Evaluation of the performance of the double crosses of maize under planting dates suitable for the fall season in the middle region (field traits)

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Abstract

With the aim of evaluating the performance of double crosses at planting dates that are suitable the fall season in the middle region of Iraq, a field experiment was conducted in the fields of the College of Agricultural Engineering Sciences - University of Baghdad - Al-Jadriya for the fall season 2022 using superior double crosses of maize were chosen from fifteen double crosses . It was obtained from the crossing of ten single crosses resulting from the crossing of five inbred lines (1=ZM43WIZE , 2=ZM60 , 3= ZM49W3E , 4=ZM19 ,5=CDCN5) by the half- dialle crossing method . Hybrids (3×5)(1×4),(3×5)(1×2),(2×4)(1×5), (4×5)(1×2), and (2×3)(1×4) , compared it with the synthetic cultivar IPPA 5012 and tested it under three planting dates:1st July, 15th July and 1st August. The Randomized Complete Block Design (RCBD) was used with four replicates in split plots arrangement. The main plots included the three planting dates and the secondary plots were double crosses with the comparison cultivar IPPA5012. The following traits were studied: number of days from planting to 50% tassling and silking, plant height, ear height, number and area of leaves. The results showed that the hybrid (3×5) (1×2) reached the tassling-and silking-earlier, taking 50.83 and 54.33 days, respectively. The same hybrid also outperformed by giving it the highest plant height , ear height , number of leaves and leaves area, as they reached (195.4 cm, 114.3 cm, 14.30 leaves, and 6588 cm ^{2}) respectively. The plants of the date of 1st August were early with tassling and silking, as they need 50.75 and 53.50 days, and the date 1st July did not differ significantly from 15 July in these two trait. The date 1st August was also superior in plant height, ear height, and leaf area, reaching 193.2 cm, 106.1, and 6375 cm^2. And there were no significant differences between the three dates in number of leaves. The interaction was significant between the two studied factors for the traits of tassling and silking , plant height and number of leaves, but it was not significant for ear height and leaf area.

Key words: Maize ,Double hybrids, Planting dates

- ***Part of MSC thesis for first author**

Introduction

Maize (*Zea may* L.) is one of the most important crops belonging to family. It occupies the second place globally after wheat in terms of cultivated area and the first place in terms of production (13). It is triple-purpose as it is food for humans and for the production of nutritional oils as well as its use as green fodder for animals or as a concentrated diet from its seeds because it contains a high level of energy from carbohydrates and protein materials. its results, the production of maize hybrids has become an agricultural revolution and the greatest event in the field of plant breeding, which led to the creation of new high-yielding hybrids around the world, which depend mainly on genetic divergence between parents (4). It is important for plant breeders because it has male and female flowers and is monoecious (13,16,18,26). This crop is distinguished by its high genetic and phenotypic variance (15,5) and understanding the nature of genetic actions that control the inheritance of traits helps to appropriate breeding method, as the maize crop is an excellent model for studying genetic regulation because it has a wide genetic base and is available for testing, and then its adaptation to environmental conditions (22).The global production rate of maize is

estimated at about 5.5 tons ha, with a cultivated area of about 184 million hectares (14), but the rate of production in Iraq is still less than the required limit, as it does not exceed 4.054 tons ha (7). (1)found in his study of some double crosses that the hybrid (3×5) (1×4) took the least time to reach , amounting to 56 days, followed by the double crosses (2×4) (1×5) and (4×5) (2×3), which reached 57.67 And 57.83 days, respectively. As for the trait of silking, the mated crosses did not differ significantly among themselves to reach silking. (3) in a study of the effect of planting dates on the yield and its components for five genotypes (Ghouta 82, Ghouta 26, Salmonella, Buhooth 106 and 5018) indicated that there were significant differences between the genotypes and for plant height trait . Buhooth 106 gave the highest height of 188 cm at the date of 10 July, while it gave Salmonella, on the date of 30 July, had the lowest height of 130 cm, and also indicated that there were significant differences between the genotypes and the trait of the ear height, as the genotype was superior to Buhooth 106 on the date of 30 July and reached 128 cm, while the Salmonella on the date of 30 July gave the lowest height of 63 cm. The results reached by (8),(9) showed in their study the effect of seven planting dates (from 20 April – 10 June) during two seasons (2019,2020) and that plant height increased with the delay of planting dates in the two seasons in 2019, the highest height was in 30 April and 3 June reached (297.1 cm) and the first two dates had a similar height of (253.6 cm), the lowest height, and in 2020 it was in dates 18 April .27 April, 3 June it reached (276.7 cm), and it was much lower in June (283.3 cm). (1) found in his study that the hybrid (2x4) (3x5) excelled in giving it the highest number of leaves, reaching 17.08 leaves . The highest leaf area reached 0.612 m ^{2} and did not differ significantly from the hybrid (4×5) (2×3) whose leaf area reached 0.604 m ^{2}, while the hybrid (4×5) (1×3) gave the least area of 0.503 m$^{.2}$. Planting dates play a role no less important than selecting good varieties, as determining the most appropriate date for plant growth is one of the bases on which to rely on in the cultivation of maize, especially when some farmers resort, under certain circumstances, to early and late planting date to provide appropriate temperatures for emergence, germination, and even to reach the stage of flowering and seed production, and that the different planting dates significantly affect the grain yield and its components. Therefore, the study aimed to evaluate the performance of double crosses of maize at different planting dates that suit the fall harvest in the middle region of Iraq.

