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Quality and quantity assessment of cocoon spinning by silkworm (*Bombyx mori)* on different montages

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ABSTRACT

This study investigates the different montages used in mounting silkworm before spinning of cocoon. In this investigation, palm fronts, basket, woven montages were used along with the plastic ones to study their efficacy. The silkworms were brushed into the rearing tray from disease-free egg card. After feeding on mulberry leaves for several days, silkworms of the 5th instars stop feeding and begin to spin cocoon. The result showed that 78% cocoon was formed from the palm front montage. This was followed by plastic montages 58%; woven montages 54%; but basket montage does not support the formation of cocoon 0%. The quality parameter that were measured include, cocoon weight, filament weight, filament length and pupa weight. Palmfront montages have the highest cocoon weight1.684gm, filament weight 0.125gm and pupa weight 1.235. The results obtained were summarized in table and graph. The palm fronts, from oil palm tree, are readily available to the rural and urban farmers in the community, exhibit the best cocoon formation. Palmfront montages, plastic montages and woven montages support the formation of cocoon. However the use of palmfront could be encourage having shown a better quantity and quality parameters.

Introduction

Sericulture which involves the rearing of silk-producing insects known as silkworm (*Bombyx mori*) is an agro-industrial endeavour which is unpopular in this part of the world although it has been in existence for about 5,000 years in china(Krishnaswami,1978). The development of these insects, start from the egg to larva through pupa to adulthood.

Cocoon shells produced by silkworm caterpillars are one kind of natural structures and polymeric composite materials which possess excellent mechanical properties (Kirshboim et al 2000). After feeding on mulberry leaves constantly for 4–6weeks (in order to store enough nutrient and to be able to shed their skins five times), silkworm larvae start to construct protective cocoons for their pupas. The cocoon protects the moth pupa against microbial degradation and desiccation during metamorphosis, and also protects against potential predators. A silkworm caterpillar spins a lightweight and compact cocoon around itself by continuously moving its head in the shape of either a figure 8 or an S and by cyclically bending and stretching its body. The construction of a cocoon needs approximately 3 days. After it has finished spinning the cocoon, the silkworm sheds its skin one last time and becomes a pupa. The silken cocoon shell is comfortable and protective, allowing the pupa in it to evolve into a silkworm moth. The ellipsoidal cocoon has the smallest thickness at its two ends so that the moth can break through it after the metamorphosis from pupa to moth (Lee, 1999). The cocoon has many wrinkles on its outer surface that form due to non-uniform shrinking during drying. Despite the introduction of man-made fibers to replace silk as a textile fiber, the advantages of man-made fiber like comparatively low prices, durability and wash and wear properties have not outweighed the indisputable superiority of silk regarding softness of feel, fitness, hygroscopic properties and above all, its incomparable affinity for dyes which are considered very important in textile industry(Aruga, 1994). The process of moving mature larva on to the cocoons frame is called mounting. Mounting process in silkworm rearing is the most labour intensive. Mounting should not be delayed when larvae mature as it results in loss of silk besides production of poor quality cocoons (Rajan, 2000). The material and structure of montages significantly affect the quality of cocoon filament and also the labour required for mounting and harvesting the cocoons. The basic concept of montages is to provide an angular uniform space for silkworm to facilitate easy cocoon formation. The fabrication and type of montages depends on the availability of chief materials in the respective places. If the material and structure of montages are not proper, it will affect the shape and size of cocoons, increases the number of double, deformed, stained cocoons and wastages of silk in the form of floss(Pang,1988.,Hiware,2001). The common montages used at present in Nigeria are made out of plastic materials which are expensive and not readily available. Thereby in this experiment, it is considered reasonable to use different mounting materials like woven montages, palm front montages, basket montages and plastic montages as a means of further enhancing cocoon formation quality and quantity. This is needed because the plastic montages is considered to be costly and scarce to come by hence to encourage the involvement of everybody especially the rural dwellers in sericulture, there is need to use common and cheaper materials that will reduce the cost of production to the minimum thus enhancing the viability of sericulture in Nigeria and other developing countries.

Methodology

This study was conducted at sericulture unit of Forest Products Development and Utilization Department of Forestry Research Institute of Nigeria, Ibadan, Oyo State. Two different hybridized varieties of silkworm namely Bivoltine 1 and Bivoltine 2 were used for the experiment. Fresh disease-free eggs of *Bombyx mori*.L were brushed into rearing trays.

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Brushing was done and reared in the rearing room up to cocoon stage at temperature range 21-25^{0}C with humidity range 82-95%. 800 silkworm larva were spread in 8 rearing trays after brushing. The silkworms were fed with mulberry leaves four times in a day. The monting treatment materials were mat-woven montages, plastic montages, palm front woven montages, and basket. Each mounting material was replicated four times. Hundred [100] silkworm larvae were mounted on different montages. Observations were made on daily basis from the beginning of the experiment to the end. Matured silkworms of the 5th instars stage were picked randomly from each tray. Those that have stopped feeding and ready for spinning cocoon were mounted on different montages. Data on the formation of the cocoon were collected. The cocoons formed were counted and the qualities of the cocoon were determined. The harvested cocoons were weighed, the pupa weight and fibre weight were determined using electronic weighing balance, number of flimsy cocoon, mortality rate were counted, fiber length was measured using meter rule.

