ESTIMATION OF GENETIC PARAMETERS USING FIVE POPULATIONS OF SOME BREAD WHEAT CRESSES
Abo Elala, Sabah H.

ABSTRACT

Two experiments were carried out using two crosses namely Giza 168 x Gemmaiza 7 and Inria x Sids 1. Five populations (P1, P2, F1, F2 and F3) for each cross were used in this investigation.

Significant positive heterotic effects were obtained for number of spikes/plant and grain yield/plant in the first cross. On the other hand, significant negative heterotic effects were found for number of kernels/spike, number of spikes per plant and grain yield per plant in the second cross. Over dominance towards the higher parent for number of kernels/spike and grain yield per plant observed in the first cross. Inbreeding depression estimates were found to be significant for all studied attributes except for number of spikes/plant and grain yield/plant in the first cross. On the other side inbreeding depression were significant negative for kernel weight in the second cross. F2 deviation (E1) were significant for all studied characters for two crosses except for number of spikes/plant and grain yield/plant in the first cross. Moreover, F3 deviation (E2) were significant for all studied characters in two crosses except for grain yield/plant in the first cross.

The (additive - additive x dominance) gene effect was significant for all studied characters in two crosses. These results suggest the potential for obtaining further improvement in most studied characters. In addition, dominance and epistasis were found to be significant for most of the studied attributes.

High to medium values of heritability estimates were found to be associated with high and moderate expected and actual gain in most characters. This obtained results indicated that selection for the studied characters could be used in the early generations but may more effective if postponed to late one.

These study concluded that it may be take in consideration the first cross (Giza 168 x Gm. 9) to improve the breeding program in the national wheat research program.

INTRODUCTION

It is well known that the development of a wheat varietal improvement strategy should be based upon the genetic information of heritability and types of gene action controlling yield and other agronomic traits. It is also known that the diallel analysis is an attempt to partition phenotypic variation into genotypic and environmental components and to subdivide genotypic variation into additive and non-additive components. These estimates can be used to draw inferences about the genetic systems involved yield and its components and the best breeding strategy to be used to improve them. Furthermore, maximum progress in improving a character would be expected with a carefully designed pedigree selection program when the additive gene action is the main component, whereas the presence of high non-additive gene action would suggest the use of a hybrid program. In addition, the effectiveness of selection will be determined by calculating heritability value as a narrow sense. In this respect, the majority of reports on genetic behavior of yield and its components in wheat indicated that, the
additive components of genetic variance are being more important than those attributed to non-additive components (Abull-Naab et al 1991).

This study was conducted to study the gene effect, heritability and comparison between actual and expected genetic gain of two bread wheat crosses derived from five parental bread wheat genotypes using five populations of each cross.

**MATERIALS AND METHODS**

Two crosses were used in the present study derived from four wide diversified parental bread wheat cultivars. The names, pedigree and origin of the parental genotypes are given in Table (1). These genotypes were used to obtain the following two crosses, Giza 168 x Gemmeiza 7 and IrinexSid's 1.

The present study were carried out at El-Giza Agricultural Research Station during four successive seasons from 2001/2002 to 2004/2005. In the first season (2001/2002), the parental genotypes were crossed to obtain F1 seeds. In the second season (2002/2003), the hybrid seed of the two crosses were sown to give F1 plants. These plants were selfed to produce F2 seeds. Moreover, the same crosses were made to ensure fresh hybrid seeds. The new hybrid seed and part of obtained seeds from F1 plants (F2 seeds) were kept in refrigerator the final experiment. In the third season (2003/2004), two F1 seeds were sown to produce F1 plants, each of F1 plants were selfed to produce F2 seeds. In addition, F1 and F2 plants were selfed to produce F2 and F3 seeds respectively. In the fourth season (2004/2005) the obtained seeds for the five Populations F1, P2, F1, F2 and F3 of the two crosses were evaluated using a randomized complete block design with three replications. The experimental unit was two rows for each of parents and F1 progenies totaling 20 plants from each of them, 20 rows for F2 generation totaling 200 plants and five rows for F3 families totaling 50 plants. Each row was 2 m. long and 20 cm. apart between rows. The plants within row were 10 cm. space. The data were recorded on individual guarded plants for, number of spikes/plant, number of kernels/spike, 100-kernel weight (g) and grain yield/plant (g). Various biometrical parameters in this study may only be calculated if the F2 genetic variance was found to be significant. In this concern, F2 genetic variance was significant. Heterosis (%) was expressed as percentage increase in F1 performance above the better parent value. Potance ratio (F) was also calculated according to Peter and Frey (1966). Inbreeding depression (%) was estimated as the average percentage decrease of the F2 from F1. In addition, F2 deviation (E1) and F3 (E2) were measured as suggested by Mather and Jinks (1971).

