GENETIC STUDIES ON GRAIN YIELD AND EARLINESS COMPONENTS IN BREAD WHEAT OF DIFFERENT PHOTO THERMAL RESPONSE

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Abstract

A diallel cross involving six bread wheat genotypes was evaluated to determine the genetic behaviour of earliness components as well as yield and its components in the F_1 and F_2 of bread wheat under optimum and late sowing dates conditions. In addition to thermal unit and susceptibility index, the resultant hybrids along (F_1 and F_2) with their parents were evaluated in two experiments. The first experement was planted in optimum sowing date on November 20th and the second one was planted in late sowing dates (Jan 1st) at field experement in Sids station, Agriculture Research Centre.

Genotypes mean squares were significant for most studied characters in both experiments as well as thermal unit and susceptibility index. The obtained results showed that positive heterosis values over better parent values were detected for different studied characters. Inbreeding depression estimates were also significant and positive for grain filling rate and grain yield/plant in most crosses under both optimum and late sowing conditions.

GCA variance values were two or more times higher than the SCA variance ones for days to maturity under both sowing dates, thermal unit under optimum sowing, grain filling period, grain filling rate and for grain yield/plant under both two sowing dates, suggesting the predominant of additive and additive x additive gene actions in controlling the studied characters. The early line (P_2) could be considered as a good combiners for the early maturity, numbers of days and thermal unit under optimum and late sowing conditions. Parent Giza168 (P_5) is a good combiner for the number of spikes/plant, grain yield/plant and its susceptibility index under late sowing condition while parent pastor (P_4) could be considered as a good combiner for thermal unit under optimum sowing date and number of kernels/spike under late sowing and for grain filling period, grain filling rate and grain yield/plant under both optimum and late sowing dates. The best SCA values were detected by the cross P_3xP_5 for the earliness of maturity (number of days and thermal unit), grain filling period, grain filling rate, number of spikes/plant, susceptibility index of number of number kernels/spike, and grain yield/plant under optimum sowing date, also, cross P_1xP_4 was superior in number of spike/plant under both optimum and late, 100-kernel weight under optimum date and grain yield under late sowing. Moreover, cross P_2 x P_5 for grain yield/plant under optimum and late dates and its susceptibility, cross P_3 x P_4 for susceptibility index (SI) of No. of spikes/plant and for grain yield/plant under optimum and late dates cross P_2 x P_6 for grain yield under optimum sowing, cross P_3 x P_6 for days and thermal unit of heading and grain yield/plant and cross P4 x P5 gave the best SCA effects for grain yield/plant under late sowing condition.

Keywords: Wheat, Heterosis, Inbreeding depression, General and Specific Combining ability, Sowing date, Susceptibility index, Early maturing, Earliness characters.

INTRODUCTION

Wheat crop (Triticum aestivum L.) sown at different dates witnesses vast differences with respect to abiotic factors such as temperature, light and humidity. The genotypes interact differently to abiotic factors, especially temperature and light in according with their photothermal responses and several morphological and productivity traits are affected (Kumar et al 1995). Therefore, there is a need to develop cultivars capable of facing the vagaries of environment effectively. The progress of breeding efforts in this direction will depend on the amount of variability presents in the germplasm.

Heading time is affected by complex interactions of temperature and photoperiod (Masle et al 1989). The three components of heading time are vernalization requirement, photoperiod response, and intrinsic-earliness. These components may act individually or in combination to achieve different adaptation strategies according to Kato and Yokoyama (1992).

In Egypt therefore, late planting starting from January after harvesting vegetables grown for exporting has increased. developing early-maturing wheat are important for increasing cultivated area of wheat through planting in the areas designated for growing cotton in summer season. Early maturing cultivars are also preferable to escape disease, pests, drought, heat and other stress injuries that occur at the end of growing season. Breeding early-maturing cultivars is an important objective in most wheat breeding programs.

Information about the inheritance of early maturing and its attributes, as well as yield and its components are very scancy to wheat breeders in developing short duration cultivars.

