BIBLIOGRAPHY

BOCLONGAN, ALAIN M. OCTOBER 2007. Influence of Alfonso and Kanva-2 Mulberry Varieties on the Growth and Cocoon Yield of PTRI SW-4 Hybrid Silkworm (*Bombyx Mori* L.). Benguet State University, La Trinidad, Benguet.

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ABSTRACT

Three mulberry (*Morus Alba* L.) varieties namely Batac, Alfonso and Kanva-2 were fed to PTRI SW-4 hybrid silkworm (*Bombyx Mori* L.) to determine the best variety/cultivars in silkworm rearing and cocoon production. Batac was used as standard check. The study was conducted from March to April, 2007 at the Benguet State University Sericulture Project, Puguis, La Trinidad Benguet and at Philippine Textile Research Institute, La Trinidad, Benguet.

The three mulberry varieties gave no significant differences on the larval duration, average larval weight, number of defective or waste cocoons, average whole cocoon weight, number of good cocoons per liter, cocoon shell percentage, cocoon filament length and denier. The Batac variety gave a significant effect on PTRI SW-4 hybrid silkworm's good cocoon recovery. The Batac mulberry variety (standard check) had a significant higher percentage of good cocoons than the two other mulberry varieties. In terms of good cocoon recovery, silkworm rearing using The Batac variety is better than Alfonso and Kanva-2 varieties. However, Kanva-2 and Batac were almost the same in all parameters.

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INTRODUCTION

The insect that produces mulberry silk is a domesticated variety of silkworm which belongs to Genus *Bombyx* under family *Bombycideae*. The mulberry silkworm is monophagous to mulberry plant because of the attractant morin present in it. The test silkworm, PTRI SW-4 is a local hybrid variety of silkworm that was derived from C102 and J102. C102 is a purebreed Chinese variety while J102 is a purebreed Japanese variety.

Mulberry sericulture is based on the mulberry leaf yield because the leaf contributes more than one third (33%) of the cocoon produced (Das *et al*., 1974). This plant, which originated from the lower slopes of the Himalayas, is a hardly perennial and can grow in almost any type of soil under various climatic conditions including that of the tropics (FAO, 1976).

It is not only the quantity, but also the quality of the mulberry leaf involving various physical, chemical/biochemical characters that are known to influence silkworm rearing. Sericulturists, however, often overlook that the bulk production of leaves is not always consistent with their high nutritional status (Purohit *et al.,* 1996).

The quality of mulberry leaf varieties has a predominating influence on the development of the silkworms and the quality of cocoons produced. If silkworm rearing and cocoon production are to be successful, it is very important that the mulberry leaves are highly nutritive and fresh for feeding silkworm. In La Trinidad, Benguet; several foreign and local varieties were introduced one after the other. Since the leaf yield and physical characters of these varieties vary greatly, they have

to be tested for their nutritive value by feeding them to different silkworm varieties (Alos, 1996).

This study was be conducted to serve as a reference by providing knowledge on the different mulberry varieties found in the locality for silkworm rearing. The results could be recommended for mass cultivation and, consequently, for silkworm rearing and profitable local cocoon production.

The objectives of the study were;

1. To determine the best locally introduced mulberry variety/varieties for rearing PTRI SW-4 hybrid silkworm.
2. To evaluate the effects of the two mulberry varieties on the larval growth characteristics, cocoon yield, cocoon filament length and denier.
3. To establish the best local mulberry variety to be recommended for mass cultivation for profitable commercial or seed cocoon production.

This study was conducted at the Benguet State University Sericulture Project, Puguis, La Trinidad, Benguet and at the Philippine Textile Research Institute at La Trinidad, Benguet from March to April, 2007.

REVIEW OF LITERATURE

Alos (1996) stated that mulberry leaf variety has a predominating influence on the development of the silkworm and quality of cocoons.

Das *et al*., (1974) stated that the events of mulberry sericulture begin with cultivation of suitable and best fit mulberry variety for an ecozone. Vegetative propagation efficiency is one of the desirable traits of superior varieties.

Not only the quantity, but also the quality of the mulberry leaf, involving various physical, chemical/biochemical characters, is known to influence the condition of silkworm rearing. However, sericulturists, in their enthusiasm to produce large quantities of leaves, often overlook that bulk production of leaves is not always consistent with their high nutritional status (Puruhit and Kumar, 1996).

