J. Agric. Chem. and Biotechn., Mansoura Univ. Vol. 4 (1): 11 - 15, 2013

COMBINING ABILITY EFFECTS IN SILKWORM, *Bombyx mori* L. BY DIALLEL CROSS

Kosba, Z. A.[1]; Souad M. Mahmoud [2]and A. I. Abou Ahmed [2]
[1] Fac. of Agric. Mans. Univ.
[2] Seric. Res. Dept. Plant Protec. Res. Inst., Agric. Res. Cent.

ABSTRACT

A six half dialled cross analysis including four entries of the mulberry silkworm *Bombyx mori*, L. was carried out to study their combining ability. Non-additive gene action is important and plays a predominant role for all the traits under study. The values of (GCA) δ^2G/ (GCA) δ^2s indicates that non-additive gene action is important for all traits measured in this work.
Keywords : Combining ability - Silkworm.

INTRODUCTION

Combining ability analysis is the most widely used biometrical tool in determining promising parents and hybrids and detecting relative magnitude of genetic variability both by plant (Sood *et al*., 2000) as well as breeders (Eisen *et al*., 1983).

Combining ability analysis by dialled cross method gives the required parameters for explanation of genetic backgrounds and choosing the best parent for hybridization (Hoseiny and Gholamy, 2002) as it gives an indication of the genetic behaviour of the parental material. It is therefore, desirable to select the parent for hybridization on the basis of their combining ability (Satenahalli *et al*., 1989).

Measuring of general and specific combining ability of parental inbred lines in terms of additive and non-additive portion of genetic variance would be of immense value in the choice of breeds and effecting crosses for improvement (Nagaraja and Govindan, 1994).

These results are in line with the findings of Seidavi *et al*. (2005) who reported that in silkworm most of the economic characters including cocoon weight, cocoon shell weight and cocoon shell ratio, non-additive genes was found predominant rather than additive gene action.

So, this study was carried out to measure the general and specific combining ability of four entries of the mulberry silkworm *Bombyx mori*, L.

MATERIALS AND METHODS

Genetic material :

Four silkworm entries used in the study were obtained from the Sericulture Research Department of Plant Protection Research Institute-Agricultural Research Center with four different origins and coded :

P1: Chinese origin.
P2: Japanese origin.
P3: Turkish origin.
P4: Thai origin.

Larvae were provided *Morus alba* var Rosa mulberry leaves four times a day during the larval period. Also, larvae were provided suitable rearing conditions (27±2 ^{o}C) and relative humidity (85±5 %) during period of young larval instars.

Half dialled cross :

Half dialled cross was made between the four entries during spring 2007. The entries were reared at Mansoura Agriculture Faculty Laboratory. The rearing technology was as described by Krishnaswami (1978). Three replicates were reared in each, the egg laying female was considered as a replicate. Analysis of variance was done according to Stel and Torrie (1980). Data were analyzed according to the method of Griffing (1956).

Quantitative traits :

1-Weight of cocoon : on the seventh day from cocoon spinning fresh cocoon.

2-Weight of cocoon shell : the cocoon shell for each sex weighted individually.

3-Cocoon shell ratio : was calculated according to (Krishnaswami *et al*., 1978) as follow :

$$\text{Cocoon shell ratio} = \frac{\text{Weight of cocoon shell}}{\text{Weight of fresh cocoon}} \times 100$$

4-Weight of pupae : the cocoon after being sexed and weighted for each treatment, pupae of each sex were removed and weighted separately and the average weight was calculated.

RESULTS AND DISCUSSION

General and specific combining abilities :

Combining ability is the evaluation of inbred for use in crossing by testing the reflection of performance of inbreds in combination with others. It can defined as being general or specific. General combining ability is the average performance of a strain in many crosses, or the average (additive) effects. While specific combining ability is a particular performance in a single cross, or the effects of deviation from the average (epistatic and dominance) (Lea, 1996).

The analysis of variance of combining ability and estimates of variance component are presented in Table 1. It is observed that general and specific combining ability were highly significant for all the traits under study. These results indicated that variations obtained are due to additive, as well as, non-additive gene action. Therefore, it is essential to estimate the variance of G.C.A, S.C.A and their ratio. This clarified that the variance of δ^2s are always higher than that of the variance of δ^2 for all the traits values of (G.C.A) δ^2g / (S.C.A) δ^2s. This suggested that non-additive gene action is important and plays a predominant role for cocoon weight, cocoon shell weight, cocoon shell ratio and pupal weight.

Table 1 : Analysis of variance of combining ability and estimates of variance components of *Bombyx mori*, L. traits.

