

**EFFECT OF ADDING SOME FOLIAR FERTILIZERS TO MULBERRY LEAVES ON SOME BIOLOGICAL ASPECTS AND SILK PRODUCTION OF SILKWORM *Bombyx mori* L.**

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**ABSTRACT**

*The effects of feeding silkworm larvae (Egypt hybrid, Giza ) on mulberry leaves supplemented with three foliar fertilizers compounds, Basfoliar combi ctip, Tecamin max and Stimoful at three concentrations (1.0, 2.0 and 3.0 % each) for one time (at the beginning of fourth instar) and two times (at the beginning of fourth and fifth instars) on some biological and technological characters were studied. Basfoliar combi ctip and Stimoful compounds at 2% kept the larvae healthy by decreasing mortality rate. In adation, a concentration of 3% of each Basfoliar combi ctip and Stimoful compounds shortened the larval duration when used one or two times. Basfoliar combi ctip and Stimoful compounds caused the highest cocooning percentage compared with control. Adult emergency increased when mulberry leaves were enriched with Basfoliar combi ctip and Tecamin max fertilizers at 2% and Stimoful fertilizer at 3% compared to control. Stimoful at 3% and Tecamin max at 2% compounds resulted the highest female fecundity when it applicated two times and one time, respectively. Fresh cocoon weight and cocoon shell weight showed significant increase when Stimoful compound used at 2% and 3%, Tecamin max at 2% and Basfoliar combi ctip at 3% respectively. Meanwhile Basfoliar combi ctip compound at 2 and 3% and Stimoful compound at 2% increased the silk content ratio compared the control. Tecamin max, Basfoliar combi ctip compounds at 2% each and Stimoful compound at 3% gave longer and heavier silk filament than the control.*

**Key words:** *Bombyx mori* L., nutritional additives, Foliar fertilizers  
Biological characters, silk production.

**INTRODUCTION**

Mulberry silkworm, *Bombyx mori* L. has been known as one of the most important economic Lepidopterain species because of the fabulous natural silk produced of its cocoons. The production of high quality and quantity of natural silk depends mainly on larval feeding with some nutritional elements of

mulberry leaves determine the growth and development of the larvae and cocoon production (Seidavi *et al.*, 2005). The development of sericulture is directly related to the mulberry cultivation because mulberry silkworm is an insect of monophagy characteristics that eats only mulberry leaves. Therefore, much efforts and researches must be involved in quantity and quality production of mulberry leaves for silkworm rearing and then cocoon production (Raman *et al.*, 1995). Nowadays, nutritional additives are commonly used to enrich the nutritional value of mulberry leaves offered to silkworm larvae where Ahmed, (1993) found that different combinations of mineral nutrients gave better larval growth and silk production. Therefore, many scientific studies were done to evaluate the efficiency of some food additives on biological and technological characters such as El-Garhy (1974), El-Hattab (1975), El-Deeb (1981) and Zannoon (1994).

The present investigation was designed to evaluate the efficiency of some foliar fertilizers, which were recommended for their cheap cost as food-nutritional additives, on the biology and silk production of mulberry silkworm, *Bombyx mori* L.

## MATERIALS AND METHODS

Biological and technological studies were done to determine the effects of addition some foliar fertilizers.

### ***I -Materials:-***

- 1- Mulberry leaves, *Morus alba* variety Balady.
- 2- The mulberry silkworm, *Bombyx mori* ( Egypt hybrid, Giza ) were obtained from the Sericulture Research Department, Plant Protection Research Institute, Agriculture Research Center, Ministry of Agriculture and Land Reclamation in Giza, Egypt.
- 3-Foliar fertilizers:
  - a- Basfoliar combi ctipb (Br 0.2 % - Mn 4 % – N 9 % – Ca 15 % - Mg 1 %) use as solution product by compo. Germany shoura chemicals
  - b- Tecamin Mx (L. amino acids 12 % – Total amino acid 14.4 % – N 7 %) use as solution product by Marchal Marten, Aspin.
  - c- Stimufol (N 25 % – P 16 % – K 12 %) use as powder product by Marchal Marten, Aspin).