Appropriate feeding of mulberry to grown silkworms at the fourth and fifth instars is ensured if farmers use the branch or shoot rearing method in which a whole branch of mulberry leaves is placed on the rearing bed. The advantages of the method are as follows: normal daily feeding can be provided three times and mulberry leaves are fresher than other methods used. It is also relatively easier to combine this with spacing, bed cleaning and more silkworms can be simultaneously reared at a lower cost. On the other hand, the leaf feeding method has declined in favor of the branch feeding method considering that branch feeding is preferred especially by medium farmers and large-scale rearers (Felix, 1996).

Diban (1997) stated that evolution and selection of mulberry varieties is a lengthy process involving domestication and evaluation under specific climatic and management condition. She further stated that agricultural varieties are groups of similar planes, by which structural features and performance may be identified from the other varieties with the same species. She also said that the yield and leaf content of mulberry varieties vary greatly, and as a consequence, immeasurable varieties have to be tested for their characteristics.

Moreover, Dalang (1997) stated that the quality of mulberry leaves affect the economic properties of the present generation of silkworm physique, cocoon quality, voltinism and moultinism.

Furthermore, Capegsan (2001) stated that among the various environmental factors which influence the cocoon crops, the most important are the quality and quantity of leaf supply, atmospheric temperature and humidity prevailing at the time of rearing and the techniques of rearing adopted. Examples to theses are the rearing, cleaning and spacing of the rearing beds.

Lastly, silkworm larvae ingest about fifty grams of mulberry leaves. About 64% of the nitrogen contained in the leaves is used for photosynthesis. One larva can produce about 0.6 grams of silk protein, estimated as the cocoon filament which consist or about 80% fibroin and 20% sericin which has a fibroin length of 1,000 – 1,500 meters per cocoon (Curiman, 2002).

MATERIALS AND METHODS

A total of nine hundred (900) PTRI SW-4 hybrid silkworm larvae were used in this study. Meanwhile, the two mulberry varieties that were mainly evaluated were Alfonso and Kanva-2 while Batac was used to serve as standard check. The other materials used were: rearing trays, rearing stands, weighing scale, heater, thermometer, hygrometer, cocooning frame, knife/bolo, chopping board, nets, lime, paraffin papers, news papers, container and data sheets. The Standard Silkworm Rearing Procedure was followed (Appendix No. 10). Each treatment was replicated three times with 100 worms per replication following the Completely Randomized Design (CRD). The different mulberry varieties were gathered from the BSU Sericulture Project, at Puguis, La Trinidad, Benguet. The different treatments were as follows:

Treatment	Mulberry Variety
T_1	Batac (Standard check)
T_2	Alfonso
T_3	Kanva-2

Data Gathered:

1. Larval duration (days). The duration of the larval period was determined by recording the days from brushing the silkworm until cocoon formation.
2. Average larval weight (g). This was gathered and determined by weighing ten samples of each replicates of 5th Instars (mature larvae before spinning). The total

weight was divided by ten (10) and the quotient indicates the maximum larval weight.

The average larval weight was computed as follows:

$$LW = \frac{\text{weight of 10 sample larvae per replicate}}{10}$$

3. Good cocoon recovery (%). This was obtained by counting the good cocoons formed per replicate and dividing the number by the standard number of worms per replicate and then multiplied by one hundred (100). Good cocoon recovery was computed by using the following formula:

$$GC = \frac{\text{Number of good cocoons} \times 100}{100}$$

4. Number of defective cocoons. This was obtained by counting the different defective cocoons such as double cocoon, flimsy cocoon, malformed cocoon, thin ends cocoon, inside-stained cocoon, loose formed cocoon and very loose formed cocoon (waste cocoon).
5. Average whole cocoon weight (g). This was determined by weighing ten (10) randomly taken good cocoons and the weight was divided by ten (10) as shown below:

$$AWCW = \frac{\text{10 randomly taken whole good cocoons}}{10}$$

6. Number of good cocoons per liter. This was determined by counting the number of good cocoons accommodated by one (1) liter beaker.
7. Cocoon shell percentage (%). This was taken by cut-opening ten (10) good cocoons per replicate and weighing it to obtain the whole cocoon weight; the Cocoon shell was weighed in the weighing balance.

