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Estimation of Hybrid Vigor of Some Egyptian Single Local Hybrids of Mulberry Silkworm, *Bombyx mori* L.

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Fifteen races resulted from silkworm breeding program at Sericulture Research Department (SRD) were used for hybridization. Fourteen hybrids were obtained and coded as; Giza C, D, R, S, T, U, A, V, W, P, H, L and Qanater 1, 2. The traits of cocoon weight, cocoon shell weight, pupal weight, cocoon shell ratio, silk productivity, fifth instar duration, total larval duration, number of cocoon per liter and pupation ratio were evaluated. Data were analyzed by using three formulae of heterosis over better, mid and check parent values. Hybrids of Giza V, C, N, Qanater 1 and 2 are promising and could be used in commercial cocoon production. Generally, there are some new hybrids can be exploited in commercial scale. Also, the local races can be evolved using the hybridization, inbreeding and selection program.

Key words: Heterosis, Hybrid vigour, *Bombyx mori*, Mulberry silkworm, Local hybrids.

Introduction

Silkworm breeding can be defined as the art and science of improving the genetic entity of silkworm in relation to their economic utilization (Anonymous, 1993).

Hybridization and selection considered as an important toot has been used by many breeders in the improvement of economic characters of silkworm *Bombyx mori* L. breeds. Breeders have many extensively studied the silkworm breeds for recognition of their economic importance for desirable traits though inbreeding. Many deleterious genes accumulated because of continuous inbreeding. This is leads to inbreeding depression, however many, resulted deterioration in some economic characters. Therefore, combination of beneficial traits could be achieved by adopting inbreeding and selection techniques. AS the silkworm breeder has at his disposal a diversified array of gene combination to manipulate and isolate new silkworm breeds having desirable qualities for commercial exploitation (Raju and Krishnamurty, 1993). The improvement of indigenous breed could be achieved through hybridizations utilizing exotic breeds. Harada (1956) reveled that new silkworm breed has been evolved through hybridization followed by selection. India has many indigenous breeds but, it suffers for new silkworm breeds in competing with china and Japan have commendable progress has been achieved in evolving robust and productive breed through hybridization (Yokoyama, 1956).

Present study carried out to estimate hybrid vigour in some local hybrids produced from hybridization of some races resulted from breeding program of Sericulture Research Department. And compare between the recommend hybrid and newest hybrids of some economic characters.

Materials and Methods

Sericulture Research Department (SRD) was carried out silkworm breeding program. It has some different races, which isolated from different imported hybrids. These races were adapted on Egyptian conditions since 2000 (Eid *et al.,* 2002, 2005; Ghazy, *et al.,* 2009). Fifteen races were used for hybridization named; K_{232}, R_{153}, V_{389}, X_{258}, W_{113}, N_{231}, A_{111}, D_{162}, F_{172} , J_{444}, Y_{468}, R_{218}, J_{234}, U_{484} and C_{221}. Fourteen hybrids were obtained and coded as; Giza C, D, R, S, T, U, A, V, W, P, H, L and Qanater 1, 2. Names and codes are illustrated in Table 1. These hybrids

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Table 1. The Names and codes of fourteen single hybrids

No.	Codes	Name
1	Giza C	K_{232} X R_{153}
2	Giza D	R_{153} X K_{232}
3	Giza R	V_{389} X X_{258}
4	Giza S	X_{258} X V_{389}
5	Giza T	W_{113} X N_{231}
6	Giza U	N_{231} X W_{113}
7	Qanater 1	A_{111} X D_{162}
8	Qanater 2	D_{162} X A_{111}
9	Giza A	F_{172} X D_{162}
10	Giza V	N_{231}X J_{444}
11	Giza W	X_{258}X J_{444}
12	Giza P	Y_{468}X R_{218}
13	Giza H	J_{234} X Y_{468}
14	Giza L	U_{484} X C_{221}

included the hybrid Giza A, which recommended by the SRD.

