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## Silk cocoon production — Code of practice



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## **Foreword**

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 357 was prepared by Technical Committee RSB/TC 029, *Textiles and Leather Engineering*,

In the preparation of this standard, reference was made to the following standard

### **Thai Agricultural Standard TAS 8201-2012**

The assistance derived from the above source is hereby acknowledged with thanks.

### **Committee membership**

The following organizations were represented on the Technical Committee on Textiles and Leather Engineering (RSB/TC 029) in the preparation of this standard.

C&H

Consumer Association (ADECOR)

National Agricultural Export Board (NAEB)

National Industrial Research Institute (NIRDA)

Rwanda Development Board (RDB)

University of Rwanda- College of Science and Technology ( UR-CST)

UTEXRWA

Rwanda Standards Board (RSB) – Secretariat

# Silk cocoon production — Code of practice

## 1 Scope

This Draft Rwanda Standard establishes the production practices for fresh cocoon made by silkworm caterpillar (*bombyx mori*), fed on mulberry leaves. This standard covers every activity of production from the rearing house to transport in order to obtain good quality silk

## 2 Terms and definitions

For the purposes of this standard, the following terms and definitions apply

### 2.1

#### Young larva or young stage silkworm

larva from hatched egg to the full grown third instar larva. (the third pre-moulting silkworm )

- First instar larva means larva from hatched egg to before the first moulting. At this stage, the larva feeds on mulberry leaves 3 to 4 days then stops eating and begins to moult (Figure A.1).
- Second instar larva means larva after the first moulting to before the second moulting. At this stage, the larva feeds on mulberry leaves 2 to 3 days then begins to moult (Figure A.1).
- Third instar larva means larva after the second moulting to before the third moulting. At this stage, the larva feeds on mulberry leaves 3 to 4 days then begins to moult (Figure A.1).
- Moulting: the manner in which an animal routinely casts off a part of its body (often, but not always, an outer layer or covering), either at specific times of the year, or at specific points in its life cycle

### 2.2

#### Grown larva or grown stage silkworm

means larva from the fourth to the fifth instar.

- Fourth instar larva means larva after the third moulting to before the fourth moulting. At this stage, the larva feeds on mulberry leaves 3 to 4 days then begins to moult (Figure A.1).
- Fifth instar larva means larva after the fourth moulting to pupa stage. At this stage, the larva feeds on mulberry leaves 6 to 8 days (Figure A.1).

## 2.3

### **Pre-moulting silkworm**

fully grown larva at each stage, stops eating, and its skin becomes lustrous and ready to moult by shedding its skin. This can be observed from the connected part between head and thorax (Figure A.2) with triangular shape (Figure A.3).

## 2.4

### **Post-moulting silkworm**

larva after moulting and start eating. The characteristics can be described by bigger head and paler colour than that of the pre-moulting silkworm. The skin is also wrinkled (Figure A.4).

## 2.5

### **Mature silkworm**

fully grown silkworm at the fifth instar larva that is ready to form its cocoon (Figure A.5).

## 2.6

### **Mounting frame or cocooning frame**

material on which cocoon is formed.

## 2.7

### **Cocoon**

the outer protective shell spun by silkworm larva covering itself before transforming into pupa stage. Usually, cocoon for the market consists of pupa and slough inside.

## 2.8

### **Fresh cocoon**

cocoon that consists of a live pupa, shell, and slough including cocoon with and without de-flossing.

## 2.9

### **Good cocoon or normal cocoon**

cocoon that shall be characteristic of its variety, free of stains, and no rough shell, with live pupa, and well-formed silk filament.

## 2.10

### Defect cocoon or poor cocoon

Defect cocoon or poor cocoon means cocoon whose shape is deviated from its variety characteristics or abnormal characteristics i.e. double cocoon (Figure A.6), pierced cocoon (Figure A.7), inside soiled cocoon (Figure A.8), outside soiled cocoon (Figure A.9), thin-shelled cocoon (Figure A.10), loose-shelled cocoon (Figure A.11), thin-ended cocoon (Figure A.12), malformed cocoon (Figure A.13), printed cocoon (Figure A.14), crushed cocoon (Figure A.15), and mouldy cocoon (Figure A.16).

