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HETEROSIS AND GENE ACTION OF YIELD AND ITS COMPONENTS AND SOME GROWTH TRAITS IN AN EIGHT PARENT DIALLEL CROSS OF BREAD WHEAT UNDER THREE SOWING DATES

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ABSTRACT: ***Eight parental cultivars and lines of bread wheat were used in a diallel cross without reciprocals to study the nature of gene action, combining ability and heterosis under three planting dates (15/10 ,15/11 and 15/12) for eight traits . Mean squares due to planting dates were highly significant for all the studied traits in F1 and F2 generations ,indicating overall differences between the three planting dates .Mean squares due to genotypes ,parents and crosses were significant for all studied traits in F1 and F2 generations under the three planting dates as well as their combined analysis except for plant height in the F1 in the third planting date for parents.Mean squares due to interaction of planting dates with genotypes were found to be significant for all studied traits in F1 and F2 except for plant height in the F1 . Mean squares due to parents vs crosses as an indication to average heterosis were signifiicant for all studied traits in the F1 and F2 generations under the three planting dates as well as for the combined data except number of spikes /plant in the second planting date and 1000- kernel weight in the first and third planting dates as well as the combined data in the F2 generation.The interaction of parents vs crosses with planting dates were significant for all studied traits in the F1 and F2 generations except for plant height and number of kernels /spike in the F1 and 1000- kernel weight in the F2 generation .The mean squares due to general (GCA) and specific combining ability (SCA) were significant for all studied traits under the three sowing dates in the F1 and F2 generations except plant height for SCA.The ratios of GCA/SCA variances were found to be greater than unity for all studied traits in the F1 and F2 generations except for grain filling period number of kernels / spike and grain yield /plant in the third planting date in the F2 generation ,indicating that additive and additive x additive types of gene action were of greater importance than other types in the inheritance of most studied characters.***

One cross (P4 xP8) was identified as promising for wheat breeding for improving yielding ability because both parental lines and cross possessed the highest general and specific combining ability effects for grain yield .The high expression of heterosis for this cross also reflected that the genetic composition of the parents was different with respect to favorable additive

genes.Also ,this hybrid was the best in SCA for most yield components,dwarfism and early maturity .

All traits were influenced by both additive and nonadditive gene effects under the three planting dates with unequal allellic frequency of the parents. Asymmetrical distribution of positive and negative alleles among the parents under planting dates might indicate that allelic expression was affected by planting date .Overdominance or partial dominance were exhibited in some traits under planting dates with the excess of dominant genes over recessive genes .

The heritability estimates in narrow sense were relatively high to moderate in the F_1 hybrids for all studied traits but were low for grain yield in the second and third planting dates . For F_2 generation ,high to moderate heritability estimates were detected for all studied traits but were low for grain filling period , number of kernels /spike and grain yield /plant in the third planting date.

Key words: *diallel crosses,combining ability ,heterosis,additive genes, overdominance*

INTRODUCTION

Increasing wheat production, as a national goal, could be achieved through increasing the production per unit area,via improving agronomic management practices as well as the genetic potentality of the cultivar. Sowing date is one of the most important limiting factors in wheat production.For starting a breeding programme to improve any crop variety , the breeders need to know the type of gene action and genetic system controlling the inheritance of the interest characters.The diallel analysis procedure is the technique of choice providing such detailed genetic informations and identifying the proper genotypes before including them in breeding programmes .The basis of progress in improving quantitative traits in plant breeding is the relative importance of type of gene action involved . After dividing the genotypic variance into additive ,dominance and epistatic variances by Fisher(1918),many genetic models were introduced to estimate the different genetic parameters (Griffing,1956 and Hayman& Mather , 1955).

Combining ability analysis of Griffing (1956), is most widely used biometrical tool for evaluating parental lines in terms of their ability to combine in hybrid combinations .With this method, the resulting total genetic variation is partitioned into the effects of general combining ability ,a measure of additive gene action and specific combining ability ,as a measure of non-additive gene action.

Exploitation of heterosis is considered to be one of the outstanding achievements of plant breeding .In self -pollinated crops like wheat the scope for utilization of heterosis depends mainly upon the direction and magnitude of heterosis.The heterosis over better parent may be useful in identifying the best hybrid combinaions but these hybrids can be immense practical value if they involve the best cultivars of the area (Prasad *et al.*,1998) .

This investigation aimed to:1- get some information on the nature of genetic system controlling yield and its components and earliness and the importance which should be given to the wheat studied materials in a breeding programme, 2- estimate the heterosis depending on the balance of different combinations of gene effects as well as on the distribution of alleles in the parents and 3- evaluate the general (GCA) and specific(SCA) combining ability and their interactions with planting dates .

MATERIALS AND METHODS

The present investigation was carried out at El-Gemmeiza Agricultural Research Station during three successive winter seasons 1999 / 2000 ; 2000/2001 and 2001/2002. In 1999/2000 season, all diallel crosses without reciprocals, were made among eight spring wheat cultivares of diverse origin. The pedigree of these genotypes is shown in Table (1). In the 2000/2001 season, thirty kernels of each of the parents and the 28 F_1 hybrids were sown in the field in rows spaced 20 cm apart and 10 cm between plants within the row, to produce the F_2 generation and the crossing was repeated to obtain additional F_1 hybrid seeds.

In the 2001 /2002 season, kernels from the parents, their F_1's and F_2's were sown at three sowing dates .Each sowing date was considered as an independent experiment with three replicates.The three dates were on the 15 st of October ,15th of November and 15th of December .Each experiment was arranged in a Randomized Complete Blocks Design with three replications .Each of the parents and their F_1 crosses was represented by one row, while each F_2 population was represented by four rows per block. Single kernels were planted at 10 cm.apart within row and 20 cm. between rows of 3 meters long.Normal cultural wheat practices were applied as that ordinary used in wheat fields of the area .At maturity, data were recorded on a random sample of 10 guarded plants in each row from the parents ,F_1 and F_2 generations .Eight characters were studied ,i.e., heading and maturity dates (days) ,grain filling period (days),plant height (cm.), number of spikes per plant , number of kernels per spike ,1000- kernel weight (g) and grain yield /plant (g).The statistical analysis procedures of Griffing's (1956) model 1, method 2 for combining ability ; Bhatt(1971) for heterosis and Hayman.,(1954) for genetic components ,were used .

Table (1): Pedigree and origin of the eight wheat genotypes used as parents in diallel crosses.

No	Genotype name and pedigree	Source
P_1	Ald's'/Tob//Chb70 ICW79-0729-2AP-2AP -1AP-1AP-3AP-OAP	Syria
P_2	Spn//Mcd/Coma/3/Nzr Swm777627-17H-4H-1H-OH	U.S.A
P_3	ID13.1/Mlt's' Swm 12174-18M-OM-4M-1M-OYE	Mexico
P_4	Lovrin 24/Coc 75 Swm8927-2Y-1Y-0Y-1AP-2AP-OAP	Mexico
P_5	Sids 4=Maya's'/Mon's'/CMH74.A592/3/Giza 157	Egypt
P_6	Gemmeiza 3=Bb/7C*2//y50E/kal*3/5/Skh 8/4/Rrw/ ww^{15} /3/Bj's'//On 3/Bon CGM4024-1GM-13GM-2GM-OGM	Egypt
P_7	Gemmeiza 9=Ald "s"/Huac//CMH 74 A.630/Sx CGM 4583 –5GM- 1GM- OGM	Egypt
P_8	Maya74's'/on//1160-147/3/BB/Gll/4/Chat's'/5/Crow's' CGm5820-3Gm-1Gm-2Gm-OGm.	Egypt

RESULTS AND DISCUSSION

Analysis of variance:

The analysis of variance for each of the three planting dates as well as for the combined data for all studied characters in F_1 and F_2 generations are presented in Tables (2 and 3),respectively .Mean squares due to planting date were highly significant for all the studied traits in F_1 and F_2 generations ,indicating overall differences between the three planting dates .The mean squares due to genotypes(parents ,F_1's and F_2's)and their interactions with planting dates were significant for all the studied traits in the F_1 and F_2 under the three planting dates as well as for the combined analysis except for plant height in the F_1 for genotypes x planting date interaction ,indicating the wide diversity between the parental materials and that the genotypes were inconsistently performed at different planting dates used in the present study .Similar results were previously drawn by El – Rassas and Mitkees (1985), Alkaddoussi *et al* (1994), Eissa *et al.*(1994) and Hamada (2002).

Mean squares due to parents and crosses were significant for all studied traits in the F_1 and F_2 generations except for plant height in the F_1 in the three planting date for parents, while the mean squares due to the interaction of planting date and both parents and crosses were significant in the F_1 and F_2 generations for all studied traits except for plant height and number of kernels /spike in the F_1 hybrids . These results indicated that the parental genotypes in F_1 and F_2 generations differed in their performance for most studied traits and varied i'n their response to planting date in all studied

Table 2. Mean squares from analysis of variance for all studied traits in each planting date as well as their combined analysis for the F_1 hybrids .

Sources of variation	d.f. S	d.f. Comb	Heading date (days) S1	S2	S3	Comb.	Maturity date (days) S1	S2	S3	Comb.	Grain filling period(days) S1	S2	S3	Comb.
Sowing date (S)		2				2635.23**				3424.14**				124.849**
Replication (Rep.)	2		0.196	2.364**	1.625**		5.335**	9.730**	11.763**		3.680**	6.215**	6.317**	
Rep x S		6				1.395**				8.943**				5.404**
Genotypes (G.)	35	35	48.576**	170.765**	68.939**	210.591**	101.752**	148.86**	116.966**	287.494**	50.911**	109.688**	73.977**	113.611**
Parents (P)	7	7	143.262**	197.779**	122.420**	433.006**	169.746**	205.644**	144.218**	512.234**	87.194**	108.957**	68.604**	233.634**
Crosses (C.)	27	27	24.014**	157.440**	56.00**	148.006**	79.188**	118.153**	101.513**	198.404**	40.816**	112.771**	72.861**	78.446**
Parents vs Crosses	1	1	48.931**	341.430**	43.921**	343.47**	235.010**	580.667**	343.428**	1119.745**	69.471**	31.575**	141.717**	222.890**
G x S		70				38.844**				40.045**				60.483**
P x S		14				15.228**				3.687**				15.560**
C x S		54				44.724**				50.225**				74.001**
P vs C x S		2				45.403**				19.680**				9.936**
GCA	7	7	172.782**	613.932**	262.017**	862.077**	422.13**	394.767**	414.468**	1121.976**	144.324**	227.319**	159.201**	295.443**
SCA	28	28	17.523**	59.970**	20.667**	47.716**	21.657**	87.390**	42.591**	78.873**	27.555**	80.28**	52.671**	68.151**
GCA x S		14				93.330**				54.693**				117.699**
SCA x S		56				25.221**				36.381**				46.176**
Error	70	210	0.481	0.488	0.452	0.473	0.498	0.436	0.464	0.466	0.993	0.816	0.977	0.929
GCA / SCA			9.860	10.237	12.678	18.070	19.491	4.517	9.731	14.225	5.237	2.831	3.022	4.335

Table 2. Cont .

Sources of variation	d.f. S	d.f. Comb	Plant height(cm) S1	S2	S3	Comb.	Number of spikes /plant S1	S2	S3	Comb.	Number of kernels /spike S1	S2	S3	Comb.
Sowing date (S)		2				17921.87**				440.757**				6900.39**
Replication (Rep.)	2		21.197**	37.458**	268.917*		12.423**	12.293**	5.617**		227.94**	211.011**	297.490**	
Rep x S		6				109.191**				10.111**				245.481**
Genotypes (G.)	35	35	106.438**	96.573**	264.167*	368.131**	17.347**	26.906**	21.226**	52.612**	113.102**	181.83**	151.226**	325.307**
Parents (P)	7	7	143.876**	183.588**	166.601	483.275**	25.312**	47.160**	29.410**	90.419**	194.753**	258.151**	212.447**	583.514**
Crosses (C.)	27	27	89.453**	69.296**	275.067*	310.497**	15.451**	22.578**	19.156**	43.659**	83.927**	143.166**	119.449**	212.413**
Parents vs Crosses	1	1	302.948**	223.946**	652.80**	1118.255**	12.783**	1.977**	19.840**	29.678**	329.28**	691.807**	580.66**	1565.98**
G x S		70				49.523				6.433**				60.427**
P x S		14				5.395				5.732**				40.918
C x S		54				61.660				6.763**				67.064**
P vs C x S		2				30.723				2.461**				17.786
GCA	7	7	326.715**	391.581**	815.994**	1432.611**	72.204**	91.377**	90.777**	234.293**	350.406**	536.28**	371.88**	1007.16**
SCA	28	28	51.369**	22.821**	126.209	102.009**	3.632**	10.788**	3.838**	7.191**	53.775**	93.214**	96.057**	154.842**
GCA x S		14				50.838				10.032**				125.721**
SCA x S		56				49.194				5.533**				44.103*
Error	70	210	1.228	1.197	109.454	37.293	0.387	0.695	0.410	0.497	14.622	28.557	22.390	21.856
GCA / SCA			6.360	17.158	6.465	14.043	19.879	8.470	23.652	32.581	6.516	5.753	3.871	6.504

* and ** indicate significant at 0.05 and 0.01 probability levels ,respectively

Table 2. Cont.