Materials and methods

A field experiment was applied in the fields of the College of Agricultural Engineering Sciences - University of Baghdad in the Field Crops Department for the fall season 2022 to evaluate five superior double crosses of maize that were selected from fifteen double crosses of maize obtained from the crossing of ten single crosses resulting from the crossing of five inbred lines (1= ZM43WIZE, 2= ZM60, 3= ZM49W3E, 4= ZM19, 5= CDCN5). By the half-diallel crossing method, which is hybrid 1 = (3×5)(1×4), hybrid 2 = (3×5)(1×2),hybrid 3=(2×4)(1×5) ,hybrid 4=(4×5)(1×2), hybrid 5=(2×3)(1×4) and compared with synthetic cultivar IPPA 5012 and tested under three planting dates. It is 1^{at} July, 15th July, and 1 August. The land was prepared for cultivation and the site of the experiment, through perpendicular plowing, harrowing, and leveling according to the recommendations. The land was divided into plots (3×3) m^2, the distance between rows was 75 cm, and between one plant and another, 25 cm. Fertilization was done with triple superphosphate fertilizer (46% P_2O_5) at a rate of 200 kg P_2O_5 ha^{-1} in one batch before planting, and nitrogen fertilizer 350 kg N ha^{-1} in the form of urea (46% N) in three batches, the first two weeks after germination, the second when the plant height is 30 cm, and the third after flowering The process of weeding was carried out manually several times during the season and according to the need, as well as field irrigation operations were carried out as needed. Seeds were sown at a rate of 2-3 seeds in each hole, and the number of plants was thinned to one plant. The experimental

land was divided into four replicates according to the randomized complete block design (RCBD) in the split plots arrangement. The main plots included the three planting dates and the secondary plots were double crosses with the comparison cultivar.Five intermediate plants were taken for each experimental unit, which were chosen randomly, with the exclusion of terminal plants, and the following traits were measured:

1. The number of days to 50% tassling: represents the period from planting to 50% of the plants for each experimental unit (11)
2. The number of days to 50% silking: represents the period from planting to emergence of 50% of the plants' silks for each experimental unit.
3. Plant height (cm): It was calculated using a long wooden ruler graduated from above the soil surface to the male inflorescence (10)
4. Ear height: it was calculated using a long wooden ruler, from the area where the stem exits above the soil surface to the internodes bearing the main ear.
5. Number of leaves: The number of active (green) leaves per plant was calculated in 50% tassling
6. leaf area (cm^2): It was measured according to the equation: the square of the leaf length (cm) under the main ear × 0.75 (11)

Statistical analysis of each of the traits was done according to analysis of variance ANOVA with split-plots arrangement, and significance was tested by F-test at a significant level of 0.05, and the _ means were compared using LSD (least significant difference) at a significant level of 0.05 for all averages according to (25) using Genestat 2022 program.