## 2.11

### Pebrine disease

protozoan disease of the silkworm, *Bombyx mori* L. caused mainly by *Nosema bombycis* Naegeli and can be transmitted via silkworm eggs

NOTE This disease is prohibited.

## 3 Requirements

### 3.1 General

Requirements of good practices for silk cocoon production are classified into 3 levels as follows:

- a) Major requirements mean the mandatory provisions that shall be complied with. In case of non-compliance, it will directly or seriously affect the quality of silk cocoons. It also includes the requirements under relevant laws and regulations as per the Sericulture centre regulations.
- b) Minor requirements mean the provisions that should be complied. In case of non compliance, it will indirectly affect quality of silk cocoons.
- c) Recommendations mean the provisions that are recommended for practices to help achieve the objectives of this Good Practices for Silk Cocoon Production.

### 3.2 Specific requirements

Requirements of Good Practices for Silk Cocoon Production shall be as per clauses 3.2.1- 3.2.3.

#### 3.2.1 Major requirements

##### 3.2.1.1 Silkworm rearing house

**3.2.1.1.1** Keep distance from the area prone to risk causing adverse health effect on silkworms such as area of pesticide application and air-polluted source. In case of risk, there shall be preventive measures in place.

**3.4.1.1.2** Clean, and not be disease harbourage affecting the health of silkworms

**3.4.1.1.3** Availability of good ventilation

**3.4.1.1.4** Availability of adequate space for rearing silkworms

**3.4.1.1.5** Availability of preventive measures for direct sunlight onto silkworms

**3.4.1.1.6** Availability of preventive measures from rain

**3.4.1.1.7** Availability of a treatment plan when pests attack the silkworms

**3.4.1.1.8** Availability of preventive measures for disease carrying pests

**3.4.1.1.9** Availability of preventive measures for pests of silkworms and cocoons e.g. Uzi fly (*Exorista bombycis* Louis), spider, ant, lizard, gecko, and rat

### **3.2.1.2 Production inputs**

#### **3.2.1.2.1 Silkworm eggs**

**3.2.1.2.1.1** Eggs are from the source that female moths have been inspected and certified for the absence of pebrine disease.

**3.2.1.2.1.2** Come from sources with good transport management, temperature not higher than 25 oC, relative humidity not less than 80%, and not be affected by light

#### **3.2.1.2.2 Third instar larva (in case that farmer does not rear the first and second instar larva)**

Silkworm eggs shall come from the source that female moths have been inspected and certified for the absence of pebrine disease. The preventive measures for disease in young larva rearing house shall be available.

#### **3.2.1.2.3 Mulberry leaves**

The mulberry plot shall be kept distance from the pesticide application area or air-polluted source. In case of risk, there shall be preventive measures in place.

#### **3.2.1.2.4 Moisture absorbent**

Availability of moisture absorbent e.g. lime and burned paddy husks (burned paddy husks shall be in their original raw shape, and not in powder)

#### **3.2.1.2.5 Cleaning agent and disinfectant**

Availability of effective cleaning agents and disinfectants for eliminating mould, bacteria, virus, and protozoa on equipment and rearing house



**3.2.1.2.6 Materials, tools and equipment**

**3.2.1.2.6.1** Materials, tools and equipment for silkworm rearing, mounting, and storage of mulberry leaves, e.g. feathers, rearing trays, leaf containers, knives, cutting board, flat baskets, mounting frames shall be clean and disinfected.

**3.2.1.2.6.2** Availability of nets or materials to enable discarding silkworm excreta and to be appropriate to silkworm stages

**3.2.1.2.6.3** Any mounting frame shall be well ventilated and shall not cause silkworm waste accumulation affecting cocoon quality and efficiency of silk reeling.

