

Pupal Preservation Using Sawdust as a Cost-Effective Technique in Commercial Grainages: A Novel Approach

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Abstract: An experimental trial was conducted to determine the cost of production and profitability of using sawdust and corrugated sheets for pupae preservation during commercial grainage. The findings of the study indicated that sawdust from the (*Cedrus deodara* tree) is more profitable and economical for silkworm seed producers, as it reduces the cost of production associated with pupae preservation in commercial grainage. The comparative cost–return analysis revealed that Rs. 0.59 can be saved for every rupee spent when sawdust is used during pupae preservation.

Keywords: Kraft Paper, Saw Dust, Pupae, Preservation, Cost.

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I. INTRODUCTION

Silkworm seed forms the backbone of the sericulture industry. Commercial grainages are centres where disease-free silkworm seeds (DFLs) are produced to meet the growing demand of commercial sericulture farmers. The timely availability of high-quality silkworm seeds in adequate quantities is crucial for the sustainable growth of the sericulture industry (Munikrishnappa and Singh, 2004, Singh and Munikrishnappa, 2009). The progress and development of the sericulture industry are often measured by the quantity of silkworm seed produced (Sanaha *et al.*, 2016). Therefore, the grainage processes must be conducted with utmost care and appropriate techniques to ensure quality seed production (Rahmathulla, 2012). In silkworm seed production, cost represents the necessary initial investment required to initiate the seed production process. For the production of commercial silkworm seeds, several grainage activities must be performed, including the procurement of seed cocoons, cutting of seed cocoons, sex separation, and pupal preservation and each of these activities involves additional costs. Similarly, in pupal preservation, it is of utmost importance to procure

corrugated sheets well in advance for use in the preservation process. Corrugated sheets used for pupal preservation can be replaced by sawdust obtained from the *Cedrus deodara* tree, which is readily available in sawmills across Jammu and Kashmir. The use of sawdust for pupal preservation in commercial grainages offers several economic advantages. This method saves working time and improves operational efficiency. In this technique, pupae are spread on sawdust instead of corrugated sheets, resulting in a saving of approximately Rs. 0.59 per corrugated sheet. Moreover, the rolling of pupae is minimized, thereby reducing the chance of healthy pupae coming into contact with dead or melted pupae. The removal of dead and melted pupae becomes easier, which minimizes the chances of further contamination. In addition, appropriate temperature conditions can be maintained, leading to an improved eclosion rate. In view of these potential benefits, the present investigation was undertaken to evaluate the efficiency of pupal preservation using sawdust as a means of reducing production costs in commercial grainages.

II. MATERIALS AND METHOD

The study was conducted to evaluate the economic performance of grainage operations using sawdust and corrugated sheet for pupal preservation. After receiving the seed cocoons, they were spread in a single layer, and defective cocoons were carefully sorted out. Subsequently, the cocoons were cut open, and the male and female pupae were separated. The pupae were then placed in trays @ 800 pupae per tray. A total of seven trays each were maintained for pupal preservation using sawdust and corrugated sheets. The male and female pupae were kept in separate rooms under controlled conditions of 25°C temperature and 75 ± 5% relative humidity. After 12 days of spinning, moth emergence began. The number of moths that emerged each day (1st to 4th days) was recorded separately for pupae preserved in sawdust and those preserved in corrugated sheets. Male moths of FC₁ were paired with female moths of FC₂ and vice versa to prepare double hybrid combinations. After allowing mating for three hours, the moths were depaired. The female moths were then placed in the oviposition room for egg laying under controlled conditions of 25°C temperature, 75 ± 5% relative humidity, and complete darkness. The male moths were kept in a cold room at 7–9°C for reuse in a second mating. After 24 hours, the female moths were transferred to the aestivation room, where the temperature and relative humidity were maintained at 25°C and 75 ± 5%, respectively. The number of melted pupae was recorded day-wise from the first to the fourth day for both sawdust and corrugated sheet preservation methods. Economic parameters such as eclosion rate, dfls production and melting percentage were recorded. The observed data were subjected to statistical analysis and presented in the form of Tables 1–2 and Figure 1. In addition, the economics of using sawdust and corrugated sheets for pupal preservation were worked out and presented in Table 3.