Results and discussion

Days Number - to 50% tassling

The results of Table (1) indicate that there are significant differences between the planting dates and the double crosses and the interaction between them, as the plants of the date of August 1^{at} were earlier in tassling and took 50.75 days, while the plants of the two dates were late July 15 and July 1, which did not differ significantly between them and took 54.33, 54.54 days , respectively, This is due to the length of the photoperiod, which leads to the rapid growth of plants, as the high temperature and the different photoperiod affect the plants' access to the flowering stage and thus lead to an increase in enzymatic activity and thus the speed of growth and development of plant organs . This is consistent with the results of both. (2), (17), (20),(21). The data of Table (1) indicated that there were significant differences between the double hybrids and the comparison IPPA 5012, as the double cross (5×3) (2×1) was earlier in reaching tassling and took 50.83 days, while the other crosses were delayed in reaching by 52.33, 53.17, 54.42 53.17 days , while it took IPPA 5012 (comparison) the longest period to reach the tassling 55.33 days, and the difference in the date of the mated crosses is attributed to the difference in the genotype resulting from the crossing of two single crosses resulting from pure and genetically divergent inbred lines, and these results came close to the results of (27), (1) ,(24). The results of the same table showed that there were significant differences of the interaction between the ‹planting dates and the double crosses in this trait, and the interaction was towards a decrease in the number of days to reach the tassling by delaying the ‹planting dates until the date of 1August, except for the hybrid (2×3) (1×4), as the number of days increased to reach the tassling by the ‹planting date of 15 July With a difference of 3.5 days from the date of 1July, the best response was for the hybrid (3 × 5) (1×2) in the last date, as it took 47.50 days and did not differ significantly from (2×3) (1×4), which took 48.00, and this confirms the results of (1), (20), (17).

Table 1. The effect of planting dates on the number of days from planting to 50% tassling for double crosses of maize in the fall season 2022.

Genotypes	Planting dates			Means
	1 st July	15 th July	1st August	
(1×4)(3×5)	52.50	53.50	55.00	52.33
(1×2)(3×5)	53.00	52.00	47.50	50.83
(1×5) (2×4)	55.50	53.50	50.50	53.17
(1×2)(4×5)	55.50	55.75	52.00	54.42
(1×4)(2×3)	54.00	57.50	48.00	53.17
IPPA5012	55.50	55.00	55.50	55.33
L.S.D 0.05			2.038	1.176
Means	54.33	54.54	50.75	
L.S.D 0.05				0.967

Days to 50% silking

The results in Table (2) indicated that there were significant differences between the ،planting dates and double crosses, and the interaction between them. The data in Table (2) showed that there were significant differences between the paired crosses in the characteristic of female flowering, as the hybrid (3x5) (1x2) was earlier in flowering and took 54.33 days and did not differ significantly from the hybrid (3x5) (1x4) which took 55.17 days and which differed from The others were 56.83, 57.75, 56.75 days, respectively, while IPPA 5012 (comparison) was delayed by needing a longer period to reach female flowering, which amounted to 58.42 days. The results also showed in Table (2) that there were significant differences between the two factors in this trait, and the interaction was towards a decrease in the number of days until the silking, by delaying the planting dates until the 1st of August, with the exception of the two hybrids (4x5) (1x2) and (2x3) (1x4), since The number of days to reach flowering at the sowing date 15 July increased by 3.75 and 1.77 from the first date 1 July, and the best response was for the double cross
(3x5) (1x2), as it took 50.50 by the of 1 August.

Table 2. The effect of planting dates on the number of days from planting to 50% silking for double crosses of maize in the fall season 2022.

Genotypes	Planting dates			Means
	1st July	15th July	1st August	
(1×4)(3×5)	56.50	56.00	53.00	55.17
(1×2)(3×5)	57.50	55.00	50.50	54.33
(1×5) (2×4)	60.25	56.25	54.00	56.83
(1×2)(4×5)	57.00	60.75	55.50	57.75
(1×4)(2×3)	58.75	60.50	51.00	56.75
IPPA5012	58.75	59.50	57.00	58.42
L.S.D 0.05			2.322	1.341
Means	58.12	58.00	53.50	
L.S.D 0.05				0.643

Plant height (cm)