These hybrids were reared during spring season in sericulture research station in Qanter El –Khairaya. Mulberry variety of *Morus alba* var Kokoso 27 was used for feeding the silkworm. Four meals were offer to silkworm daily. Foam strips and polythene sheets were used during young instars (Ghazy, 2008). Silkworms were reared under the laboratory conditions. Each hybrid was representing by three replicates. Nine traits were observed. The traits were cocoon weight (CW), cocoon shell weight (CSW), pupal weight (PW), cocoon shell ratio (CSR), silk productivity (SP), fifth instar duration (FD), total larval duration (LD), number of cocoon per liter (C/L) and pupation ratio (PR). Data were analyzed by using three formulae of heterosis as follows:

1-The formulae of estimating herosis over better and mid parent values:

Heterosis was estimated by using the following formulae of (Rao *et al*., 2002):

1- *Heterosis over better parent value*(*BPV*)

$$=\frac{\overline{F}_1-BPV}{BPV}\times 100$$

2- *Heterosis over mid parent value*(*MPV*)

$$=\frac{\overline{F}_1-MPV}{MPV}\times 100$$

$Where: \overline{F}_1$:*Mean of hybrid*

BPV: The best value of the parents which involving in the hybridization.

MPV: The average value of the parents which involving in the hybridization.

2- The formula of heterosis over check parent value:

Heterosis was calculated according the formula of Singh *et al*., (2002b) as

$$Heterosis\ over\ CPV=\frac{\overline{F}_1-CPV}{CPV}\times 100$$

Where CPV: Check Parent Value

Results and Discussion

Table 2 reveals the average performances of some Egyptian races and their hybrids. Data in (Fig. 1) shows the heterosis of fourteen single local hybrids of weights of cocoon, pupa and shell, cocoon shell ratio and silk productivity. All hybrids acquired positive hybrid vigour over better parent value for traits of weights of cocoon, pupa and shell, and silk productivity, except hybrid of Giza L of silk productivity and cocoon shell weight traits. Hybrids of Qanater 1, 2, Giza A, V and W were the highest hybrid vigour values of the four previous characters. Five hybrids of Giza S, A, V, W Qanater 1and 2, were earned positive hybrid vigour of cocoon shell ratio trait.

(Fig. 2) shows heterosis over better parent value for pupation ratio, fifth instar duration, total larval duration and number of cocoon per liter characters. Negative heterosis is preferred for fifth instar duration, total larval duration and number of cocoon per liter traits, while the positive heterosis is better for pupation ratio trait. All hybrids under study show negative heterosis for total larval duration and number of cocoon per liter traits except the hybrid of Giza U for number of cocoon per liter character. Seven hybrids acquired hybrid vigour for fifth instar duration. Only three hybrids of Giza R, V and W earned positive heterosis for pupation ratio trait.

Hybrids of Qanater 1, 2, Giza A and S earned hybrid vigour over better parent value for traits of weights of cocoon, pupa and shell, cocoon shell ratio , silk productivity, fifth instar duration, total larval duration and number of cocoon per liter. They acquired negative hybrid vigour for pupation ratio trait. While, Giza V and W hybrids have best hybrid vigour for all traits except no hybrid vigour for fifth instar duration. Hybrid vigour is varying in direction and value, also for different combinations. Similar result is obtained by Ghazy and Fouda (2006) and Singh *et al*., (2002a) studied heterosis in different hybrid combinations for many characters of *Bombyx mori* L. The results explain that the degree and