**3.2.1.2.6.4** Cocoon containers shall be airy and well ventilated.

**3.2.1.2.6.5** Availability of properly working thermometer and relative humidity devices

**3.2.1.2.7 Silkworm management and rearing****3.2.1.2.7.1 General management**

**3.2.1.2.7.1.1** Enlarged area of silkworm bed shall be provided in correspondence with each stage of the silkworm development.

**3.2.1.2.7.1.2** Collect, exterminate, and dispose of abnormal, weak, scrubby, and diseased silkworm properly.

**3.2.1.2.7.1.3** Collect slower post-moulting or under grown silkworm than that of the same development stage to rear separately.

**3.2.1.2.7.1.4** Availability of disposal measures for wastes e.g. silkworm excrete, mulberry branches and unconsumed leaves both inside and surrounding

**3.2.1.2.7.1.5** area of the rearing house.

**3.2.1.2.7.1.6** Adequate and continuous feeding of mulberry leaves at each meal by keeping their freshness and maintaining unconsumed leaves at low level to facilitate air flow and prevent accumulation of heat and dampness that cause disease to silkworm

**3.2.1.2.7.1.7** Manage density of silkworms not too crowded to prevent heat accumulation and insufficient feeding

**3.2.1.2.7.1.8** Prior to pre-moulting of silkworm, remove excreta and unconsumed leaves from rearing house and reduce moisture of such rearing house.

**3.2.1.2.7.1.9** After post-moulting of silkworm and before feeding of first meal of each development stage, there shall be prevention and disinfection from silkworm diseases.

**3.2.1.2.7.2 Rearing of young larva**

**3.2.1.2.7.2.1** Availability of clean material lining for rearing containers

**3.2.1.2.7.2.2** Properly prevent and disinfect the larvae from the disease that may be carried by the infected larvae.

**3.2.1.2.7.2.3** Collection of newly hatched larvae from egg sheets.

**3.2.1.2.7.2.4** Carefully transfer to avoid causing any harm to the larvae.

**3.2.1.2.7.2.5** Evenly spread of larvae for their healthy growth.

**3.2.1.2.8 Management of mature silkworms and cocoons**

**3.2.1.2.8.1** Silkworms laid down on mounting frame shall be mature.

NOTE: Maturity for silkworms is 55 days

**3.2.1.2.8.2** Quantity of silkworms shall be proportional to the types and sizes of mounting frames to provide sufficient space for spinning with good air flow.

**3.2.1.2.8.3** Collect dead or non-spinning silkworms to exterminate and/or dispose properly.

**3.2.1.2.8.4** Harvest cocoons after larvae develop to fully formed pupae and when their skins turn yellow brown.

**3.2.1.2.8.5** De-floss the outer part covering cocoon shells.

**3.2.1.2.8.6** Sort defect cocoons from the good ones.

**3.2.1.2.8.7** Keep cocoons waiting for transportation in a manner that they are not too densely overlaid causing accumulated heat and moisture that affect cocoon quality.

**3.2.1.2.8.8** Packing shall not damage cocoon.

**3.2.1.2.9 Transportation of cocoons**

Prevent damage of cocoons from accumulation of heat and moisture by good ventilation management.

**3.2.1.2.10 Hygiene and cleanness**

**3.2.1.2.10.1** Availability of preventive measure for silkworm diseases that may be carried by persons entering the rearing house.

**3.2.1.2.10.2** Availability of cleaning and disinfecting measures for the surrounding area of rearing house.

**3.2.1.2.10.3** Availability of cleaning and disinfecting measures for transported vehicle for silkworm eggs and larvae.

**3.2.1.2.10.4** There shall be disposal measures for wastes e.g. silkworm excrete, mulberry branches and leaves after each rearing cycle both inside and surrounding area of the rearing house to prevent the spread of diseases.

