

EFFECT OF DIFFERENT METHODS OF ARTIFICIAL HATCHING ON THE SILKWORM, *Bombyx mori* L. PRODUCTIVITY.

Eid, M. A. A.¹; S. A. S. El-Maasarawy¹; Souad M. Abd El-Naby² and Tahia A. Fouad²

1- Faculty of Agric., Cairo Univers. Econom. Entom. Depart

2- Seric. Res. Dept., Plant Prot. Inst., Agric. Res. Cent.

ABSTRACT

Three artificial hatching methods ; hydrochloric acid under room temperature, hot hydrochloric acid and hot water were used to terminate the diapause of diapausing eggs of three silkworm races of *B. mori* L. for late Autumn rearing season. Egg performance as post treatment period, one day hatching rate, practical hatching rate, general hatching rate, rate of bluish eggs , rate of non bluish eggs and rate of dead eggs were recorded .

Also, the economical characters as weight of mature larvae, total larval duration, larval mortality percentage, cocoon, cocoon shell and pupal weights, cocoon shell ratio, cocooning and pupation percentages were also registered . Results show that hot acid treatment was inferior than the other two methods for most of the parameters under study .

INTRODUCTION

In order to increase silk production in the temperate zones, the mulberry silkworm , *Bombyx mori* L., must be reared for two or three rearings around the year . (Krishnaswami *et al.* , 1973)

The artificial hatching of silkworm *B. mori* L., eggs is an important tool for providing silkworm larvae at any time in any rearing season. Various methods have been applied to terminate the diapause of the silkworm eggs including the physical methods of activation such as artificial hibernation , the treatment with hot water (Rahman and Ahmed 1989) , the stimulation by friction , the stimulation by high temperature, the stimulation by low temperature the stimulation by high atmospheric pressure, exposure to sunshine and electric induction . Also, the chemical methods of activation such as the treatment with hydrochloric acid , nitric acid , sulphuric acid , aqua regia treatment and sodium chloride solution . (Tanaka , 1964 ; Wang , 1989 and Aruga , 1994)

In the present study , an attempt has been made to evaluate three methods of artificial hatching for rearing late Autumn season which in turn increase Egypt silk production by increasing rearing seasons around the year

MATERIALS AND METHODS

Evaluation of three methods of artificial hatching have been applied to terminate the diapause of *Bombyx mori* L. eggs . After emergence of moths,

the females and males were allowed to mate for 3.5 – 4 hours according to (Tanaka , 1964 ; Tayade *et al.* , 1988), the eggs were preserved at 24 C° and 75 – 80 % relative humidity till the age of eggs reached to 20 hours .

Three artificial hatching methods were applied by using hydrochloric acid treatment under room temperature (T₁) according to (Manjula and Hurkadli ,1986 and Hosny , 1994) , hot acid treatment (T₂) according to (Krishnaswami *et al.*, 1973 ; Wang , 1989) and hot water treatment (T₃) adopted by (Wang , 1989) . The age of eggs , specific gravity and concentration of acid, the duration of treatment, temperature of liquid, storing period at 5 C° after treatment were given in Table 1 .

Duration of treatment depend on the origin of the silkworm race where the Japanese races were immersed to 80, 6 and 0.083 minutes when using hydrochloric acid treatment under room temperature, hot acid and hot water treatment, respectively , while Chinese race was dipped for to 80, 5 and 0.067 minutes for the same above treatments respectively . After treatment , egg – cards were incubated at 24 C° and 80 – 90 % relative humidity until hatching .