Sources of variation	d.f. S	d.f. Comb	1000- kernel weight S1	S2	S3	Comb.	Grain yield /plant S1	S2	S3	Comb.
Sowing date (S)		2				960.067**				12789.66**
Replication (Rep.)	2		8.697**	5.102**	7.465**		16.323**	10.014**	14.289**	
Rep x S		6				7.095**				13.542**
Genotypes (G.)	35	35	96.101**	156.157**	110.895**	310.38**	83.860**	256.033**	239.401**	154.523**
Parents (P)	7	7	88.135**	158.114**	146.093**	349.045**	77.786**	152.221**	300.620**	301.38**
Crosses (C.)	27	27	100.762**	156.189**	94.776**	297.317**	70.872**	274.827**	226.455**	110.325**
Parents vs Crosses	1	1	26.025**	141.600**	299.734**	392.483**	477.034**	475.272**	160.407**	319.851**
G x S		70				26.386**				212.385**
P x S		14				21.649**				114.624**
C x S		54				27.205**				230.914**
P vs C x S		2				37.438**				396.432**
GCA	7	7	389.409**	459.453**	295.569**	1091.454**	252.501**	353.799**	244.989**	267.648**
SCA	28	28	22.773**	80.331**	84.725**	115.113**	41.697**	231.591**	238.002**	126.24**
GCA x S		14				26.487**				291.819**
SCA x S		56				26.358**				192.525**
Error	70	210	0.697	0.734	0.571	0.667	0.699	1.300	4.854	2.284
GCA / SCA			17.099	5.719	4.566	9.481	6.055	1.527	1.029	2.120

* and ** indicate significant at 0.05 and 0.01 probability levels ,respectively

Table 3.Mean squares from analysis of variance for all studied traits in each planting date as well as their combined analysis for the F_2 generation .

Sources of variation	d.f. S	d.f. Comb	Heading date (days) S1	S2	S3	Comb.	Maturity date (days) S1	S2	S3	Comb.	Grain filling period (days) S1	S2	S3	Comb.
Sowing date (S)		2				2761.611**				3718.92**				210.84**
Replication (Rep.)	2		3.501**	3.463**	1.114		2.374	3.795**	0.191**		3.671	0.754	0.633	
Rep x S		6				2.693**				2.120				1.759
Genotypes (G.)	35	35	80.221**	234.261**	101.416**	312.44**	162.268**	210.896**	197.74**	493.510**	93.324**	145.585**	93.753**	186.95**
Parents (P)	7	7	143.262**	197.77**	122.420**	433.006**	161.466**	205.644**	144.218**	502.507**	82.494**	108.957**	68.604**	224.065**
Crosses (C.)	27	27	35.692**	195.794**	65.787**	173.293**	115.192**	153.477**	81.125**	262.838**	96.635**	160.068**	68.772**	161.461**
Parents vs Crosses	1	1	841.225**	1528.24**	916.378**	3225.44**	1438.90**	1797.97**	3721.15**	6658.69**	79.727**	10.954**	944.302**	615.426**
G x S		70				51.729**				38.699**				72.855**
P x S		14				15.228**				4.411**				17.995**
C x S		54				61.990**				43.478**				82.007**
P vs C x S		2				30.200**				149.673**				209.779**
GCA	7	7	150.276**	685.05**	258.73**	855.197**	485.99**	463.916**	272.640*	1111.127**	179.96**	226.870**	59.765**	215.239**
SCA	28	28	62.707**	121.563**	82.088**	176.751**	81.335**	147.641**	179.021*	339.106**	71.664**	125.264**	102.251**	179.880**
GCA x S		14				119.43**				55.713**				125.679**
SCA x S		56				34.803**				34.443**				59.649**
Error	70	210	0.834	0.623	0.684	0.714	1.234	0.824	1.100	1.053	1.865	0.954	1.722	1.514
GCA / SCA			2.396	5.635	4.167	4.838	5.975	3.142	1.522	3.276	2.511	1.811	0.584	1.196

* and ** indicate significant at 0.05 and 0.01 probability levels ,respectively

Table 3. Cont .

Sources of variation	d.f. S	d.f. Comb	Plant height(cm.) S1	Plant height(cm.) S2	Plant height(cm.) S3	Plant height(cm.) Comb.	Number of spikes /plant S1	Number of spikes /plant S2	Number of spikes /plant S3	Number of spikes /plant Comb.	Number of kernels /spike S1	Number of kernels /spike S2	Number of kernels /spike S3	Number of kernels /spike Comb.
Sowing date (S)		2				16695.01**				430.256**				4661.43**
Replication (Rep.)	2		0.676	5.495**	6.867**		0.717	2.332**	0.616		18.995	8.333	8.161	
Rep x S		6				4.346*				1.221**				11.830**
Genotypes (G.)	35	35	168.63**	174.972**	348.689**	588.910**	14.099**	28.182**	20.077**	48.742**	116.657**	124.570**	172.746**	323.765**
Parents (P)	7	7	143.876**	183.586**	166.601**	483.275**	25.312**	47.160**	29.410*	90.419**	194.753**	258.151**	214.02**	585.126**
Crosses (C.)	27	27	86.992**	76.368**	259.597**	295.315**	11.643**	24.254**	18.160**	39.649**	67.199**	65.801**	41.864**	100.692**
Parents vs Crosses	1	1	2546.44**	2776.99**	4028.78**	9255.42**	1.902**	1.387	6.510**	2.526*	905.357**	776.293**	3417.61**	4517.219**
G x S		70				51.695**				6.808**				45.104**
P x S		14				5.395**				5.732**				40.899**
C x S		54				63.821**				7.204**				37.086**
P vs C x S		2				48.395**				3.637**				291.024**
GCA	7	7	323.95**	364.307**	813.284**	1340.23**	67.348**	94.655**	82.269**	214.574**	209.588**	265.97**	171.256**	589.542**
SCA	28	28	129.811**	127.639**	232.54**	401.07**	3.286**	11.564**	4.529**	7.284**	93.424**	89.216**	173.118**	257.321**
GCA x S		14				80.655**				9.849**				28.644**
SCA x S		58				44.454**				6.048**				49.218**
Error	70	210	1.570	1.462	1.903	1.645	0.365	0.584	0.682	0.544	9.201	8.502	7.587	8.430
GCA / SCA			2.495	2.854	3.497	3.341	17.452	8.185	18.164	29.458	2.243	2.981	0.989	2.291

* and ** indicate significant at 0.05 and 0.01 probability levels ,respectively

Table 3.Cont.

Sources of variation	d.f. S	d.f. Comb	1000- kernel weight S1	1000- kernel weight S2	1000- kernel weight S3	1000- kernel weight Comb.	Grain yield /plant S1	Grain yield /plant S2	Grain yield /plant S3	Grain yield /plant Comb.
Sowing date (S)		2				1126.38**				7324.401**
Replication (Rep.)	2		0.114	23.266**	24.201**		4.501**	0.724	2.476	
Rep x S		6				15.860*				2.567
Genotypes (G.)	35	35	108.860**	112.351**	83.760**	237.552**	34.941**	201.314**	184.1**	184.581**
Parents (P)	7	7	88.131**	158.127**	146.093**	349.05**	77.957**	152.221**	300.67**	301.807**
Crosses (C.)	27	27	117.629**	104.296**	70.503**	217.425**	22.129**	207.736**	66.230**	115.312**
Parents vs Crosses	1	1	17.205	9.395*	5.357	0.505	79.732**	371.557**	2550.57**	1234.23**
G x S		70				33.709**				117.887**
P x S		14				21.650**				114.521**
C x S		54				37.502**				90.392**
P vs C x S		2				15.726				883.816**
GCA	7	7	359.685**	379.910**	269.28**	903.93**	111.961**	287.92**	149.293**	248.714**
SCA	28	28	46.154**	45.461**	37.378**	70.958**	15.686**	179.66**	192.801**	168.547**
GCA x S		14				52.473**				150.231**
SCA x S		56				29.016**				109.80**
Error	70	210	14.525	2.167	1.451	6.048	1.144	1.901	5.768	2.937
GCA / SCA			7.793	8.356	7.204	12.738	7.137	1.602	0.774	1.475

* and ** indicate significant at 0.05 and 0.01 probability levels ,respectively

traits except for plant height and number of kernels /spike in the F_1 hybrids. These results are similar to those reported by Eissa *et al.* (1994), Abd El-Magied (1995),Awaad (2001),El-Morshidy *et al*(2001)and Moustafa (2002).

Heterosis

Mean squares due to parents vs crosses (average heterosis) in Tables (2 and 3)were signifiicant for all studied traits in the F_1 and F_2 generations in the three planting dates as well as their combined data except for number of spikes /plant in the second planting date and 1000- kernel weight in the first and third planting dates as well as their combined data in the F_2 population . The variance due to Interaction of parents vs crosses with planting dates (Tables 2 and 3) was significant for all studied traits in the F_1 and F_2 generations except for plant height and number of kernls /spike in the F_1 hybrids and 1000- kernel weight in the F_2 generation .It could be concluded that the test of potential parents for the expression of heterosis would be necessarily conducted over a number of environmental conditions.These findings are in agreement with those of Hendawy (1994) and Kheiralla *et al.* (2001) .

Heterosis expressed as the percentage deviation of the F_1 performance from its better parent for all studied traits at the three planting dates as well as their combined data,is presented in Table (4).High positive percentages of heterosis would be of interest in most traits under investigation ,however for heading date ,maturity date, grain filling period and plant height ,high negative percentages values would be useful from the breeders point of view. For heading date, one cross (P2xP7) expressed significant negative heterotic effects relative to better parent in the first ,second and third planting dates as well as their combined analysis in the F_1 hybrids ,respectively.As for maturity date , one cross (P_3 xP_5)expressed significant negative heterotic effects relative to better parent at the three respective planting dates as well as, their combined data in the F_1 hybrids.Hendawy (1994) and Morad (2001), found significant heterotic effect for heading and maturity date.With respect to grain filling period , one cross (P_1x P_3) of the F_1 hybrids exhibited significant negative (favorable) heterotic effects at the three planting dates and their combined data. These findings are in agreement with those of Przulj and Mladenov(1999).For plant height, seven, nine,one and one hybrids expressed significant negative heterotic effects relative to better parent in the first ,second and third planting dates as well as the combined analysis ,respectively .These findings are in agreement with those of El – Rassas and Mitkees (1985), Abd El-Magied (1995), Ashoush *et al* (2001)and El-Hosary *et al* (2000).

Concerning the number of spikes /plant ,twelve ,eight ,thirteen and seven crosses expressed significant positive heterotic effects relative to better parent in the first ,second ,third planting dates and the combined analysis ,respectively . For number of kernels/spike ,three hybrids (P_1 xP_6 ,P_3 xP_6 and

Table 4 :Heterosis percentage relative to better parents values in the three planting dates as well as their combined data for all traits studied in the F_1 crosses

Crosses	Heading date(days)				Maturity date(days)				Grain filling period(days)				Plant height(cm.)			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	6.98	-3.75**	-1.84**	-0.09	-1.25*	1.30	0.36	0.17	5.52	24.80	12.07	14.06	16.38	1.44	-1.23	-1.51
P_1xP_3	8.76	10.53	3.23	7.51	2.20	-1.20*	0.20	-1.04	-19.50**	-27.05**	-5.61**	-17.19**	30.92	4.39	2.96	3.52
P_1xP_4	0.98	4.21	-4.40**	-0.16	-0.10	-1.90**	0.14	-0.64	1.55	-9.58**	10.35	-1.07	17.27	6.82	2.81	8.47
P_1xP_5	1.01	12.66	4.95	9.31	-1.95**	4.23	-0.88	0.56	-15.48**	12.09	5.92	0.55	-3.46**	-3.07**	-1.79	-3.02
P_1xP_6	-5.47**	12.00	-1.54**	2.20	-0.05	7.91	-2.70**	2.01	8.47	2.59	-4.78**	1.67	-0.8	-4.65**	-3.40	-3.49
P_1xP_7	1.97	2.22	-1.51**	0.89	0.15	-0.17	0.98	0.3.4	-2.75**	5.39	0.01	-2.66**	-3.87**	4.80	-2.81	-0.31
P_1xP_8	4.22	2.22	-0.03	2.10	-1.78**	1.13	0.81	0.100	-10.34**	-1.44	2.38	-3.64**	3.05	7.17	2.37	4.34
P_2xP_3	8.32	0.70	-2.53**	1.87	-0.97	-1.05	1.961	-0.02	7.50	4.51	12.68	8.44	3.04	-1.79*	-1.48	0.3.2
P_2xP_4	-1.29*	-0.52	-2.58**	1.44	-1.80**	0.49	2.38	0.41	17.15	22.36	23.45	21.44	97.32	3.62	0.89	0.89
P_2xP_5	8.50	15.88	7.97	10.98	-2.98**	0.70	2.95	0.30	12.41	18.05	25.19	18.91	-1.52	-2.92**	-1.70	-7.31
P_2xP_6	-3.81**	3.68	-1.94**	-3.14**	-0.94	0.55	0.91	0.19	12.68	33.72	11.54	18.94	-0.09	-2.50**	-33.37**	-12.85**
P_2xP_7	-9.26**	-6.90**	-5.12**	-7.06**	3.18	0.09	0.92	1.34	34.58	19.49	14.06	22.23	-2.56**	1.46	-1.38	-0.66
P_2xP_8	7.24	-8.22**	-1.23*	-5.61**	2.61	1.78	0.006	1.33	31.63	36.64	6.80	24.87	6.61	5.92	4.73	5.70
P_3xP_4	7.96	-1.83	0.19	3.09	1.35	5.38	-6.87**	-0.04	-76.28**	13.18	19.91	-5.95**	-0.09	-0.34	0.6	0.19
P_3xP_5	4.39	0.3.7	7.13	3.96	-1.36*	-3.21**	-2.68**	-2.44**	-2.79**	14.56	3.52	4.69	-0.02	2.13	3.97	2.21
P_3xP_6	4.85	-0.42	-0.69	-1.10*	-0.80	-0.34	-1.97**	-1.04	2.06	12.07	-1.28	-0.92	-0.12	3.78	077	0.78
P_3xP_7	9.69	2.08	9.33	6.81	8.16	-4.39**	0.51	2.00	5.74	-41.76**	-16.46**	-7.08**	-7.75**	-5.44**	-0.95	-5.06
P_3xP_8	7.92	-3.76**	5.75	2.95	7.02	-0.02	-0.49	2.39	5.61	8.21	-9.65**	1.32	-1.35	3.74	1.68	1.55
P_4xP_5	8.54	-3.76**	7.84	5.74	-2.84**	-12.88**	-0.71	-5.63**	-10.12**	-85.06**	-0.05	-11.06**	-1.43	2.45	0.13	0.54
P_4xP_6	-2.53**	-7.33**	-0.57	3.52	0.08	-0.02	-1.11*	-0.36	5.31	13.33	-2.11*	5.56	-3.32**	3.49	-3.52	-0.87
P_4xP_7	-1.32*	-6.87**	-1.42*	3.38	0.84	-6.59**	-5.91**	-4.02**	4.70	-5.76**	-13.87**	-5.19**	-11.78**	-6.3.4**	-0.55	-0.91
P_4xP_8	0.79	-1.74**	-2.24**	1.12	-0.90	-4.94**	-1.24*	-2.42**	-3.93**	-11.19**	0.53	-4.80**	7.76	-6.83**	-1.76	-5.38
P_5xP_6	7.38	1.93	7.66	4.16	0.80	-1.41*	-1.50*	-1.77**	2.06	8.81	-1.30	3.26	-3.19**	0.67	4.33	-3.73
P_5xP_7	12.89	0.58	13.65	8.76	5.30	1.31	-0.65	1.90	-3.92**	9.02	15.23	-3.44**	-0.04	4.19	-1.05	1.08
P_5xP_8	13.13	4.27	18.30	11.68	5.52	1.05	4.28	3.54	-3.78**	7.03	-9.14**	-2.10*	12.30	6.07	4.89	7.46
$P_6 x P_7$	1.90	-3.64**	9.30	2.53	7.60	-0.63	3.71	3.44	19.02	4.86	-6.31**	5.29	4.34	4.33	-2.25	2.03
$P_6 x P_8$	4.39	-2.47**	10.81	4.24	7.26	6.46	4.94	6.21	13.04	22.79	-5.59**	10.02	10.98	7.24	10.94	9.57
$P_7x P_8$	-3.37**	1.07	1.02	-0.12	-4.46**	-6.15**	0.70	-3.31**	-6.27**	-20.30**	0.18	-8.63**	2.18	-2.43**	-0.58	-0.48
L.S.D. at 5 %	1.127	1.135	1.092	1.100	1.146	1.073	1.107	1.093	1.619	1.467	1.606	1.542	1.801	1.777	16.99	9.772
L.S.D. at 1 %	1.495	1.506	1.449	1.443	1.521	1.424	1.468	1.433	2.148	1.947	2.130	2.022	2.388	2.358	22.55	12.814