**3.2.1.2.10.5** In case of disease spreading in the rearing house, disinfection shall be carried out before moving tools, equipment, and remaining materials, including silkworm excrete.

#### **3.2.1.2.11 Record keeping**

Record the following information:

- a) day-month-year of silkworm mounting;
- b) daily temperature and relative humidity of silkworm rearing house;
- c) keep records for at least 1 year;
- d) day-month-year of harvesting fresh cocoon;
- e) day-month-year of the first hatching
- f) application of substances used to prevent and control silkworm diseases; and
- g) cleaning and disfecting the tools, equipment and materials used

### **3.2.2 Minor requirements**

#### **3.2.2.1 Production inputs**

##### **3.2.2.1.1 Silkworm eggs**

Known date (day/month/year) of production

##### **3.2.2.1.2 Mulberry leaves**

**3.2.2.1.2.1** The quantity of mulberry leaves shall be sufficient for feeding each lot of silkworms.

**3.2.2.1.2.2** Mulberry leaves should be fresh, clean, without damage from pests and diseases that affect the health of silkworms.

#### **3.2.2.2 Materials, tools and equipment**

Availability of clean, moisture preserved, and well ventilated covering materials used for young larva rearing tray or container

### **3.2.2.3 Silkworm management and rearing**

#### **3.2.2.3.1 General management**

Appropriate maturity of mulberry leaves should be suitable for each stage of the silkworm development in order to provide sufficient nutrients.

#### **3.2.2.3.2 Rearing of young larva**

**3.2.2.3.2.1** Mulberry leaves for feeding shall be chopped to appropriate size and shape and spread evenly to help larva eating.

**3.2.2.3.2.2** Areas or shelves allocated for flat basket for newly hatched larvae shall be of temperature between 27°C and 28°C and relative humidity not lower than 90%.

**3.2.2.3.2.3** Areas or shelves allocated for flat basket for larvae of the second and third instar larva shall be of temperature between 26°C and 28°C and relative humidity not lower than 80% except the times before pre-moulting silkworm and during moulting.

#### **3.2.2.4 Management of mature silkworms and cocoons**

Place mounting frame of spinning silkworms in the area of relative humidity between 65% and 70%.

#### **3.2.2.5 Record keeping**

Record the following information regarding day-month-year of egg incubation (in case of farmer self-operation)

### **3.2.3 Recommendations**

#### **3.2.3.1 Production inputs**

##### **3.2.3.1.1 Silkworm eggs**

**3.2.3.1.1.1** Known source of production

**3.2.3.1.1.2** Come from production source of not less than 90% hatching rate

##### **3.2.3.1.2 Third instar larva (in case that farmer does not rear the first and second instar larva)**

Come from the sources with good transport management, temperature not higher than 27°C, relative humidity between 75% and 85%. The transport should be done after moulting and feeding of the first meal. There should be preventive measures for pest in order to obtain the healthy third instar larva

#### **3.2.3.2 Materials, tools and equipment**

**3.2.3.2.1** Availability of sieve for even dispersion of moisture absorbents and disinfectants

**3.2.3.2.2** Availability of scale for weighing mulberry leaves

### **3.2.3.3 Silkworm management and rearing**

#### **3.2.3.3.1 Hatching (in case of farmer self-operation)**

Control temperature to be maintained between 25°C and 26°C, relative humidity to be maintained between 80% and 85%, and manage light exposure in order to develop healthy embryo and to hatch concurrently on specified period of time.

#### **3.2.3.3.2 Rearing of Grown larva**

Areas or shelves allocated for flat basket for rearing shall be of temperature between 24°C and 25°C and relative humidity between 70% and 75% except the times before pre-moulting and during moulting, the relative humidity shall be reduced

#### **3.2.3.3.4 Management of mature silkworms and cocoons**

**3.2.3.3.1** Place mounting frame of spinning silkworms in the area of temperature between 24°C and 25°C with good air flow.