Each of the tested compounds were used alone at three concentrations (1.0, 2.0 and 3.0 %) in the distilled water.

### ***II -Methodes:***

#### **Rearing technique:**

The mulberry silkworm, *Bombyx mori* (Egypt hybrid, Giza) was used in the present work in the laboratory of Sericulture Research Department of Plant

Protection Research Institute, Agriculture Research Center.. Rearing was carried out under controlled laboratory conditions of  $26 \pm 2$  °c and  $70 \pm 5$  % RH. Rearing procedures were achieved according to Krishnaswami (1978) rearing technique.

Mulberry leaves were dipped in prepared concentrations of the used materials and fed to mulberry silkworm larvae and offered to two groups of silkworm larvae, the first group were fed with treated leaves only one time at the beginning of 4<sup>th</sup> larval instar. The second group were fed two times at the beginning of 4<sup>th</sup> and 5<sup>th</sup> larval instars, during spring season of year 2010.

### ***I- Biological studies:***

The following biological aspects under study were recorded.

- 1- Larval mortality (%)
- 2- Larval duration (day)
- 3- Cocooning percentage (%)
- 4- Adult emergence (%)
- 5- Fecundity of female (number of deposited egg/ female).

### ***II-Technological studies:***

#### **1- Cocoon indices:**

Ten resulted fresh cocoons from each concentration were collected, cleaned, weighed and carefully cut. The pupae and exuviate were removed, and cocoon shells were weighed. Silk content ratio was calculated according to formula by Tanaka, (1964).

$$\text{Silk content ratio (\%)} = \frac{\text{Weight of fresh cocoon shell (mg)}}{\text{Weight of fresh cocoon (mg)}} \times 100$$

#### **2- Reelable silk filament parameters:**

Another ten cocoons from each concentration of the resulted fresh cocoons were collected; oven dried and reeled by individual reeling machine. The length (m) and weight (mg.) of the dried reelable filament were determined. The sizes of reelable filaments were calculated according to Tanaka (1964) formula:

$$\text{Silk filament size (dn)} = \frac{\text{Weight of silk filament (mg)} \times 9000}{\text{Length of silk filament (m)}}$$

### **Statistical analysis:**

The obtained results were subjected to statistical analysis of variance (LSD) and the data were presented as means according to Snedecor and Cochran (1982 ) method using software COSTAT program.

## RESULTS AND DISCUSSION

### *I-Effect of foliar fertilizers on biological studies:*

Treated silkworm larvae were divided into two groups. The first group larvae were fed with treated leaves one time at the beginning of 4<sup>th</sup> larval instar and the second group was fed two times at the beginning of 4<sup>th</sup> and 5<sup>th</sup> larval instars.

#### **1- Larval mortality**

##### *The 4<sup>th</sup> instar:*

Data in Table (1) indicated that concentration at 2% of each Basfoliar combi ctip and Stimoful decreased larval mortality percentages from 10% in the control to 5 and 5.5%, respectively. All means of treated compounds kept the 4<sup>th</sup> larvae healthy when compared with the control. Basfoliar combi ctip exhibited the least mean at larval mortality percentage (5.83%).

##### *The 5<sup>th</sup> instar:*

It was found that each of Basfoliar combi ctip and Stimoful foliar fertilizers at 1% concentration recorded the least percentage of 5<sup>th</sup> instar larval mortality when treated only in fourth instar larvae or when treated in both fourth and fifth instars. The mean of treated Basfoliar combi ctip concentration gave the lowest larval mortality compared with the other compounds and control (Table 1).

#### **2- Larval duration**

##### *The 4<sup>th</sup> instar:*

Data presented in Table (1) revealed that Basfoliar combi ctip compound at concentration 3% and Stimoful compound at 2 and 3% recorded the shortest larval duration, this durations were 5days for the previous mentioned treatments, respectively compared with 7 days in the control. On the other hand, Tecamin max compound exhibited larval duration 8 days when used at 3% concentration. On contrast, no significant differences were found between the means of the three compounds.