Fig 1 Pupa Preserved (Saw Dust)



Fig 2 Pupa Preserved (Corrugated Sheet)

III. RESULTS AND DISCUSSION

Silkworm seed production is a critical component for the sustainability and continuity of the sericulture industry. Effective cost management in silkworm seed production necessitates a comprehensive and systematic approach. This includes enhancing labour efficiency, engaging skilled personnel, procuring high-quality seed cocoons, adopting improved technologies, innovation *etc.* Such an integrated strategy not only minimizes production costs but also enhances operational efficiency and supports long-term sustainability and profitability of the seed production system. The results of the analysis presented in Table 1 reveals that moth emergence rates showed a significantly higher emergence rate compared to the Corrugated Sheet method on the 1st day, 2nd day, 3rd Day and 4th day ($p < 0.05$). The data presented in Table 2 indicate a comparative analysis of disease-free layings (DFLs) between the sawdust treatment and the corrugated sheet method. A statistically significant difference was observed in DFL production on the 1st day ($p = 0.03$), 2nd day ($p = 0.04$), 3rd day ($p = 0.01$), and 4th day ($p = 0.04$), with all values being significant at the 5% level ($p < 0.05$). The data on pupal melting percentage recorded from Day 1 to Day 4 revealed a lower pupal melting under the sawdust treatment (2%) compared to the corrugated sheet (3%) (Fig. 1). This finding indicates that the use of sawdust for pupal preservation is more effective in minimizing pupal melting during grainage operation. An analysis was conducted to evaluate the cost of production and net returns associated with the use of sawdust and corrugated sheets for pupal preservation in silkworm seed production. The data presented in Table 3 reveal that the use of sawdust for pupal preservation resulted in a saving of Rs. 0.59 over single corrugated sheet. Furthermore, the calculated cost-benefit ratio of 1:1.59 indicates greater economic efficiency of the sawdust method compared to the corrugated sheet method used for pupal preservation.

Table1: Influence of Pupal Preservation by Using (Saw Dust vs. Corrugated Sheet) on Emergence of Moths.

| Day | Saw dust Mean | Corrugated Sheet Mean | t-value | p-value | CD (5%) | CV (%) | Significance |
|---------|---------------|-----------------------|---------|---------|---------|--------|--------------|
| 1st Day | 119.71 | 115.29 | 2.625 | 0.037 | 2.04 | 2.50% | Significant |
| 2nd Day | 392.00 | 388.00 | 2.592 | 0.024 | 3.36 | 1.74% | Significant |
| 3rd Day | 235.14 | 232.86 | 2.551 | 0.025 | 1.95 | 1.72% | Significant |
| 4th Day | 39.14 | 34.86 | 2.468 | 0.043 | 2.32 | 4.11% | Significant |

Table 2: Influence of (Saw Dust vs. Corrugated Sheet) on DFLs Production.

| Day | Saw dust Mean | Corrugated Sheet Mean | t-value | p-value | CD (5%) | CV (%) | Significance |
|---------|---------------|-----------------------|---------|---------|---------|--------|--------------|
| 1st Day | 115.43 | 113.14 | 2.39 | 0.03 | 2.09 | 1.57% | Significant |
| 2nd Day | 396.14 | 382.29 | 2.61 | 0.04 | 2.27 | 2.72% | Significant |
| 3rd Day | 234.43 | 230.86 | 2.88 | 0.01 | 2.70 | 1.00% | Significant |
| 4th Day | 42.71 | 35.86 | 2.55 | 0.04 | 2.88 | 4.86% | Significant |

Table 3: Comparative Analysis of Cost and Returns Using Sawdust and Corrugated Sheets for Pupa Preservation In Commercial Grainages.

| Particulars | Cost of saw dust per Kg (Rs.) | Standardized saw dust for pupae preservation @800 pupae | Cost of 200 (g) saw dust (Rs.) |
|--|---------------------------------|--|---------------------------------|
| Saw dust | Rs. 20 | 200 (g) | Rs. 4 |
| | Cost of corrugated per Kg (Rs.) | Corrugated sheet extracted from 1 Kg | Cost of single corrugated sheet |
| Corrugated sheet or paper | Rs. 79 | 08 No's | Rs. 9.87 |
| | Cost (Rs.) | | Cost (Rs.) |
| (A.) Corrugated sheet or paper for pupae preservation 5600 @800 pupae per sheet | 79 | (B). Cost of pupae preservation 5600 pupae @800 pupae per tray (Saw dust) | 32 |
| Total return (A-B) | 79-32 | 47 | |
| Cost Benefit Ratio | 1:1.59 | | |