**3.2.3.3.2** Sort the infected cocoons from the other defectives to exterminate and/or dispose or utilise properly

#### **3.2.3.5 Record keeping**

Record the following information:

- a) date and time of pre-moulting and postmoulting
- b) description of abnormality of silkworm
- c) problems and obstacles of each lot of rearing

## **4 Assessment Criteria**

Assessment criteria for compliance as detailed in clause 3 shall be as follows:

- a) All of the major requirements shall be fully complied with.
- b) The minor requirements shall be complied with not less than 60% of total number of minor
- c) requirements (the improvement up to 70% of all minor requirements shall be made within 2 years)

## Annex A (informative)

### Illustration of silk cocoon



Figure A.1 first to fifth instar lava of silk worm



Figure A.2 Silkworm



**Figure A.3 Premoulting silkworms**

Illustrating the triangular shape at junction of head and thorax



**Figure A.4 Post moulting silk worms**

Illustrating bigger head and paler colour than those of pre-moulting with wrinkled skin and start eating





**Figure A.5 Mature silkworm**

Illustrating transparent body with up-rising head and eagerly moving, ready for cocoon spinning

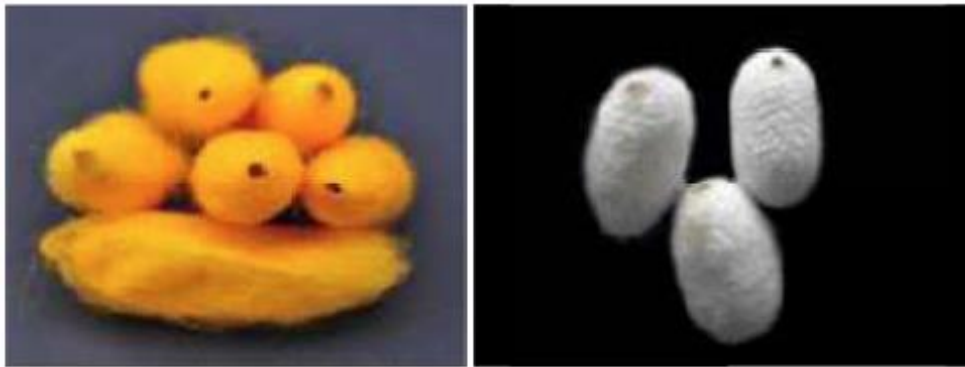


**Figure A.6 Double cocoon**

Double cocoon means a cocoon jointly built by at least two silkworms. Such cocoon, when reeling tends to break often because their silk baves intertwined with each other. The silk yarn is uneven and lower reeling efficiency. Double cocoon is caused by various reasons such as varieties, overcrowded silkworms per mounting frame, type of mounting frame is not proper for silk worms. Double cocoon is normally used as material for dupion

(Dupion means silk reeled from defective cocoons. The yarn is large and suitable for warp for weaving)





**Figure A.7 Pierced cocoon**

Pierced cocoon means a cocoon pierced by Uzi fly maggot, or silkworm moth, or ants, or other animals, leaving a hole on the cocoon and causing silk yarn breaking and rather low reeling efficiency



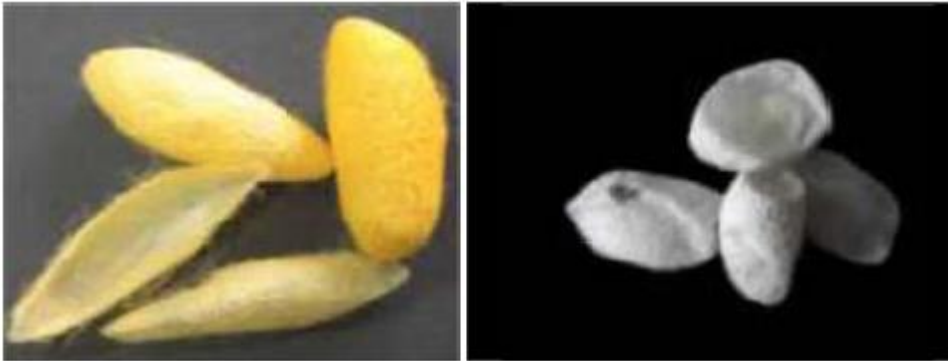
**Figure A.8 Inside soiled cocoon**

Inside soiled cocoon means a cocoon containing dead pupa or spinning by infected silkworm which dies inside either at larva or pupa stage, and causing stains. When reeling, will produce low quality silk yarn