* and ** denote significant values at 0.05 and 0.01 levels of probability ,respectively

Table 4.Cont.

Crosses	Number of spikes /plant				Number of kernels /spike				1000 kernel weight				Grain yield /plant			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	17.38**	-1.02	11.01**	7.45**	2.19	9.27*	0.48	4.06	-13.14	-16.58	13.59**	-4.36	-3.61	-2.40	-29.10	-14.23
P_1xP_3	3.46**	7.14**	-2.35	2.85**	5.745	-9.65	6.80	0.34	2.61**	1.92**	0.30	1.59*	40.44**	27.88**	-42.57	-3.78
P_1xP_4	-20.68	-4.01	7.86**	-5.71	11.46**	-22.40	9.05*	0.21	-2.37	-3.16	-0.36	-2.01	-3.37	-5.59	-18.32	-3.39
P_1xP_5	-4.57	-30.96	-23.55	-22.21	-3.53	0.93	5.37	1.11	-9.09	-0.86	-7.30	-1.19	60.58**	9.30**	-38.99	-7.35
P_1xP_6	12.59**	-22.71	-9.50	-10.02	12.23**	9.99**	10.74**	11.47**	-8.08	-21.21	-20.08	-16.76	16.01**	-2.86	-55.87	-21.22
P_1xP_7	8.49**	-9.27	6.48**	0.78	-2.71	8.18*	-0.42	5.28	1.25	-2.75	-2.13	0.61	17.41**	3.80**	-36.99	-3.70
P_1xP_8	4.01**	0.18	5.18**	5.62**	8.01*	1.13	2.33	3.83	-18.82	-16.21	-6.66	-14.37	3.24**	-7.39	-54.58	-26.83
P_2xP_3	0.35	-10.39	-14.22	-9.01	-10.50	-13.88	-6.83	-10.34	-1.17	-13.96	2.01**	-2.68	48.70**	-6.88	29.64**	24.13**
P_2xP_4	-15.79	-31.67	-4.73	-18.21	-11.67	-7.77	-14.69	-11.26	-5.48	-13.20	-11.55	-10.22	2.46**	-40.07	5.72**	-12.81
P_2xP_5	-30.69	-19.02	-16.31	-21.12	-18.14	-1.28	-9.05	-9.13	-12.13	-15.28	-9.160	-12.60	58.37**	33.39**	42.39**	41.47**
P_2xP_6	-17.41	-21.11	13.05**	-8.91	1.07	5.22	-1.29	1.66	6.16**	0.36	5.58**	3.84**	4.15**	-5.08	-8.15	-4.39
P_2xP_7	-5.30	-15.62	8.86**	-4.51	9.75**	8.01*	-16.11	0.27	-10.49	12.68**	1.26**	1.72**	36.71**	32.45**	0.09	14.63**
P_2xP_8	-8.11	14.30**	19.10**	15.91**	-7.98	4.25	-23.07	-9.19	-13.05	3.32**	4.47**	1.71**	-9.04	27.58**	-53.32	-11.61
P_3xP_4	-16.25	1.38*	4.01**	1.80**	9.26**	12.96**	5.46	9.14*	-8.15	-9.24	-7.64	-8.49	-25.98	3.31**	21.26**	4.62**
P_3xP_5	-34.01	-36.98	-33.56	-35.04	11.08**	-8.94	-8.98	-9.60	-12.92	-19.42	-13.64	-14.92	27.18**	-10.18	-6.29	-0.84
P_3xP_6	-17.29	3.70**	-6.08	-21.26	15.57**	8.39*	9.59*	10.90**	-3.15	-12.08	-9.03	-8.32	-9.50	-28.49	-15.37	-20.14
P_3xP_7	7.59**	4.17**	4.01**	-7.35	-2.71	-6.45	6.13	-1.93	-3.00	35.63**	27.73**	20.74**	3.65**	-4.30	8.57**	3.85**
P_3xP_8	-8.45	-1.53	-17.00	-8.77	4.51	18.78**	11.29**	12.05**	-11.72	0.83	3.87**	-2.38	63.69**	17.61**	0.42	13.62**
P_4xP_5	-34.68	-37.84	-20.14	-31.33	-14.56	-11.63	-12.82	-12.94	-0.87	9.59**	15.58**	7.91**	0.50	-11.97	7.01**	1.69
P_4xP_6	-14.44	5.92**	-0.71	-5.14	5.86	16.63**	16.39**	13.43**	8.99**	2.57**	3.11**	4.72**	46.30**	34.73**	-69.62	-13.21
P_4xP_7	17.23**	-5.49	3.97**	5.68**	-14.30	-12.72	7.27	-6.69	6.05**	14.05**	11.19**	10.60**	53.01**	7.56**	-29.46	3.11*
P_4xP_8	10.67**	3.76**	4.50**	-0.62	15.36**	13.00**	18.93**	1.82	2.73**	11.13**	4.98**	7.97**	29.20**	30.07**	54.64**	3.13*
P_5xP_6	6.15**	0.28	7.80**	-0.84	-10.72	2.05	2.04	-1.84	5.98**	0.90	-3.69	2.70**	-0.20	-3.01	-27.11	-10.58
P_5xP_7	-33.36	-33.84	-39.77	-35.66	2.91	5.78	-1.74	2.31	-10.91	-11.94	-4.32	-9.21	-8.21	-6.72	2.74	-4.53
P_5xP_8	-13.15	-18.58	-34.57	-23.65	-8.21	-6.46	-4.57	-6.33	-6.35	-7.97	-1.85	-5.53	34.35**	-31.98	-25.73	-20.70
$P_6 x P_7$	29.10**	-9.62	-11.14	-9.42	2.76	-7.69	0.38	-1.84	0.561	-7.02	11.12**	-4.19	18.97**	8.35**	18.64**	15.23**
$P_6 x P_8$	15.57**	46.28**	-12.09	17.18**	22.30**	19.45**	22.18**	22.89**	-1.21	0.41	-0.35	-6.30	0.30	41.76**	-53.53	2.91*
$P_7x P_8$	2.35**	-13.76	3.69**	-3.54	3.56	-4.65	8.41**	2.13	3.28**	8.90**	4.47**	5.66**	15.22**	-36.03	-34.62	-17.05
L.S.D. at 5 %	1.011	1.355	1.041	1.129	6.213	7.519	7.688	7.481	1.357	1.392	1.228	1.307	1.358	1.852	3.579	2.418
L.S.D. at 1 %	1.341	1.797	1.381	1.480	8.242	9.975	10.199	9.810	1.800	1.847	1629	1.714	1.802	2.457	4.749	3.171

* and ** denote significant differences at 0.05 and 0.01 levels of probability ,respectively

P_6 xP_8)of the twenty eight hybrid combinations had significantly more kernels /spike than their respective higher parents in the three planting dates and their combined data in the F_1 hybrids .For 1000- kernel weight ,four hybrids (P_4 xP_6 ,P_4 xP_7 ,P_4 xP_8 and P_7 xP_8)expressed significant positive heterotic effects relative to better parent values in the three planting dates as well as their combined data in the F_1 hybrids. Hamada and Tawfelis(2001);Morad (2001) and Hamada (2002) found significant positive heterotic effects for number of spikes /plant ,number of kernels/spike and 1000- kernel weight .

Concerning grain yield /plant ,P_2xP_5 ,P_4 xP_8 and P_6 xP_7 significantly exceeded their better parent values in the first ,second and third planting dates as well as their combined analysis ,respectively ,in the F_1 hybrids. These hybrids exhibited heterosis for one or more of studied traits contributing yield . The heterotic magnitude ,however ,differed from case to case.These findings are in agreement with those of AbdEl-Aty (2000), Morad (2001) and Hamada (2002). This finding agreed with the general trend where the expression of heterosis for a complex trait could be explained on the basis of component interaction , as the numerical value recorded for a complex trait is always a function of its components .It could be concluded that these crosses would be efficient and prospective in wheat breeding programs for improving grain yield .Significant positive heterotic effects relative to higher yielding parent were also reported before by El-Hosary *et al* (2000), El-Seidy and Hamada (2000)and Ashoush *et al* (2001).

Combining ability

The analysis of variance for combining ability as outlined by Griffing's(1956) method 2 model 1 for each planting date and combined data for all studied traits is shown in Tables (2 and 3).The mean squares associated with general (GCA) and (SCA)specific combining ability were significant for all studied traits under the three sowing dates in the F_1 and F_2 generations except plant height for specific combining ability in the F_1 hybrids in the third planting date .Both additive and non additive gene effects were involved in determining the performance of all studied traits . Also, GCA / SCA ratios for grain filling period , number of kernels / spike and grain yield /plant in the third planting date in the F_2 generation were less than unity ,indicating the predominance of non-additive gene action in the inheritance of such traits. On the other hand , high GCA /SCA ratios which exceeded the unity were detected for other trais cases, indicating that additive and additive x additive types of gene action were more important than non additive gene effects controlling these traits .The mean squares of interaction between planting date and both GCA and SCA combining ability were significant for all studied traits in the F_1 and F_2 generations except plant height for general combining ability x planting date and SCA x planting date in the F_1 hybrids , revealing that the magnitude of additive , additive x additive and non additive types of gene action varied from one planting date to another .Similar results were previously drawn by Ronga *et al* (1995) ,El-Morshidy *et al* (2001)and Moustafa (2002).

General combining ability effects:-

1- In F_1 generation : -

Estimates of GCA effects of the individual parental lines for each studied trait in the three planting dates as well as their combined analysis in the F_1 generation are presented in Table (5).General combining ability effects were found to differ significantly from zero in all cases. High positive values would be interest for all traits in question except heading date , maturity date , grain filling period , and plant height whereas high negative effects would be useful from the breeders point of view .Parental cultivars Sids 4(P_5) , Gemmeiza 3(P_6) , and Line P_3 expressed significant negative effects for heading and maturity dates in the three planting date as well as the combined analysis, indicating that the three genotypes could be considered as good general combiners for developing early genotypes . For grain filling period ,significant negative GCA effects were detected for Line P_3 in the second and third planting dates as well as their combined data. Therefore , the line P_3 was considered as the best combiner for decreased grain filling period .For plant height, the parental cultivars Sids 4(P_5), Gemmeiza 3(P_6) , line P_1 and line P_2 gave the highest significant negative GCA effects in the three planting dates as well as the combined data.Therefore these parents were considered as the best general combiners for these traits .For number of spikes / plant , line P_3 ,line P_4 and cultivar P_7 expressed significant positive general combining ability effects for this trait in the three planting dates as well as the combined analysis . For number of kernels/ spike ,parental cultivar Sids 4(P_5) gave significant positive combining ability effects , therefore this parent was considered as the best combiner for this trait in the three planting dates as well as the combined analysis .Parental line P_4 ,cultivar sids 4(P_5) and cultivar gemmeiza 3(P_6) expressed significant positive general combining ability effects for 1000-kernel weight in the three planting dates as well as the combined analysis ,while the parent line P_4 gave the highest significant positive general combining ability effects in the three planting dates as well as the combined analysis for grain yield /plant . Therefore this parent was considered as the best combiner for this trait. It is worth to note that the parental line P_4 which possessed high general combining ability effects for grain yield / plant , showed the same for one or more of the traits contributing to grain yield .