Successful breeding programs need continous information about the genetic variation and systems governing earliness attributes, as well as grain yield and its components. Contradictory results were obtained by several authors with respect to genetic systems govering these characters. Reports are conflicting as to the effect of early-vs late heading genotypes on grain filling. Several researchers indicated that the final grain yield was more related to the rate of grain filling (Mou et al 1994). Meanwhile, Gebeyehou et al (1982) and reported that grain filling duration was more important than the grain filling rate. However, Menshawy (2005) reported that bread wheat genotypes differed significantly in both rate and duration of grain filling.

The timing of the initiation of vegetative and reproductive organs depends upon temperature and photoperiod, but the survival and subsequent size of such organs is dependent upon the supply of assimilates. The choice of sowing date is, therefore, vital to ensure both sufficient grain sites initiated and that sufficient assimilates will be available to initially support and subsequently fill these sites (Satorre and Slafer 1999).

Several genes have been reported to be involved in the control of heading time, including late heading. Heritability estimates of development of traits in spring wheat were intermediate to high (Mou and Kronstad 1994). Meanwhile, values of heritability in narrow sense were more than 50 % for days to heading, grain filling period and rate of grain filling (Abdel-Nour, Nadya 2006 and Menshawy 2007).

On the other side, Abdel-Nour, Nadya (2006) found that GCA and SCA were significant for days to heading , maturity and grain yield/plant.

Information about association of earliness and grain yield and its components can help breeders for increasing the selection efficiency. Tawfelis (2006) found significant variation in yield and its components among wheat genotypes under normal and late planting. He also reported that delaying sowing date reduced number of kernels spike^{-1}, kernel weight and grain yield.

The main objectives of this study were to: (1) evaluate the genetic variabilities of earliness and grain yield with its components characters for some early-maturing wheat genotypes under optimum and late sowing dates. (2) determine the relationships among earliness traits and each grain yield and susceptibility index of these genotypes. (3) detected the magnitude of genetic divergence between some early-maturing wheat genotypes under the two sowing dates based on earliness and grain yield as well as its components. (4) to determine which of the six studied cultivar(s) has (have) the general and /or specific combining abilities to produce good hybrid (s), early-maturing and/or tolerate late sowing stress. This information would help breeders to manipulate earliness components to develop high yielding and early maturing cultivars via selection for these characters in early generations, and also will help breeders in selecting these parental combinations which when crossed would result in the highest proportion desirable segregates, and identifying early cultivars. Therefore, the present investigation, early heading and maturing sources as well as high yielding ones, were crossed and tested under optimum and late sowing conditions.

MATERIALS AND METHODS

This study was conducted during the three successive seasons 2006/2007 to 2008/ 2009. six widely diverse bread wheat genotypes were used in this study. Three local cultivars Sakha61, Giza 168 and Sakha 95, promising early line #1 and two exotic cultivars introduced from ICARDA differing in earliness were selected for this study (Table 1).

Table 1. Name, pedigree and origin of the six bread wheat cultivars

No.	Parent	Pedigree	Relative earliness	Origin
1	Sakha 61	INIA/RL4220//7c//Yr"S" CM115430 – 2S – 5S – 0S	Early	Egypt
2	Early line	BCH"S"//HORK"S"/4/7C/pato(B)/3/LR64INIA//INIA/BB/5/CNO/GLL//BB/INIA/3/NAPO//TOB66/5PROW"S.	Very early	Egypt
3	Kam Chan		Intermediate	ICARDA
4	Pastor		Intermediate	ICARDA
5	Giza 168	MRL/Buc//SERI	Late	Egypt
6	Line #1	SKAUZ*Z/SIRMA	Early	Egypt

The study was carried out at El-Giza Research Station during two successive seasons, in 2006/2007 season, all possible crosses without reciprocals among the six parents were made. In the second season 2007/2008, the 21 entries (15 F_1's and 6 parents) were planted in the field, the hybrid seed of the crosses were sown to give the F_1 plants and at the same time all possible crosses among the six parents were made. The final experiment (the third season) was conducted at Sids Research Station, Beni Sweif Governorate, Agriculture Research Center, ARC in 2008/ 2009 season, the 6 parents, 15 F_1 hybrid seeds and 15 F_2 seeds) were planted in the field using the randomized complete block design (RCBD) with three replications. Each entry from parents and F_1 seeds were planted in a plot of two rows and the F_2 seeds were planted in a plot of six rows, each row was 3.0 m long and 20 cm apart, the plants within rows were 10 cm apart.