##### *The 5<sup>th</sup> instar:*

Data tabulated in Table (1) indicated that Basfoliar combi ctip at 2% and Stimoful at 3% compounds when applied only on fourth instar larvae significantly decreased the fifth instar of larval duration, from 11 days in the control to 9 days. Meanwhile when Stimoful applied at 3% on the fourth and fifth instars significantly decreased the fifth instar duration to 8 days. On the other hand, Basfoliar combi ctip compound at 2 and 3% recorded 9

**Table 1. Effect of some foliar fertilizers on some biological characters of mulberry silkworm *Bombyx mori* L. larvae.**

Compounds	Conce.	Larval mortality (%)			Larval duration (day)		
		4th	5th		4th	5th	
			Treated in 4 <sup>th</sup> instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> instars		Treated in 4 <sup>th</sup> instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> instars
Basfoliar combi ctip	1%	6.50	7.00	5.50	6.00	10.00	10.00
	2%	5.00	7.50	6.00	6.00	9.00	9.00
	3%	6.00	6.50	6.00	5.00	9.00	9.00
	Mean	5.83	7.00	5.83	5.67	9.33	9.33
Tecamin max	1%	6.00	7.50	6.50	6.00	10.00	9.00
	2%	7.50	9.00	9.00	7.00	10.00	11.00
	3%	10.00	11.00	13.00	8.00	13.00	13.00
	Mean	7.83	9.17	9.50	7.00	11.00	11.00
Stimoful	1%	6.50	7.00	6.00	6.00	10.00	10.00
	2%	5.50	8.00	6.00	5.00	10.00	9.00
	3%	6.00	7.50	6.50	5.00	9.00	8.00
	Mean	6.00	7.50	6.17	5.33	9.67	9.00
Control		10.00	12.00		7.00	11.00	
LSD 5% for concentrations		1.173***	1.593***	2.778***	1.019***	1.645**	1.703***
LSD 5% for compounds		2.289**	2.015**	3.249**	ns	ns	ns

days. Tecamin max compound at 3% concentration prolonged significantly the duration to 13 days.

**3- Cocooning percentage:**

As shown in Table (2), the investigated three compounds increased the cocooning percentage as compared to control (61.67%) . Adding of Stimoful at 3% caused the highest percent of cocooning being 90.42% and 93.08 % when mulberry leaves were treated one time or two times , respectively. Also, Basfoliar combi ctip fertilizer at 2% recorded 91.57% when used two times.

**4- Adult emergence:**

Data presented in Table (2) showed that Stimoful compound at 3% exhibited the highest percent of adult emergence recording 95% when used two times. Basfoliar combi ctip and Tecamin max fertilizers at 2% concentration

**Table 2: Effect of some foliar fertilizers on some biological characters of mulberry silkworm *Bombyx mori* L.**

Compounds	Conc.	Cocooning %		Emergence %		Fecundity (No.egg/female)	
		Treated in 4 <sup>th</sup> larval instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> larval instars	Treated in 4 <sup>th</sup> larval instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> larval instars	Treated in 4 <sup>th</sup> larval instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> larval instars
Basfoliar combi ctip	1%	71.66	76.47	85.00	85.00	325	330
	2%	84.73	91.57	90.00	90.00	327	343
	3%	85.10	88.29	80.00	85.00	334	340
	Mean	<b>80.49</b>	<b>85.44</b>	<b>85.00</b>	<b>86.66</b>	<b>328.67</b>	<b>337.76</b>
Tecamin max	1%	73.40	80.31	85.00	85.00	332	340
	2%	80.00	83.24	90.00	90.00	362	374
	3%	66.67	67.77	85.00	85.00	320	336
	Mean	<b>73.35</b>	<b>77.10</b>	<b>86.66</b>	<b>86.66</b>	<b>338</b>	<b>350</b>
Stimoful	1%	84.49	81.81	80.00	90.00	321	335
	2%	86.77	86.77	85.00	90.00	334	362
	3%	90.42	93.08	90.00	95.00	352	377
	Mean	<b>87.22</b>	<b>87.22</b>	<b>85.00</b>	<b>91.66</b>	<b>335.67</b>	<b>358</b>
Control		<b>61.67</b>		<b>70.00</b>		<b>303</b>	
LSD 5% for concentrations		<b>15.574*</b>	<b>1.703***</b>	<b>8.515**</b>	<b>8.516***</b>	<b>15.479***</b>	<b>16.166***</b>
LSD 5% for compounds		<b>13.390*</b>	<b>14.969*</b>	<b>8.593**</b>	<b>6.656***</b>	<b>25.633*</b>	<b>28.736**</b>