2- F_2 generation

Estimates of GCA effects of the individual parental lines for each trait in the three planting dates as well as their combined analysis in the F_2 generation are presented in Table (6).The parental cultivars Sids 4(P_5) and Gemmeiza 3(P_6) showed highly significant negative general combining ability

Table 5.Estimates of general combining ability effects of parents for all characters studied under the three planting dates as well as their combined data in the F_1 population.

Parents	Heading date				Maturity date				Grain filling period			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P1	0.695	6.554	0.821	2.690	-0.384*	3.885	1.424	1.641	-1.080**	-2.668**	0.603	-1.048**
P2	0.529	2.310	0.504	1.114	-1.010**	1.842	0.794	0.541	-1.540**	-0.468**	0.290	-0.572**
P3	-2.320**	-0.659**	-0.005	-0.995**	-2.494**	-5.377**	-2.759**	-3.543**	-0.173	-4.718**	-2.753**	-2.548**
P4	0.862	-0.372**	-0.529**	-0.013	-0.100	-0.750**	-0.595**	-0.482**	-0.963**	-0.378*	-0.066	-0.469**
P5	-3.630**	-6.192**	-5.202**	-5.008**	-3.447**	-3.240**	-3.115**	-3.268**	0.183	2.951	2.086	1.740
P6	-1.240**	-7.409**	-2.625**	-3.758**	-4.587**	-4.271**	-3.565**	-4.141**	-3.346**	3.138	-0.940**	-0.382**
P7	2.095	3.624	3.054	2.924	6.632	3.615	3.874	4.707	4.536	-0.008	0.820	1.782
P8	3.009	2.144	3.984	3.045	5.392	4.295	3.944	4.544	2.383	2.151	-0.040	1.498
L.S.D.(gi)at 5%	0.310	0.268	0.281	0.112	0.377	0.308	0.356	0.136	0.464	0.332	0.446	0.164
L.S.D.(gi) at 1%	0.411	0.356	0.372	0.147	0.501	0.409	0.472	0.179	0.615	0.441	0.591	0.215
L.S.D.(gi- gj)at 5%	0.469	0.405	0.424	0.174	0.570	0.466	0.538	0.212	0.701	0.502	0.674	0.254
L.S.D.(gi- gj)at 1%	0.622	0.538	0.563	0.228	0.757	0.618	0.714	0.277	0.931	0.666	0.894	0.333

* and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 5.Cont.

Parents	Plant height				Number of spikes/plant				Number of kernels/spike			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P1	-0.336	-4.056**	-2.126**	-2.173**	-0.039	1.318**	0.080	0.453**	0.027	2.002**	1.547**	1.192**
P2	-1.170**	-2.156**	-5.880**	-3.002**	-0.426	-0.215	0.160	-0.160	2.480**	-0.104	0.774	1.050**
P3	2.343	1.536	3.763	2.547	0.706**	1.245**	1.563**	1.171**	-3.129	-4.010	-2.265	-3.135
P4	2.706	3.216	4.126	3.350	2.203**	1.595**	1.356**	1.718**	-3.335	-2.347	-2.085	-2.589
P5	-4.243**	-2.900**	-5.133**	-4.092**	-2.303	-3.775	-3.550	-3.209	4.314**	5.779**	4.930**	5.008**
P6	-3.633**	-3.026**	-5.173**	-3.944**	-0.586	-1.188	-0.993	-0.922	-0.639	-0.704	-0.559	-0.634
P7	-1.050**	1.913	2.246	1.036	1.246**	0.621**	1.099**	0.989**	1.317*	0.779	-1.409	0.229
P8	5.383	5.473	7.976	6.277	-0.800	0.398**	0.283*	-0.039	-1.035	-1.394	-0.932	-1.121
L.S.D.(gi)at 5%	0.425	0.410	0.468	0.171	0.205	0.259	0.281	0.098	1.030	0.991	0.936	0.387
L.S.D.(gi) at 1%	0.564	0.545	0.622	0.224	0.272	0.344	0.372	0.129	1.367	1.314	1.241	0.507
L.S.D.(gi- gj)at 5%	0.643	0.621	0.708	0.265	0.310	0.392	0.424	0.152	1.558	1.498	1.415	0.599
L.S.D.(gi- gj)at 1%	0.854	0.824	0.940	0.347	0.411	0.521	0.563	0.199	2.067	1.987	1.877	0.786

* and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 5.Cont.

Parents	1000 -kernel weight				Grain yield /plant			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P1	-3.584	-3.905	-2.406	-3.298	-2.015	2.098**	0.388	0.157
P2	-2.884	-5.229	-3.826	-3.980	-1.268	-1.624	-1.254	-1.382
P3	-3.278	-2.899	-2.260	-2.812	-3.005	-2.867	4.388**	-0.494
P4	0.702**	1.107**	0.953**	0.921**	3.586**	0.580**	2.332**	2.166**
P5	4.929**	2.997**	2.130**	3.352**	-1.678	-6.127	-1.965	-3.257
P6	5.665**	6.721**	6.120**	6.168**	2.411**	3.897**	-5.087	0.407**
P7	-1.431	0.400**	0.013	-0.339	4.208**	0.283	0.232	1.575**
P8	-0.117	0.806**	-0.723	-0.011	-2.238	3.759**	0.964	0.828**
L.S.D.(gi)at 5%	0.283	0.291	0.256	0.108	0.284	0.387	0.748	0.201
L.S.D.(gi) at 1%	0.376	0.386	0.341	0.142	0.377	0.514	0.993	0.264
L.S.D.(gi- gj)at 5%	0.429	0.440	0.388	0.168	0.429	0.585	1.132	0.312
L.S.D.(gi- gj)at 1%	0.569	0.584	0.515	0.221	0.570	0.777	1.501	0.409

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 6.Estimates of general combining ability effects of parents for all studied characters under the three planting dates as well as their combined data in the F_2 generation.

Parents	Heading date				Maturity date				Grain filling period			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P1	0.536	6.097	0.460	2.364	-0.072	4.270	1.433	1.876	-0.609**	-1.827**	0.973	-0.487**
P2	1.850	2.897	0.900	1.882	-0.902**	0.963	2.026	0.695	-2.752**	-1.934**	1.126	-1.186**
P3	-2.00**	-0.472**	-0.266*	-0.913**	-2.429**	-4.913**	-4.736**	-4.026**	-0.429*	-4.440**	-4.470**	-3.113**
P4	0.123	-0.082	-0.546**	-0.168**	-0.099	-0.830**	-0.063	-0.330**	-0.223	-0.747**	0.483	-0.162*
P5	-4.116**	-6.659**	-5.120**	-5.298**	-3.512**	-2.920**	-2.313**	-2. 915**	0.604	3.739	2.806	2.383
P6	-1.543**	-6.472**	-2.683**	-3.566**	-4.109**	-3.710**	-4.980**	-4.266**	-2.565**	2.762	-2.296**	-0.700*
P7	2.560	2.664	3.596	2.940	6.137	3.156	3.730	4.341	3.577	0.492	0.133	1.401
P8	2.590	2.027	3.660	2.759	4.987	3.983	4.903	4.624	2.397	1.955	1.243	1.865
L.S.D.(gi)at 5%	0.235	0.236	0.226	0.091	0.239	0.224	0.230	0.090	0.338	0.306	0.334	0.128
L.S.D.(gi) at 1%	0.312	0.314	0.301	0.120	0.318	0.297	0.306	0.118	0.448	0.406	0.443	0.168
L.S.D.(gi- gj)at 5%	0.356	0.358	0.344	0.141	0.362	0.339	0.348	0.140	0.511	0.463	0.507	0.197
L.S.D.(gi- gj)at 1%	0.472	0.475	0.456	0.185	0.480	0.450	0.462	0.184	0.678	0.615	0.673	0.259

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 6.Cont.

Parents	Plant height				Number of spikes/plant				Number of kernels/spike			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P1	-1.129**	-3.313**	-2.610**	-2.351**	0.128	1.416**	0.175	0.573**	-1.604	2.401**	4.360**	1.718**
P2	-2.075**	-2.343**	-4.797**	-3.072**	-0.579	-0.040	0.138	-0.160	0.382	2.394*	-0.426	0.783*
P3	2.137	2.126	4.379	2.881	0.677**	1.191**	1.645**	1.171**	-3.394	-6.089	-3.376	-4.286
P4	2.437	2.800	3.975	3.071	2.467**	1.249**	1.351**	1.689**	-3.767	-6.435	-2.870	-4.357
P5	-2.759**	-3.376**	-5.737**	-3.957**	-2.679	-3.805	-3.658	-3.381	6.255**	5.780**	5.873**	5.970**
P6	-4.495**	-3.760**	-5.434**	-4.563**	-0.662	-1.103	-1.225	-0.997	-0.320	0.227	1.293	0.400
P7	0.204	2.193	2.782	1.726	1.354**	0.679**	1.275**	1.102**	3.579**	1.171	-2.430	0.773*
P8	5.680	5.673	7.442	6.265	-0.705	0.413**	0.298**	0.002	-1.130	0.551	-2.423	-1.001
L.S.D.(gi)at 5%	0.376	0.371	3.555	0.814	0.323	0.283	0.217	0.094	1.299	1.816	1.808	0.623
L.S.D.(gi) at 1%	0.499	0.493	4.716	1.067	0.429	0.376	0.288	0.123	1.724	2.409	2.133	0.817
L.S.D.(gi- gj)at 5%	0.569	0.562	5.375	1.261	0.319	0.428	0.329	0.145	1.964	2.745	2.431	0.965
L.S.D.(gi- gj)at 1%	0.755	0.745	7.131	1.654	0.424	0.568	0.436	0.191	2.606	3.842	3.225	1.266

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 6.Cont.

Parents	1000- kernel weight				Grain yield /plant			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P1	-3.374	-1.550	-0.57	-1.831	-1.285	1.818**	2.008**	0.847**
P2	-1.912	-5.896	-4.470	-4.093	0.302	-1.166	-2.441	-1.101
P3	-3.992	-2.662	-2.350	-2.868	-1.866	-2.380	1.085*	-1.053
P4	0.997	0.489	0.456*	0.648**	1.346**	0.565*	1.565**	1.159**
P5	4.435**	2.133**	0.543*	2.370**	-1.013	-5.994	-2.864	-3.290
P6	5.714**	6.197**	6.033**	5.981**	1.513**	2.805**	-1.880	0.813**
P7	-1.338	0.229	0.043	-0.355	3.263**	0.899**	-0.508	1.218 **
P8	-0.928	1.059**	0.313	0.148	-2.261	3.452**	3.035**	1.408**
L.S.D.(gi)at 5%	1.295	0.500	0.409	0.327	0.363	0.468	0.816	0.228
L.S.D.(gi) at 1%	1.718	0.663	0.543	0.430	0.482	0.621	1.082	0.299
L.S.D.(gi- gj)at 5%	1.958	0.756	0.619	0.508	0.549	0.708	1.234	0.35 4
L.S.D.(gi- gj)at 1%	2.597	1.003	0.821	0.666	0.729	0.939	1.637	0.46 4

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

effects for heading date in the three planting dates as well as their combined data revealing that both cultivars could be considered as excellent general combiners for developing early genotypes .For maturity date cultivars sids 4 (P_5), gemmeiza 3 (P_6) and line P_3 as well as for grain filling period P_2 line showed highly significant negative estimates of general combining ability effects in the three planting dates as well as their combined analysis ,revealing that these cultivars could be considered as excellent general combiners for developing early genotypes.Concerning plant height, the cultivars Sids 4 (P_5),Gemmeiza 3(P_6) cultivar and line P_2 exhibited highly significant negative general combining ability effects in the three planting dates as well as their combined data . The cultivar Gemmeiza 9 , line P_4 and line P_3,had highly significant positive general combining ability effects for number of spikes / plant in three planting dataes as well as their combined data .For number of kernels / spike, cultivars Sids 4 (P_5)proved to be the best general combiner in the three planting dates as well as the combind analysis . The cultivars Sids 4(P_5) and Gemmeiza 3(P_6), showed highly significant positive values of general combining ability effects for 1000- kernel weight in three planting dates and their combined analysis, proving to be excellent general combiners in this respect . The Line 4 exhibited significant positive general combining ability effects for grain yield / plant in the three planting dates and their combined data, proving to be good general combiner for this trait .

Specific combining ability effects :-

1- F1 hybrids

Estimates of the specific combining ability effects of the F_1 hybrids for the studied traits in the three planting dates as well as the combined analysis are presented in Table (7).Significant negative specific combining ability effects in the three planting dates as well as their combined analysis were obtained for heading date in four crosses ,i.e cultivars Gemmeiza 3 and Gemmeiza 9 with each of line P_2 and line P_4 .Concerning maturity date, the four hybrid combinations P_2x P_6 ,P_4 xP_6 ,P_4 xP_7 and P_4 xP_8 showed highly significant negative specific combining ability effects in the three planting dates as well as their combined analysis. As indicated before the parental cultivar Gemmeiza 3(P_6) , proved to be an excellent general combiner for heading date and maturity date in the three planting dates as well as the combined data .As for grain filling period ,the two hybrids combinations P_1 xP_3 and P_5 xP_6 were found to exhibit highly significant negative specific combining ability effects in the three planting dates as well as the combined analysis .Earliness if found in what is favourable for escaping from destructive injuries by stress conditions and intensive production .Regarding plant height ,twelve ,ten ,one and three hybrids exhibited significant negative specific combining ability effects in the first ,second ,third planting dates as well as their combined analysis ,respectively .However the cross P5 xP8 was

Table 7.Estimates of specific of combining ability effects of F_1 crosses for all studied traits under the three planting dates as well as their combined data in the F_1 generation .