Table.1.Procedures of different treatments of artificial hatching :

	Age of eggs (in hrs)	Specific gravity	Concentration (%)	Temperature of liquid (C°)	Duration of treatment (in mins)	Storing period at 5 C° (in days)
T ₁	20	1.110	22	24	80	20
T ₂	20	1.075	15	46	5-6	-
T ₃	20	-	-	48	0.067-0.083	-

Three races of mulberry silkworm, *B. mori* L. were used J2MJ, J2PJ (Japanese univoltine races) and Dch a Chinese univoltine race were obtained from Sericulture Research Department Giza , Egypt. After artificial hatching treatments, the silkworm were reared during an addition rearing season at late Autumn which started at 20 October during the years of 2003 and 2004. Mulberry leaves of *Morus alba* Var. Kukoso – 27 were used for feeding the larvae. The average of relative humidity were 66.5 ± 9 % and 65.7 ± 8 % during 2003 , 2004 while the average of temperature were 23.1 ± 2 C° and 25.5 ± 2 C°, respectively inside the rearing room .

Data were recorded for different parameters as post treatment period , one day hatching rate (Percentage of hatched larvae on the first day) , practical hatching rate, (Percentage of hatched larvae during two days of hatching) , general hatching rate (Percentage of hatched larvae during seven days) , rate of bluish eggs (8th – 9th day) , rate of non bluish eggs and rate of dead eggs according to Yang *et al.*, (1997) . Weight of mature larvae (20 larvae) , total larval duration , larval mortality percentage. Cocoon weight , cocoon shell weight , pupa weight, cocoon shell ratio (30 females and 30 males) for each , cocooning percentage and pupation ratio.

Statistical analysis were adopted according to Senedecor and Cochran (1967) .

RESULTS AND DISCUSSION

1-Evaluation of three methods of artificial hatching :

The effect of three methods of artificial hatching on the egg performance and economical parameters of *B. mori* L. silkworm are illustrated in Tables 2 and 3.

A-Egg performance :

The results in Table 2 indicate that the post treatment periods differ significantly between the three artificial hatching methods (10.57 , 8.67 and 9.67 days) for T_1 , T_2 and T_3 , respectively . These results are confirmed with the findings of Manjula and Hurkadli (1996) who found that the duration of hatching were 9 to 10 days for bivoltine silkworm eggs treated with acid treatment .

Table(2): Evaluation of three artificial hatching methods of mulberry silkworm *Bombyx mori* L. on egg performance .

<i>Ch</i> \ <i>T</i>	T_1	T_2	T_3	<i>F</i>	<i>LSD</i>
Post treatment period (%)	10.57	8.67	9.67	162.600*	0.210
One day hatching rate (%)	12.59	15.10	13.82	0.482	-
Practical hatching rate (%)	32.46	51.96	36.37	17.374*	6.992
General hatching rate (%)	86.78	93.97	81.14	24.648*	3.659
Rate of bluish eggs (%)	91.01	97.50	89.76	22.440**	2.479
Rate of non bluish eggs (%)	2.39	0.16	1.85	14.001**	0.880
Rate of dead eggs (%)	6.56	2.33	8.32	14.080*	2.320

* significant at 5% , ** high significant at 0.05

Hot acid treatment (T_2) is the best treatment for one day hatching-rate, practical hatching rate, general hatching rate, rate of bluish eggs wherever hatching (%) were 93.97 % compared to 86.78 % for T_1 and 81.14 % for T_3 . The observed hatching (%) is in accordance with those reported by (HurKadli and Manjula 1991 and 1992) for acid treatment and Singh *et al.*, 1990 for hot water treatment . Rate of dead eggs was lowest 2.33 % for T_2 than that of the T_1 and T_3 . The obtained results show that hot acid treatment (T_2) was superior than the other two treatments for egg performance . On the other hand Yang *et al.* , 1997 reported that the post treatment periods did not differ for Chinese and Japanese races when the 20 hrs eggs were treated with corona discharge and acid treatment . Also, Singh *et al.* , 1990 found that, the rearing performance of hot water and acid treated eggs of the bivoltine strains did not show any differences .