The genotypes were evaluated under optimum sowing date (OS) and late sowing one (LS). Planting of (OS) was in 20 Nov. and (LS) was in the 1st of Jan.

Data were recorded on a random sample of 10 guarded plants from each row. The studied characters were taken on earliness components i.e. number of days to heading, number of days to maturity, grain filling period (number of days from heading to maturity) and grain filling rate (the grain yield divided by grain filling period). In addition, number of days to heading and number of days to maturity also were expressed as thermal unit time (TTi). Thermal time was calculated as the accumulation if degree-days, (TTi) considering that temperature changed linearly during the day between maximum and minimum temperature following a triangular function:

$TT_i = [(T\ max\ i + T\ min\ i)/2] - T_b$

$T_b =$ O C

Where T max i. and T min i. are the maximum and minimum daily air temperature on the i^{th} day and T_b is the base temperature below which the rate of development is assumed to be zero (Gomez-Macpherson and Richard, 1997).

Table 2. Average of monthly temperature at Beni Swief governorate from heading to physiological maturing during 2008/2009 season.

Month	**Period**	**Average temperature**
November	21- 30	18.7
December	1- 10	19.3
	11 – 20	17.4
	21 – 31	15.1
January	1- 10	13.9
	11 – 20	15.9
	21 – 31	16.3
February	1- 10	17.3
	11 – 20	16.9
	21 – 31	15.0
March	1- 10	16.9
	11 – 20	17.0
	21 – 28	16.8
April	1- 10	21.2
	11 – 20	22.9
	21 – 30	22.5
May	1- 10	23.2
	11 – 20	26.2
	21 – 31	26.3

Average = (Maximum + Minimum) / 2

Measurements were recorded in optimum and late sowing dates for number of spikes/plant, number of kernels/spike, 100-kernel weight and grain yield/plant.

The susceptibility index (SI) was used as a measure of late planting tolerance in terms of minimization of the reduction in grain yield or yield components caused by unfavorable versus favorable environments. (SI) was calculated for each genotype according to the formula of Fisher and Maurer (1978).

$SI = (1-Y_{ls} / Y_{os}) / D$

Where :

SI = an index of late sowing susceptibility

Y_{Ls} = yield or yield components from late sowing experiment of a genotype

Y_{os} = yield or yield components from optimum sowing experiment of a genotype

D = late sowing intensity =

1- (mean Y_{ls} of all genotypes / mean Y_{os} of all genotypes).

Analysis of variance was performed for all studied characters in optimum and late sowing dates experiments as well as susceptibility index according to Steel and Torrie (1980). General and specific combining abilities were estimated according to Griffing as method 2 model 1 (1956).

The amount of heterosis (H%) was expressed as the percentage increase of F_1 above better parent values. Inbreeding depression (ID%) also was calculated as the difference between the F_1 and F_2 means expressed as percentage of the F_1 mean.

Heterosis (H%) over better parent value $= \frac{\bar{F}_1 - \overline{BP}}{B_P} \times 100$

Inbreeding depression (ID%) $= \frac{\bar{F}_1 - \bar{F}_2}{F_1} \times 100$.

Moreover name and pedigree of the six parental materials are presented in Table 1.

RESULTS AND DISCUSSION

Analysis of variance for all the studied characters in optimum and late sowing date experiments as well as thermal unit and susceptibly index is presented in Table 3. Results indicated that mean squares due to genotypes were significant for all the characters indicting a wide range of diversity for these characters. Mean squares due to both parents and crosses in F_1 and F_2 were significant for all characters in both optimum and late sowing as well as thermal unit and susceptibility index.