Crosses	Heading date				Maturity date				Grain filling period			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	3.272	-4.997**	0.962	-0.254	0.605	-0.770*	0.251	0.028	-2.667**	4.227	-0.711	0.283
P_1xP_3	1.889	4.172	1.762	2.607	-4.201**	-5.893**	-0.252	-3.449**	-6.090**	-10.065**	-2.014**	-6.056**
P_1xP_4	0.165	1.882	-1.057**	0.330	3.135	-0.210	3.974	2.299	2.969	-2.092**	5.032	1.969
P_1xP_5	1.072	0.356	-2.917**	-0.495*	-2.284**	3.812	-2.376**	-0.282	-3.357**	3.454	0.542	0.213
P_1xP_6	-3.167**	4.572	-3.287**	-0.627**	-1.887**	4.602	-5.776**	-1.020**	1.279	0.03	-2.487**	-0.392
P_1xP_7	-1.470**	1.135	-1.434**	-0.589**	-1.501**	-0.230	-1.118**	-0.950**	-0.030	-1.365**	0.315	-0.360
P_1xP_8	0.332	1.872	-0.164	0.680	-2.884**	0.842	0.207	-0.611**	-3.217**	-1.029**	0.372	-1.291**
P_2xP_3	0.242	-1.594**	-3.611**	-1.654**	-1.871**	-2.387**	1.387	-0.956**	-2.113**	-0.792	4.998	0.697
P_2xP_4	-1.347**	0.582	-0.197	-0.320	-0.067	3.196	4.547	2.558	1.279	2.814	4.745	2.879
P_2xP_5	-1.407**	6.158	-1.091**	1.220	-2.721**	2.286	2.097	0.554	-1.313**	-3.872**	3.188	-0.665*
P_2xP_6	-4.081**	-5.561**	-4.061**	-4.567**	-2.124**	-2.557**	-1.735**	-2.139**	1.956	3.004	2.325	2.428
P_2xP_7	-3.917**	-1.264**	-2.241**	-2.474**	0.062	-1.357**	-1.245**	-0.846**	3.979	-0.092	0.995	1.627
P_2xP_8	-4.014**	-4.727**	-0.404	-3.048**	0.045	0.182	-3.685**	-1.152**	4.059	4.910	-3.281**	1.896
P_3xP_4	1.702	2.418	0.168	1.430	0.192	7.939	-7.988**	0.047	-1.510**	5,520	-8.157**	-1.382**
P_3xP_5	-0.357	-2.971**	-0.491	-1.273**	0.272	-1.370**	-0.272	-0.456*	0.629	1.600	0.218	0.816
P_3xP_6	1.035	0.575	-1.861**	-0.083	-0.431	2.119	1.327	1.005	-1.467**	1.544	3.188	1.088
P_3xP_7	0.565	-0.094	3.858	1.443	2.288	-6.147**	-2.148**	-2.002**	1.722	-6.052**	-6.007**	-3.445**
P_3xP_8	-0.797*	-4.791**	0.728	-1.619**	2.038	-4.040**	-3.355**	-1.785**	2.836	0.750	-4.084**	-0.165
P_4xP_5	0.352	-2.261**	-0.011	-0.639**	-3.357**	-14.520**	-0.645	-6.174**	-3.710**	-12.259**	-0.634	-5.534**
P_4xP_6	-1.321**	-5.681**	-1.481**	-2.827**	-1.694**	-1.530**	-2.245**	-1.823**	-0.373	4.150	-0.764	1.004
P_4xP_7	-2.091**	-5.351**	-1.861**	-3.100**	-1.841**	-5.830**	-6.755**	-4.809**	0.249	-0.479	-4.894**	-1.708**
P_4xP_8	-0.354	0.285	-2.657**	-0.908**	-2.957**	-4.290**	-1.428**	-2.892**	-2.603**	-4.575**	1.228	-1.983**
P_5xP_6	1.185	1.162	2.258	1.535	-1.314**	-1.273**	-0.495	-1.027**	-2.500**	-2.435**	-2.754**	-2.563**
P_5xP_7	1.015	-5.941**	0.478	-1.482**	0.438	0.926	-4.372**	-1.002**	-0.577	6.867	-4.851**	0.479
P_5xP_8	1.152	-2.337**	3.915	0.910	1.855	-0.267	0.987	0.858	0.702	2.070	-2.927**	-0.051
P_6xP_7	-0.191	-5.294**	2.508	-0.992**	1.135	-6.317**	0.161	-1.673**	1.326	-1.022*	-2.347**	-0.681*
P_6xP_8	1.779	-3.657**	3.678	0.600	1.885	2.189	0.554	1.543	0.106	5.847	-3.124**	0.943
P_7xP_8	-1.324**	4.738	-1.034**	0.793	-4.894**	-3.810**	3.711	-1.664**	-3.570**	-8.549**	4.745	-2.458**
L.S.D.sij at 5 %	0.722	0.726	0.698	0.407	0.734	0.686	0.708	0.403	1.036	0.939	1.028	0.570
L.S.D.sij at 1 %	0.958	0.963	0.926	0.534	0.974	0.910	0.939	0.520	1.376	1.246	1.364	0.747
L.S.D.sij-sik at 5 %	1.068	1.076	1.034	0.601	1.086	1.018	1.048	0.598	1.536	1.391	1.522	0.844
L.S.D.sij-sik at 1 %	1.417	1.428	1.372	0.788	1.441	1.351	1.391	0.784	2.038	1.796	2.019	1.107

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 7.Cont.

Crosses	Plant height				Number of spikes/plant				Number of kernels/spike			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	-0.12	-1.128	3.670	0.807	0.977**	1.012*	0.151	0.731**	4.513*	4.154	2.070	3.579*
P_1xP_3	-0.466	0.468	-1.439	-0.479	0.887**	1.947**	0.811*	1.215**	-0.71	-2.329	4.487	0.482
P_1xP_4	10.833	2.328	-1.169	3.997	-1.302	-0.677	0.938**	-0.347	2.996	-7.315	5.713*	0.464
P_1xP_5	-1.936**	-1.795**	1.877	-0.618	1.044**	-0.188	-0.151	0.234	4.940*	0.900	3.770	3.203*
P_1xP_6	-0.566	-3.211**	2.207	-0.523	0.561	-1.524	-0.918	-0.627	1.083	6.887*	2.850	3.607*
P_1xP_7	-4.233**	0.834	-5.442	-2.947	0.711*	-0.774	1.114**	0.350	-0.816	4.511	-2.026	0.555
P_1xP_8	-4.043**	-0.178	-5.069	-3.097	-0.162	0.759	0.424	0.340	-0.74	-0.435	0.100	-0.358
P_2xP_3	0.680	-3.535**	0.280	-0.858	1.228**	0.371	-1.018	0.193	-1.963	-5.689	3.773	-1.292
P_2xP_4	-4.32**	1.624	3.083	0.129	0.105	-3.820	-0.791	-1.502	-2.023	-0.509	-3.189	-1.910
P_2xP_5	0.576	-1.865**	-10.402	-3.897**	-0.548	1.467**	0.218	0.379	-8.08	-0.992	-3.876	-4.316
P_2xP_6	0.313	-1.948**	-24.006**	-8.547**	-1.364	-1.534	1.118**	-0.593	2.496	3.094	3.670	3.087*
P_2xP_7	-1.986**	-0.101	1.977	-0.037	-0.148	-0.417	1.551**	0.328	5.463**	4.351	-4.806	1.689
P_2xP_8	0.07	1.218	3.483	1.590	-0.488	2.049**	2.261**	1.274**	-2.593	2.004	-10.546	-3.711
P_3xP_4	2.533	1.054	1.440	1.678	-1.218	1.114*	0.634	0.177	3.586	4.307	-1.716	2.059
P_3xP_5	-2.17**	-1.035	0.353	-0.950	-0.571	-0.483	-0.255	-0.436	1.030	0.924	-0.859	0.364
P_3xP_6	-4.1**	0.114	-1.319	1.767	-0.688	-2.965	1.311**	-0.780	4.740*	1.211	1.087	2.345
P_3xP_7	-2.90**	-4.238**	0.800	-2.112	0.128	-3.315	0.711*	-0.825	0.973	-0.265	3.443	1.383
P_3xP_8	-1.043	2.914	0.859	0.337	0.355	1.451**	-1.611	0.064	-0.883	10.987**	1.937	4.013**
P_4xP_5	-3.87**	-1.375*	-2.876	-2.707	-0.494	-1.088	0.838	-0.248	-1.230	-1.025	-4.666	-2.308
P_4xP_6	-6.033**	-0.858	-3.646	-3.512	0.388	2.409**	1.388**	1.311**	-0.286	7.090*	5.280*	4.028**
P_4xP_7	-6.833**	-4.011**	1.637	-3.069	2.905**	0.025	-0.428	0.834**	-6.320	-3.285	3.737	-1.956
P_4xP_8	-4.510**	-6.925**	-3.089	-4.841**	0.965**	1.659**	0.698*	0.990**	5.490**	7.301*	6.430*	6.407**
P_5xP_6	-6.736**	0.984	2.300	0.849	1.901**	1.364**	0.414	1.227**	-1.776	4.041	3.970	2.078
P_5xP_7	-0.836*	1.064	-2.818	-0.862	-1.214	0.281	-1.585	0.872	4.690*	6.297*	4.427	5.138**
P_5xP_8	3.986	-0.448	-1.842	0.565	-0.088	-1.418	-0.875	-0.794	0.933	-3.582	1.987	-0.221
P_6xP_7	2.20	0.614	-1.152	0.553	-0.264	1.679**	-0.018	0.465*	1.533	-5.982	-5.259	-3.236
P_6xP_8	1.923	0.168	7.087	3.059	0.695*	3.179**	-0.408	1.155**	6.210**	5.137	8.833**	6.727**
P_7xP_8	2.523	-2.285**	-1.862	-0.541	0.845*	-0.537	0.591	0.299	2.876	-3.905	4.090	1.020
L.S.D.sij at 5 %	1.164	1.140	10.899	3.617	0.648	0.868	0.667	0.418	3.983	5.567	4.929	2.769
L.S.D.sij at 1 %	1.531	1.512	14.45	4.743	0.859	1.152	0.885	0.648	5.285	7.385	6.539	3.631
L.S.D.sij-sik at 5 %	1.708	1.686	16.128	5.352	0.958	1.285	0.988	0.618	5.894	8.237	7.293	4.097
L.S.D.sij-sik at 1 %	2.266	2.237	21.394	7.016	1.272	1.705	1.310	0.811	7.819	10.927	9.676	5.373

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 7.Cont.

Crosses	1000- kernel weight				Grain yield/plant			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	-3.036	-2.901	7.133**	0.398	-2.641	-0.470	1.994	-0.372
P_1xP_3	2.023**	3.701**	-0.166	1.852**	3.308**	3.198**	-9.916	2.196**
P_1xP_4	0.376	-0.571	-0.046	-0.080	-0.559	-3.682	3.440**	-0.333
P_1xP_5	1.949**	6.171**	5.976**	4.699**	4.338**	8.892**	-1.894	3.778**
P_1xP_6	-0.852	-5.952	-6.413	-4.406	-1.774	-4.999	-6.839	-4.471
P_1xP_7	1.243**	-1.797	-2.506	-1.020	4.004**	0.237	-10.160	0.361
P_1xP_8	-4.236	-6.204	-3.670	-4.703	-1.825	-6.728	-11.658	-6.737
P_2xP_3	1.757**	-4.708	0.253	-0.899	4.994**	-5.811	8.827**	2.670**
P_2xP_4	-1.722	-4.315	-3.860	-3.299	-0.143	-15.848	5.783**	-2.402
P_2xP_5	-0.416	-0.871	-1.003	-0.763	4.901**	9.149**	2.215	5.421**
P_2xP_6	5.814**	8.670**	9.573**	6.019**	1.511**	-2.209	3.504**	0.935
P_2xP_7	-4.055	4.092**	0.413	0.149	0.347	13.304**	0.618	4.756**
P_2xP_8	-2.202	5.118**	3.183**	2.033**	-3.105	11.662**	-9.415	-0.286
P_3xP_4	-2.696	-4.645	-3.626	-3.656	-4.060	1.883**	9.273**	2.365**
P_3xP_5	-0.389	-5.601	-3.736	-3.242	0.170	-2.442	-5.628	-1.633
P_3xP_6	1.374**	-1.325	-0.293	-0.081	-1.485	-10.764	-2.572	-4.940
P_3xP_7	-0.862	12.395**	10.513**	7.348**	1.350**	0.218	0.206	0.591
P_3xP_8	-1.176	1.455**	1.350**	0.543*	2.127**	8.724**	10.508**	7.119**
P_4xP_5	2.163**	7.224**	6.916**	5.434**	-0.120	-0.669	10.028**	3.079**
P_4xP_6	3.727**	3.734**	3.393**	3.818**	5.089**	12.252**	-17.150	0.064
P_4xP_7	2.057**	3.822**	2.933**	2.937**	4.625**	1.399	-6.604	-0.192
P_4xP_8	1.776**	2.715**	0.790*	1.753**	6.139**	10.524**	3.829**	1.011*
P_5xP_6	0.967*	0.777	-1.650	0.031	1.047*	3.160**	-1.784	0.807
P_5xP_7	-1.136	-4.587	-2.143	-2.615	-2.342	2.540**	2.194	0.797
P_5xP_8	0.016	-2.674	-0.173	-0.943	0.170	-8.801	4.416**	-1.405
P_6xP_7	1.527**	-1.558	-0.566	-0.199	-0.099	1.682**	10.490**	4.024**
P_6xP_8	-0.752	2.668**	3.036**	1.650**	1.714**	12.076**	-5.682	2.702**
P_7xP_8	4.110**	2.289**	-0.858	1.914**	3.773**	-16.879	-2.002	-5.036
L.S.D.sij at 5 %	0.870	0.893	0.787	0.484	0.871	1.187	2.295	0.895
L.S.D.sij at 1 %	1.154	1.184	1.044	0.634	1.155	1.575	3.045	1.174
L.S.D.sij-sik at 5 %	1.287	1.321	1.165	0.716	1.289	1.757	3.396	1.324
L.S.D.sij-sik at 1 %	1.707	1.752	1.545	0.939	1.710	2.331	4.505	1.737