The estimates of mean effect parameter (m), additive-additive x dominance (d*), dominance (h), dominance x dominance (e) and additive x additive (i) were obtained by five parameters model illustrated by Hayman model according to Singh and Chaudhary (1985).

Heritability was calculated in both broad and narrow sense according to Mather's procedure (1949) and parent-off spring regression according to Sekai (1960). Furthermore, the expected and actual genetic advance (Δg) was computed according to Johansen et al (1955). Likewise, the genetic gain
represented as percentage of the F2 and F3 mean performance (Δg%) was estimated using the method of Miller (1958). On the other hand, Hendawy (1958) reported that, non-additive components of genetic variance seemed to be more important inheritance of certain characters in wheat. Heritability was estimated for most traits by many investigators (Abul-Hassan et al. 1991; and Mosaad et al. 1980), but variant estimates have been reported.

Table (1): The name, pedigree and origin in for four parental bread wheat cultivars.

<table>
<thead>
<tr>
<th>Genotype (Name)</th>
<th>Pedigree</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giza 168</td>
<td>MRL/BUC/SERI, CM93946-9M-DY-OM-2Y-OZ.</td>
<td>EGYPT</td>
</tr>
<tr>
<td>Gymeza 7</td>
<td>CM74A, 830/SERI 82/AGENT, CM4611-2GM-3GM-1GM-0GM.</td>
<td>EGYPT</td>
</tr>
<tr>
<td>Irina</td>
<td>BUC/FLK/MYNA/VUL. CM91575</td>
<td>MEXICO</td>
</tr>
<tr>
<td>Sids 1</td>
<td>HD21/PAVON'S //1158.57/MAYA74'S</td>
<td>EGYPT</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

Varietal differences in response to their genetic background were found to be significant in most characters under investigation. The genetic variances within F2 populations were also found to be significant for all studied characters in the two crosses. Therefore, different biometrical parameters used in this investigation were estimated. Means and variances of five populations i.e., P1, P2, F1, F2 and F3 for the studied characters in the two crosses are presented in Table (2). Heterosis percentage over better parent, potence ratio (P), inbreeding depression percentage, E1, E2 and different gene action for the four studied characters are given in Table (3).

Table 2: Means (x) and variances (s^2) for the studied characters using the five populations (P1, P2, F1, F2 and bulk F3 families) for two bread wheat crosses.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Parameters</th>
<th>Giza 168 x Gymeza 7</th>
<th>Irina x Sids 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
<td>P2</td>
<td>F1</td>
</tr>
<tr>
<td>No of spikes/plant</td>
<td>X</td>
<td>21.54</td>
<td>19.75</td>
</tr>
<tr>
<td>No of kernels/spike</td>
<td>X</td>
<td>60</td>
<td>69.8</td>
</tr>
<tr>
<td>100-kernels weight (g)</td>
<td>X</td>
<td>4.46</td>
<td>5.04</td>
</tr>
<tr>
<td>Grain yield/plant (g)</td>
<td>X</td>
<td>55.35</td>
<td>52.9</td>
</tr>
</tbody>
</table>