The cocoon shell percentage was computed by using the following formula:

$$CS\ \% = \frac{\text{Weight of shell}}{\text{Whole cocoon weight}} \times 100$$

8. Cocoon filament length (m). This was determined by individual reeling of three cocoons randomly obtained per replicate in an epprovette and recording each cocoon's filament length as shown by the epprovette.

9. Denier. The size of silk thread in denier was obtained by using the following formula:

$$D = \frac{\text{Filament weight}}{\text{Filament length}} \times 9000$$

RESULTS AND DISCUSSION

Larval Duration

Table 1 shows the number of days the silkworms completed their larval stage. Statistical analysis revealed no significant differences among the treatment means on the larval duration. Results showed that the three (3) mulberry varieties Batac, Alfonso, and Kanva-2 have the same larval duration of 27 days. This implies that these mulberry varieties did not significantly differ from each in terms of affecting the larval growth duration.

Average Larval Weight

Table 2 presents the average larval weight. Statistical analysis showed no significant differences among treatment means. Nevertheless, Kanva-2 and Batac had slightly higher larval weight with a mean of 4.05grams while Alfonso gave the lowest larval weight with a mean of 4.04grams.Table 2 also revealed that the three mulberry varieties had a little difference in terms of affecting the average larval weight.

Table 1. Larval duration

TREATMENT	MEAN (days)
T_1.Batac (Standard Check)	27
T_2-Alfonso	27
T_3-Kanva-2	27

*Means with the same letter are not significantly different at 5% level DMRT.

Table 2. Average larval weight

TREATMENT	MEAN (g)
T_1-Batac (Standard Check)	4.05
T_2-Alfonso	4.04
T_3-Kanva-2	4.05

*Means with the same letter are not significantly different at 5% level DMRT.

Good Cocoon Recovery

The good cocoon recovery as affected by the three mulberry varieties is presented in Table 3. Statistical analysis showed a significant difference among the three treatment means. Batac mulberry variety gave the highest recovery of good cocoons with a mean of 71.66%, followed by Kanva-2 variety with a mean of 68.33%. Finally, Alfonso variety had the lowest mean of 66.33%.

The mulberry Batac mulberry variety had a significant higher percentage of good cocoons than the two other mulberry varieties. In terms of good cocoons recovery, silkworm rearing using the Batac mulberry variety is better than Alfonso and Kanva-2 varieties. Although, Alfonso and Kanva-2 produced good cocoons, they had lower quality than the silkworm fed with Batac variety.

Table 3. Good cocoon recovery

TREATMENT	MEAN (%)
T_1-Batac (Standard Check)	71.66^{a}
T_2-Alfonso	66.33^{b}
T_3-Kanva-2	68.33^{ab}

*Means with the same letter are not significantly different at 5% level DMRT.

Number of Defective or Waste Cocoons

The number defective or waste cocoons were obtained by counting the different defective cocoons. Statistical analysis showed that there were no significant differences among the three mulberry varieties as presented in Table 4. Nevertheless, Kanva-2 variety had the highest mean of 10.00 followed by Alfonso variety with a mean of 8.33, while Batac variety gave the lowest mean of 8.00 in the number of defective or waste cocoons. Furthermore, Kanva-2 variety had a higher mean than Alfonso and Batac varieties in terms of this parameter.

Average Whole Cocoon Weight

Table 5 shows the average whole cocoon weight; Statistical analysis revealed that there were no significant differences among the different mulberry varieties fed to the silkworm. However, Batac variety gave the highest mean of 2.09grams while Alfonso and Kanva-2 varieties had the same mean of 2.03grams average whole cocoon weight.

Table 4. Number of defective or waste cocoons

TREATMENT	MEAN
T_1-Batac (Standard Check)	8.00
T_2-Alfonso	8.33
T_3-Kanva-2	10.00

*Means with the same letter are not significantly different at 5% level DMRT.

Table 5. Average whole cocoon weight

TREATMENT	MEAN (g)
T_1-Batac (Standard Check)	2.09
T_2-Alfonso	2.03
T_3-Kanva-2	2.03

*Means with the same letter are not significantly different at 5% level DMRT.

