



Performance of Agrahayani grainage using P1 bivoltine seed cocoons from Southern India

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Background: Silkworm seed plays an important role; since sericulture is a cash-generating activity, disease-free eggs are very important for the success of silkworm rearing. Production of disease-free crossbreed silkworm seed during the Agrahayani crop is very important because it is a crucial crop in West Bengal.

Methods: Grainage performance for cross breeds such as pupation rate, cocoons per kg, DFLs obtained, total egg weight, cocoon DFLs ratio, pairing (%) and egg recovery was calculated as per the SOP.

Results: The present study on grainage performance during Agrahayani crop using the P1 bivoltine seed cocoons from South India showed that, egg recovery (g/kg) was high in N x (SK6 x SK7) with 50.37g /kg of seed cocoons followed by N x FC2 of 49.04 g/kg. The cocoon:DFLs ratio was recorded 3.09:1 in N x (SK6 x SK7), 2.63 in N x FC2 and 2.45:1 in N x FC1.

Conclusion: This result has proved that P1 bivoltine seed cocoons from South India may be utilised for the grainage production in Agrahayani crop in upcoming years.

Keywords: grainage, agrahayani, bivoltine, nistari, performance, sericulture, silkworm

Introduction

Silk production in Bengal dates back to ancient times, with references to silk and sericulture found in historical texts and records. The region's favourable climatic conditions and rich natural resources made it an ideal place for silk production (Harishkumar & Vijay, 2025). As an agro-based cottage industry, sericulture is vital for rural livelihoods in West Bengal, benefiting about 1, 22,920 families due to its low capital requirements and steady returns. The potential of sericulture to rejuvenate the rural economy and its labour-intensive nature, West Bengal has seen a consistent increase in mulberry raw silk production, rising from 1,090 MT in 1995-96 to 2,131 MT in 2023-24 (CSB, 2024). But along with government agencies, private participation has gained much prominence in silkworm seed production in West Bengal (Munikrishnappa & Singh, 2009). The state is home to 14,892 hectares of mulberry plantations, with major production hubs in Murshidabad, Malda, and Birbhum (Vijay et al., 2025). These regions rely on seven seed crops to generate commercial hybrids seeds (Disease Free Layings DFL's), which include Agrahayani (September–October), Falguni (December–January), Boisaki (February–March), Jaistha (April–May), Shrivani (May–June), Aswina (August–September) and Bhaduri (July–August). The seasons from June to October, particularly Jaistha, Shrivani, Bhaduri

(Rainy), and Ashwina (Autumn), are considered unfavourable due to heavy climatic fluctuations, presenting significant challenges for seed crop rearing (Abhilash et al., 2021). SSPC, Dakshin Bhawanipur, is the only egg production centre in North Bengal which has been supplying the needs of commercial farmers for the past 35 years. Since this centre has been supplying the crossbreed silkworm seed requirements of West Bengal, Uttar Pradesh, and all eastern states (Ministry of Statistics & Programme Implementation, 2024). Production of quality P1 DFLs is the primary requisite for good seed crop rearing, which is done by Adopted Seed Rearers (ASRs). Rearing was started by ASRs before 42-45 days of commercial crop, and unfavourable seasons is one of the main challenges for ASRs due to unpredicted temperature & extreme humidity with climatic fluctuations (Chakrabarty et al., 2023). During the month of September, high temperature and humidity concomitantly in P1 Agraphayani crop which results rearing of Multivoltine race (Nistari) is preferred for seed production during unfavourable seasons, whereas bivoltine hybrid (SK6 x SK7) is reared by ASRs of West Bengal state government in selected areas during P1 Falgooni (December-January) and P1 Baisakhi (March) only. However, Agraphayani is a major commercial crop for farmers, due to favourable climatic conditions and high cocoon price etc., production of bivoltine cocoons for grainage it's not possible due to adverse climatic conditions during the seed crop rearing (Sajaneet et al., 2024). In such situation, Southern India grainages were supporting for conducting the grainage in West Bengal. Silkworm egg quality refers to disease freeness, viability, uniform hatching and importantly package of rearing (Ullal & Narashimhanna, 1981) and it depends on management practices during the seed crop rearing i.e., rearing temperature, humidity, nutrition and traits of the breed (Gauravet al., 2015). Therefore, the seed production directly affects the survival rate, life span, growth of silkworm, quantity and quality of cocoon (Rahmathulla, 2012). Hence, it is compulsory to conduct these egg production processes with standard operating procedures (Harishkumar et al., 2025). The study conducted for assess the performance of South India bivoltine P1 seed cocoons for Agraphayani crop.