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 combinations but these hybrids can be immense practical value if they involve the best cultivars of the area (Presad et al. 1988).
Significant positive heterotic effects were found for all studied characters except for number of spikes/plant in the first cross and for number of kernels/spike and grain yield/plant which showed significant negative one the second one. Similar results were reported El-Hosary et al. (2000), Moustafa (2002), Hendawy (2003), El-Sayed (2004), Abdel-Nour, Nadya et al. (2005), Abdel-Nour, Nadya (2006), Abdel-Nour, Nadya and Moshref (2006). Number of spikes/plant, number of kernels/spike and kernel weight are the main components of grain yield/plant, Hence, if it is found in increasing heterosis one or more of these attributes with others being constant would lead to favorable yield increase in hybrid. The lack of significance in heterosis of number of spikes/plant in the first cross could be due to the lower magnitude of the non-additive gene action. These results are in agreement with those of El-Rassas and Mitkees (1985). The pronounced heterotic effect for kernel weight in the first cross (giza 165 x Gemma 7) and second cross (liina x Sid 1) would be of interest in a breeding program for high yielding ability by selecting this character.

The Potence ratio (P) showed over-dominance towards the higher parent for all studied characters except for number of spikes/plant, and grain yield/plant which showed complete dominance towards the lower parent while number of kernels/spike showed complete dominance towards the higher parent. These results are in harmony with those obtained by Mosaed et al. (1990), Abul-Naas et al. (1991), Al-Kaddouss et al. (1994), Moustafa (2002), Hendawy (2003), Abdel-Nour, Nadya (2005) and Abdel-Nour, Nadya and Moshref (2006).

Significant values of inbreeding depression were detected for all studied characters except for number of kernels/spike in first cross and for grain yield/plant in the second one. However, significant negative inbreeding depression values was detected for 100-kernel weight in the second cross. This is a valid results, since the expression of heterosis in the F1 will be followed by considerable reduction in F2 performance. The obtained results for most cases were in harmony with that obtained by Khalifa et al. (1997).

Significant heterosis and insignificant inbreeding depression were obtained for grain yield/plant in the first cross. Moreover, significant positive heterosis and significant negative inbreeding depression for kernel weight in the second cross was detected. The condensation between heterosis and inbreeding depression estimates could be due to the presence of linkage between genes in these materials (Van der Veen, 1959).

Significant positive F2 deviation (E1) were indicated for kernel weight for two crosses. Meanwhile, significant negative values were obtained for number of spikes/plant, number of kernels/spike and grain yield/plant in the second cross, and for number of kernels/spike in the first one. These results may refer to the contribution of epistatic gene effects in the performance of these characters. On the other hand, insignificant F2 deviation (E1) was detected for number of spikes/plant and grain yield/plant in the first cross. This may indicate that the epistatic gene effects have minor contribution in the inheritance of these characters.
Significant positive F3 deviation (E2) was revealed for kernel weight in the two crosses. Moreover, significant negative values were detected for the rest studied the characters of the two crosses except for grain yield/plant in the first cross. These results would ascertain the presence of epistasis in such large magnitude as to warrant great deal of attention in breeding programs.

Nature of gene action was determined by using the five parameters analysis (Hayman's model) according to Singh and Chaudhary (1985) are presented in Table 3. The estimated mean effect parameter (m), which reflects the contribution of the over all mean plus the locus effect and interactions of the fixed loci, was found to be highly significant for all the studied characters. The additive gene effect (d*) was significantly positive for; number of spikes/plant and grain yield/plant in the two crosses, for the kernels/spike in the first cross; and for kernel weight in the second one. Meanwhile, the additive gene effect (d*) was significantly negative for the rest studied characters in two crosses. These results suggest the potential for obtaining further improvement for these characters by using pedigree selection program. Similar results were obtained by El-Hosary et al (2000), Moustafa (2002), Hendawy (2003), El-Sayed (2004), Abdel-Nour et al (2005) Abdel-Nour, Nadya (2006) and Abdel-Nour, Nadya and Mosthraf (2006).