Number of Good Cocoons per Liter

Statistical analysis showed no significant differences on the number of cocoon per liter as shown by Table 6. However, the Batac and Kanva-2 mulberry varieties gave slightly higher number of cocoon per liter with the same mean of 82.00 while the Alfonso mulberry variety produced the lowest number of cocoon per liter with a mean of 81.33.

Table 6. Number of good cocoons per liter

TREATMENT	MEAN
T_1-Batac (Standard Check)	82.00
T_2-Alfonso	81.33
T_3-Kanva-2	82.00

*Means with the same letter are not significantly different at 5% level DMRT.

Cocoon Shell Percentage

Table 7 shows the cocoon shell percentage as affected by the treatments. Results gave no significant differences as revealed by statistical analysis. However, Batac variety yielded the highest cocoon shell percentage with a mean of 23.25%, followed by Kanva-2 variety with a mean of 22.71%. Alfonso gave the lowest mean percentage of 21.71%.

Cocoon Filament Length

The cocoon filament length is shown in Table 8, Statistical analysis revealed no significant differences among treatment means. However, Batac obtained the longest filament length with a mean of 1,242.89 meters, followed by Kanva-2 with a mean of 1,195.88 meters. Meanwhile, Alfonso gave the shortest filament length with mean of 1,144.44 meters.

Table 7. Cocoon shell percentage

TREATMENT	MEAN (%)
T_1-Batac (Standard Check)	23.25
T_2-Alfonso	21.71
T_3-Kanva-2	22.71

*Means with the same letter are not significantly different at 5% level DMRT.

Table 8. Cocoon filament length

TREATMENT	MEAN (m)
T_1-Batac (Standard Check)	1242.89
T_2-Alfonso	1144.44
T_3-Kanva-2	1195.88

*Means with the same letter are not significantly different at 5% level DMRT.

Denier

Denier determines the size of silk thread. Table 9 shows the Denier results of the cocoons fed with the three mulberry varieties. Statistical analysis proved that there were no significant differences among the treatment means. However, Batac variety yielded the highest mean of 2.48, followed by Kanva-2 with a mean of 2.45, while Alfonso yielded the lowest mean of 2.43.

Table 9. Denier

TREATMENT	MEAN
T_1-Batac (Standard Check)	2.48
T_2-Alfonso	2.43
T_3-Kanva-2	2.45

*Means with the same letter are not significantly different at 5% level DMRT.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The influence of Alfonso and Kanva-2 mulberry varieties on the growth and cocoon yield of PTRI SW-4 hybrid silkworm was studied at the Benguet State University Sericulture Project, and at the Philippine Textile Research Institute Technology Center at La Trinidad, Benguet from March to April 2007. The parameters used for evaluation were: larval duration, average larval weight, good cocoon recovery, number of defective or waste cocoons, average whole cocoon weight, number of good cocoons per liter, cocoon shell percentage, cocoon filament length and denier.

There were three trials used and each treatment was replicated three times with 100 worms per replication following the completely randomized design (CRD). The different mulberry varieties were gathered from the BSU Sericulture Project. A total of nine hundred (900) PTRI SW-4 silkworm eggs were used for this study. The silkworm eggs were obtained at PTRI-La Trinidad where they were acid treated and incubated. Afterwards, it was brushed and reared at BSU Sericulture Project from first instar until mounting and harvest. The harvested cocoons were then assessed for its quality at Philippine Textile Research Institute (PTRI).

Conclusion

Results of this study revealed that the three mulberry varieties tested did not significantly affect the performance of PTRI SW-4 hybrid silkworm on the larval

duration, average larval weight, number of defective or waste cocoons, average whole cocoon weight, number of good cocoons per liter, cocoon shell percentage, cocoon filament length and denier. However, statistical analysis showed that Batac variety gave a significant effect on good cocoon recovery of PTRI SW-4 hybrid silkworm. This mulberry variety had the highest recovery of good cocoons with a mean of 71.66%, followed by Kanva-2 variety with a mean of 68.33% while Alfonso variety had the lowest mean of 66.33%. Batac also had slightly high mean on the average whole cocoon weight, cocoon shell percentage, cocoon filament length and denier. While, Kanva-2 variety had gave high number of defective or waste cocoons and have the same mean with Batac variety in larval duration, average larval weight and number of good cocoon per liter. Lastly, the Alfonso variety did not significantly differ from the standard check (Batac) in terms of the performance of PTRI SW-4 hybrid silkworm in all the parameters used.