The results of Table (3) indicate that there are significant effects in the plant height trait of IPPA 5012 cultivar and double crosses, and the interaction between them. Where the plants of the third date, 1at August, gave the highest plant height, reaching 193.2 cm, and it did not differ significantly from the second date, 15th July, which gave 185.0, while the first date, 1st July, decreased from the two dates 15th July and 1 st August, by 14.80% and 11.02%, respectively. The reason may be attributed to the decrease in photoperiod and the moderation of degrees The temperature and relative humidity increased in the month of 1st August , so the duration of the carbon metabolism processes increased, which led to an increase in the metabolites, and then the plant height increased. This confirms the results of (6), (2),(20),(17). The results of Table (3) showed the superiority of the double hybrid (3×5) (1×2) by giving it the highest plant height of 195.4 cm, with an increase of 6.48%, 8.85%, 11.92%, 11.15%, and 7.16% over the hybrid (3×5) (1×4) and (2×4)(1×5), (4×5)(1×2), (2×3)(1×4), and comparison IPPA 5012, respectively. The difference between the double crosses is attributed to the genes included in each hybrid, which resulted from the crossing of four inbred lines, and then the variation in the physiological processes that take place within the hybrid, such as the difference in the proportion of auxins, gibberellins, and cytokines, which are known to control plant height and the different duration of vegetative growth leading to flowering. How much is attributed to the superiority of the ability The distinguished hybrid exploits the available growth factors more efficiently than the of the others hybrids and the synthetic variety (comparison). These results are consistent with what was obtained by (28),(1),(20),(17). The response of the plant height differed significantly according to the difference of the double hybrids and the planting dates Table (3). The date was 15th July and 1 st August, and the same hybrid achieved the highest plant height of 215.2 cm for the date 1 August, while the hybrid (4x5) (1x2) gave the lowest height of 153.8 cm in the date 1 st July.

Table 3. Effect of planting dates on plant height (cm) of double crosses of maize in the fall season 2022.

genotypes	Planting dates			Means
	1st July	15th July	1st August	
(1×4)(3×5)	164.4	188.5	197.8	183.5
(1×2)(3×5)	169.8	201.2	215.2	195.4
(1×5) (2×4)	159.8	174.5	204.2	179.5
(1×2)(4×5)	153.8	174.8	187.8	172.1
(1×4)(2×3)	162.9	179.5	178.2	173.6
IPPA5012	176.9	191.5	175.8	181.4
L.S.D 0.05	14.78			8.53
Means	164.6	185.0	193.2	
L.S.D 0.05	9.70			

Ear height (cm)

Table (4) shows that there was a significant effect of planting dates on the genotypes, as the third date,1 st August , had a higher rate of 106.1 cm, while the second date, 15thJuly , gave the lowest rate of 94.3 cm. It did not differ significantly from the first date,1 st July , which had a height of 94.6 cm. The ear height is caused by a difference in the height of the plant, which is a result of the difference in temperature and photoperiod during the successive stages of growth, which caused an increase in the vegetative growth of the plant, which in turn led to an increase in the materials represented and then an increase in the height of the ear. This result is consistent with (2), (20), (17). The same table also showed that there were significant differences between the double crosses in the trait of ear height, as the hybrid (3x5) (1x2) was taller, giving it the highest ear height of 114.3 cm, with an increase of 15.33%, 17.59%, 25.74%, 28.13%, and 15.10% over the hybrid (3x5) (1x4), (2x4)(1x5), (4x5)(1x2), (2x3)(1x4), and comparison IPPA 5012, respectively. This result is consistent with what was obtained by (1), (29), (17) who found that the double hybrids that gave the highest mean plant height also gave the highest ear height. Table (4) showed that there were no significant differences between the sowing dates and mating crosses due to ear height.

Table 4. Effect of planting dates on ear height (cm) of double crosses of maize in the fall season 2022.

Genotypes	Planting dates			Means
	1st July	15th July	1st August	
(1×4)(3×5)	95.9	95.4	105.9	99.1
(1×2)(3×5)	105.5	108.2	129.2	114.3
(1×5) (2×4)	90.2	90.4	111.0	97.2
(1×2)(4×5)	87.1	90.3	95.2	90.9
(1×4)(2×3)	90.2	84.8	92.8	89.2
IPPA5012	99.0	96.5	102.5	99.3
L.S.D 0.05	NS			8.31
Means	94.6	94.3	106.1	
L.S.D 0.05	6.63			

Leaves number

The results of Table (5) showed that there were no significant differences between the sowing dates in terms of the number of leaves, and this is consistent with what was reached by (20) in the study of the effect of dates in the Baghdad location, which found that there were no significant differences in the number of plant leaves for the sowing dates(either)and in double crosses The results showed that there were significant differences among genotypes, as the hybrid (3x5) (1x2) excelled by giving it the highest number of leaves amounting to 14.30 leaves. The results of the analysis also showed that the number of leaves differed significantly according to the different planting dates and double crosses. The best response was for the hybrid (3x5) (1x2), with an increase of 13.65% for the second date over the third, and there was no significant increase between the first and second dates, and the same hybrid achieved the highest number of 15.40 leaves. On the 1st of August, while the hybrid (2x4) (1x5) gave the least number of leaves, reaching 11.70 leaves on the 15th of July.