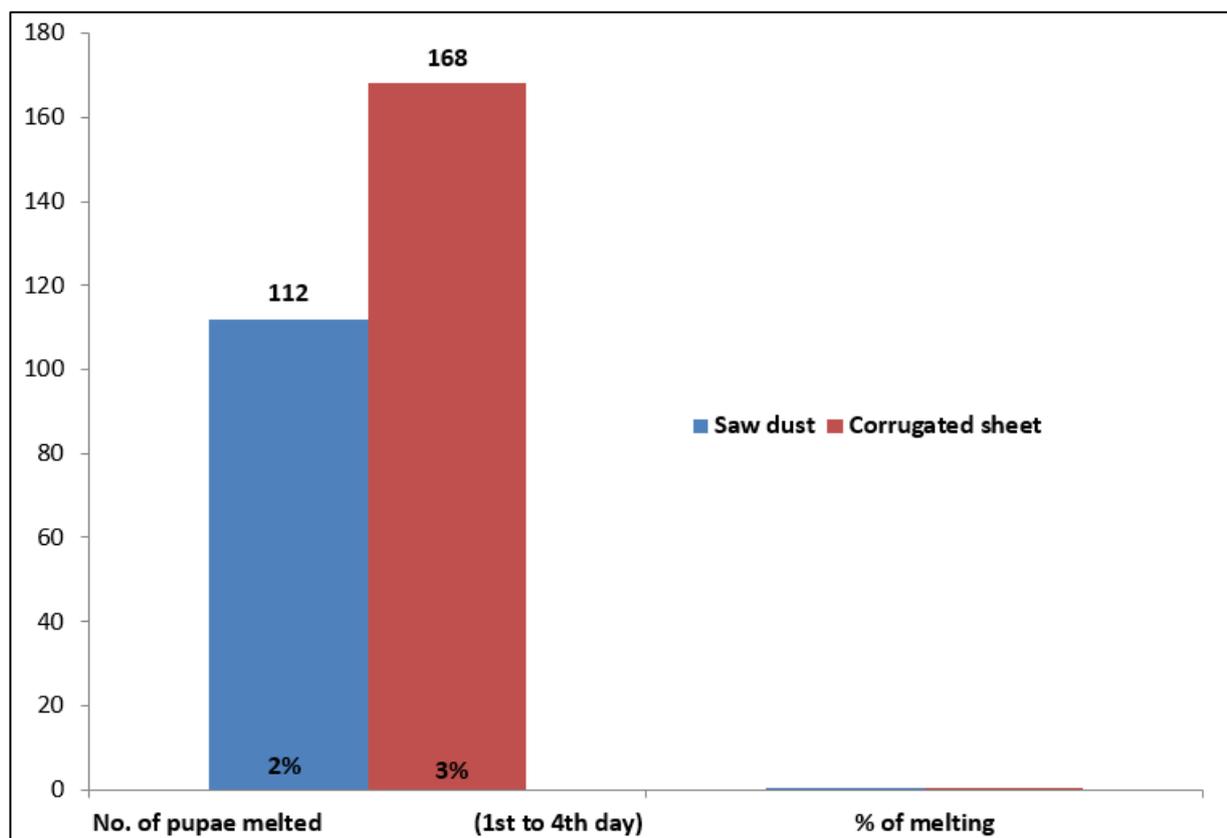


Fig.1: Pupal Melting Recorded from Day 1 To Day 4 Under Sawdust and Corrugated Sheet Preservation.

IV. CONCLUSION

Cost management in silkworm seed production requires a comprehensive approach that includes improving labour efficiency, engaging skilled personnel, procuring quality seed cocoons adopting new technologies *etc.* This strategy not only lowers production expenses but also enhances seed production efficiency, thereby improving long-term profitability. The present study revealed that the use of sawdust for pupal preservation during silkworm seed production resulted in a cost–benefit ratio of 1:1.59.

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