and Stimoful at 1 and 2% recorded 90% adult emergence when used two times.

### 5- Fecundity:

As illustrated in Table (2) all concentrations of fertilizers significantly increased female fecundity compared with control. Tecamin max at 2% and Stimoful fertilizers at 3% recorded the highest number of deposited eggs when used one time or two times.

The same trend of increasing the female fecundity was also reported by Shymala and Gowda (1981) when added some amino acids, Zannoon (1994) when enriched mulberry leaves with different solutions of bee honey and also, Megalla (1984) reared 4<sup>th</sup> and 5<sup>th</sup> instar of eri silkworm *Philosomia ricini* larvae on a diet containing ascorbic acid (as a source of vitamin C), yeast (as a source of vitamin B) and chloramphenicol. He found that, the presence of ascorbic acid, yeast or chloramphenicol alone or with any combination usually increase the percentage of emerged moth and the number of deposited eggs per female. In the same trend Haq and Saleem (1985) found that when silkworm larvae were fed on 0.2% N treated mulberry leaves affected pupation rate, moth emergence, fecundity and hatching percentage of silkworm *B. mori*. The three authors, Khan and Saha (1997) who investigated mulberry leaves soaked in

0.08, 0.16, 0.32 and 0.64% calcium lactate, Manoharan (1997) who used the hydrolyzed soybean protein at 2% and Bojan *et al.* (2006) who used that 100 ppm selenium and 400 ppm zinc nitrate supplements when were added in silkworm feeding found that the cocoon and cocoon shell measurements were increased.

## **2-Effect of the foliar fertilizers on technological characters:-**

### **a- Cocoon indices:-**

As shown in Table (3) the three fertilizers revealed significant increasing in the fresh cocoon weight, cocoon shell weight and silk content ratio when compared with the control. Stimoful fertilizer at 3% concentration showed the highest fresh cocoon weight and cocoon shell weight (1.445 and 0.239 g, respectively )when used one time, and (1.464 -0.257g, respectively ) when applied two times. Basfoliar combi ctip fertilizer at 3% increased the silk content ratio recording 18.572 %. While Stimoful fertilizer recorded 18.767% at 2% concentration when used two times.

These results are in agreement with Rathinam and Chetty (1991) who stated that when larvae of *Bombyx mori* were fed on mulberry leaves soaked in the fertilizer mixture Five Phos. 6X. Significant improvements in the economic characters of the silkworms were observed for treatment with the salt supplement at 3%. And also with Madhuri and Saha (1998) who found using zinc sulphate (Zn So<sub>4</sub>. 7H<sub>2</sub>O) at 0.1 and 0.2% increased cocoon, shell weight and shell ratio.

### **b- Reelable filament characters:-**

Data tabulated in Table (1) indicated that adding Tecamin max at 2% and Stimoful compounds at 3% gave the highest length of silk filament when used one or two times. The respective previous treatments recorded 1126.3 and 1100.6 m when used, one time and 1140.1 and 1111.3 m when used two times. Again, Tecamin max at 2% and Stimoful at 3% increased the silk filament weight when used one or two times. These respective treatment record 0.219 and 0.224 g when used two times. Accordingly Basfoliar combi ctip at 2% and Stimoful fertilizers at 3% caused increasing of the silk filament size recording 1.784 and 1.813 dn, respectively, when used two times compared with the control.