B-Economic parameters :

The data obtained in Table 3 clarify that hot acid treatment (T_2) is the best treatment for most of all parameters under study. There are high significant differences between the three artificial hatching treatments for weight of mature larvae , total larval duration , cocoon weight , cocoon shell

weight , pupal weight , cocoon shell ratio and cocooning percentage except for pupation ratio (92.56 %) . These are in agreement with the findings of Manjula and Hurkadli , 1986 , 1990 ; Singh *et al* ., 1990 ; Hurkadli and manjula , 1992 ; Singh *et al* ., 1993 ; Saheb *et al* ., 1996 and Yang *et al* ., 1997. they found that hot acid treatment is better than hydrochloric acid treatment under room temperature, hot water treatment and stimulation by corona discharge.

Table(3): Evaluation of three artificial hatching methods of mulberry silkworm *Bombyx mori* L. on means of some economic parameters.

Ch \ T	T1	T2	T3	F	LSD
Weight of mature larvae (mg)	2633.16	2854.65	2767.81	64.703**	38.61
Total larvae duration (day)	37.39	36.77	37.56	92.824*	0.123
Larval mortality (%)	20.55	22.70	26.37	4.987*	3.796
Cocoon weight (g)	0.97	1.07	1.04	86.229*	0.015
Cocoon shell weight(g)	0.188	0.201	0.193	16.911	0.005
Pupa weight (g)	0.779	0.855	0.812	75.879*	0.0122
Cocoon shell ratio (%)	19.44	19.04	18.87	5.360	0.349
Cocooning percentage (%)	79.76	86.06	74.74	20.778*	3.586
Pupation ratio (%)	90.83	92.56	90.10	1.901	-

* significant at 5% , ** high significant at 0.05

2-Evaluation of three silkworm , *Bombyx mori* L. races :

The data recorded in Tables 4 and 5 represent the mean values of egg performance and economic parameters of three races of *B. mori* L. silkworm treated with three different artificial hatching methods.

A-Egg performance :

The obtained data in Table 4 show high significant differences among the hatching performance of the three races. The post treatment periods differ significantly between the three races under study (9.97, 9.67, 9.27 days) for R_1 , R_2 and R_3 , respectively .

The Chinese race (R_3) is the best race for most of all parameters under study wherever , the practical hatching rate (44.40 %) , general hatching rate (90.97 %) and rate of bluish eggs (94.68 %) were highest. Also rate of dead eggs were lowest (3.76 %) for Chinese race . Similar results were obtained by Singh *et al* ., 1990 as they found that the Chinese strains obtained maximum hatchability at 4 seconds of treatment while Japanese strains showed a good hatchability in all levels of hot water treatments . Also Yang *et al* ., 1997 reported differences in post treatment period and rate of dead eggs between the Chinese and Japanese races when the cold stored eggs were treated by corona discharge .

Table(4):Mean values of some economic characters of three races of silkworm , *B. mori* L. on egg performance .

<i>Ch</i> \ <i>R</i>	<i>R</i> ₁	<i>R</i> ₂	<i>R</i> ₃	<i>F</i>	<i>LSD</i>
Post treatment period (%)	9.97	9.67	9.27	22.200	0.210
One day hatching rate (%)	15.98	12.84	12.71	1.047	-
Practical hatching rate (%)	32.94	43.45	44.40	6.603**	6.992
General hatching rate (%)	87.44	83.48	90.97	8.370	3.659
Rate of bluish eggs (%)	93.24	90.35	94.68	6.326**	2.479
Rate of non bluish eggs (%)	1.20	1.82	1.38	1.019	-
Rate of dead eggs (%)	5.88	7.56	3.76	5.393	2.320

* significant at 5% , ** high significant at 0.05

B-Economic parameters :

The data recorded in Table 5 represent the mean values of some economic parameters of three races of silkworm *Bombyx mori* L. The Japanese race (*R*₁) is superior than the Chinese race of *R*₃ for weight of mature larvae (2881.88 mg) , total larval duration (36.20 days) , cocoon weight (1.09 g) , cocoon shell weight (0.206 g) , pupal weight (0.846 g) and cocooning percentage (70.98 %). There are highly significant differences between races for all parameters under study except for larval mortality percentage and cocoon shell ratio . Similar results was obtained by Gith , 1975 ; Abdel-wahab *et al.* , 1980 ; Saheb *et al.* , 1996 and Yang *et al.* , 1997 , they found that the Japanese race is better than the Chinese race for weight of body, weight of fresh cocoons, weight of cocoon shell and weight of pupae.