Materials and Method

The study was undertaken at the Silkworm Seed Production Centre, Dakshin Bhawanipur, in north Bengal of West Bengal, it has a wide climatic range with geological coordinates of latitude 25.57° N and longitude 88.34° E with average rainfall of 1600mm to 1850mm. A total 297.0 kg of P1 bivoltine seed cocoons of SK6 x SK7, FC1 and FC2 were purchased in three different breeds from the SSPC, Bangalore and Mysore (Karnataka). After receipt of the cocoons were spread in trays in single layer and melted cocoons were sorted out. Only FC2 seed cocoons were cut open, male pupae separated out and placed at the rate of 700 pupae per tray. Remaining all bivoltine cocoons were kept in single layer for emergence. For the female component, total Nistari cocoons were procured from the different zones such as Gazole, Malda, Bethuadahari, Nadia, Kaliyaganj etc., After receipt of the multivoltine seed cocoons were spread in the individual layer in trays with proper labelling. After the cocoon assessment, all the cocoons were cut open, sex separated, only females were kept for grainage purpose (Ministry of Statistics & Programme Implementation, 2024). Female and male were kept in storage rooms at 25°C and 75±5% RH. The males were emerged before three days of emergence of females for pairing and synchronization. Grainage operations such as pairing, depairing, oviposition, egg washing, drying were done using the standard procedures of silkworm egg production. Since, it is cross breed DFLs, daily washed and dried eggs need to keep separately in the cold rooms. The grainage performance for cross breeds such as pupation rate, mean cocoons per kg, DFLs obtained, total Egg weight, cocoon:DFLs ratio, pairing (%) and egg recovery was calculated using the following formulae (Singh et al., 2020). The mean data were analysed using the AGRES software package (version 0.74).

$$\begin{aligned} \text{Number of DFLs produced} &= \frac{\text{Total weight of seed (g)}}{\text{Weight of 100 DFLs (25g)}} \\ \text{Pairing (\%)} &= \frac{\text{No. of Pairs obtained}}{\text{No. of cocoon processed}} \\ \text{DFLs (\%)} &= \frac{\text{No. of DFLs obtained}}{\text{No. of actual cocoons processed}} \\ \text{Cocoon: DFLs ratio} &= \frac{\text{No. of actual cocoons processed}}{\text{No. of DFLs obtained}} \end{aligned}$$

$$\text{Egg Recovery} = \frac{\text{Total egg weight}}{\text{Weight of cocoons}}$$

Results and Discussion

The objective of the SSPC is the production and supply of quality seed with true to the breed characters. The cocoons used for production are of high quality and disease freeness. Therefore, the seed cocoons receiving at the grainages are undergo to purchase norms with set of characteristics (Singh & Saratchandra, 2004). The results of the reports showed that a total of 297.0 kg in that, 222.0 kg of SK6 x SK7, 35.0 kg of FC1 and 40.0 kg of FC2 seed cocoons were procured from the South India grainages for assessing the Agrahayani crop performance (Figure 1). Kabita et al., 2023 stated that SK6 x SK7 could be a suitable breed to rear in Malda region of West Bengal but local availability, disease, lack of knowledge in rearing and above all the apathy regarding this breed hindered the silkworm rearing. After assessing the procured cocoons, a 94 %, 88 % and 92% pupation rates were noted in all the races. It is revealed that, 608, 694 and 678 of actual number of cocoons per kg for bivoltine seed cocoons and the male percentage was highest in SK6 x SK7 (48.94 %) followed by FC1 (46.97%) seed cocoons. The melting percentage was high in SK6 x SK7 and lowest in FC2 seed cocoons. Amardev Singh (2025) reported that the, no of cocoon per kg in FC1 is 560 and FC2 is 554, pupation percentage was 90 and 83 respectively.

