

Improving mulberry silkworm rearing using powders of lime and wood ash and its effects on productivity

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Abstract

Estimation of cocoon crops loss in Egypt is ranged 38 to 46% due to various reasons including bad rearing procedures and diseases infections. Procedure of rearing technique is very effective of cocoons crop quantity and quality. So, enhancement of rearing technique would raise the quality and quantity of cocoons. Effects of using powders of lime, mulberry wood ash and common disinfectant to improve silkworm rearing technique were investigated in the present study.

All treatments tested in this study were caused reduction in mortality percentage comparing with control. As well as improving most traits under investigation. Using mulberry wood ash daily and common disinfectant generally acquired the best results. So that, mulberry wood ash daily and common disinfectant was recommended for enhancement the rearing mulberry silkworm.

Keywords: *Bombyx mori*, rearing techniques, economic traits, characters, common disinfectant

1. Introduction

Silkworm, *Bombyx mori* consider as one of important economic insect that converts leaf protein to silk. The commercial use of silk applied in many countries at Asia, Africa and Europe continents. Mulberry silk is the most important type of all silk and contributes to as much as 95% of the world's silk production. One major challenge in silkworm rearing is its susceptibility to a number of diseases.

Silkworm *Bombyx mori* was very sensitive to various diseases because of it would be domesticated over about forty-four centuries caused by microsporidia, bacteria, viruses and fungi [1].

Diseases management of mulberry silkworm consider as one of the necessary items of successful silkworm rearing for raising yield and quality of cocoons. Suitable disinfection of the rearing room, rearing tools and rearing bed protect and control the silkworm diseases and maintains hygiene for cocoon production [2, 3, 4].

Diseases widespread in all leading silk producing countries caused losses estimated to be about 30 percent of total loss [5]. Indian sericulture has been loss in crop due to silkworm diseases by pathogen viz., viruses, fungi, bacteria and microsporidia. Unsuitable disinfection, unhygienic rearing conditions lead to by various silkworm diseases [5, 6, 7].

Every year the loss of cocoon in Egypt are ranged 38- 46% because of diseases infections, rearing procedures and other factors. Improving silkworm rearing technique is very important to increase cocoon crops quantity and quality. Consequently, the profit of silkworm rearers will be raise. So that the present study is attempt to enhance the technique of silkworm rearing.

2. Materials and Methods

Leaves of *Morus alba* var canava-2 were offered four times daily. During young instars leaves were chopped, while during the grown instars (fourth and fifth instars) the whole leaves and shoots were offered. Three replicates were adopted for all treatments. Each treatment contains five

hundred mulberry silkworm larvae of strain A₁₁₁. Foam strips were used during young instars. Polythene sheets were adopted for bottom and cover for rearing trays [8]. Average of temperature and humidity of rearing room were recorded. Mean of temperature was 21.91 ° C ± 0.23 and 52.18 % ± 0.11 for humidity.

Combination of common disinfectants, mulberry wood ash powder was carried out. Also, Lime powder combined with mulberry wood ash and common disinfectant were adopted. Pruning branches were burning and crushed. Lime powder purchase from local markets which are used for common disinfectant carrier matter. Timing of treatments designed as mentioned in Table 1.

Treatments of common disinfectant, lime powder and wood ash were used as illustrated in Table 1.

Table 1: Codes of different treatments combinations used in the experiment.

code	Treatment and time of application
A	Mulberry ash daily
B	Mulberry ash daily + Common disinfectant in recommended time
C	Common disinfectant daily
D	Lime powder daily
E	Lime powder daily + Common disinfectant in recommended time
F	Common disinfectant in recommended time
G	Control (without any application)

Mulberry wood ashes were collected from burn pruning mulberry fields waste. Lime powder was purchase from local market in Egypt.

Common disinfectants (3 g paraformaldehyde + 3 g salicylic acid + 3 g benzoic acid + 91 lime powder) which commonly used by rearers [9]. They mentioned that the best time was the beginning of the second instar, the second day of the third instar, second day of fourth larval instar, second, fourth and sixth day of the fifth instar.