Table 5. Effect of planting dates on leaves number of double crosses of maize in the fall season 2022.

Genotypes	Planting dates			Means
	1st July	15th July	1st August	
(1×4)(3×5)	12.95	13.50	12.70	13.05
(1×2)(3×5)	13.95	13.55	15.40	14.30
(1×5) (2×4)	13.70	11.70	13.85	13.08
(1×2)(4×5)	13.35	14.70	12.80	13.53
(1×4)(2×3)	14.05	13.10	12.60	13.25
IPPA5012	12.90	13.55	13.25	13.23
LSD 0.05	1.372			0.792
Means	13.48	13.31	13.43	
LSD 0.05	Ns			

Leaf area (cm^2)

The importance of leaf area appears in the volume of photosynthesis , and leaves have developed and provided mechanisms to tolerant sever environmental conditions and absorb light and carbon dioxide. Increasing the leaf area leads to an increase in carbon synthesis by increasing the interception of solar radiation and air exchange and investing it in the best way in preparing metabolic materials to fill outfalls in all grain Filling Stages (23). The results in Table (6) show that there are significant differences in the leaf area between the planting dates and between the double hybrids, but there are no significant effects of the interaction between them, as the third date, 1 August, gave the highest leaf area of 6375 cm^2, with an increase of 14.28% and 13.28%. 73% for the two dates July 1 and July 15, while the1 July gave the least leaf area of 5578 cm^2 and did not differ significantly from the second date 15 July. This result agreed with (6) ,(2) ,(17) but did not agree with what (19) reached in their study of some field traits of maize with the effect of planting dates,

that there was no significant effect on the leaf area of the plant.

Table 6. Effect of planting dates on leaves area (cm^2) of double crosses of maize in the fall season 2022.

Genotypes	Planting dates			Means
	1st July	15th July	1st August	
(1×4)(3×5)	5385	5412	6573	5790
(1×2)(3×5)	6159	6554	7052	6588
(1×5) (2×4)	5414	5363	5847	5541
(1×2)(4×5)	5419	5061	6264	5581
(1×4)(2×3)	5319	5527	5469	5438
IPPA5012	5772	5715	7044	6177
L.S.D 0.05			NS	417.2
Means	5578	5605	6375	
L.S.D 0.05				408.0

References

1. **Abdel AL-amir, A.N. and B.H.Hadi.**2018.Evaluate the performance of double single hybrids and inbreds of maize under different plant population and estimate heterosis and hybrid vigor .Anbar J. Agric . sci .16(1):817-835.
2. **AL-kaisy , K.H.R.A.**2015. study of phenotypic proparities and productivity for some crosses cron (Zea mays L.) in Different Cultivation dates . college of Agric .Univ . of Tekrit . Iraq .Pp:83.
3. **Al-Mashhadani, A.N.**2010**.**Effects of sowing dates on yield and components of five maize (*Zea mays* L.) genotypes.Al-Anbar J.Agric.Sci.8(2):64-70.
4. **AL-salm, S.H.F .**2012. Evaluation performance and testing of hybrid vigor of locally bred single crosses of yellow cron. Master thesis ,college of Agriculture – Al-Muthanna University –Iraq.
5. **Amanah,A. J. and B.H. Hadi .**2021. Genetic Analysis by using partial Diallel crossing of maize in High plant Densities (Estimation GCA, SCA and some Genetic parameters).In IOP conference series :Earth and Environmental Science.910 (012135):1-10.
6. **Amiri,A.M.J**.2021**.**Detection of non allelic interaction via generation mean analysis for factorial hybrids maize at different locations. Ph.D. Dissertation, Dept. of Field Crop, Coll. Of Agricultural Engineering Science, University of Baghdad. pp:191.
7. **Aziz , M.S. and Mohammed .A.S.**2012. Effect of spring and autumn season sowing dates no yield of corn synthetic varietiss. (Zea mays L.)Al-Rafeedaen J.40(1):2224-9796.
8. **Central statistical organization.**2021. https//www.google .com/search .
9. **Djamam, k., Owen ,G., west , MM., Allen ,S., Koudahe. K., Darapuneni , M., O ,Neill, M.,**.2020.Relationship between relative maturity and grain yield of maize (*Zea mays L*.) hybrids in northwest new mexico for the 2003-2019 period . Agriculture 10,290.