Mean performance for parents and their hybrids (F_1) are presented in Table 4.a also parents F_2 crosses are presented in table 4.b.

P_5 (Giza 168) expressed the highest mean value for the number of spikes/plant under both optimum and late sowing, also parent P_4 (Pastor) had the best mean value for grain yield/plant under both optimum and late sowing while for number of kernels/spike under late sowing and 100-kernel weight under optimum sowing. Meanwhile parent P_3 (Kan Chan) the most desirable values for kernel weight under late sowing.

Regarding hybrid mean performance, it is clear that the highest desirable values in optimum sowing experiment were recorded by cross combination P_1xP_4 for early heading (days and thermal unit), number of spikes/plant and kernel weight; P_2xP_4 for early maturing (days and thermal unit), grain filling period, grain filling rate and grain yield/plant and P_4xP_5 for number of kernels/spike. Under late sowing experiment, the best hybrid were P_1 x P_2 early maturing (days and thermal unit) and grain filling period; P_4xP_5 for grain filling rate;P_4xP_6 for number of kernels/spike; P_5xP_6 for number of spikes/plant; P_2xP_4 for kernel weight and P_2xP_5 for grain yield /plant. Such results indicated that these crosses combinations are promising and prospective in late sowing condition. The most desirable hybrids for susceptibility index were detected by crosses P_1xP_3 for number of spikes/plant; P_3 x P_5 for number of kernels/spike; P_2 x P_4 for 100-kernel weight and P_1 x P_5 for grain yield/plant.

From these results it could be concluded that the two crosses combinations P_2 x P_5 and P_3 x P_4 seemed to be the best among the studied hybrids since they expressed the most desirable values for most traits under optimum, late sowing and susceptibility index, respectively. In this connection, several investigators reported that there was a wide range of response to late sowing tolerance in wheat genotypes. Among those are Abdel-Nour, Nadya (2005), Abdel-Nour, Nadya (2006), Menshawy (2007), Abdel-Nour, and Abdel-Nour, Nadya and Zakaria (2010).

3a

3b

4a

4a cont

4b

4a cont

Heterosis

Heterosis expressed as the percentage deviation of F_1 mean values from better parent values for earliness components, and yield and its components is presented in Table (5). Significant negative heterotic effect relative to better parent values would be useful from the breeders point of view, in this respect early heading and maturity (days and thermal unit) for P_1 x P_4 under optimum sowing date and also P_1 x P_4 for early maturing under late sowing, early maturing (days and thermal unit) for crosses P_1 x P_2, P_1 x P_5 and P_3 x P_5 under optimum sowing date and cross P_4 x P_6 under late sowing date. Significant positive heterotic effect relative to better parents values would be of interest for unmber of spikes/plant for crosses P_1 x P_2, P_1 x P_4 and P_5 x P_6 under optimum and late sowing dates, for number of kernels /spike in the cross P_4 x P_5 under optimum sowing date while in these crosses P_3 x P_5, P_3 x P_6 and P_5 x P_6 under late sowing, for 100-kernel weight for crosses P_1 x P_5, P_1 x P_6, P_3 x P_5 and P_3 x P_6 under optimum sowing date and for grain yield/plant for the crosses P_1 x P_3, P_1 x P_6, P_2 x P_3, P_2x P_4, P_2 x P_5, P_3 x P_4, P_3 x P_5, P_3 x P_6, P_4 x P_5 and P_5 x P_6 under optimum sowin date, while P_1 x P_5, P_2 x P_5 and P_4 x P_5 under late sowing date. Also significant negative heterotic effect relative to better parent values would be of interest for most traits of susceptibility index under this investigation. Heterosis would be of economical value when the F_1 hybrid exceeds its better parents, thereat, if the breeder planned a programme of selection in the advanced segregating generations from such superior specific hybrids, the expected improvement would be fruitful.