Table 2. Performance of some Egyptian mulberry silkworm races and hybrids

	CW	CSW	PW	CSR	Fd	SP	LD	C/L	PR
K232	0.913	0.209	0.738	22.908	8.000	2.607	33.000	210.000	98.182
R153	0.915	0.203	0.753	22.364	8.000	2.542	33.000	184.000	99.091
V389	0.914	0.193	0.711	21.373	9.000	2.148	34.000	162.667	94.000
X258	0.840	0.162	0.683	19.258	9.000	1.800	34.000	170.667	86.250
W113	1.006	0.227	0.780	22.908	8.000	2.841	33.000	159.000	97.500
N231	0.840	0.156	0.677	18.733	9.000	1.737	34.000	174.667	94.000
D162	0.870	0.166	0.713	19.207	9.000	1.849	34.000	196.000	86.667
A111	0.802	0.149	0.633	18.773	9.000	1.660	34.000	225.333	97.000
F172	0.804	0.136	0.653	16.986	9.000	1.516	34.000	222.667	93.333
J444	0.740	0.156	0.596	21.071	8.000	1.944	33.000	216.000	92.857
Y468	0.757	0.175	0.644	23.028	9.000	1.949	34.000	244.000	94.444
R218	0.969	0.216	0.774	22.377	8.000	2.698	33.000	184.000	99.091
J234	0.805	0.169	0.642	20.829	9.000	1.882	34.000	204.000	98.889
U484	1.044	0.322	0.885	31.129	9.000	3.582	34.000	184.000	94.000
C221	0.795	0.150	0.658	19.006	9.000	1.663	34.000	220.000	83.333
Giza C	1.334	0.287	1.071	21.706	8.000	3.581	29.000	128.143	95.714
Giza D	1.165	0.230	0.934	19.888	8.000	2.878	29.000	144.200	95.000
Giza R	1.238	0.260	0.961	21.256	8.000	3.248	29.000	136.143	98.000
Giza S	1.139	0.264	0.902	23.622	8.000	3.294	29.000	144.800	94.000
Giza T	1.149	0.239	0.897	21.005	8.000	2.989	29.000	150.000	94.000
Giza U	1.117	0.250	0.897	22.496	8.000	3.121	29.000	159.200	89.091
Qanater 1	1.401	0.280	1.128	20.996	8.000	3.505	29.000	120.333	96.000
Qanater 2	1.463	0.352	1.156	24.294	8.000	4.396	29.000	119.200	85.000
GizaV	1.375	0.300	1.087	21.980	8.000	3.752	29.000	113.400	99.000
GizaW	1.337	0.272	1.056	20.446	8.000	3.395	29.000	129.000	98.000
Giza P	1.271	0.280	1.003	22.306	8.000	3.501	29.000	133.600	89.000
Giza H	1.229	0.248	0.963	20.359	8.000	3.105	29.000	148.600	95.000
Giza L	1.262	0.277	0.981	22.154	8.000	3.462	29.000	125.600	90.833
Giza A	1.285	0.277	1.020	21.758	8.000	3.465	29.000	129.750	89.333

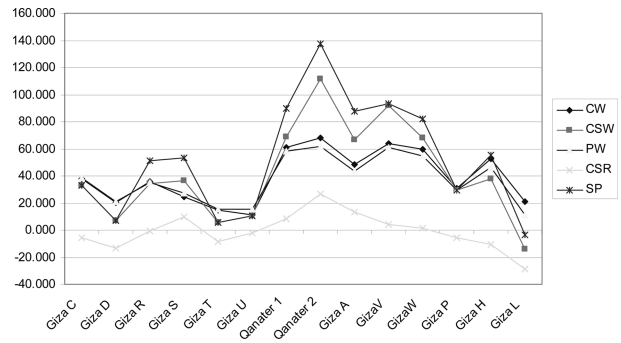

Fig. 1. Heterosis values of weights of cocoon (CW), pupa (PW) and shell (CSW), cocoon shell ratio (CSR) and silk productivity (SP) traits over better parent value.

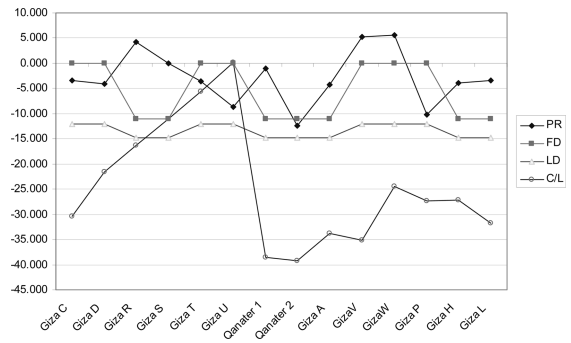

Fig. 2. Heterosis values of pupation ratio (PR), fifth instar duration (FD), total larval duration (LD) and number of cocoon per liter (C/L) traits over better parent value.

direction of heterosis varied for different characters and for different hybrid combinations.

Heterosis over mid parent value

Data in (Fig. 3) presents heterosis of weights of cocoon,

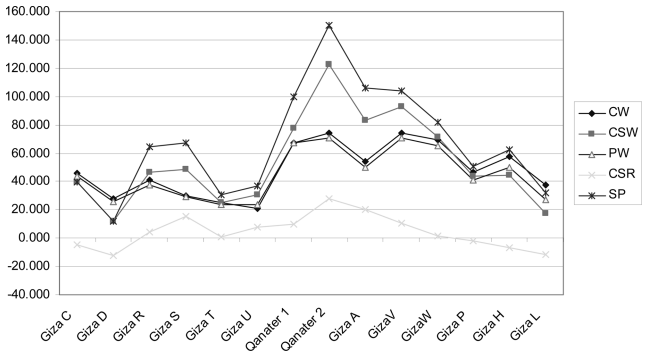

Fig. 3. Heterosis values of weights of cocoon (CW), pupa (PW) and shell (CSW), cocoon shell ratio (CSR) and silk productivity (SP) traits over mid parent value.