Results and Discussion

The result presented in table 1 and 2 showed that cocoon can be formed in all the montages used except basket which does not have any suspension for the silkworm to attach. The highest value 78% of cocoon formation was observed under palm front montages. Plastic and woven montages also helped in the formation of the cocoon with 58% and 54% coccon formation respectively.

The result in table 1 and fig 1 showed that the highest yield of cocoon is gotten from palm front montages. It is evident from the mean data of the experiment (Table 1) that in general, montages of Palm front twigs, showed a marginal tendency to improve many of the economic characteristics as compared to the woven montages and plastic montage. The basket montage used does not support the formation of the cocoon by the larva, majority of the larva turn pupa without forming cocoon. The results as shown in Table 1 and Figure 1 with Photo Plate 1 were significantly different in all post-cocoon parameters.

Plate 1: 5th instar stage of silkworm

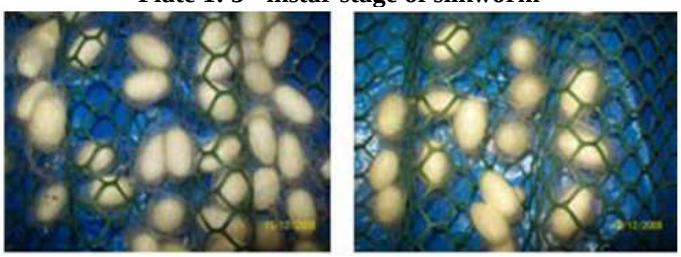

Plate 2: Cocoon formed under plastic montages

Plate 3: Cocoon formed under woven montages

Table 1: cocoon quality parameters among the four montages used

Types of montages	Cocoon weight (gm)	Cocoon formed (%)	Pupa weight (gm)	Shell weight (gm)	Filament weight (gm)	Filament length(m)
Plastic montages	1.320	58	1.050	0.178	0.095	456.98
Palm front montages	1.684	78	1.235	0.231	0.125	560.15
Woven montages	1.256	54	1.015	0.167	0..085	432.11
Basket montages	-	-	-	-	-	-

*The values of above parameters are of Average value of ten

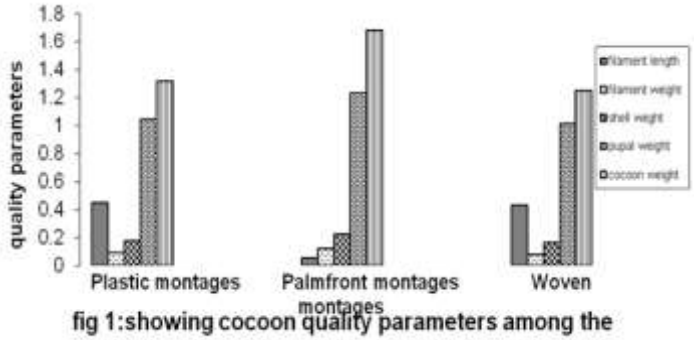

fig 1:showing cocoon quality parameters among the montages

The Cocoon weight, Pupa weight, shell weight, pupa weight, filament weight and filament length showed higher values for palm front montage. From this it is clear that Palm fronts twigs shows better result as compared to other montages on silkworm cocoon. The results of the present study correlate with (Chandrakanth *et. al* 2004.,and Datta 2008) where the authors on their different studies used five types of montages shoot rearing rack rotary type, plastic collapsible, fixed vertical type, bamboo montages and rotary montages considering cocooning (%), Double cocoon(%), Floss(%), Defective cocoon (%), Single cocoon weight (gm), Shell weight (gm), Shell ratio (%), and Reelability (%) in which there were merits as well as demerits during study time and also shows variations in economic parameters of cocoon production and quality in each type of montages. Datta *et al* 2008, also shows Plastic collapsible montage, an alternate to bamboo spiral montage in Eastern India. Chikkanna *et al* (2009)., also study qualitative improvement in terms of economic gained by using two different types of montages for silkworm cocoon. He also quoted that, types of montages and mounting environmental condition play a paramount role in determining the quality of cocoons of silkworm, *Bombyx mori.* Pandey, *et al*.,(2007)., using plant shoot montages in North- western India which shows better result during study period. Datta *et al*., 2007., also study comparative study of spinning of silkworm in two types of montages which correspond to the result obtained. Although palmfront is natural parts plant that is subjected to biodegradation but the immediate use of it can safe farmers from cocoon wastage and financial embarrassment as a result of high cost of plastic montages. Thus from the present study, it is concluded that the Palm fronts that are directly placed on rearing bed to spin cocoon helping the farmer to save labour and there will not be any problems of identifying and picking ripe larvae by newly joined sericulturist. However, this method needs more space but during emergency time when there were no sufficient montages, farmers can make use of Palm fronts montages as very good alternative. The palm front montages are playing important role in saving the cocoon crop and are readily available and easy to use for farmers.

Conclusion and Recommendation

The coccon production is the end product of silkworm rearing before transferring to textile industry. The quality and quantity of coccon produced is very essential to the sericulturist. Palmfront montages exhibit the highest cocoon qualities and quantities among the parameters measured. Although the palmfront montages has some demerit in terms of biodegradation and sticking to the shell of the coccon. All needed precautions are needed to be put into consideration to get optimum quantity and quality of cocoon. It is therefore been recommended that sericulturist should explore the use of palmfront which are readily available in their environment.

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