Several studies have also demonstrated significant levels of heterosis in wheat (Abdel-Nour, Nadya 2005, Abdel-Nour, Nadya2006, and Abdel-Nour, Nadya and Zakaria 2010) . They stated that genetic diversity its important for heterotic expression. Therefore, the level of heterosis expressed in this study may reflect a high degree of genetic diversity among these parents.

Inbreeding depression

Significant inbreeding depression was found for maturity of thermal unit in the crosses P_2 x P_4 , P_2 x P_5 and P_3 x P_6 under late sowing date, for grain filling rate and grain yield/plant in most crosses under optimum and late sowing dates, for number of spikes/plant in the cross P_1 x P_3 under late sowing and for number of kernels/spike in the cross P_1 x P_6 and was found negative significant inbreeding depression in the cross P_3 x P_4 under late sowing date.

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Combining ability analysis

Analysis of variance for combining ability in optimum and late sowing dates experiments as well as thermal unit and susceptibility index is presented in Table (3). Mean squares associated with general (GCA) and Specific (SCA) were significant for all studied traits except GCA for heading of days and thermal unit, maturity of thermal unit, number of spikes/plant for Sus. Index., number of kernels/spike under optimum sowing and 100-kernel weight under both optimum and late sowing dates and SCA for number of kernels/spikes under optimum sowing and for 100-kernel weight under optimum and late sowing dates. High GCA/SCA ratios which largely exceeded the unity were detected for the most traits under study. Such results indicated that the additive and additive x additive types of gene action are responsible for the inheritance of these traits. The importance of additive genetic variance for wheat grain yield susceptibility index and its components as well as late sowing date tolerance was previously reported by Abdel-Nour, Nadya 2005 and 2006, Menshawy 2007, and Abdel-Nour, Nadya and Zakaria 2010.

Estimates of GCA effects $(\widehat{gi})$ for individual parents to each that traits in optimum and late sowing dates experiment as well as thermal unit and susceptibility index are presented in Table (7). Highly significant positive $(\widehat{gi})$ values would be of interest for all traits of yield and its components in optimum and late sowing dates conditions, whereas highly significant and negative $(\widehat{gi})$ values are preferred in early maturing (days and thermal unit) and susceptibility index. Under optimum sowing date condition, parent P_1 ranked the best for number of spikes/plant, while P_2 was the best general combiner for early maturing (days and thermal unit) and grain filling period. Parent P_4 expressed the highest significant $(\widehat{gi})$ effects for early maturing of thermal unit, grain filling period, grain filling rate and grain yield/plant. In late sowing experiment condition, parent P_1 was the best combiner for number of kernels/spikes, while P_2 was the best combiner for early maturing of days and thermal unit and grain filling period, whereas parent P_4 expressed the highest significant $(\widehat{gi})$ effects for early maturing, grain filling period, grain filing rate number of kernels/spike and grain yield/plant and parent P_5 the best combiner for number of spikes/plant and ranked the second best combiner for grain yield/plant .

For susceptibility index, parent P_1 ranked the second best combiner for number of kernels/spike, parents P_2 ranked the second best combiner for kernel weight, whereas parents P_4 was the best combiner for number of kernels/spike and parent P_6 was the best combiner for kernel weight, while parent P_5 was the good combiner for grain yield/plant.

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In conclusion, parental parent P_4 could be considered as good combiner for grain yield/plant and most of its components and early maturing under both optimum and late sowing, parent P_2 could be good combiner for early maturing under both optimum and late sowing and P_5 could be considered as a good combiner for grain yield and most of its components under late sowing condition.

Specific combining ability effects for all the studied traits in optimum and late sowing conditions as well as thermal unit and susceptibility index are presented in Table (8). In optimum sowing condition the most desirable Sij effects were detected by the cross combination P_1 x P_4 for early heading (days and thermal unit), number of spikes/plant and kernel weight, P_1 x P_5 for early heading and maturing (days and thermal unit), grain filling period, P_2 x P_4 for early heading (days and thermal unit), grain filling rate and number of spikes and grain yield/plant, P_3 x P_5 early maturing (days and thermal unit), grain filling period and grain filling rate P_2 x P_5, P_2 x P_6 and P_3 x P_4 for grain yield/plant and P_3 x P_6 for early heading (days and thermal unit) and grain yield/plant.