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

the best for shortness.Ten ,eleven ,ten and nine hybrids had significant positive specific combining ability effects for number of spikes /plant in the first ,second and third planting dates as well as the combined analysis, respectively. The best combinations were P_1 xP_3 and P_4 xP_8 in the three planting dates and their combined analysis for this trait .For number of kernels /spike ,seven ,five four and nine parental combinations had significantly positive specific combining ability effects in the first ,second and third planting dates as well as the combined data ,respectively .The cross P_4 xP_8 gave significant positive specific combining ability effect for this trait in the three planting dates as well as the combined analysis .For 1000-kernel weight, line P_4 with each of Sids 4(P_5) ,Gemmeiza 3(P_6) ,Gemmeiza 9(P_7) ,line P_8 , P_1 xP_5 and P_2 xP_6 were found to exhibit significant positive specific combining ability effects in the three planting dates as well as the combined analysis .Concerning grain yield /plant the two crosses P_3 xP_8 and P_4 xP_8 showed highly significant positive specific combining ability effects in the three planting dates and their combined data .It is of interest to mention that line P_4 was found to be an excellent general combiner for grain yield /plant ,therefore the hybrid combinations P_4 xP_8 would be of practical importance in a breeding programme for developing either hybrid wheat cultivars or pure lines since it surpassed the best performing respective parent for the trait in view in the three planting dates as well as the combined analysis and contained one excellent combiner for this trait .

2-F2 generation

Estimates of the specific combining ability effects of the hybrids combinations in the three planting dates and their combined data are presented in Table (8).For heading date, the seven hybrid combinations P_1 xP_5 ,P_2 xP_3 ,P_2 xP_4 ,P_2 xP_6 ,P_2 xP_7 ,P_4 xP_5 and P_4 xP_6 showed significant negative specific combining ability effects in the three planting dates and their combined data .Concerning maturity date the eleven crosses combinations P_1 xP_2 ,P_1xP_3 ,P_2 xP_3 ,P_2 xP_5 ,P_2 xP_6 ,P_2 xP_7 , P_4 xP_5 ,P_4 xP_6 ,P_4 xP_8 , P_5 xP_6 and P_7 xP_8 showed significant negative specific combining ability effects in the three planting dates as well as their combined data .As showen before three parental genotypes line P_3 ,sids 4 and Gemmeiza 3 proved to be excellent general combiners for this trait in the three planting dates and their combined data(Table 6) .Significant negative specific combining ability effects for grain filling period were detcted in the three planting dates as well as their combined data in five crosses(P_1 xP_3,P_3xP_7 ,P_4xP_5 ;P_5xP_6 and P_7 xP_8) .As for plant height, the eleven hybrid combinations P_1 x P_6 , P_1 x P_7 , P_1 x P_8 ,P_2 x P_6 , P_2 xP_7, P_3 x P_6, P_4 x P_5, P_4 xP_6 ,P_4 x P_8 , P_5 x P_7 and P_5 x P8 were found to exhibit significant negative specific combining ability effects in the three planting dates .It is of interest to mention that line P_2 cultivar sids 4 and cultivar Gemmeiza 3 were found to be good general combiners for this trait ,however the remaining five parents P_1 , P_3, P_4, P_8 and P_7 were detected to be

Table 8.Estimates of specific of combining ability effects of crosses for all studied traits under the three planting dates as well as their combined data in the F_2 generation .

Crosses	Heading date				Maturity date				Grain filling period			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	2.162	-5.323**	-0.146	-1.102**	-1.276*	-2.636**	-4.128**	-2.680**	-3.439**	2.686	-3.982**	-1.578**
P_1xP_3	2.979	2.38	1.863	2.341	-8.026**	-6.75**	-7.641**	-7.472**	-11.005**	-9.13**	-9.305**	-9.813**
P_1xP_4	2.062	4.660	-1.612**	1.703	1.613	-1.443**	0.428	0.199	-0.449	-6.103**	2.041	-1.503**
P_1xP_5	-1.877**	-3.32**	-4.239**	-3.145**	-1.406*	2.613	-3.485**	-0.759*	0.470	5.933	0.754	2.386
P_1xP_6	-5.267**	1.863	-1.682**	-1.762**	-4.832	3.676	-2.568**	-1.241**	0.434	1.823	-0.885	0.520
P_1xP_7	-5.837**	0.763	-3.962**	-3.012**	1.313	-3.91**	0.858	-0.579	7.151	-4.673**	4.821	2.432
P_1xP_8	0.582	2.376	-3.026**	-0.022	-5.2246**	2.476	-3.876**	-2.216**	-6.829**	0.100	-0.852	-2.193**
P_2xP_3	-1.253*	-5.11**	-4.552**	-3.638**	-3.532**	1.973**	-5.278**	-3.594**	-2.279**	3.136	-0.725	0.043
P_2xP_4	-3.303**	-3.863**	-1.096*	-2.754**	-2.726**	4.933	-4.008**	-0.600	0.577	8.796	-2.912**	2.153
P_2xP_5	-3.010**	5.623	-4.322**	-0.57*	-5.412**	-1.276*	-1.588**	-2.759**	-2.402**	-6.900**	2:734	-2.189**
P_2xP_6	-4.733**	-6.793**	-7.266**	-6.264**	-5.339**	-3.98**	-3.005**	-4.108**	-0.605	2.813	4.361	2.156
P_2xP_7	-6.137**	-2.793**	-4.212**	-4.381**	1.140	-0.166	0.521	0.498	7.277	2.626	4.734	4.879
P_2xP_8	-8.183**	-2.913**	0.857	-3.413**	1.513	0.62	-1.115*	0.339	9.967	3.633	-1.972*	3.752
P_3xP_4	-2.087**	5.006	1.620	1.600	2.690	7.188	6.378	5.385	4.677	2.180	4.797	3.885
P_3xP_5	0.372	-5.206**	-2.679**	-2.504**	0.670	-1.99**	0.664	-0.218	0.297	3.216	3.344	2.286
P_3xP_6	0.016	-0.656	-4.089**	-1.576**	0.077	1.006	1.514	0.866	0.061	1.663	5.604	2.442
P_3xP_7	-1.387**	1.41	1.563	0.528	-5.076**	-9.18**	-9.091**	-7.782**	-3.689**	-10.59**	-10.655**	-6.311**
P_3xP_8	-3.567**	-8.276**	-0.393	-4.081**	0.930	-8.526**	-5.226**	-3.606**	4.497	1.75	-4.828**	0.472
P_4xP_5	-2.143**	-1.78**	-1.122*	-1.675**	-5.822**	-17.716**	-10.465**	-11.334**	-3.679**	-15.956**	-9.342**	-9.659**
P_4xP_6	-2.033**	-6.976**	-5.666**	-4.892**	-4.016**	-1.62**	-11.348**	-5.661**	-1.982*	5.356	-5.628**	-0.769
P_4xP_7	-0.637	-1.343**	-3.812**	-4.931**	0.730	-7.073**	-5.155**	-3.832**	1.367	3.276	-1.342	1.098
P_4xP_8	0.282	-3.43**	-3.809**	-2.318**	-6.562**	-5.786**	-3.791**	-5.380**	-6.845**	-2.356**	0.017	-3.061**
P_5xP_6	1.392	-1.123**	3.707	1.325	-1.536**	-4.296**	-1.328*	-2.387**	-2.929**	-3.173**	-5.035**	-3.712**
P_5xP_7	0.822	-4.156**	-0.139	-1.157**	-2.622	2.583	-5.235**	-1.758**	-3.445**	8.74	-5.095**	-0.600
P_5xP_8	1.476	-1.443**	2.097	0.710	1.683	1.803	-2.138**	0.449	0.207	3.246	-4.235**	-0.260
P_6xP_7	-2.400**	-5.006**	1.850	-1.852**	-0.249	-4.520**	-1.751**	-2.173**	2.151	0.486	-3.602**	-0.321
P_6xP_8	1.552	-6.36**	2.820	-0.662**	1.957	-1.866**	0.644	0.245	0.404	4.493	-2.175**	0.907
P_7xP_8	-1.617	4.473	-1.692**	0.387	-5.162**	-5.233**	-6.628**	-5.681**	-3.545**	-9.726**	-4.935**	-6.069**
L.S.D.sij at 5 %	0.9516	0.822	0.861	0.500	1.157	0.945	1.092	0.607	1.422	1.617	1.367	0.728
L.S.D.sij at 1 %	1.262	1.091	1.143	0.656	1.535	1.254	1.449	0.797	1.887	1.350	1.814	0.955
L.S.D.sij-sik at 5 %	1.408	1.217	1.274	0.740	1.712	1.399	1.616	0.899	2.105	1.06	2.023	1.072
L.S.D.sij-sik at 1 %	1.868	1.615	1.691	0.971	2.272	1.856	2.144	1.0799	2.792	1.998	2.684	1.414

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 8.Cont.

Crosses	Plant height				Number of spikes/plant				Number of kernels/spike			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	-0.534	-1.545*	1.828	-0.083	0.421	0.517	0.803	0.580**	-1.833	-4.865	-5.039	-3.912
P_1xP_3	-2.014**	-1.839**	0.185	-1.222**	-0.378	1.857**	0.497	0.658**	-6.290	-2.925	-1.699	-3.605
P_1xP_4	5.189	-0.652	-2.511**	0.675	-1.775	0.540	-0.229	-0.488	1.350	-1.822	1.745	-0.737
P_1xP_5	-4.027**	2.030	1.248	-0.249	0.331	-0.366	-1.022	-0.349	2.433	-3.315	-6.195	-2.026
P_1xP_6	-3.470**	-5.109**	-2.777**	-3.785**	0.748*	-2.376	-1.046	-0.891	2.320	2.767	-1.705	1.127
P_1xP_7	-3.087**	-9.249**	-11.531**	-7.955**	0.881**	-1.686	0.660	-0.048	2.798	-2.015	-3.322	-0.847
P_1xP_8	-1.320**	-2.875**	-3.527**	-2.574**	1.028**	0.737	1.643**	1.136**	-0.350	-2.542	-5.365	-2.752
P_2xP_3	2.685	-5.739**	-7.094**	-3.362**	0.742*	0.357	-1.249	-0.050	-1.210	0.914	-2.692	-1.062
P_2xP_4	-5.644**	0.814	1.275	-1.251**	0.112	-4.792	-0.842	-1.841	-3.103	1.884	-0.472	-0.563
P_2xP_5	-0.327	-2.469**	-10.297**	-4.364**	1.452**	1.177**	0.997*	1.208**	-8.620	-1.609	-1.822	-4.017
P_2xP_6	-3.604**	-4.209**	-18.657**	-8.823**	-1.097	-1.176	0.640	-0.544	2.600	-7.692	-11.099	-5.397
P_2xP_7	-5.187**	-1.849**	-3.344**	-3.460**	-0.031	-0.452	0.847	0.121	3.543*	-8.375	-11.449	-5.427
P_2xP_8	-0.454	-3.375**	-2.807**	-2.212**	-2.017	1.870**	1.697**	0.616*	-2.536	-3.335	-5.025	-3.632
P_3xP_4	-1.490**	1.220	0.365	0.031	-1.187	1.047*	0.320	0.060	-4.960	-3.809	-6.232	-5.001
P_3xP_5	-3.540**	-4.129**	0.692	-2.325**	0.318	-0.016	-0.739	-0.145	-2.443	3.030	-2.282	-0.565
P_3xP_6	-5.017**	-3.669**	-5.187**	-4.818**	0.202	-2.869	1.137**	-0.509	1.681	2.247	1.107	3.266**
P_3xP_7	-7.134**	-5.775**	-0.187	-4.365**	-0.264	-3.312	1.877**	-0.566	-0.880	3.197*	-1.042	0.424
P_3xP_8	-2.034**	-0.269	-5.651**	-2.651**	0.015	0.343	-2.272	-0.637	-0.193	-4.695	-0.152	-1.681
P_4xP_5	-3.437**	-3.275**	-6.571**	-4.428**	-0.077	-2.099	0.267	-0.636	-3.003	0.167	-5.295	-2.710
P_4xP_6	-5.281**	-2.049**	-8.131**	-5.153**	-0.227	3.047**	1.610**	1.476**	0.283	4.917**	0.627	1.942*
P_4xP_7	-8.197**	-4.522**	2.848	-3.290**	1.905**	0.603*	-0.382	0.775**	-5.673	-6.632	-4.955	-5.420
P_4xP_8	-4.164**	-11.415**	-4.947**	-6.842**	0.752*	1.527**	1.267**	1.182**	6.443**	7.707**	3.100*	4.162**
P_5xP_6	2.435	-2.032**	0.595	0.332	1.245**	1.717**	1.517**	1.493**	-3.500	-0.642	-6.755	-3.632
P_5xP_7	-5.747**	-3.305**	-8.057**	-5.703**	-1.254	-0.359	-1.709	-1.107	-4.590	-2.425	-1.905	-2.973
P_5xP_8	-8.160**	-2.965**	-2.254**	-4.467**	-1.274	-0.936	-1.059	-1.089	-4.903	-8.152	-5.715	-6.257
P_6xP_7	-1.057	1.87	-2.451**	-0.640	-1.037	0.587	-0.265	-0.238	-13.303	-4.342	-0.215	-5.953
P_6xP_8	0.542	0.894	5.452	2.229	0.908**	2.410**	1.715**	0.867**	0.516	0.997	1.374	0.962
P_7xP_8	1.425	0.287	0.065	0.592	1.542**	0.200	-0.575	0.388	0.093	0.247	0.890	0.410
L.S.D.sij at 5 %	1.305	1.259	1.437	0.759	0.629	0.796	0.860	0.437	3.160	3.037	2.869	1.720
L.S.D.sij at 1 %	1.731	1.671	1.906	0.996	0.835	1.056	1.141	0.573	4.192	4.030	3.806	2.255
L.S.D.sij-sik at 5 %	1.931	1.863	2.126	1.124	0.931	1.178	1.273	0.646	4.675	4.494	4.245	2.545
L.S.D.sij-sik at 1 %	2.562	2.472	2.821	1.474	1.235	1.563	1.689	0.847	6.202	5.962	5.632	3.337