This result nearly similar to that of Bojan *et al.* (2006) who found 100 ppm selenium and 400 ppm zinc nitrate supplements when were added in silkworm feeding, increased the cocoon and cocoon shell measurements. Also, Rajakumari *et al.* (2006) cleared that the mulberry leaves enriched with certain amino acids showed significant effect in cocoon weight, shell weight, shell ratio and filament length.

**Table 3. Effect of some foliar fertilizers on cocoon indices of mulberry silkworm *Bombyx mori* L.**

Compounds	Conc.	Fresh cocoon weight (g)		Shell cocoon weight (g)		Silk ratio %	
		Treated in 4 <sup>th</sup> larval instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> larval instars	Treated in 4 <sup>th</sup> larval instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> larval instars	Treated in 4 <sup>th</sup> larval instar only	Treated in 4 <sup>th</sup> & 5 <sup>th</sup> larval instars
Basfoliar combi ctip	1%	1.110	1.230	0.188	0.213	16.936	17.317
	2%	1.218	1.316	0.209	0.241	17.159	18.313
	3%	1.342	1.373	0.245	0.255	18.256	18.572
	Mean	<b>1.223</b>	<b>1.306</b>	<b>0.214</b>	<b>0.236</b>	<b>17.450</b>	<b>18.067</b>
Tecamin max	1%	1.118	1.130	0.182	0.198	16.279	17.522
	2%	1.350	1.412	0.230	0.247	17.037	17.492
	3%	1.118	1.149	0.155	0.163	13.864	14.186
	Mean	<b>1.195</b>	<b>1.230</b>	<b>0.189</b>	<b>0.202</b>	<b>15.726</b>	<b>16.400</b>
Stimoful	1%	1.200	1.305	0.187	0.212	15.583	16.245
	2%	1.365	1.428	0.244	0.268	17.875	18.767
	3%	1.445	1.464	0.239	0.257	16.539	17.554
	Mean	<b>1.110</b>	<b>1.230</b>	<b>0.223</b>	<b>0.245</b>	<b>16.886</b>	<b>17.522</b>
Control		<b>1.105</b>		<b>0.150</b>		<b>13.537</b>	
LSD 5% for concentrations		<b>0.1895**</b>	<b>0.1899**</b>	<b>0.0288**</b>	<b>0.0309**</b>	<b>1.623**</b>	<b>1.623**</b>
LSD 5%for compounds		ns	<b>0.181*</b>	ns	<b>0.0534*</b>	<b>2.014*</b>	<b>2.250**</b>

**Table 4: Effect of some foliar fertilizers on silk filament characters of mulberry silkworm *Bombyx mori* L.**

Compounds	Conc.	Silk filamet length (m)		Silk filamet weight (g)		Silk filamet size (dn)	
Basfoliar combi ctip	1%	1000.3	1010.2	0.176	0.192	1.583	1.710
	2%	1060.4	1079	0.196	0.214	1.663	1.784
	3%	967.4	1002.3	0.188	0.197	1.748	1.768
	Mean	<b>1009.3</b>	<b>1030.5</b>	<b>0.186</b>	<b>0.201</b>	<b>1.664</b>	<b>1.754</b>
Tecamin max	1%	955.4	971.3	0.168	0.176	1.582	1.630
	2%	1126.3	1140.1	0.210	0.219	1.677	1.728
	3%	990.4	1005.4	0.183	0.195	1.662	1.745
	Mean	<b>1024.0</b>	<b>1038.9</b>	<b>0.187</b>	<b>0.196</b>	<b>1.640</b>	<b>1.701</b>
Stimoful	1%	920.3	966.6	0.150	0.171	1.466	1.592
	2%	1010.7	1088.7	0.190	0.217	1.691	1.793
	3%	1100.6	1111.3	0.214	0.224	1.749	1.813
	Mean	<b>1010.5</b>	<b>1055.5</b>	<b>0.184</b>	<b>0.204</b>	<b>1.635</b>	<b>1.732</b>
Control		<b>845.8</b>		<b>0.130</b>		<b>1.383</b>	
LSD 5% for concentrations		ns	<b>152.820*</b>	<b>0.0294***</b>	<b>0.0422**</b>	<b>0.224*</b>	<b>0.2209*</b>
LSD 5% for compounds		<b>128.054*</b>	<b>118.361*</b>	<b>0.0376*</b>	<b>0.0355***</b>	<b>0.1677*</b>	<b>0.1341***</b>