Under late sowing date condition cross P_1 x P_2 for early heading and maturing and grain filling period, P_4 x P_5 early heading and maturing and grain yield/plant, P_1 x P_4 for number of spikes/plant and grain yield/plant, P_2 x P_5 for grain yield/plant, P_3 x P_4 for grain yield/plant and P_5 x P_6 for number of spikes/plant and number of kernels/spike.

Regarding susceptibility index the most desirable SCA effects were obtained by the crosses P_1 x P_3 for number of spikes/plant, cross P_1xP_5 for grain yield/plant P_2x P_3 for number of kernels/spike, P_2 x P_4 for number of kernels/plant and 100-kernel weight, P_2 x P_5 for grain yield/plant, P_3 x P_4 for number of spikes/plant, P_3xP_5 for number of kernels/plant, P_4xP_6 for number of kernels/plant and grain yield/plant and P_5xP_6 for number of kernels/plant.

From the present results it could be concluded that the hybrids P_2 x P_5 and P_3 x P_4 seem to be the best among studied crosses as it expressed the most desirable Sij effects for most traits under optimum and late sowing dates and for susceptibility index, hybrid P_4 x P_5 the most desirable Sij effects for early heading and maturing (days and thermal unit) and grain yield/plant under late sowing condition crosses P_1 x P_5 and P_3 x P_5 under optimum sowing and cross P_4 x P_5 under late sowing are considered to be promising hybrids for earliness as they showed high specific combining ability effects and involved one good combiner for earliness and another good combiner for yield. It is worthy to note, that theses hybrids were a result of crossing poor x good and good x good general combiners. In such hybrids, desirable transgressive segregates would be expected in the subsequent generations, if the additive genetic system present in the good combiner and the complementary epistatic in the F_1 acted in the same direction to maximize the yielding ability.

The results are similar to these obtained by Abdel-Nour, Nadya (2006) and Abdel-Nour, Nadya and Zakria (2010). Therefore, it may be prospective in wheat breeding programs towards the development of new genotypes characterized by higher yield potentiality and tolerance to late sowing condition.

Wheat breeders could manipulate earliness components to a cultivar, via selection for these traits in early generation due to the additive gene action in their genetic control. These information also help breeders is selection parental combination that would result in the highest proportion of desirable segregates and identify early genotypes. These genotypes should be late planting tolerant and could be used in double cropping systems mainly, i.e. cotton-wheat system.

REFERENCES

1. Abdel-Nour, Nadya A. R. 2005. Genetic studies for yield and its components on drought and drought susceptibility index in wheat. Egypt. J. Agric. Res., 83 (4).
2. Abdel-Nour, Nadya A. R. 2006. Genetic studies on heading, maturity and yield and its components for late sowing condition in wheat (T. aestivum L.). Egypt J. Agric. Res., 84 (2).
3. Abdel-Nour, Nadya A. R and Manal A. Hassam. 2009. Determination of gene effects and variance in three bread wheat crosses for low water (drought). Egypt J. Plant Breed. 13: 235 –249.
4. Abdel-Nour, Nadya A. R and M. M. Zakaria. 2010. Genetic analysis for heat tolerance of grain yield in three bread wheat crosses under upper Egypt conditions. Egypt. J. Plant Breed.
5. Fischer, R. A. and R. Maurer. 1978. Drought resistance in spring wheat cultivars. I. Grain yield responses. Aust. J. Agric. Res. 29: 897 – 912.
6. Gebeyehou, G. D. R. Knott, and R. J. Baker. 1982. Rate and duration of grain filling in durum wheat cultivars. Crop. Sci. 22: 337 – 340.
7. Ghandorah, M. O. 1987. Vegetative period, grain filling rate and grain yield relationships in durum wheat. Alex. J. Agric. Res. 32 (1): 103 – 114.
8. Griffing, J. B.1956. Concept of general and specific combining ability in relation to diallel crossing systems. Australian J. Biol., Sci., 9: 463–493.
9. Gomez-Macpherson, H. and R. A. Richards. 1997. Effect of early sowing on development in wheat isolines differing in vernalization and photoperiod requirements. Field Crops Research 54: 91- 107.