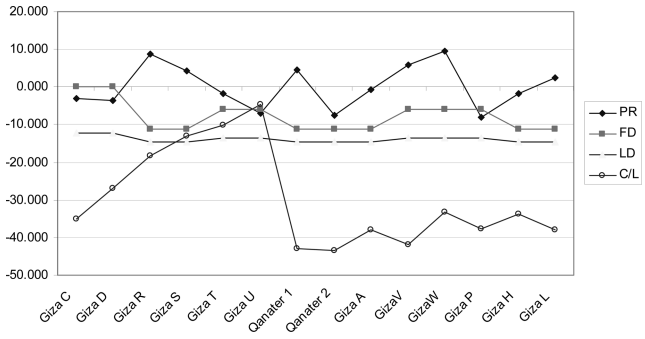

Fig. 4. Heterosis values of pupation ratio (PR), fifth instar duration (FD), total larval duration (LD) and number of cocoon per liter (C/L) traits over mid parent value.

pupa and shell, cocoon shell ratio and silk productivity over mid parent value. Positive heterosis was observed for all pervious characters for all hybrids except cocoon shell ratio. Nine hybrids of Giza R, S, T, U, A, V, W, Qanater 1 and 2 earned positive value for all characters.

Data of pupation ratio, fifth instar duration, total larval duration and number of cocoon per liter characters present in (Fig. 4). All hybrids have hybrid vigour for total larval duration and number of cocoon per liter characters. Hybrids of Giza C and D showed no hybrid vigour of fifth instar duration traits, while others hybrids acquired best hybrid vigour for the same character. Only six hybrids have hybrid vigour for pupation ratio trait.

Hybrid vigour was observed for hybrids of Giza R, S, V, W, L and Qanter 1 for all pervious four characters.

Hybrids of Giza R, S, V, W, L and Qnater 1 acquired best hybrid vigour for weights of cocoon, pupa and shell, cocoon shell ratio, silk productivity**,** pupation ratio, fifth instar duration, total larval duration and number of cocoon per liter traits. There are some promising hybrids can used for commercial scale and for evolving parents. The results are in agreement with the findings of Ghazy and Fouda

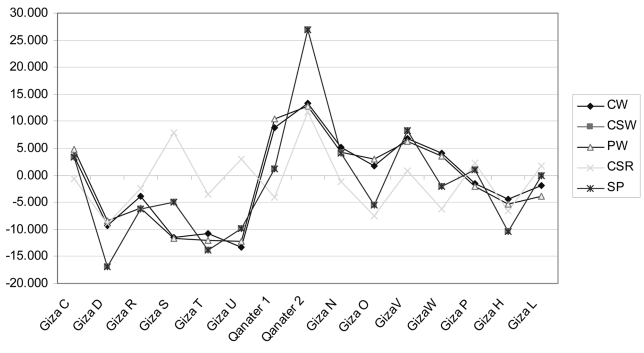

Fig. 5. Heterosis values of weights of cocoon (CW), pupa (PW) and shell (CSW), cocoon shell ratio (CSR) and silk productivity (SP) traits over check parent value.

(2006) and Rao *et al.,* (2002) who estimate the hybrid vigour effects over mid parent value of different hybrid combinations of silkworm *Bombyx mori* L for several quantitative characters. The results indicated that some hybrids manifesting positive hybrid vigour for quantitative characters. These hybrids can be used to increase silk production and to select suitable parents for breeding.

Heterosis over check parent value

Heterosis value over check parent for traits of weights of cocoon, pupa and shell, cocoon shell ratio and silk productivity is found in (Fig. 5). Hybrid of Giza A is recommended by Sericulture Research Department considered as check parent. Positive hybrid vigour were obtained for hybrid of Giza C, N, O, V, W, Qanater1 and 2 for both cocoon and pupal weight traits. Six different hybrids were earned positive hybrid vigour over check parent value for characters of cocoon shell weight, cocoon shell ratio and silk productivity.

Hybrids of Qnatar 2 and Giza V showed positive hybrid vigour over check parent value for all the pervious characters. While hybrids of Giza C, N, and Qnatar 1 acquired positive heterosis for all characters except cocoon shell ratio.

Heterosis of thirteen single local hybrids for traits of pupation ratio, fifth instar duration, total larval duration and number of cocoon per liter were found in (Fig. 6). Both fifth instar and total larval duration have no hybrid vigour over check parent value for all hybrids under study.