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 8.Cont

Crosses	1000- kernel weight				Grain yield/plant			
	S1	S2	S3	Comb.	S1	S2	S3	Comb.
P_1xP_2	-1.852	-4.764	4.573**	-0.681	-3.865	-1.320	-0.424	-1.870
P_1xP_3	4.527*	5.501**	-0.246	3.260**	-1.133	10.219**	-8.650	0.991
P_1xP_4	0.737	2.949**	0.246	1.311	-0.509	-4.625	0.535	-1.533
P_1xP_5	-0.233	0.972	4.593**	1.777*	3.483**	5.501**	-2.701	2.094**
P_1xP_6	-3.579	-1.958	-1.663	-2.400	-1.943	-7.699	-7.185	-5.609
P_1xP_7	1.040	1.475	0.393	0.970	3.573**	-3.793	-5.257	-1.825
P_1xP_8	-5.669	-5.487	-5.643	-5.599	0.765	-7.945	-11.101	-6.093
P_2xP_3	2.098	-2.584	0.653	0.055	2.549**	-7.485	-3.167	-2.701
P_2xP_4	-0.991	-3.171	-1.153	-1.771	1.636**	-14.941	-5.481	-6.262
P_2xP_5	-2.229	-1.380	1.426*	-0.727	3.529**	6.451**	4.282**	4.754**
P_2xP_6	2.924	1.387	4.303**	2.872**	1.702**	-4.781	-0.002	-1.026
P_2xP_7	-3.655	4.755**	-2.873	-0.590	1.486**	9.824**	-1.107	3.401**
P_2xP_8	0.401	4.992**	0.790	2.061**	0.444	9.071**	4.049**	4.521**
P_3xP_4	-1.345	-6.638	-1.506	-3.163	-0.928	0.173	-11.657	0.923
P_3xP_5	0.717	-4.548	-1.260	-1.696	-0.368	-4.201	-4.510	-3.026
P_3xP_6	-2.495	-2.579	-5.483	-3.519	-0.695	-11.734	-4.128	-5.519
P_3xP_7	3.458	7.721**	7.140**	6.106**	1.421*	-2.128	-0.234	-0.313
P_3xP_8	-11.518**	2.158**	-0.763	-3.374	2.713**	7.319**	4.222**	4.751**
P_4xP_5	0.627	1.232	-3.900	-0.679	1.318*	-4.079	5.609**	0.949
P_4xP_6	1.281	2.834**	-0.856	1.086	-1.875	8.253**	-7.675	-0.432
P_4xP_7	1.268	2.935**	3.400**	2.534**	-1.158	-1.440	-7.414	-3.337
P_4xP_8	4.284*	2.172**	2.863**	2.331**	1.603**	7.473**	3.525**	3.019**
P_5xP_6	4.277*	1.157	-0.876	1.519*	-1.215	1.346	-2.912	-0.926
P_5xP_7	-7.802	-0.207	-4.986	-4.332	-1.298	2.080**	0.349	0.378
P_5xP_8	2.487	-3.404	-2.556	-1.157	0.826	-9.533	-4.794	-4.500
P_6xP_7	1.958	-3.872	-1.176	-0.254	0.174	2.052**	6.831**	-1.772
P_6xP_8	1.974	4.764**	7.086**	4.608**	1.600**	4.600**	-5.512	0.229
P_7xP_8	1.328	-2.001	0.810	0.045	-0.983	-16.427	-8.017	-8.475
L.S.D.sij at 5 %	3.970	1.533	1.255	1.456	1.114	1.436	2.502	1.015
L.S.D.sij at 1 %	5.267	2.034	1.665	1.910	1.478	1.905	3.319	1.331
L.S.D.sij-sik at 5 %	5.874	2.269	1.857	2.155	1.649	2.125	3.702	1.502
L.S.D.sij-sik at 1 %	7.793	3.011	2.463	2.826	2.187	2.819	4.911	1.970

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

among the poorest general combiners for this trait .With regard to the number of spikes /plant, the four hybrid combinations P_2 xP_5 ,P_4 xP_8, P_5 xP_6 and P_6 xP_8 exhibited significant positive specific combining ability effects in three planting dates as well as their combined data .Also , the cross P_4 xP_8 exhibited significant positive specific combining ability effects for the number of kernels /spike and 1000- kernel weight in the three planting date and their combined data . For grain yield/plant, the three hybrid combinations P_2 xP_5 ,P_3 xP_8 ,P_4 xP_8 exhibited significant positive specific combining ability effects in the three planting dates as well as their combined data . The results obtained here concerning general and specific combing ability effects could generally indicate that the best hybrid combinations for their SCA effects were obtained from crossing between parents having high x high, high x low or low x low GCA effects.Consequently ,it could be concluded that general combining ability effects of the parental lines were generally unrelated to the specific combining ability effects of their respective crosses .

Genetic components

Estimates of the genetic components presented in Table (9), showed that additive genetic variance (D) was significant for all studied characters in the three planting dates in the F_1 and F_2 generations except for plant height in the third planting date in the F_1 hybrids.These results indicated that the additive gene effects played a major role in the inheritance of all traits in F_1 and F_2 generations.The dominant component (H_1) was significant for all studied traits in the three planting dates in the F_1 and F_2 generations except plant height in the third planting date in the F_1 hybrids.Values of (H_1) for all studied traits were greater than the respective (D)in the three planting dates in the F_1 and F_2 generations except heading date in the first and third planting dates in the F_1 ; maturity date in the first planting date in the F_1 ; plant heght in the second planting date in the F_1; number of spikes /plant in the first and third planting dates in the F_1 and F_2 generations;number of kernels /spike in the first planting date in the F_1 and grain yield /plant in the first planting date in the F_2.generation .The component of variation due to the dominance effects associated with gene distribution (H_2) was significant for all traits studied in the three planting dates in the F_1 and F_2 generations .All H_2 values were smaller than H_1 values for all traits except plant height in the third planting date in the F_1 ,which complies with the theoretical assumption of Hayman (1954) and could be a further proof for the unequal proportions of positive and negative alleles in the parents at all loci for these traits ,indicating unequal allel frequency .The overall dominance effects of heterozygous loci (h^2) were significant for all studied traits in the three planting dates in the F_1 and F_2 generations except heading date in the third planting date in the F_1 ;grain filling period in the second planting date in the F_1, the first and the second planting dates in the F_2;plant height in the third planting date in the F_1;number of spikes /plant in the second planting date in

Table 9 :Additive (D) ,dominance (H) genetic variances and their derived parameters for all traits under the three planting date in the F_1 and F_2 generations

Components of variance		Heading date			Maturity date			Grain filling period		
		S1	S2	S3	S1	S2	S3	S1	S2	S3
D	F_1	47.59±2.80**	65.74±5.22**	40.64±3.09**	56.37±1.45**	68.31±13.90**	47.81±6.97**	28.70±2.34**	35.99±8.27**	22.49±9.01*
	F_2	47.45±6.11**	65.69±11.57**	40.57±5.42**	53.40±2.80**	68.24±19.87**	47.71±10.27**	26.85±10.67*	36.00±16.04*	22.30±10.94*
H_1	F_1	28.74±6.45**	84.90±12.00**	32.35±7.12**	24.53±3.33**	118.89±31.97**	54.01±16.03**	42.45±5.39**	121.57±19.02**	80.96±20.70**
	F_2	77.45±14.05**	146.62±28.61**	70.34±12.47**	78.84±6.45**	172.75±45.68**	163.54±23.62**	106.99±24.52**	193.01±36.89**	126.05±25.15**
H_2	F_1	17.47±5.61**	64.12±10.44**	22.28±6.19**	22.80±2.90**	93.88±27.81**	45.72±13.95**	29.15±4.69**	95.02±16.55**	56.71±18.01**
	F_2	57.34±12.3**	118.43±23.15**	58.37±10.85**	76.60±5.61**	149.33±39.74**	158.21±20.55**	82.70±21.34**	148.09±32.09**	108.22±20.88**
h^2	F_1	7.95±3.76**	55.93±7.01**	7.15±4.15	38.46±1.94**	95.16±18.65**	56.23±9.35**	11.24±3.15**	5.03±11.10	23.08±11.17*
	F_2	137.88±8.20**	250.62±15.52**	150.24±7.28	235.88±3.76**	294.84±26.65**	610.34±13.78**	12.80±14.31	1.65±21.52	154.67±14.67**
F	F_1	39.76±6.62	-3.44±12.33	32.35±7.12**	1.56±3.42	39.68±32.86	-2.59±16.48	22.58±5.54**	28.46±19.55	21.11±21.27
	F_2	50.46±14.45**	-9.42±27.35	17.25±12.82	-12.30±6.63	26.83±46.95	18.59±24.27	23.23±25.21	43.23±37.92	32.37±25.85
E	F_1	0.157±0.935	0.18±1.74	0.16±1.03	0.21±0.48	0.23±4.63	0.25±2.32	0.36±0.78	0.32±2.75	0.37±3.01
	F_2	0.302±2.03	0.23±3.85	0.23±1.80	0.42±0.93	0.30±6.62	0.35±3.42	0.63±3.55	0.31±5.34	0.56±3.64
$(H_1/D)^{0.5}$	F_1	0.777	1.136	0.892	0.659	1.319	1.062	1.216	1.837	1.897
	F_2	1.277	1.493	1.316	1.215	1.591	1.851	1.995	2.315	2.377
$H_2/4H_1$	F_1	0.152	0.188	0.172	0.232	0.197	0.211	0.172	0.195	0.175
	F_2	0.185	0.201	0.207	0.242	0.216	0.241	0.193	0.191	0.214
h_2/H_2	F_1	0.455	0.872	0.321	1.686	1.013	1.229	0.385	0.053	0.407
	F_2	2.404	2.116	2.573	3.079	1.974	3.857	0.154	0.011	1.429
Heritability (N.S)	F_1	0.678	0.735	0.755	0.827	0.531	0.715	0.559	0.414	0.468
	F_2	0.368	0.633	0.543	0.634	0.462	0.301	0.395	0.335	0.123
R	F_1	-0.063	0.501	-0.183	-0.837**	0.714**	0.850**	-0.241	0.341	0.573
	F_2	0.846**	0.747**	0.520	0.276	0.737**	0.857**	-0.373	0.469	0.552
R^2	F_1	0.004	0.251	0.033	0.701	0.510	0.723	0.058	0.116	0.329
	F_2	0.716	0.558	0.270	0.076	0.544	0.735	0.139	0.220	0.304

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 9.Cont.

Components of variance		Plant height			Number of spikes/plant			Number of kernels/spike		
		S1	S2	S3	S1	S2	S3	S1	S2	S3
D	F_1	47.36±9.27**	60.46±3.31**	17.57±41.28	8.19±0.49**	15.38±1.51**	9.61±0.41**	58.06±5.28**	74.84±10.31**	60.80±12.49**
	F_2	47.44±8.08**	60.67±5.77**	54.85±25.90*	8.31±0.33**	15.51±1.72**	9.57±0.51**	61.75±11.09**	83.21±7.86**	68.80±11.08**
H_1	F_1	65.04±21.31**	24.62±7.63**	64.63±94.91	4.27±1.12**	15.74±3.48**	4.79±0.95**	53.88±12.15**	89.26±23.71**	113.62±28.72**
	F_2	128.35±18.58**	112.36±13.28**	241.53±59.55**	4.17±0.76**	17.18±3.96**	5.91±1.17**	111.81±25.51**	115.11±18.07**	171.92±25.47**
H_2	F_1	57.99±18.54**	23.70±6.63**	69.18±82.57	3.85±0.98**	12.10±3.02**	3.93±0.83	45.88±10.57**	80.65±20.63**	79.17±24.98**
	F_2	112.50±16.16**	110.29±11.56**	213.23±51.80**	3.97±0.66**	13.39±3.44**	5.02±1.02**	89.52±22.19**	83.70±15.72**	141.71±22.16**
h^2	F_1	49.44±12.43**	36.41±4.45**	90.49±55.37	1.99±0.65**	0.17±2.03	3.17±0.55**	51.02±7.09**	108.56±13.83**	90.88±16.75**
	F_2	417.55±10.84**	455.37±7.75**	660.67±34.74**	0.25±0.44	0.13±2.31	0.96±0.68	147.15±14.86**	126.12±10.54**	559.59±14.86**
F	F_1	10.59±21.90	11.30±7.84	-104.38±97.55	-1.36±1.15	7.03±3.57*	-2.35±0.98	22.97±10.49*	14.97±24.37	45.08±29.52
	F_2	18.17±19.10	16.96±13.65	-44.10±61.21	1.04±0.78	6.69±4.07	-0.94±1.21	61.20±26.22*	85.80±18.58**	82.51±26.18**
E	F_1	0.59±3.09	0.73±1.10	37.96±13.76*	0.24±0.16	0.33±0.50	0.18±0.13	6.84±1.76**	11.21±3.43**	10.01±4.16*
	F_2	0.51±2.69	0.52±1.92	0.68±8.63	0.12±0.11	0.21±0.57	0.22±0.17	3.15±3.89	2.83±2.62	2.53±3.69
$(H_1/D)^{0.5}$	F_1	1.710	0.638	1.917	0.722	1.011	0.705	0.963	1.092	1.367
	F_2	1.644	1.360	2.098	0.709	1.052	0.786	1.345	1.176	1.580
$H_2/4H_1$	F_1	0.223	0.240	0.267	0.225	0.192	0.205	0.212	0.225	0.174
	F_2	0.219	0.245	0.221	0.237	0.195	0.212	0.200	0.181	0.206
h_2/H_2	F_1	0.852	1.536	1.307	0.518	0.014	0.806	1.111	1.346	1.147
	F_2	3.711	4.128	3.098	0.064	0.010	0.192	1.643	1.506	3.948
Heritability (N.S)	F_1	0.592	0.789	0.515	0.805	0.640	0.845	0.540	0.521	0.457
	F_2	0.440	0.448	0.540	0.769	0.638	0.793	0.309	0.377	0.178
r	F_1	0.421	-0.354	-0.212	0.428	0.192	0.244	0.163	0.369	-0.051
	F_2	0.875**	0.824	0.211	0.090	0.618	0.612	0.828**	0.399	0.917**
R^2	F_1	0.177	0.125	0.045	0.183	0.037	0.059	0.026	0.136	0.002
	F_2	0.766	0.679	0.044	0.008	0.382	0.374	0.687	0.159	0.842

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

Table 9.Cont.