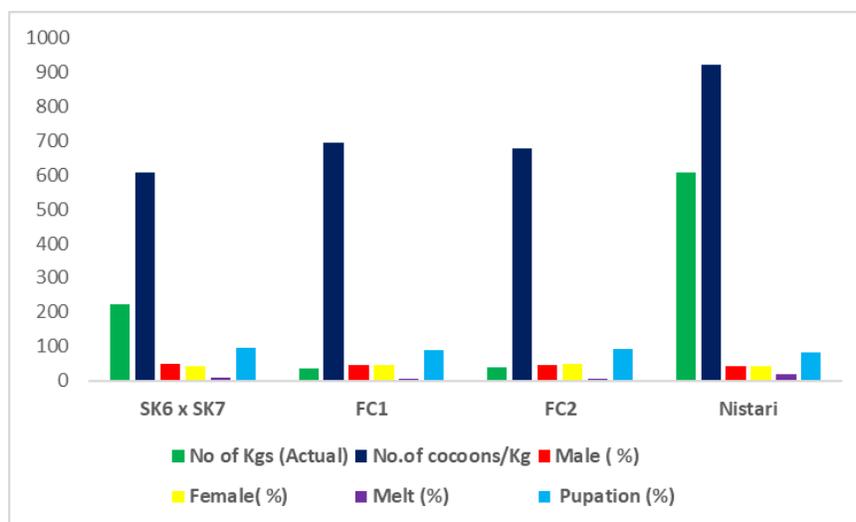


Figure 1. Assessment of cocoon parameters in different races

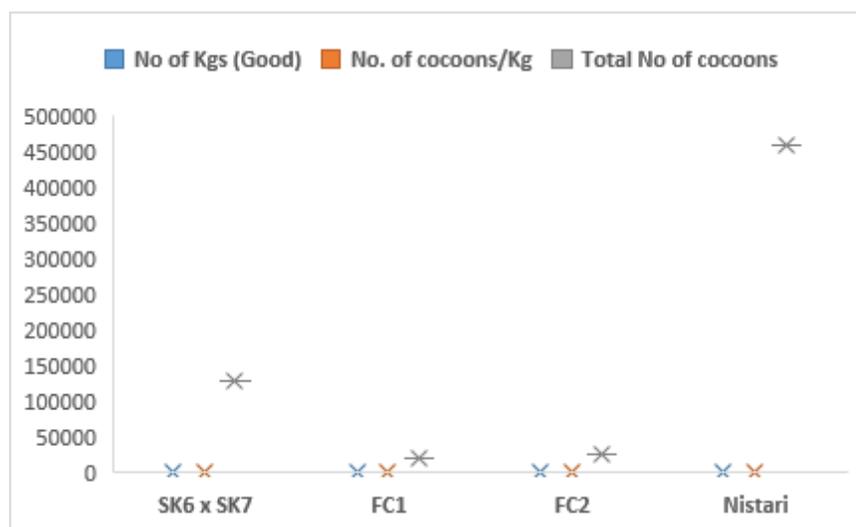


Figure 2. Number of cocoons processed for production performance

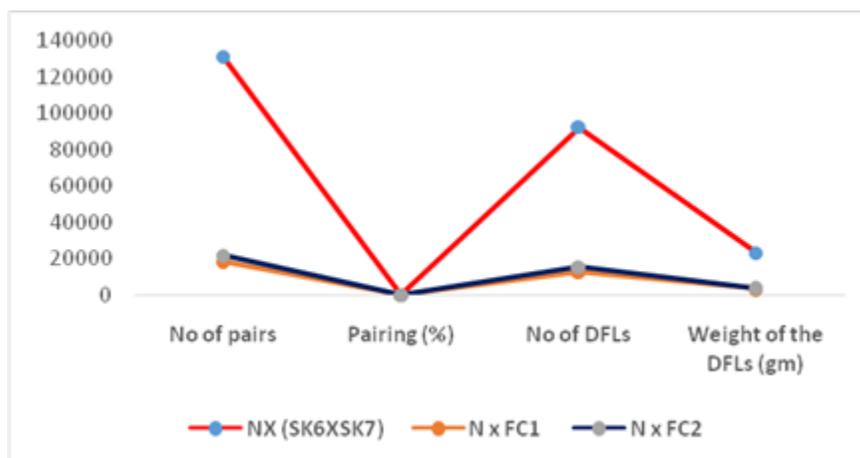


Figure 3. Effect of different races in grainage production performance

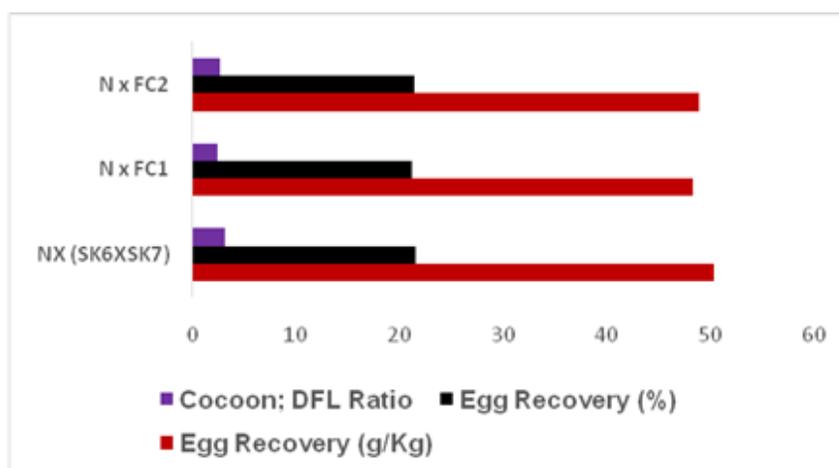


Figure 4. Performance of seed cocoons on economic parameters of grainage

The Nistari cocoons were procured from the different seed zone of West Bengal, around 608.40 kg with pupation rate of 82% with average cocoons per kg was 922. The female percentage of Nistari was 42.02 with melting of 17.5%. [Chakrabarty et al. \(2023\)](#) reported that, Nistari seed cocoon production during the Agrahayani crop was increased with higher cocoon yield and pupation percentage. From the different cocoons, around 212.15 kg of SK6 x SK7, 32.35 kg of FC1, 38.04 kg of FC2 bivoltine seed cocoons used as Male component and 540.74 kg of multivoltine seed cocoons used as Female (Figure 2). After processing the total seed cocoons, 120450 DFLs were produced in Agrahayani crop (Figure 3), out of the total DFLs, 92400 of N x (SK6 x SK7), 12650 of N x FC1 and 15400 of N x FC2. The pairing percentage was approximately 30% in all the combinations. These results were on bar with [Saha et al. \(2011\)](#), who documented that, grainage performance in terms of pairing percentage, DFLs percentage, recovery percentage. The egg recovery (g/kg) was high in N x (SK6 x SK7) with 50.37g /kg of seed cocoons followed by N x FC2 of 49.04, which is above the norms of the breed characteristics (Figure 4). Further, it is noted that, 3.09:1 in N x (SK6 x SK7), 2.63 in N x FC2 and 2.45:1 in N x FC1 of cocoon:DFLs ratio (Figure 4). [Singh et al. \(2020\)](#) found the highest egg recovery of 55.48 g/kg in FC1 and 58.51g/kg in FC2, when bivoltine cocoon used from the Southern India.

Conclusion

From the study, it is observed that the Agrahayani grainage has recorded better performance in egg recovery (%), pairing, cocoon:DFLs ratio as well as quality of the eggs. This result has proved that P1 bivoltine seed cocoons from South India may be utilised for grainage production in the Agrahayani crop in upcoming crops.

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Author contributions

We declare that all authors were equally contributed towards this manuscript.

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Conflict of interest

There is no competing interest from the authors

Ethics approval

Not applicable.

AI tool usage declaration

We declare that, we did not use any AI tool for this manuscript for generating scientific content of this manuscript.

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