Recommendation

Based on the overall results of this study, Batac variety is still recommended in the rearing of PTRI SW-4 hybrid silkworm for good cocoon recovery which could give a profitable sericulture business enterprise. The other mulberry varieties (Kanva-2 and Alfonso), especially Kanva-2, are also recommended as alternative feeds for silkworm rearing.

Finally, the researcher recommends that further similar studies be conducted using other silkworm hybrids and a year-round experiment be done.

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APPENDICES

APPENDIX TABLE 1. Larval duration (days)

TREATMENTS	REPLICATIONS 1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	27	27	27	81	27
T_2-Alfonso Variety	27	27	27	81	27
T_3-Kanva-2 Variety	27	27	27	81	27
TOTAL				243	27

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	0	0	0^{ns}	6.94	18.0
Error	4	0	0			
TOTAL	6	0				

ns- not significant CV = 0%

APPENDIX TABLE 2. Average larval/weight (g)

TREATMENTS	REPLICATIONS 1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	4.07	4.05	4.03	12.15	4.05
T_2-Alfonso Variety	4.03	4.04	4.06	12.13	4.04
T_3-Kanva-2 Variety	4.05	4.06	4.05	12.16	4.05
TOTAL				36.44	4.04

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	0.0001	0.00007	0.24^{ns}	6.94	18.0
Error	4	0.0003	0.00032			
TOTAL	6	0.0004				

ns- not significant CV= 0.45%

APPENDIX TABLE 3. Good cocoon recovery (%)

	REPLICATIONS				
TREATMENTS	1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	74	69	72	215	71.66
T_2-Alfonso Variety	70	65	64	199	66.33
T_3-Kanva-2 Variety	68	67	69	204	68.00
TOTAL				618	68.66

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	43.5555	21.7777	7.84 **	6.94	18.0
Error	4	11.1111	2.7777			
TOTAL	6	54.6666				

** = highly significant CV= 2.42%

APPENDIX TABLE 4. Number of defective or waste cocoons

TREATMENTS	REPLICATIONS 1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	8	9	7	24	8
T_2-Alfonso Variety	11	8	6	25	8.33
T_3-Kanva-2 Variety	8	12	10	30	10
TOTAL				79	8.77

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	6.8888	3.4444	0.84 ^{ns}	6.94	18.0
Error	4	16.4444	4.1111			
TOTAL	4	23.3333				

ns-not significant CV= 24%

APPENDIX TABLE 5. Average whole cocoon weight (g)

	REPLICATIONS				
TREATMENTS	1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	2.11	2.06	2.11	6.28	2.09
T_2-Alfonso Variety	2.06	2.13	1.90	6.09	2.03
T_3-Kanva-2 Variety	2.09	1.91	2.11	6.11	2.03
TOTAL				18.48	2.05

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	0.0072	0.0036	0.30 ^{ns}	6.94	18.0
Error	4	0.0486	0.0121			
TOTAL	4	0.0558				

ns-not significant CV= 5.37%

APPENDIX TABLE 6. Number of cocoons per liter

TREATMENTS	REPLICATIONS 1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	84	80	82	246	82.00
T_2-Alfonso Variety	78	84	82	244	81.33
T_3-Kanva-2 Variety	84	82	80	246	82.00
TOTAL				736	81.77

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	0.8888	0.4444	0.05 ^{ns}	6.94	18.0
Error	4	33.7777	8.4444			
TOTAL	4	34.6667				

ns-not significant CV= 3.55%

APPENDIX TABLE 7. Cocoon shell percentage (%)

	REPLICATIONS				
TREATMENTS	1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	24.27	23.97	21.31	69.55	23.18
T_2-Alfonso Variety	21.82	23.26	20.05	65.13	21.71
T_3-Kanva-2 Variety	23.48	22.70	21.46	67.64	22.54
TOTAL				202.32	22.47

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	3.6662	1.8331	3.49 ^{ns}	6.94	18.0
Error	4	2.1020	0.5255			
TOTAL	6	5.764				

ns-not significant CV= 3.21%

APPENDIX TABLE 8. Cocoon filament length (m)