Components of variance		1000- kernel weight			Grain yield /plant		
		S1	S2	S3	S1	S2	S3
D	F_1	29.07±2.96**	52.41±7.14**	48.44±5.81**	25.55±2.93**	50.22±23.23*	98.50±41.01*
	F_2	24.66±7.91**	51.79±6.00**	48.00±3.07**	25.57±1.46**	50.11±15.42**	98.33±19.59**
H_1	F_1	35.35±6.82**	113.24±16.43**	84.11±13.37**	46.09±6.75**	300.22±53.41**	390.05±94.26**
	F_2	55.36±18.20**	63.48±13.80**	52.33±7.06**	21.54±3.37**	232.08±35.46**	232.43±45.05**
H_2	F_1	24.96±5.93**	97.01±14.29**	76.37±11.63**	43.92±5.87**	296.02±46.47**	256.75±82.01**
	F_2	47.01±15.83**	54.85±12.01**	45.32±6.14**	16.14±2.93**	229.23±30.85**	177.67±39.19**
h^2	F_1	4.13±3.97	23.10±9.58*	49.06±7.80**	78.09±3.94**	77.74±31.16*	25.57±54.99
	F_2	0.76±10.61	1.13±8.05	0.57±4.12	12.90±1.96**	60.68±20.69**	417.62±26.28**
F	F_1	-20.14±7.01	2.03±18.89	17.57±13.74	-8.27±6.94	7.35±54.91	189.53±101.88
	F_2	-20.77±18.70	8.64±14.18	20.97±7.26**	17.77±3.48**	17.15±36.45	142.50±46.30**
E	F_1	0.30±0.98	0.28±2.38	0.25±1.93	0.37±0.97	0.51±7.74	1.70±13.66
	F_2	4.70±2.63*	0.91±2.00	0.69±1.02	0.41±0.48	0.62±5.14	1.89±6.53
$(H_1/D)^{0.5}$	F_1	1.103	1.469	1.317	1.343	2.445	1.989
	F_2	1.498	1.107	1.044	0.917	2.151	1.537
$H_2/4H_1$	F_1	0.176	0.214	0.226	0.238	0.247	0.164
	F_2	0.212	0.216	0.216	0.187	0.246	0.191
h_2/H_2	F_1	0.165	0.238	0.642	1.778	0.262	0.099
	F_2	0.016	0.021	0.013	0.799	0.264	2.350
Heritability (N.S)	F_1	0.819	0.575	0.499	0.613	0.240	0.242
	F_2	0.620	0.638	0.585	0.597	0.236	0.102
r	F_1	-0.406	-0.448	-0.643*	-0.101	-0.030	0.522
	F_2	0.584	0.218	-0.326	-0.375	0.216	0.896**
R^2	F_1	0.165	0.201	0.413	0.010	0.001	0.272
	F_2	0.341	0.047	0.106	0.141	0.046	0.804

*and ** denote significant at 0.05 and 0.01 levels of probability ,respectively

the F_1 and in the three planting dates in the F_2 ;1000-kernel weight in the first planting date in the F_1 and in the three planting dates in the F_2 generation and grain yield /plant in the third planting date in the F_1.This result indicated that the effects of dominance was due to heterozygosity .The covariance of additive and dominance (F) was not significant for all studied traits in the three planting dates in the F_1 and F_2 generations except heading date in the first and third planting dates in the F_1 and in the first planting date in the F_2 ;grain filling period in the first planting date in the F_1 ;number of spikes /plant in the second planting date in the F_1 ;number of kernels /spike in the first planting date in the F_1 and in the three planting dates in the F_2 ;1000-kernel weight in the first planting date in the F_1 and the third planting date in the F_2 and grain yield /plant in the first and the third planting dates in F_2 generations . The F value was negative for heading date in the second planting date in the F_1 and F_2 generations ;maturity date in the third planting date in the F_1 and the first planting date in the F_2;plant height in the third planting date in the F_1 and F_2 generations ;number of spikes /plant in the first and the third planting dates in the F_1 and the third planting date in the F_2 generation; 1000-kernel weight in the second planting date in the F_1 and F_2 and grain yield /plant in the first planting date in the $F_{1,}$ indicating an excess of recessive over dominant alleles (Table 9).These results are in agreement with those obtained by AlKaddoussi *et al* (1994), Hassan,*et al.* (1996),Hamada and Tawfelis (2001) and Morad (2001).

The degree of dominance $(H_1/D)^{0.5}$ was higher than unity for all studied traits in the three planting dates in the F_1 and F_2 generations indicating an overdominance effect except heading date in the first and the third planting dates in the F_1 ,maturity date in the first planting date in the F_1 ;plant height in the second planting date in the F_1;number of spikes /plant in the first and third planting dates in the F_1 and F_2 generations;number of kernels /spike in the first planting date in the $F_1$and grain yield /plant in the first planting date in the F_2 generation were the value of $(H_1 /D)^{0.5}$ was less than unity, indicating a partial dominance effect .Values of $H_2/4H_1$ in the three planting dates in the F_1 and F_2 generations for all traits were less than 0.25 except plant height in the third planting date in the F_1, revealing asymmetric distributions of positive and negative alleles among parents . The h^2/H_2 values for all studied traits in three planting dates in both generations suggested that there were one or more pairs of genes affecting the inheritance of these traits .The heritability in narrow sense estimates were relatively high to moderate in the F1 hybrids for all traits studied except grain yield in the second and third planting date a which showed low narrow sense heritability values .For F_2 generation ,high to moderate heritability estimates were detected for all traits studied except grain filling period , number of kernels /spike and grain yield /plant in the third planting date, indicating low narrow sense heritabilities .Heritability estimates in narrow sense for F1 hybrids were more than F2 generation for all traits studied except plant height in the third planting date and 1000-kernel weight in the second and third planting dates . These results agreed with those found by Przulj and Mladenov(1999); Hamada and Tawfelis (2001) ;Hamada (2002) and Moustafa (2002) .

The correlation coefficient (R)values between yr and (Wr +Vr) were significant and positive for heading date in the first and second planting date in the F_2 generation ;maturity date in the second and third planting dates in the $F_1$and in the second and third planting dates in the F_2 ;plant height in the first and second planting dates in the F_2 ;number of kernels /spike in the first and third planting dates in the F_2 ;1000-kernel weight in the third planting date in the F_1 and grain yield /plant in the third planting date in the F_2, indicating that the dominant genes were operating towards decreasing these traits .Significant negative values were observed for maturity date in the first planting date and 1000-kernel weight in the third planting date in the F_1, indicating that the dominant genes were operating towards increasing these traits while the other traits were insignificant ,indicating ambidirectional dominance .The square values of (R^2) were less than unity for all traits studied under the three planting dates, suggesting that none of parental lines was completely dominant or recessive for genes controlling any of these traits. These results agreed with those reported by Hassan,*et al.* (1996) and Yadav *et al* (1998) .

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قوة الهجين والفعل الجينى لمحصول الحبوب ومكوناته وبعض صفات النمو في الهجن التبادلية لثمانية أباء من قمح الخبز تحت ثلاثة مواعيد زراعة

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الملخص العربى

أجرى تقييم كل الهجن التبادلية (غير العكسية) الناتجة من التهجين بين ثمانية اباء تشمل اربع أصناف و أربع سلالات من قمح الخبز فى محطة البحوث الزراعية بالجميزة في موسم ١٩٩٩/٢٠٠٠ ، ٢٠٠٠/ ٢٠٠١، ٢٠٠١/٢٠٠٢ بغرض تقدير القدرتين العامة والخاصة على الائتلاف ونوع فعل الجين وقوة الهجين وتفاعلاتهما مع ثلاثة مواعيد زراعة(١٥اكتوبر ، ١٥نوفمبر، ١٥ديسمبر) وكانت الصفات المدروسة هي ميعاد التزهير ،ميعاد النضج، فترة امتلاء الحبوب ، طول النبات ، عدد السنابل للنبات ، عدد حبوب السنبلة ، وزن الألف حبة ، ومحصول الحبوب بالنبات.ويمكن تلخيص أهم النتائج المتحصل عليها كما يلى :

كان التباين الراجع الى مواعيد الزراعة معنويا لجميع الصفات المدروسة فى الجيلين الأول والثاني والتباين الراجع إلى التراكيب الوراثية والأباء والهجن المدروسة معنويا لجميع الصفات فى الجيلين الأول والثاني و التحليل المشترك بينهما فى الثلاثة مواعيد فيما عدا طول النبات فى الميعاد الثالث للأباء في الجيل الأول وكذلك كان التباين الراجع الى التفاعل بين كل من مواعيد الزراعة و التراكيب الوراثية معنويا لجميع الصفات المدروسة فى الجيلين الأول والثاني فيما عدا صفة طول النبات في الجيل الأول .وكذلك كان التباين الراجع الى قوة الهجين معنويا لمعظم الصفات المدروسة تحت مواعيد الزراعة والتحليل المشترك لهما فى الجيلين الاول والثانى فبما عدا عدد السنابل للنبات فى الميعاد الثانى، وزن الف حبة فى الميعاد الاول والثالث والتحليل المشترك بينهما فى الجيل الثانى . كان التباين الراجع الى التفاعل بين كل من مواعيد الزراعة وقوة الهجين معنويا لجميع الصفات المدروسة فى الجيلين الاول والثانى فيما عدا صفة طول النبات و عدد حبوب السنبلة فى الجيل الاول ووزن الف حبة في الجيل الثاني .

كـــان التبايـــن الراجع الى القدرة العامة والخاصة على التالف معنوي فى جميع الصفات المدروســـة تحـــت مواعيد الزراعة الثلاثة والتحليل المشترك بينهما فى الجيل الاول والثانى فـــيما عـــدا صفة طول النبات للقدرة الخاصة على الائتلاف و أظهرت النسبة بين تباين القدرة العامـــة الى تباين القدرة الخاصة على التالف فى الجيلين الاول والثانى والتى زادت عن الوحدة لجميع الصفات فيما عدا فترة امتلاء الحبوب وعدد حبوب السنبلة ومحصول الحبوب للنبات فى المـــيعاد الثالث للجيل الثانى مما يدل على ان التباين الوراثي المضيف والمضيف × المضيف هما الأكثر أهمية فى وراثة معظم الصفات المدروسة.

تـــم تحديد الهجين الأب الرابع × الأب الثامن كأفضل مادة وراثية حيث تفوق في قدرته الائتلافية الخاصة وقوة الهجين لصفة كمية المحصول وارتفاع النبات (نحو القصر)والتبكير فى النضـــج وهـــذا الهجيـــن يمكن استغلاله مباشرة في تحسين القدرة المحصولية تحت مواعيد الزراعة فى برامج تربية القمح.

تأثـــرت الصفات كلها بالفعل الجينى المضيف وغير المضيف تحت مواعيد الزراعة الثلاثة مـــع توزيـــع الـــيلى غير متساوي فى الأباء ولوحظ ان التوزيع غير المتماثل للاليلات الموجبة والســـالبة بيـــن الابـــاء تحت مواعيد الزراعة لكل الصفات .ولوحظ وجود سيادة فائقة لبعض الصـــفات وسيادة جزئية لصفات أخري تحت مواعيد الزراعة مع زيادة الجينات السائدة على المتنحية.

كانـــت قـــيم الكفـــاءة التوريثـــية بمعـــناها الضيق عالية او متوسطة فى معظم الصفات المدروســـة تحـــت الـــثلاث مواعيد للزراعة فى الجيلين الأول والثاني، بينما كانت منخفضة لصـــفة محصـــول الحـــبوب فـــى الميعادين الثاني والثالث فى الجيل الأول ولصفة فترة امتلاء الحبوب وعدد حبوب السنبلة ومحصول حبوب النبات فى الميعاد الثالث فى الجيل الثانى .