10. **Djaman , K., O,Neill , M., Owen , G.K., Smeal, D., koudahe, K., west, M., Allen , S., Lom-bard , K., lrmak , S.,** 2018. Crop evapotranspiration , irrigation water requirement and water productivity of maize from meteorological data under semiarid climate . water 10(4),405.
11. **Elsahooki, M. M.** 1990.Maize production and Breeding .Coll. Of Agric. Univ. of Baghdad. Ministry of Higher Edu and scientific Res . Pp:398.
12. **Elsahookie , M. M. and A. A. Daoud .**2021.Genome and plant breeding . Ministry of Agriculture-Republic of Iraq.PP:364.
13. **Elsahookie, M.M.,A.A. Daoud and S.H. Cheyed.** 2022**.** Lectres in plant Genetic Engineering Ministry of Agriculture – Republic of Iraq. Pp:555.
14. **F.A.O**.(2022**).**http:www.fao.org/site/56v deiault**.**
15. **FAO.**2018**.** https//www.google.com/search?q.
16. **Hadi, B.H., W.A. Hassan, N.Y. Abed and K.M. Wuhaib**.2019. The comparison of several methods for calculating the degree of heritability and calculating the number of genes II. Yield componets. Int. J. Agricult. Stat. Sci, 15(2): 789-794.
17. **Hadi,B. H.,W. A. Hassan.** 2021. Evaluating the performance of introduced varieties of Maize (*Zea mays* L.) and estimating some genetic Parameters. *Int. J. Agricult. Stat. Sci*, **17**(1): 85 – 91.
18. **Hashim ,A.N .**2021. Evaluation the performance of maize single crosses and their inbred lines under different sowing Dates.Sedgley,R.H.1991. An appraisal of the Donald ideotype after 21 years. Field crop Res.26:221-226.
19. **Hassan, W.A., B.H. Hadi and K.M. W uhaib.** 2018. Estimation of some genetic parameters for grain yield And its components of maize under watered and water stress. Int. J. Agricult. Stat. Sci, 14(2): 553-559.
20. **Ibrahim, A.S and N.Y. Abed. 2015.** Heterosis of traits of maize as influenced by planting date . The Iraq J.Agri.sci.46(2):206-213.
21. **Kazem ,K.A.**2020. Evaluation of the performance of introduced varieties of maize under different planting dates and locations .M. SC. Thesis ,coll.of Agricultural Engineering Science ,University of Baghdad. Pp:143**.**
22. **Khalaf, N. S. and W. A. Hassan**.2022. Study of yield and its components of introduced varieties of maize under different plant densities. *Iraqi J. of Market Research and Consumer Protection.*14(1): 52-64.
23. **Lee, E.A. and M.Tollenaar.**2007. physiological bases of successful breeding strategies for maize grain yield . crop sci. 47:202-215.
24. **Shenawa ,M.H.A.**2018**.**Molecular effect of plant density in methylation level and gene expression inbred lines and hybrids of maize (Zea mays L.) college of Agriculture university of Anbar.120.
25. **Steel,R.G.B and J.H.Torri** .1980. Principles and procedures of statistics.A biometric approach.2nd edition. MCG raw-Hill Book company.NewYork,USAm, Pp:20-90.
26. **Terefe, w., A. Teklewold and K. Tesfaye.** 2019**.**Combining ability of selected maize(Zea mays L.) inbred lines adapted to highland Agro-Ecologies of Ethiopia .Inter J Agri Biosci . 8(2):99-105.
27. **Wuhaib , K.M.** 2012a. Testing introduced maize germplasm by line X tester method 1- Yield and yield component . Iraqi J. Agri. Sci. 43(1):38-48.
28. **Wuhaib , K.M.** 2012b. Testing of introduced germplasm of maize by line X tester mating system . II- Phenotypic traits. Iraqi J. Agri. Sci. 43(2):45-55.
29. **Wuhaib, K. M., B. H. Hadi and W. A. Hassan**. 2016. Some genetic parameter in maize using full diallel crosses. The *Iraqi J. Agri. Sci*.47(5):1151-1165.