Table(5):Mean values of some economic characters of three races of silkworm , *B. mori* L. on some economic parameters.

<i>Ch</i> \ <i>R</i>	<i>R</i> ₁	<i>R</i> ₂	<i>R</i> ₃	<i>F</i>	<i>LSD</i>
Weight of mature larvae(mg)	2881.88	2500.84	2872.91	245.65**	38.61
Total larvae duration (day)	36.20	37.23	38.29	599.920**	0.123
Larval mortality (%)	24.44	22.36	22.82	0.688	-
Cocoon weight (g)	1.09	1.01	0.99	80.684**	0.01534
Cocoon shell weight(g)	0.206	0.191	0.186	36.778**	0.0046
Pupal weight (g)	0.846	0.807	0.793	38.631**	0.01224
Cocoon shell ratio (%)	19.10	19.12	19.12	0.006	-
Cocooning percentage (%)	85.01	70.98	84.56	41.022**	0.210
Pupation ratio (%)	89.10	88.92	95.46	16.441**	3.586

* significant at 5% , ** high significant at 0.05

The present study show that treatment with hot hydrochloric acid to terminate the diapause of the silkworm eggs was superior than the other two treatments hydrochloric acid treatment under room temperature and hot water treatment for most of the egg parameters as well as the economical parameters for rearing additional rearing season during late Autumn . These findings were confirmed by Singh *et al.* , 1993 results who reported that the treatment of diapausing eggs in hydrochloric acid was found to be most safe, technical and economical to obtain the good and uniform hatchability .

REFERENCES

- Abdel-Wahab, A. E.; A. T. Elgarhy and S. M. Gith (1980). On the Technological properties of silk produced by several races of the silkworm *Bombyx mori* L. Proc. 1st Conf. Plant Prot. Res. Inst. Egypt, 155 – 162 .
- Aruga, H. (1994). Principles of Sericulture . Translated from Japanese Balkema , Rotterdam.pp.120-123.
- Gith, S. M. (1975). Studies on different races of the silkworm *Bombyx mori* L. under Egyptian environmental conditions . M. Sc. Thesis , Fac. Agric. Al – Azhar University , Egypt.
- Hosny, A. (1994). Evaluation of four rearing of univoltine *Bombyx mori* L., around the year by means of two acid treatment procedures . Zeitschrift Angewandte Zoologie . , 80 (4) : 501 – 505.
- Hosny, A. and Souad, M. Mahmoud (2002). Cocoon production of *Bombyx mori* L. raised on leaf crop of two types of mulberry fields around the year. 2nd Inter. conf . Plant Prot. Res. Inst. Cairo, Egypt .(1):233 – 236.
- Hurkadli, H. K. and A. Manjula (1991). Artificial hatching of bivoltine silkworm eggs, *Bombyx mori* at different hours of oviposition for tropical conditions (Lepidopteran: Bombycidae), *Sericologia* , 31 (1): 1 – 3.
- Hurkadli, H. K. and A. Manjula (1992). Safe period of acid treatment for bivoltine silkworm (*Bombyx mori* L.) Hybrid eggs at different hours of oviposition for varying temperatures . Indian J. Seric., 31 (2) : 97 – 100.
- Krishnaswami, S.; M. N. Narasimhanna ; S. K. Suryanarayan and S. Kumararaj (1973). *Sericulture Manual* . 2 . Silkworm Rearing . FAO . Agricultural Service Bulletin. pp.51-52.
- Manjula, A. and H. K. Hurkadli (1986). Cold acid treatment of bivoltine silkworm eggs , *Bombyx mori* for tropical country. *Sericologia* , 26 (1) : 25 – 29.
- Manjula, A. and H. K. Hurkadli (1990). Cold acid treatment of bivoltine hybrid silkworm eggs, *Bombyx mori* L. for tropical country. *Indian J. Seric.*, 29 (1) : 138 - 141.
- Manjula, A. and H. K. Hurkadli (1996). Studies on the hibernation schedule for bivoltine pure and hybrid silkworm eggs, *Bombyx mori* L. (Lepidoptera: Bombycidae), aestivated for twenty days under tropical conditions. *Sericologia* , 36 (4) : 665 – 675.
- Rahman, S. M. and S. U. Ahmed (1989). Artificial hatching of hibernated eggs of silkworm , *Bombyx mori* L . by warm water treatment. *Bangladesh Journal of Zoology.*(17) : 2 , 117 – 121.
- Saheb, N. M. B. ; V. Kumar ; B. B. S. Negi and M. V. Samson (1996). Acid treatment in relation to refrigeration of silkworm eggs . *Indian J. Seric.*, 35 (1) : 77 – 79 .
- Singh, R. ; J. Nagaraju and K. Vijayaraghavan (1990). Effect of hot water on the prevention of diapause in the silkworm , *Bombyx mori* L. *Sericologia* , 30(4) : 443 – 447 .
- Singh, G. P. ; V. P. Mathur and C. K. Kamble (1993). Factors influencing the diapause : A brief account . *Indian Silk* , August , 32 – 33.