Pupation ratio exhibit positive hybrid vigour for all hybrids except hybrid of Giza U, P and Qanater 2. Hybrids of Giza C, N, V, W, L Qanater 1 and 2 acquired hybrid vigour for number of cocoon per liter.

Hybrid of Giza V was best hybrid vigour for weights of cocoon, pupa and shell, cocoon shell ratio, silk productivity, pupation ratio and number of cocoon per liter. And

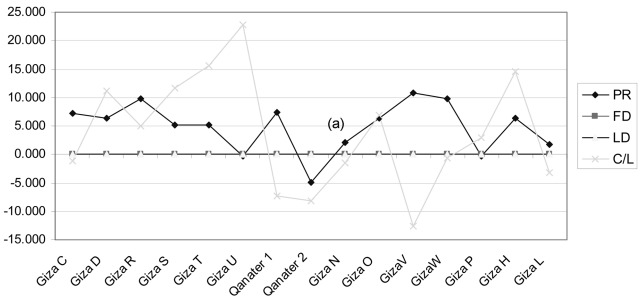

Fig. 6. Heterosis values of pupation ratio (PR), fifth instar duration (FD), total larval duration (LD) and number of cocoon per liter (C/L) traits over check parent value.

exhibited no hybrid vigour for fifth instar duration, total larval duration. While, hybrids of Giza C, N, Qanater 1 and 2 have hybrid vigour for six characters together. There is some promising hybrid can be exploitation in commercial scale. These results are coincidence with the result of Ghazy (2007) and Rajalakshmi *et al*., (1998) who studied heterosis on rearing and cocoon characters of some hybrids of silkworm, *Bombyx mori* L. Data revealed that some hybrids were highly promising over the existing checks hybrid.

References

Anonymous (1993) Principles and techniques of silkworm breeding. United Nations 1.

Eid MAA, El-Maasrawy SAS, Hosny A, Ghazy UMM (2002). Combining ability in Silkworm *Bombyx mori* L. XIXth Congress of the international Sericultural Commission 97-103.

Eid MAA, El-Maasrawy SAS, Hosny A, Ghazy UMM (2005). Combining ability estimates in the silkworm, *Bombyx mori* for larval and cocoon traits. Sericologia 45(2), 127-132.

Ghazy UMM (2008) Rearing first three instars of mulberry silkworm *Bombyx mori* L. under polythene cover.Bull. Ent.Soc. Egypt 85, 271-279.

Ghazy UMM (2007) Manifestation of Hybrid Vigour in Different Crosses of the Silkworm, *Bombyx mori* L. (Proc. 2nd Inter. Conf. Ent. Soc. Egypt vol(1), 175-183.

Ghazy UMM, Fouda MM (2006) Evaluation of four local simple hybrids of silkworm *Bobmyx mori* L. Bull Ent Soc Egypt 83, 191-199.

Ghazy UMM, Saad IAI , Fouad TA (2009). Comparison between some local and imported bulgarian hybrids of silkworm *Bombyx mori* L. Bull Ent Soc Egypt 86, 101-107.

Harada C (1956) On the relation between commercial characters and their F1 hybrids in *Bombyx mori*. Proc. Int. Genet. Symp 252-356.

Rajalakshmi E, Chauhan TPS, Kamble CK (1998) Hybrid vigour among newly evolved bivoltine hybrids of silkworm *Bombyx mori* under Hill conditions. Indian J Agric Sci 68(9), 620-624.

Raju PJ, Krishnamurthy NB (1993) Breeding of two bivoltines, MG 511 and MG 512, of silkworm *Bombyx mori* L. for higher viability and silk productivity. Sericologia 33, 577-587.

Rao PS, Rekha M, Nishitha NV, Pallavi SN, Mahalingappa KC (2002) Hybrid vigour in polyvoltine X bivoltine (sex-limited cocoon colour) hybrid of silkworm *Bombyx mori* L. Int J Indust Entomol 4(1), 37-41.

Singh R, Rao DR, Kariappa BK, Sanyal P, Premalatha V (2002a) Studies on parthenogenetic development, hybrid vigour and cocoon shape variability in bivoltine F1 hybrids of silkworm, *Bombyx mori L.* Int J Indust Entomol 5(1), 59-65.

Singh T, Saratchandra B, Murthy GN (2002b) An analysis of heterosis in the silkworm, *Bombyx mori* L. Int J Indust Entomol 5 (1), 23-32.

Yokoyama T (1956): On the application of heterosis in Japanese sericulture. Proc Int Genet Symp 527-531.