Dominance gene effect (p) was significant positive for all studied characters of two crosses except for kernel weight which showed significant negative. Significance of these components indicated that, both additive and dominance gene effects are important in the inheritance of these characters. Therefore, selecting desired characters may be practiced in the early generations but may be more effective in late ones (Shehab El-Din 1993).

Dominance x dominance (e) type of gene action was significant for kernel weight and number of kernels per spike in the first one. On the other hand, additive x additive type of epistasis (i) was detected to be significant positive for all studied characters except for kernel weight which seemed negative significant in the first cross. The importance roles of both additive and non-additive gene action in most studied characters indicated that selection procedures based on the accumulation of additive gene effects may be very successful in improving these characters. Similar results were reported by Gouda et al (1993); Al-Kaddousi et al (1994), Hosary et al (2000), Moustafa (2002), Hendawy (2003), Abdel-Nour, Nadya (2006) and Abdel-Nour, Nadya and Mosthraf (2006).

Heritability in both broad and narrow senses, between generations (parent-offspring regression) are presented in Table (4). High heritability values in broad sense were detected for all studied characters.

High to moderate estimates of narrow sense heritability and parent-offspring regression was found for all studied characters in the two crosses. The differences in magnitude of both and narrow sense and parent-offspring regression, heritability estimates for all studied characters would be ascertained the presence of both additive and non-additive gene effects in the inheritance of these characters. This conclusion was also confirmed by estimates of gene action parameters.
Table 3: Heterosis, potency ratio, inbreeding depression and gene action parameters for the two bread wheat crosses.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Cross</th>
<th>Heterosis % over B.P</th>
<th>Potency Ratio (P)</th>
<th>Inbreeding depression %</th>
<th>Gene action parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of spikes/plant</td>
<td>I</td>
<td>6.65</td>
<td>2.575</td>
<td>7.1*</td>
<td>21.32** 0.995* 7.407** -8.293* 8.692** -0.478 -5.695**</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>-17.3**</td>
<td>-0.27</td>
<td>4.57*</td>
<td>19.65** 3.425** 9.567** -15.333** 17.342** -1.413** -9.525**</td>
</tr>
<tr>
<td>No. of kernels/spike</td>
<td>I</td>
<td>14.81**</td>
<td>1.323</td>
<td>0.283</td>
<td>67.95** 5.1** 10.24** 19.68** 27.19** -3.575** -14.73**</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>-2.86*</td>
<td>0.074</td>
<td>11.17**</td>
<td>68.8** -2.46** 30.127** -25.573** 24.972** -9.026** -35.415**</td>
</tr>
<tr>
<td>100-kernels weight (g)</td>
<td>I</td>
<td>5.95**</td>
<td>2.034</td>
<td>0.745*</td>
<td>5.3** -0.39** -1.013** 2.187** -2.164** 0.255** 1.229**</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>4.28**</td>
<td>2.086</td>
<td>-0.61**</td>
<td>6.013** 0.175** -0.366** -0.84** 0.381 0.576** 1.229**</td>
</tr>
</tbody>
</table>

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

Table 4: Heritability and expected versus actual gain for all studied characters in two crosses of bread wheat.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Cross</th>
<th>Heritability</th>
<th>Expected gain</th>
<th>Actual gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>broad sense</td>
<td>narrow sense</td>
<td>Parent off-</td>
</tr>
<tr>
<td>No. of spikes/plant</td>
<td>I</td>
<td>63.37</td>
<td>64.2</td>
<td>74.81</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>83.02</td>
<td>44.91</td>
<td>61.56</td>
</tr>
<tr>
<td>No. of kernels/spike</td>
<td>I</td>
<td>92.64</td>
<td>63.94</td>
<td>78.29</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>81.71</td>
<td>71.27</td>
<td>70.37</td>
</tr>
<tr>
<td>100-kernels weight (g)</td>
<td>I</td>
<td>80.01</td>
<td>01.55</td>
<td>83.60</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>80.69</td>
<td>75.11</td>
<td>82.35</td>
</tr>
<tr>
<td>Grain yield/plant (g)</td>
<td>I</td>
<td>94.5</td>
<td>76.14</td>
<td>85.07</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>92.31</td>
<td>71.64</td>
<td>82.07</td>
</tr>
</tbody>
</table>
Similar results were obtained by Gouda et al (1993), El-Sayed (2004) and Abdel-Nour-Nadia et al (2005). Also, Table (4) showed that the expected versus actual genetic gain for all studied characters. The expected genetic advance (Δg% of F2) and actual genetic advance (Δg% of F3) ranged from moderate to high for all studied characters in the two crosses except for kernel weight in two crosses. These results indicate that the possibility of practicing selection in early generation to enhance these characters and hence selecting high yielding genotypes. Dixit et al (1960) pointed out high genetic advance, but in order to make effective selection, high heritability should be associated with high genetic gain.