- Senedecor, G. W. and W. G. Cochran (1967). Statistical Methods. Iowa , USA. The Iowa State University Press .
- Tanaka, Y. (1964). Sericology .Central Silk Board , Bombay. India.pp.92-94.
- Tayade, D. S. ; M. D. Jawal and P. K. Unchegaonkar (1988). Hatching percentage in silkworm eggs as influenced by silkworm races , varieties of mulberry and mating duration . Indian J. Seric. , 27 (2): 145 – 148.
- Wang, S. M. (1989). Silkworm Egg Production . FAO. Agricultural Services Bulletin , 73/3 .
- Yang, M. G.; Z. Xu ; J. S. Chen ; S. J. Ye and Y. Q. Ye (1997). Preliminary study on artificial hatching of silkworm eggs stimulated by corona discharge . Sericologia , 37 (1): 41 – 51.

تأثير طرق التفقيس الصناعي المختلفة على إنتاجية دودة الحرير التوتية
محمد أحمد أحمد عيد^١، صلاح عبد الله صالح المعصرواي^١،
سعاد مرسى محمود عبد النبي^٢ و تحية عزوز فؤاد^٢.
١- كلية الزراعة جامعة القاهرة قسم الحشرات الاقتصادية والمبيدات
٢- قسم بحوث الحرير معهد بحوث وقاية النباتات مركز البحوث الزراعية

أجريت هذه الدراسة باستخدام بعض طرق التفقيس الصناعي (المعاملة بحامض الهيدروكلوريك تحت درجة حرارة الغرفة العادية- المعاملة بالحامض الساخن - المعاملة بالماء الساخن) و ذلك لكسر بيات بيض ديدان الحرير التوتية الساكن diapause للحصول على يرقات ديدان الحرير خلال اى وقت على مدار العام.
وتم معاملة بيض بعض سلالات ديدان الحرير أحادية الجيل univoltine races عمر ٢٠ ساعة وتحضين البيض على ٢٤م و ٨٠-٩٠% رطوبة نسبيه حتى الفقس.
وسجلت قياسات فقس البيض والقياسات الاقتصادية و ذلك خلال موسم الخريف المتأخر . وقد اثبتت هذه الدراسة ان المعاملة بحامض الهيدروكلوريك الساخن أعطت أفضل النتائج بالمقارنة بطريقة المعاملة بحامض الهيدروكلوريك تحت درجة حرارة الغرفة العادية و المعاملة بالماء الساخن.