While the best weighed for one gram of silkworm eggs were (1.66, 4.98 and 41.98 g) for second, third, fourth. And 62.50 g for second day, fourth day, sixth day of the fifth instar.

The experiments were inducted in the Sericulture Research Department–Plant Protection Research Institute- Agriculture Research Center in Giza Governorate.

Fifteen traits were taken into considerations. There were 5th larval duration, whole larval duration, 5th larval weight, number of cocoon per liter, pupation ratio, double cocoon percentage, cocoon crop by number and weight for 10,000 fourth larvae. Also, data of cocoon weight, cocoon shell weight, pupal weight, cocoon shell ratio for female and male, filament length, filament weight and filament size.

Four characters were calculated as follows:

1. Mortality percentage

Mortality of silkworm larvae was conducted with following formula:

$$\text{Mortality (\%)} = \frac{\text{No. of larvae kept}}{\text{Total number of larvae}} \times 100$$

2. Cocooning percentage

Estimation of percentage of cocooning was adopted by using the following formula [10].

$$\text{Cocooning percentage (\%)} = \frac{\text{No of cocoons formed}}{\text{Total number of larvae kept}} \times 100$$

3. Silk productivity

Silk productivity was adopted by the following equation [11].

$$\text{Silk productivity (cg)} = \frac{\text{Cocoon shell weight (cg)}}{\text{Fifth instar duration (day)}}$$

Where cg: Centigram

4. Silk Ratio (Silk Recovery):

Silk ratio was calculated as the next formula:

$$\text{Silk Ratio (Silk Recovery)} = \frac{\text{Weight of silk filament}}{\text{weight of dried cocoon}} \times 100$$

Statistical analysis was applied to the collected data using SAS program [12].

3. Results & Discussion

Illustrated data found in Table 2 explained mean values of traits fifth larval duration, larval duration, fifth larval weight, number of cocoon per liter, pupation ratio, double cocoon percentage, cocoon crop by number and cocoon crop by weight.

Significant differences were detected for all characters except fifth, total larval duration and double cocooning percentage. A and B Treatments represented lowest fifth and total larval duration. All treatments acquired lowest percentage of mortality percentage. B treatment is lowest mortality followed by C and E treatments.

Weight of fifth larvae of control treatment G was lowest treatment. Highest fifth larval weight earned by B, A, C and E treatments.

Worst treatment of cocoon per liter trait was found for G treatment. Best results were appeared for B, A, F and E treatments.

Cocooning Percentage of control treatment G was the lowest ones. While B, E, C and A are the best treatments. Pupation ratio showed best results for C, B, A and E. All treatments have superior results comparing with control

treatment G. Treatments of B, C and D have best results of double cocoon percentage trait. Regarding to the character of cocoon crop by number and weight it is obvious that best result were recorded for B, E, C, A and F respectively. While lowest results registered for control treatment G.

From the previous results it could be concluded that, control treatment has worst results with non-significant for fifth and whole larval durations and double cocoon percentage. B (Mulberry ash daily and Common disinfectant in recommended time) treatment is best treatment for fifth larval duration, whole larval duration, mortality percentage, fifth larval weight, cocoon/liter, cocooning percentage, pupation ratio, double cocooning percentage, cocoon crop by number and weight.

Enhancement of the characters under study may be due to using mulberry wood ash and disinfectant which have effective effect on mulberry silkworm diseases and improve the quality of traits. These results are in agreements with those found by [6, 13] who registered that lime, lime with bleaching powder and hydrated lime powder application of bundh powder as a bed disinfectant effectively inactivated the NPV and reduce larval mortality, flacherie and muscardine diseases.

Wood ash can be highly effective in protecting the tasar crops from diseases such virosis, bacteriosis, pebrine, and muscardine. The wood ash is highly alkaline when suspended in water and can act as an antiviral agent [14, 15].