Generally, the most biometrical parameters resulted from the two crosses were higher in magnitude. Consequently, it could be concluded that the crosses (Giza 158 x Gemmeiza 7) would be of interest in a breeding program for bringing out the maximum genetic improvement.

REFERENCES


Abo Ela'a, Sabah H.


تقييم التوأمات الوراثية باستخدام العشائر الخمسة في بعض هجين من قمح الخبز

برنامج البوسقي لبحث الفحص - مركز البحوث الزراعية

تعرض هذه الورقة في مなかなか تداول الورقة أربع موانع مذكورة من 2001 حتى 2004 على هجين من قمح الخبز وجميع جزءين 18 X جزءين 2 و(البرينها X سمسم) وتمت ترتيب الورقة على كل من الألوان والأزواج الأولى الثانية والثالثة وحولت النتائج كما يلي:

1- كانت نتائج الورقة مهذبة عالية جدا بالنسبة للفحص عند الحبوب في الساعة ومحصول الزيت.

2- أظهرت دراسة طبقة الرغوة أن درجة البذور كانت عالية جدا بالنسبة في جميع الورقة وتمت ترتيب الورقة ان تأثير الحبوب الصغرى كان مهم جدا بالنسبة للحصول على الورقة في الورقة الأولى ومن ثم الورقة الثانية.

3- كانت النتائج السبئية للحبوب عالية جدا بالنسبة في جميع الورقة تحت الدراسة ومن ثم علاج الورقة في الورقة الأولى ومن ثم الورقة الثانية.

4- كانت نتائج الورقة عالية جدا بالنسبة للحبوب في الورقة الأولى ومن ثم الورقة الثانية.

5- تأثرت النتائج الدقيقة كأنها مهذبة جدا بالنسبة في كل الورقة الموردة ما عدا عند الحبوب الوعرة وقصة وحن الورقة للورقات الفردية للسمسم الأول والثاني، بينما أظهرت فيها سلامة وفعالية بالنسبة للصمغة وقصة وحن الورقة في الورقة الأولى.

6- كانت الورقات الجبل الثاني (E1) والورقات الجبل الثالث (E2) ومعنويات معظم الورقات في الورق.

7- أظهرت الورقات النموذجية جداً الورقات حسب ما ذكر سابقا ومعنويات الورقات كما أظهرت الورقات الزراعية في الورقة الأولى ومن ثم النموذجية. وتمت ترتيب الورقات بواسطة متوسطة بحثية توضح وصلات اثاثية بين واقع الورقات.

8- كانت قد تم تنظيم الورقات الممتازة على بيانات طفيلة مع المتخصصين في إنتاج الخبز وتم تحديد الورقات المناسبة. وتتم ترشيح الورقات من خلال الأعداد وتمت إعادة الورقات بعد ذلك.

9- أظهرت التأثيرات الزراعية المتساوية وكذلك أوائل الورقاتирования في ورقة الحبوب.

10- توصي الورقة بأنه الحبوب الأول (E1 X جزءين 2) في الورقة عند العمل برامج تربية في برنامج البوسقي لبحث الفحص.