## CONCLUSION

According to the overall results of this study it could be concluded that, the foliar fertilizers Basfoliar combictp at 2% and Stimoful at 3% when added to mulberry leaves offered to silkworm larvae decreased mortality and larval duration while increased cocooning, adult emergence, female fecundity, silk content ratio and silk filament, length and size. This compounds used as nutritional additives, they found positive impact of supplements on the silkworm growth and silk production because its contents of necessary nutritional elements such as nitrogen, potassium and some amino acids.

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## تأثير إضافة بعض الأسمدة الورقية لأوراق التوت على بعض الصفات البيولوجية وإنتاج الحرير لدودة الحرير التوتية.

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\*\*قسم وقاية النبات- كلية الزراعة بمشتهر- جامعة بنها.

- درس تأثير تغذية يرقات دودة الحرير على أوراق التوت المعاملة بثلاثة مركبات من الأسمدة الورقية وهى باسفوليار كومبى ستيب و تيكامين ماكس و ستيموفول بثلاثة تركيزات ( ١% و ٢% و ٣%) على بعض الصفات البيولوجية و إنتاج الحرير. سجلت أقل نسبة موت فى اليرقات عند التركيز ٢% لكل من المركبين باسفوليار كومبى ستيب و ستيموفول مقارنة بالكنترول. و قصرت فترة الأعمار اليرقية الكبيرة عند معاملة الأوراق مرة أو مرتين بشكل ملحوظ عند تركيز ٣% لكلا المركبين السابق ذكرهما بالمقارنة بالكنترول. وسجلت الزيادة فى نسبة النشترنق عند استخدام تركيزى ٢ و ٣% للمركبين السابق ذكرهما
- زادت نسبة خروج الفراشات عندما دعمت أوراق التوت بالتركيز ٢% فى حالة المركبين باسفوليار كومبى و تيكامين ماكس و التركيز ٣% للمركب ستيموفول مقارنة بالكنترول. سجل معدل الزيادة فى عدد البيض الذى تضعه كل أنثى زيادة معنوية عند استخدام ستيموفول ٣% فى بداية العمر الرابع و الخامس (مرتين) و تيكامين ماكس ٢% فى بداية العمر الرابع. سجلت زيادة معنوية لوزن الشرانق الطازجة و وزن قشرة الشرانق باستخدام تركيزى ٢ و ٣% لمركب ستيموفول و ٢% لمركب باسفوليار كومبى ستيب. وكانت المعاملة بمركب الباسفوليار كومبى ٢% و ٣% زادت من نسبة الحرير فى الشرنقة. كما اعطى مركب باسفوليار كومبى ٢% و التيكامين ٣% أعطيا زيادة معنوية فى طول ووزن وحجم خيط الحرير.

**التوصية:** إن استخدام بعض الأسمدة الورقية مثل باسفوليار كومبى و ستيموفول كإضافات غذائية لأوراق التوت المقدمة ليرقات الحرير أدت لخفض نسبة الموت و فترة العمر اليرقى و من جهة أخرى أدت لزيادة نسبة النشترنق و نسبة خروج الفراشات و عدد البيض الذى تضعه الأنثى كما حققت تلك المركبات زيادة فى محتوى الحرير و طول الخيط الحريري وحجمه.