين.

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REFERENSES

Al-rawi, K. M. and A. M. khalaf- allah (1998). Design and Analyses Of Agricultural Experiment. Directorate of Book House of publishing & prossing Mosul Univ. Iraq. (In Arabic).

Al-Savic, H. SH. H. (2005). Gene Action, Estimation Some Parameters and Heterosis in Maize Plant (*Zea mays l*) by Using Factorial Crosses M.Sc. Thesis, Techniqual College– Almseape, Iraq.

Balko, L. G. and W. A. Russell (1980). Effects of rates of nitrogen fertilizer on maize inbred lines and hybrid progeny. Prediction of yield responses. *Maydica, Bergamo. 25: 65-79.*

Chungji, H.; H. Woongcho and T. Yamakawa (2006). Diallel analysis of plant and ear intropical maize (*Zea may L*) J. *Facnity. Agiculturer. Kyushu University.*, *51(2).233 – 238.*

Clark, R. B. and R. R. Duncan (1991). Improvement of plant mineral nutrition through breeding. *Field Crops Researchi, Amsterdam, 27: 219-240.*

Cook, K. A. and A. R. Hallauer (2009). Linkage disequilibrium in maize F_2 population of (B73 × M17). *Maize Genetic Newsletter, 82:156 – 167.*

Dawod, K. M; A.S. MOhamad and K. H. Kanosh (2009). Inheritance of grain yield in half diallel maize population. *IraqiJ. Agiculturer Science.,* 82: 156 – 167.

Deletic, N.; C. Stokovic; V. Duric; S. Gudzic and M. Biberdzic (2005). The effect of high selection intensity on the change of maize yields components additive variance. *Genetika, 37: 71 – 76.*

Derera, J.; P. Tongoona; B. S Vive, and M.D. Laing (2007). Gene action controlling grain yield and secondary traits in southern African maize hybrids under drought and non drought environments. *Euphytica, 91. 89 – 97.*

Eito Eugenio, G. E; E. M. Ivanildo; E. O. G. pauio; N. P Sidney; X. S. Manoel; A.P.P Cleso; F. M. Walter; H. E. R. Pedro and C. D. O. Antonio (2002). Combining ability for nitrogen using a selected of inbred lines from tropical maize population. *Revista Brasileira de Milhoe, Sorgo, l: 68 – 77.*

Hamed, M. H. Y. (2008). Estimation Of Some Parameters For Inbreds of Maize (*Zea mays l*) M.Sc. Thesis agric. College. Tikrite University, Iraq.

Kemphorne, O. (1957). An Introduction To Genetic Statistics. John Wiley and Sons, Inc, New York, P.545.

Lafitte, H. R; Edmeades, G.O. (1995). Association between traits in tropical maize inbred lines and their hybrids under high and low soil nitrogen. *Maydica*, *Bergamo,40, P. 259-267.*

Lee, E. A. A; M. Singh, J. and B. Good (2008). Used of sister lines and performance of modified single – cross maize hybrid. *Crop Science.,* 46: 312 – 320.

Mohammadi, S. A; B. M. Prasanna; C. Sudan, and N. N. Singh (2008). Heterogenic patterns of maize parental lines and prediction of hybrid performance. *Biotechnology., 22 (1): 541 – 547.*

Moll, R. H; E. L Kam Prath, and W. A. Jackson (1982). Analysis and interpretation of factors with contribute to efficiency of nitrogen utilization. *Agronomy. Journal*, 74: 562-564.

Muchow, R. C. and T.R. Sinclaif (1994). Nitrogen response of lead photosynthesis and conopy radiation use efficiency infield grown maize and sorghum. *Crop Science, Madison, 34, 721 – 723.*

Najeeb, S.; A.G. Rather; G.A. Parray; Sheikh and S.M. Razvi (2009). Studies on genetic variability, genotypic correlation and path coefficient analysis in maize high altitude temperate ecology of Kashmir. *Maize Genetics Cooperation News letter. 83:1–8* .

Pollmer, W. G.; D. K. Eberhard, and B. S. Dhilon (1979). Genetic control of nitrogen uptake and translocation in maize. *Crop Science., 19:83 – 86.*

Rather, A. G; S. Najeeb; A. A.Wani; M. A. Bhat; and G. A. Parray (2009). Combining ability analysis for turcicum leaf blight (TIB) and other agronomic traits in maize (*Zea mays l*) under high altitude temperate conditions of Kashmir. *Maize Genetic Coaperation News letter*, 83 : 1 – 5.

Rizzi, E.; C. Balconi; L. Menbrini; F. M. Stefanini; F. Copollino and M. Motto (1993). Genetic variation and relationship among N–related traits in maize, *Maydica, Bergamo, 38:23-30.*

Ta, C.T.; and Wieland, R.T. (1192). Nitrogen partitioning in maize during ear development. *Crop Science, Madison*, *32:443–451.*