Also, mulberry wood ash was adopted on mulberry silkworm, *Bombyx mori*. The results reported that, mulberry wood ash reduces grown mortality percentage and number of cocoon per liter. Also, was enhanced the cocooning percentage and pupation ratio [16].

Table 3 registered the mean values of cocoon weight, cocoon shell weight, pupae weight, cocoon shell ratio, silk productivity, filament weight, filament length, filament size and silk ratio.

Control treatment has lowest mean comparing to A, B, C, D, E and F treatments for the previous characters. B treatment is the best for the previous traits followed by treatment A.

Non-significant differences were recorded for filament weight character. Significant differences was obtained for trait of filament size, G treatment was the highest mean. B, E, C and A were the lowest treatments. Regarding to the silk ratio trait, significant differences was recorded. Control treatment (G) was lowest silk ratio, while treatments of B, A, F and E was highest silk ratio.

Differences between sex and interaction between sex and treatments for five silkworm traits of lime and wood ash powders treatments were found in Table 4. Highly significant differences were detected between female and male for weight of cocoon & pupal and cocoon shell ratio. Females were heavier than males for weight of cocoon & pupa. While male cocoon shell ratio was higher than female. Insignificant difference was found between sexes for cocoon shell weight and silk productivity traits. Regarding to the interaction between treatments and sexes, non-significant differences were obtained for the previous characters.

From the previous results it was clearly that, the value of characters superior by using all treatments comparing with control. Best results were recorded for B (using mulberry wood ash and disinfectant in recommended time) treatment. Ash and disinfectant increase the hygienic conditions and improved characters silkworm of the mulberry. These results are coincidence with those founded by [6, 17] recorded

that application of Rashamkeet disinfectant which contains lime powder application of hydrated lime powder improving the cocoon yield, cocoon weight, shell weight, pupal weight, shell ratio and filament length. The presence of lime powder as one of the constituents reduces the excessive moisture of

the bed and provides suitable microclimatic condition. Also, using mulberry wood ash on mulberry silkworm, *Bombyx mori* lead to raise mean value of fresh cocoon weight, cocoon shell weight, pupal weight, cocoon shell ratio and silk productivity traits for both sexes ^[16].

Table 2: Mean values of ten characters of mulberry silkworm for treatments of lime and wood ash powders.

Character Treatment	Fifth larval duration (days)	Whole larval duration (days)	Mortality (%)	5 th Larval Weight (g)	Cocoon/liter (No.)	Cocooning (%)	Pupation (%)	Double Cocooning (%)	Crop Number	Crop /Weight (g)
A	7.000	29.000	20.000	2.214	111.440	90.667	97.000	2.000	9066.000	19010.994
B	7.000	29.000	7.400	2.223	105.840	95.000	99.000	0.667	9500.000	20545.372
C	7.667	29.667	7.800	2.172	121.333	93.133	100.000	0.667	9313.000	19427.356
D	7.667	29.667	25.400	2.098	121.800	89.333	95.000	0.667	8933.000	17883.531
E	7.667	29.667	13.000	2.152	113.680	94.600	97.000	1.067	9460.000	19479.480
F	7.667	29.667	28.000	2.130	112.933	90.000	96.000	1.067	9000.000	18280.505
G	7.667	29.667	47.000	1.980	127.540	73.667	89.000	0.800	7366.700	13692.537
F Between treatments	0.240	0.06	32.360**	2.860*	5.920**	7.660**	4.270**	0.680	36.270**	95850.000**
LSD 5%	-	-	7.440	0.137	8.655	8.027	4.895	-	368.800	6.882

Where: A (Mulberry ash daily), B (Mulberry ash daily + Common disinfectant in recommended time), C (Common disinfectant daily), D (Lime powder daily), E (Lime powder daily + Common disinfectant in recommended time), F (Common disinfectant in recommended time), G (Control without any application) & (*) significant at 0.05; (**) highly significant at 0.01.