S.V.	D.F.	Cocoon weight		Cocoon shell weight		Cocoon shell ratio		Female weight	
		Female	Male	Female	Male	Female	Male	Female	Male
G.C.A	3	0.096	0.021	0.075	0.132	4.707	6.341	0.090	0.039
S.C.A	5	0.096	0.022	0.023	0.338	15.223	1.719	0.035	0.022
GCA variance $\delta^2 g$	--	0.000	0.121	0.011	0.010	0.001	0.010	0.000	0.002
SCA variance $\delta^2 g$	--	0.316	0.201	0.180	0.553	0.030	0.141	0.032	0.033
GCA $\delta^2 g$/SCA $\delta^2 s$	--	0.000	0.104	0.061	0.018	0.033	0.070	0.000	0.060
Error		0.016	0.020	0.048	0.002	4.716	3.658	0.025	0.034

These results are in accordance with the findings of Bhargava *et al*., (1992); Malik *et al*., (1994) and Eid *et al*., (2002), who reported that the non-additive gene action was found to be dominant in the control of single cocoon weight, shell weight, shell ratio and larval duration of *Bombyx mori*, L.

General combining ability (G.C.A) effect :

The estimate of general combining ability of different lines gave information how additive genetic effect interact in hybrid forms including the average direct and heterosis (Eisen *et al*., 1983).

Data obtained in Table 2 represents the effects of the general combining ability of each parent used in the study.

The obtained results appeared that, it is possible to separate combining ability of the four parents in two groups, parent with positive additive genetic effect estimates (P1 and P2) and with negative additive genetic effect estimates (P2 and P3). P1 gave highly positive significant increment for all the studied traits except male cocoon weight. P4 parent showed the same significant for cocoon shell ratio and pupal weight. It could be concluded that P1 parent was good combiner for cocoon weight, cocoon shell weight and pupal weight under study. However, P4 was good combiner for two traits i.e. cocoon shell ratio and pupal weight. Non of them was a good combiner for all traits under study.

These results agreed with Subba Rao and Sahani (1989); Singh *et al*., (1990); Rahman *et al*., (1992) and Eid *et al*., (2002), who found that no single parent was found as a good general combiner for all economic traits of *Bombyx mori*, L.

Specific combining ability (S.C.A) effect :

Table (3) represents the effects of specific combining ability estimated from F1 hybrid data. Positive significant (S.C.A) effects for cocoon weight were obtained for (P1xP2), P1xP3. Other hybrids showed poor combination. The best combinations for the cocoon shell weight and their (S.C.A) effects were (P1xP2) and P1xP3 for female and male. In respect of cocoon ratio, hybrid P1xP3 and female hybrid of P2xP3 exhibited positive significant effect, while in pupal weight trait, P1xP2, P1xP3 showed positive significant effect of (S.C.A).

From the obtained results, it was noted that P1xP2 hybrid is the best combiner hybrid which is a preferable combiner for cocoon weight, cocoon shell weight and pupal weight for both sexes.

Table 2 : Estimates of general combining ability effects of four entries of *Bombyx mori*, L. silkworm.

Traits / Entries	Cocoon weight		Cocoon shell weight		Cocoon shell ratio		Pupal weight	
	Female	Male	Female	Male	Female	Male	Female	Male
P1	0.0381	0.0304	0.0141	0.0303	0.0137	0.0216	0.0270	0.0234
P2	-0.0306	-0.0170	-0.0170	-0.0316	-0.0511	-0.0270	-0.0467	-0.0234
P3	0.0303	-0.0200	-0.0477	-0.0460	0.0167	0.0160	-0.0143	-0.0210
P4	0.0700	0.0322	0.0077	0.0336	0.0220	0.0306	0.1800	0.0270
L.S.D 0.05	0.0066	0.0098	0.0151	0.0307	0.0199	0.0148	0.0108	0.0128
L.S.D 0.01	0.0140	0.0138	0.0199	0.0411	0.0127	0.0185	0.0143	0.0169

Table 3 : Estimates for specific combining ability of six hybrids of *Bombyx mori*, L. silkworm.

Traits / Entries	Cocoon weight		Cocoon shell weight		Cocoon shell ratio		Pupal weight	
	Female	Male	Female	Male	Female	Male	Female	Male
P1 x P2	0.1140	0.0333	0.0360	0.0546	0.0030	0.0070	0.0187	0.0633
P1 x P3	0.1146	0.0600	0.0363	0.0570	0.1100	0.0570	-0.0200	0.0570
P1 x P4	0.0080	0.0670	-0.0623	0.0133	-0.0173	-0.0623	0.0166	0.0133
P2 x P3	-0.0373	-0.0433	0.0388	0.0153	0.0786	0.0338	0.0306	0.106
P2 x P4	0.0386	0.0090	0.0333	0.0153	0.0533	0.0333	-0.0033	-0.0300
P3 x P4	0.0400	-0.0533	0.0633	0.0100	0.0100	0.0633	0.0010	-0.0260
L.S.D 0.05	0.0866	0.0240	0.0151	0.0256	0.0482	0.0348	0.0108	0.0311
L.S.D 0.01	0.1140	0.0316	0.0191	0.0496	0.0636	0.0448	0.0143	0.0409

The results obtained herein agreed with Ghazy (2002), who found that only one cross was the best combiner hybrid preferable combiner for fresh cocoon weight and cocoon shell weight from 17 crosses under study.