**Figure A.9 outside soiled cocoon**

Outside soiled cocoon means cocoon stained by other silkworm excrete before cocooning or infected silkworm putrefied the cocoon, which makes it difficult to reel.



**Figure A.10 Thin-shelled cocoon**

Thin shelled cocoon means a cocoon produced by ill-fed silkworm with poor spinning ability and cause thin shell. In other case, the mature silkworm is late in mounting, thus spinning on the side of rearing trays or corner of rearing table.



**Figure A.11 Loose-shelled cocoon**

Loose-shelled cocoon means a cocoon produced under an improper environmental condition. The cocoon is flossy and not compact. When reeled, the yarn often breaks.



**Figure A.12 Thin-ended cocoon**

Thin ended cocoon means a cocoon that due to the characteristic of some silkworm varieties or caused by high temperature during egg incubation. Sometimes this occurs due to low temperature during cocooning. The cocoon is unusually thin at one end, and when boiled thinner part is soggy and broken and difficult to reel



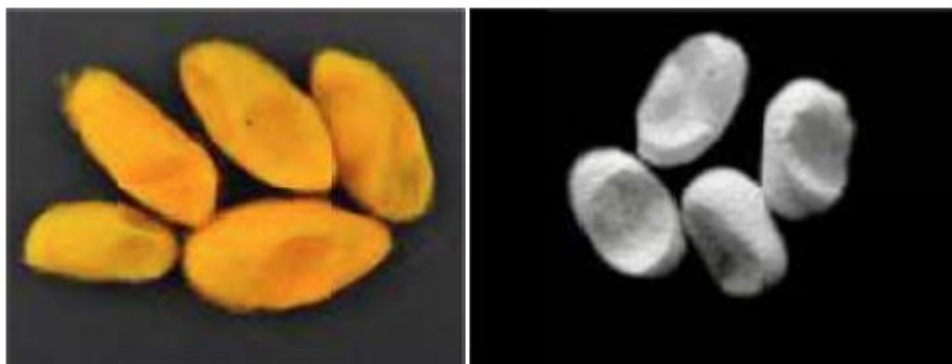
**Figure A.13 Malformed cocoon**

Malformed cocoon means a cocoon produced from silk worm in an inappropriate mounting frame, or from weak silkworm preventing the silkworms from completing the cocooning process and the cocoon shape becomes irregular. When boiled with normal cocoons, such cocoons are either soggy or harden depending on their characteristics.



**Figure A.14 Printed cocoon**

Printed cocoon or cocoon with prints of mounting frame means a cocoon produced by a silkworm attached to the edge of mounting frame or lining paper or improper mounting frame. The cocoon is too flat with some thicker parts due to overcrowded silkworms per mounting frame, leaving inadequate space for cocooning.



**Figure A.15 crushed cocoon**

Crushed cocoon means a cocoon caused by crushing to one another, over packing or inappropriate handling during transportation and storage.



**Figure A.16 Mouldy cocoon**

Mouldy cocoon means a cocoon stored under poor ventilation causing moisture accumulation in the container or the storage room. This condition allows mould to grow on the cocoon shell.

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- [1]    FAO Agricultural Services Bulletin 80. 1990. Sericulture Training Manual. FAO, Rome.
- [2]    FAO Agricultural Services Bulletin 73/2. 1992. Silkworm Rearing. FAO, Rome.

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