Table 3: Mean values of nine characters of mulberry silkworm for treatments of lime and wood ash powders.

Character Treatment	Cocoon weight (g)	Cocoon shell Weight (g)	Pupal weight (g)	Cocoon shell ratio (%)	Silk productivity (C.g)	Filament Length (m)	Filament Weight (g)	Filament Size (denier)	Silk Ratio (%)
A	2.097	0.408	1.630	19.539	5.824	1077.150	0.245	2.072	37.047
B	2.159	0.429	1.669	20.000	6.123	1175.850	0.247	1.889	39.664
C	2.086	0.396	1.629	19.063	5.651	984.300	0.216	2.020	34.416
D	2.002	0.385	1.553	19.139	5.494	889.950	0.215	2.238	31.464
E	2.052	0.393	1.596	19.281	5.616	997.050	0.225	1.984	36.668
F	2.031	0.386	1.583	19.040	5.510	929.250	0.225	2.220	36.926
G	1.856	0.320	1.473	17.388	4.573	818.850	0.216	2.389	34.223
F Between treatments	10.300**	11.590**	5.880**	3.660**	11.580**	4.590**	1.170	2.500*	2.360*
LSD 5%	0.083	0.028	0.073	1.182	0.393	156.900	-	0.310	4.845

Where: A (Mulberry ash daily), B (Mulberry ash daily + Common disinfectant in recommended time), C (Common disinfectant daily), D (Lime powder daily), E (Lime powder daily + Common disinfectant in recommended time), F (Common disinfectant in recommended time), G (Control without any application) & (*) significant at 0.05; (**) highly significant at 0.01.

Table 4: Differences between sex and interaction between sex and treatments of five silkworm traits of lime and wood ash powders treatments.

Character Treatment	Cocoon weight (g)		Cocoon shell weight (g)		Pupal weight (g)		Cocoon shell ratio (%)		Silk productivity (C.g)	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
A	2.265	1.929	0.421	0.395	1.785	1.475	18.640	20.438	6.013	5.635
B	2.311	2.014	0.430	0.428	1.813	1.524	18.728	21.272	6.139	6.113
C	2.229	1.943	0.390	0.401	1.779	1.479	17.592	20.534	5.573	5.728
D	2.099	1.904	0.392	0.377	1.642	1.463	18.542	19.735	5.603	5.385
E	2.175	1.930	0.385	0.401	1.725	1.467	17.831	20.730	5.498	5.733
F	2.133	1.930	0.392	0.380	1.679	1.488	18.427	19.655	5.601	5.419
G	1.949	1.763	0.322	0.318	1.565	1.382	16.815	17.961	4.597	4.549
Mean	2.166	1.916	0.390	0.386	1.713	1.468	18.082	20.046	5.575	5.509
F Between Sex	121.460**		0.390		151.020**		37.440**		0.380	
F Treatment X Sex	0.920		0.580		1.240		0.900		0.500	
LSD 5%	-		-		-		-		-	

Where: A (Mulberry ash daily), B (Mulberry ash daily + Common disinfectant in recommended time), C (Common disinfectant daily), D (Lime powder daily), E (Lime powder daily + Common disinfectant in recommended time), F (Common disinfectant in recommended time), G (Control without any application) & (*) significant at 0.05; (**) highly significant at 0.01.

4. Conclusions

Basic materials of different six treatments were lime and mulberry wood ash. Combination between treated timing and number of treatments were adopted. For fifth larval duration, whole larval duration, 5th larval weight, larval mortality, number of cocoons per liter, cocooning percentage, pupation ratio, double cocoon percentage, cocoon crop by number and weight. Cocoon weight, cocoon

shell weight, pupal weight, cocoon shell ratio, silk productivity for female and male, filament length, filament weight, filament size and silk ratio traits.

Using mulberry wood ash daily and common disinfectant generally acquired the best results. So, this treatment was recommended for enhancement the rearing mulberry silkworm, *Bombyx mori* L.

5. References

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