In conclusion, it could be concluded that P1xP2 and P2xP3 have the highest SCA estimates for cocoon weight, cocoon shell weight, pupal weight and mature larval weight (for P1xP2 only) and this could promote them as good commercial hybrids

REFERENCES

Bhargava, S.K.; Thiagarajan, V.; Babu, M.R. and Nagaraj, B. (1992). Combining ability and genetic analysis of quantitative traits in silkworm *Bombyx mori*, L. J. Genetic and Breeding, 46(4), 327-330.

Eid, M.A.A.; El-Maasarawy, S.A.S.; Hosny, A. and Ghazy, U.M.M. (2002). Combining ability in silkworm *Bombyx mori*, L. X1Xth Congr. of the Inter. Seric. Commis. Bangkok-Thailand, 97-103.

Eisen, E.J.; Horstgen-Schivark, G.; Saxton, A.M. and Brandy, T.R. (1983). Genetic interpretation of diallel crosses with animals. Theor Appl. Genet., 65: 17-23.

Ghazy (2002). Combining ability from 17 crosses under study.

Griffing, B. (1956). Concepts of general and specific combining ability in relation to diallel crossing systems.

Hosseing Moghadam, S.H. and Gholamy, M.R. (2002). The combining ability effects and heterosis in the silkworm (*Bombyx mori*, L.) by diallel cross of eight inbred lines. X1Xth Congr. of the Inter. Seric. Commi. Bangkok-Thailand, 104-109.

Krishnaswami, S. (1978). New technology of silkworm rearing. Bull. No.2, Centr. Seric. Res. and Train. Inst., Mysore, India.

Lea, H.Z. (1996). Basic principles and practical techniques of silkworm breeding. Dept. of Biol., Kangwon Nat. Univ., Chun Chon, Korea.

Malik, G.N.; Kamili, A.S.; Trag, A.R. and Lone, A.H. (1994). Heterobiotic analysis for six quantitative traits in some silkworm *Bombyx mori*, L. genotypes. Entomon., 19(3-4): 105-108.

Nagaraja, M. and Govindan, R. (1994). Combining ability estimates in the silkworm, Samia Cynthia ricini, Boisd., for larval and cocoon traits. Sericologia, 34(3): 455-460.

Rahman, S.; Mahfuzar, K.; Haqie, T. and Ahmed, S.U. (1992). Heterosis in breeding depression and correlation coefficient in silkworm, *Bombyx mori*, L. (English summary), (Bangladesh J. 2001. 20(2): 269-278).

Satenahalli, S.B.; Govindan, R. and Goud, J.V. (1989). Combining ability in silkworm *Bombyx mori*, L. Mysore J. Agric. Sci., 23: 216-219.

Singh, R.; Nagaraju, J.; Rao, R.R.M.; Premalatha, V.; Vijayaraghavan, K. and Gupta, S.K. (1990). Heterosis analysis in the silkworm *Bombyx mori*, L. Sericologia, 30(3): 293-300.

Sood, V.K.; N.D. Rana and Gupta, V.P. (2000). Combining ability and gene action for seed yield and its components in soybean (Glycin maxl, Merrill). J. Genet., 60: 249-250.

Steel, R.C.D. and Torrie, J.H. (1980). Principles and Procedures of Statistics and Biometrical Approach 2nd Ed. Mc Graw Hill.

Subba Rao, G. and Sahai, V. (1989). Combining ability and heterosis studies in bivoltine strains of silkworm *Bombyx mori*, L. Uttar Pradesh J. 2001. 9(2): 150-164.

القدرة العامة على الإئتلاف الناتجة من التهجين نصف الدائري لديدان الحرير التوتية

زكريا عبد المنعم كسبه[1] ، سعاد مرسى محمود[2] و أحمد إبراهيم أبو أحمد[2]

[1] قسم الوراثة – كلية الزراعة – جامعة المنصورة – مصر.

[2] قسم الحرير – معهد بحوث وقاية النبات – مركز البحوث الزراعية.

أجريت هذه الدراسة بهدف تقدير القدرة العامة على الإئتلاف لعدد أربعة من سلالات ديدان الحرير التوتية ، وقد أجريت هذه الدراسة خلال الأعوام الثلاثة التالية : 2008 ، 2009 ، 2010. وقد أوضحت النتائج المتحصل عليها من تحليل وتقييم الهجن الناتجة من التزاوج نصف الدائري للسلالات الأربعة المستخدمة من ديدان الحرير التوتية أهمية تأثير الجينات غير المضيفة في القدرة العامة على الإئتلاف لهذه السلالات و في لعب الدور الأهم لكل الصفات المدروسة وكذلك تبين أنه لا يوجد هجين معين له أحسن القيم في تأثيرات القدرات الخاصة.

قام بتحكيم البحث

أ.د / خليفه عبد المقصود زايد	**كلية الزراعة – جامعة المنصورة**
أ.د / محمد عبد الباعث الصباحى	**كلية العلوم – جامعة الأسكندريه**