TREATMENTS	REPLICATIONS 1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	1,319	1,233.66	1,176	3,728.66	1,242.66
T_2-Alfonso Variety	1,121	1,130	1,182.33	3,433.33	1,144.44
T_3-Kanva-2 Variety	1,229.66	1,265.33	1,092.66	3,587.65	1,195.88
TOTAL				10,7496.64	1,194.32

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	14546.47	7273.23	1.44 ^{ns}	6.94	18.0
Error	4	20147.37	5036.84			
TOTAL	6	34,6938.84				

ns-not significant CV= 5.94%

APPENDIX TABLE 9. Denier

	REPLICATIONS				
TREATMENTS	1	2	3	TOTAL	MEAN
T_1-Batac Variety (Standard Check)	2.59	2.33	2.52	7.44	2.48
T_2-Alfonso Variety	2.56	2.30	2.43	7.36	2.45
T_3-Kanva-2 Variety	2.70	2.27	2.39	7.36	2.45
TOTAL				22.16	2.46

ANNOVA TABLE

Source of Variation	Degree of freedom	Sum of squares	Mean of squares	F	Tabulated $F_{0.05}$	Tabulated $F_{0.01}$
Treatment	2	0.0037	0.0018	0.42 ^{ns}	6.94	18.0
Error	4	0.0177	0.0044			
TOTAL	4	0.0214				

ns-not significant CV= 2.71%

Appendix B. STANDARD SILKWORM REARING PROCEDURE

I. Silkworm Rearing House Disinfection

Before rearing starts; the room and implements is cleaned, washed and dried. Formalin is prepared using 16 liters of water to be mixed in 3% formalin. The solution is used in fumigating the rearing room. Upon disinfection, the rearing room is tightly closed for 24 hours to ensure effective disinfection. This is done ten days before brushing, Disinfection is effective at a higher temperature above 24ºC, and it is conducted at 11:00 am. As for the other implements this are soaked in 2% formaldehyde solution, followed by sun-drying.

The nine hundred (900) newly-hatched larvae (PTRISW-4) were separated from the egg cards by placing finely chopped mulberry leaves over them. Afterwards, they were transferred in a clean rearing tray by brushing the worms with the use of white, clean feather.

II. Feeding

The silkworms is fed three times a day, respectively at 7:00 am, 1: 00 pm and 6: 00 pm. Young –ages (1^{st} – 3^{rd} instar) is fed with finely chopped mulberry leaves while grown-up stage (4^{th} – 5^{th} instar) is fed with the whole leaves. The leaves are harvested by leaf plucking.

III. Bed Cleaning

Bed cleaning is done using nets placed with, finely chopped mulberry leaves for the young ages while, whole leaves for the grown-up stage. The net is lifted when all the larvae have crawled up to be transferred in a separate tray. This is maintained to reduce heat and avoid immediate respiration of the mulberry leaves which may cause drying and silkworm diseases.

IV. Bed Spacing

As the silkworm grows and develops, the size of the rearing bed is enlarged accordingly. The worms is arranged evenly, neither too crowded nor spaced too far apart, as either would cause insufficient feeding and irregularity in development or waste of leaves and rearing appliances.

Spacing is carried out together with bed cleaning or feeding. Clean chopsticks and clean white feathers is used to enlarge the bed for the young worms and for the grown worms.

V. Silkworm Disinfection

In silkworm rearing, the outbreak of diseases is closely related to the hygienic conditions of the rearing beds. Pathogens are usually excreted by the worm's droppings, which will contaminate the mulberry. If healthy worms eat the feces, they can contact diseases. Since rearing beds are the main source for the rearing of the pathogens, disinfection of the beds is essential. Lime powder is generally used to disinfect the worm's body and the rearing beds. Fresh lime powder has a strong

disinfecting effect on many diseases. It also has an antidotal effect on chemically polluted leaves. Fresh lime powder can isolate pathogens and keep the rearing beds dry. There are also some disinfecting chemical alternatives like burnt rice hull with formalin and others.

VI. Mounting

This is done by picking the matured worms and placing them in the cocooning frame after 19-25 days of rearing. Matured worms are determined with the following characters: body color is translucent, eat less mulberry leaves, and wave its head and moves towards the periphery in search for spinning area.

VII. Cocoon Harvesting

Harvesting of the cocoons is done seven days after mounting. After which the harvested cocoons is deflossed and sorted, respectively, in each treatment replication.