10. Kato, K. and H. Yokoyama. 1992. Geographical variation in heading characters among wheat landraces Triticum L. and its implication for their adaptability. Theor. Appl. Genet. 84: 259 – 265.
11. Kumar, K., R. P. Singh and K. P. Singh. 1995. Pattern of genetic variability for morphological and productive traits in wheat genotypes having differential photo thermo response. Indian J. Genet. 55 (3): 330 – 337.
12. Masle, J, G. Doussinault and B. Sun. 1989. Response of wheat genotypes to temperature and photo period in natural condition. Crop. Sci., 29: 712 – 721.
13. Menshawy, A. M. M. 2005. Genetic analysis for earliness components in some wheat genotypes of different photo thermal response. Fourth Plant Breeding Conference (March 5). Egypt. J. Plant Breed. 8 (1): 31–37. Special Issue.
14. Menshawy, A. M. M. 2007. Evaluation of some early bread wheat genotypes under different sowing dates: 1- Earliness characters , 2- Agronomic characters . fifth Plant Breeding Conference (May 27 Giza). Egypt. J. Plant Breed. 11(1): 25– 55 .
15. Mou, B. and W. W. E. Kronstad. 1994. Duration and rate of grain filling in selected winter wheat population. Crop Sci. 34: 833 – 837.
16. Mou, B., W. E. Kronstad and N. N. Saulescu (1994). Grain filling parameters and protein content in selected winter wheat population: II. Association. Crop Sci. 34: 838–841.
17. Satorre E. H. and G. A Slafer. 1999. Wheat Ecology and physiology of yield determination. In effects of sowing date and the determination of optimum sowing date (eds. M. D. Denmett) Haworth Press, Inc. New York, PP. 123–133.
18. Steel, R. G. D. and J. H. Torrie. 1980. Principles and procedures of statistics. A biometrical approach. Second Ed. McGraw-Hill PP. 167- 173.
19. Tawfelis, M. B. 2006. Stability parameters of some bread wheat genotypes (Triticum aestivum) in new and old lands under Egypt conditions. Egypt. J. Plant Breed. 10 (1): 223–246.

دراسات وراثية على المحصول وصفات التبكير لقمح الخبز المختلفة في استجابتها للحرارة والضوء

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قسم بحوث القمح– معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة

يعتبر فهم التحليل الوراثي لمكونات التبكير وتأثرها بميعاد الزراعة أمراً ضرورياً لاستنباط سلالات قمح مبكرة النضج لزراعة القطن وكذلك لسلالات أخرى يمكن زراعتها في ميعاد متأخر (أول يناير) بعد حصاد الخضروات في الميعاد في شهر مايو .

أجريت جميع الهجن التبادلية بين ستة أصناف وسلالات من قمح الخبز متباينة في تبكيرها موسم 2007/2006 ، ثم زُرعت الهجن لإنتاج الجيل الأول F_1 في الموسم الثالث 2007/ 2008 م في محطة البحوث الزراعية بالجيزة . في الموسم الثالث 2008 / 2009 تم تقييم الآباء والحبوب الهجينية للجيل الأول F_1 وكذلك الحبوب الناتجة من نباتات F_1 في محطة البحوث الزراعية بسدس وذلك بزراعتها في ميعادين الأول (15 نوفمبر وأول يناير) .

تم حساب عدد الأيام حتى طرد السنابل وعدد الأيام حتى النضج الفسيولوجي وطول فترة امتلاء الحبوب وكذلك معدل امتلاء الحبوب ، عدد السنابل/ نبات ، عدد الحبوب / سنبلة ، وزن الحبوب و وزن محصول النبات. كما تم تقدير القدرة على التآلف طبقاً لمقترح *Griffing (1956)* الطريقة الثانية، ثم تم تقدير معامل الحساسية لتحمل الزراعة المتأخرة باستخدام معادلة *Fischer and Maurer (1978)*.

وكانت أهم النتائج هي:

١) كان التباين الراجع إلى القدرة العامة والخاصة على الائتلاف معنوياً في معظم الصفات تحت الدراسة مما يدل على أن الفعل الجيني المضيف له أهمية في وراثة هذه الصفات المدروسة .

٢) أظهرت النتائج أن هناك قوة هجين بالنسبة لأفضل الأبوين في معظم الصفات المطلوبة وبالنسبة لصفة وزن حبوب النبات وكذلك وجدت قوة هجين لأفضل أب لعشر هجن تحت ظروف الزراعة في الميعاد الأمثل وثلاثة هجن بالنسبة للزراعة المتأخرة .

٣) أما بالنسبة للنقص الناتج عن تأثير التربية الداخلية فكانت معنوية لمعظم الهجن لمعدل امتلاء الحبوب، و وزن الحبوب/نبات في الميعادين الأمثل والمتأخر .

٤) كان التباين الراجع إلى التراكيب الوراثية معنوياً لجميع الصفات تحت الدراسة في الميعادين وكذلك للوحدات الحرارية لمكونات التبكير ومعامل الحساسية للمحصول ومكوناته ، فقد كان P_2 هو الأفضل لعدد الأيام حتى النضج الفسيولوجي والوحدات الحرارية له وفترة امتلاء الحبوب بالنسبة لكل من الزراعة في الميعاد الأمثل والمتأخر P_4 هو الأفضل بالنسبة للنضج الفسيولوجي وفترة امتلاء الحبوب ومعدل امتلاء الحبوب ووزن محصول الحبوب /نبات تحت كل من الميعادين الأمثل والمتأخر P_5 أفضل أب لصفة وزن المحصول لحبوب/نبات لمعدل الحساسية.

٥) الهجين $P_3 \times P_5$ أعطى تأثيراً مرغوباً لصفة التبكير وعدد السنابل/نبات ومعامل الحساسية لعدد الحبوب / سنبلة ومحصول حبوب النبات تحت ظروف الزراعة في الميعاد الأمثل بينما كان للهجين $P_1 \times P_4$ تأثيراً مرغوباً لصفة عدد السنابل/ نبات لظروف الزراعة في الميعاد الأمثل والمتأخر ، ووزن مائة حبة لظروف الزراعة في الميعاد الأمثل ومحصول الحبوب/نبات تحت ظروف الزراعة المتأخرة . أما الهجين $P_2 \times P_5$ فأظهر تأثير مرغوب بالنسبة لصفة وزن حبوب النبات تحت ظروف كل من الزراعة في الميعاد الأمثل والمتأخر وكذلك معامل الحساسية للزراعة المتأخرة ، الهجين $P_3 \times P_4$ لمعامل الحساسية لصفة عدد السنابل/نبات ووزن الحبوب/نبات تحت ظروف الزراعة في الميعاد الأمثل والمتأخرة. الهجين $P_4 \times P_5$ أعطى أعلى قدرة خاصة على الائتلاف بالنسبة لصفة وزن حبوب النبات تحت ظروف الزراعة المتأخرة .

٦) ولقد كانت النسبة بين تباين القدرة العامة والقدرة الخاصة على التآلف تفوق الوحدة لمعظم الصفات ويشير ذلك إلى أهمية التأثير الوراثي المضيف والتفوق من النوع المضيف × المضيف في توارث الصفات تحت الدراسة .

٧) كما أوضحت النتائج أن التأثير الجيني المضيف هو المكون الأساسي للاختلافات الوراثية مما يشير إلى أن الانتخاب في الأجيال الانعزالية المبكرة قد يكون فاعلاً لاستنباط سلالات من القمح مبكرة النضج ذات محصول عالي .