Original Research Article

ASSESSING PROSPECTIVE BIVOLTINE HYBRIDS OF SILKWORM (*Bombyx mori* L.): A COMPREHENSIVE ANALYSIS

Abstract:

It is well-known fact that hybrid selection plays a critical role in the success and sustainability of sericulture operations. Therefore, evaluating bivoltine hybrids in a region like Jammu and Kashmir (JK) serves specific purposes to the local economy and agricultural practices. In this context, the study was undertaken for one season to assess and evaluate the performance of bivoltine silkworm hybrids as potential hybrids best suitable for subtropical conditions of Jammu Division of JK. Eleven bivoltine silkworm single hybrids were selected for the study along with double hybrid check. The performance of these hybrids was evaluated based on a cumulative index i.e., E.I. value, which considered various positive traits related to egg, larval, cocoon and post-cocoon parameters. Among the twelve selected single bivoltine hybrids including check double hybrid, FC1×FC2 (59.84) which is double hybrid ranked 1st. Following the top ranked double hybrids other bivoltine single hybrids viz., PO3× ND5 (57.48), U-3×U-1 (55.77), U-4×U-6 (54.97), JD6×U-6 (51.47) and ND3 × NSP (50.84) scored cumulative E.I. value greater than 50 for positive traits and have been recognized as superior hybrids in term of egg, larval, cocoon and post cocoon parameters.

Key words: Silkworm, bivoltine hybrid, Evaluation Index.

1. INTRODUCTION: Bivoltine silk, known for its superior quality and higher productivity compared to other types of silk, holds significant potential for large-scale production in the country. This can be achieved by focusing on expanding the production of bivoltine hybrids can bring several benefits to the sericulture industry and the overall economy. Bivoltine hybrids are foreseeable for large scale production because of some reasons such as quality, high productibility, market demand, economic value, sustainability and many more.

Sericulture significantly contributes to the rural economy as it contributes substantial returns within short period. More than 30,000 families in Jammu and Kashmir rely on sericulture as their primary source of income, this indicates the vital role sericulture plays in sustaining livelihoods within the region (Ullal and Narashimhanna, 1981). Elite bivoltine silkworm breeds are critical factor in ensuring the production of high-quality raw silk due to their controlled life cycle and improved silk fiber characteristics. Though they lack genetic plasticity to thrive in

Commented [AB1]: Change the citations into numbers has done in R&D. Follow the same adverse conditions prevailed in the field acts as a constraint to exploit the full economic potential of these new hybrids. Farmers might be hesitant to adopt productive hybrids of bivoltine crops that have desirable silk quality traits, unless the issue of instability in these crops at the farmers' level is effectively resolved. In essence, the statement emphasizes that for productive hybrids of bivoltine crops with high-quality silk traits to be successful in the market, it's crucial to address the challenges that farmers face at their level. This could involve research and development efforts to create more stable hybrid varieties, providing farmers with proper training and resources to manage these crops effectively, and ensuring that the benefits of adopting these hybrids outweigh the potential risks and challenges. Selection of potential hybrids to serve as commercial exploitation material is one of the pre-requisites contributing to the success of hybrids under the prevailing environment. Evaluation of silkworm hybrids helps to critically analyze the new hybrids in terms of effectiveness, easiness and economic benefits, thereby helping to choose the most effective hybrid combination for commercial exploitation (Dayananda, 2010).

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People from across the world prefer to buy silk produced in J&K. During 2022-2023 academic year, J&K produced about 79 MT of raw silk (Anon. 2023). The farmers practicing sericulture in Jammu and Kashmir completely rely on FC1×FC2 (double hybrid), evolved in southern regions of India which is better suited to their native climatic conditions. Due to lack of genetic diversity among the silkworms raised in this region, this issue is crucial. Hence, there is now an urgent need to develop hybrids that would adapt to the native climatic conditions of this region. By realizing the importance of bivoltine sericulture, silkworm breeders are making continuous efforts in evolving high yielding bivoltine silkworm breeds for commercial purpose in the country (Rao *et al*., 2006). In J&K, silkworm breeders have successfully evolved various breeds/hybrids suitable to climatic conditions of UT and timely evaluation of these genetic resources is an essential prerequisite to gauge the extent of variability among hybrids. Therefore, this type of research is important for the sericulture industry as it helps in optimizing silk production by selecting silkworm varieties that can thrive in the local climate. It can also contribute to the economic development of the region by providing local farmers with the knowledge and tools to engage in sericulture practices that are well-suited to their environmental conditions. The ultimate goal is to determine whether introducing these hybrids would bring tangible benefits to the region and its stakeholders. Addressing these challenges, the present study has been envisaged to evaluate the potential productive bivoltine single

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2. MATERIALS AND METHODS: For the experiment, silkworm rearing was conducted in autumn season at Division of Sericulture, Faculty of Agriculture, SKUAST- Jammu, Main campus Chatha, Jammu (J&K). Eleven indigenous bivoltine silkworm single hybrids evolved by Division of Sericulture, SKUAST-Jammu namely U-8×PO1, ND3×PO1, PO1×U-8, U-3×U-1, JD6×U-6, U-4×U-6, PO3×ND5, U-6×ND3, ND3×NSP, ND2×NSP, SH6×NB4D2 along with one check double hybrid namely FC1×FC2 from Regional Sericulture Research Station (RSRS), Dehradun were selected reared as three replications with population size 350 worms per tray (2” ×3” = 6” feet) as per standard rearing techniques by (Krishnaswami *et al*., 1978) and (Dandin *et al*., 2003) under Completely Randomized Design (CRD). The performance of silkworm hybrids was evaluated by Evaluation index method. Evaluation index is the performance index which gives a single value measure of the multiple trait performance of a population. The data presented for the hybrids was analyzed by following (Mano *et al*., 2013):

$$\text{E. I.} = \frac{\text{A}-\text{B}}{\text{C}} \times 10 + 50$$

Where, A = Value obtained for a particular trait of the hybrid combinations.

B = Mean value of a particular trait of all the hybrid combinations.

C = Standard deviation of a particular trait.

10 = Standard unit

50 = Fixed value

The E.I. value for the selection of hybrids / breeds was 50 or >50 for positive traits and 50 or < 50 for negative traits.

3. RESULTS AND DISCUSSION: E.I. analysis is crucial for selecting the most promising silkworm hybrids for further cultivation and production, ensuring the optimal use of resources and maximizing the yield and quality of silk production in the given region. In order to determine the stability of these hybrids, an evaluation performance index (E.I.) was calculated which gives a single numerical value that represents the overall measure of the multiple trait performance of a population.

The Evaluation Index values of all the selected hybrids for different parameters are presented in Table 1. Egg characters (Figure-1) generally represents the richness of laying, egg viability, uniformity in hatching and more importantly good rearing performance of progeny [21]. Evaluation Index values of

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selected twelve bivoltine silkworm hybrids showed that maximum value for fecundity was observed in check hybrid FC1×FC2 (61.22) followed by single hybrids PO3×ND5 (60.65), U-4×U-6 (56.05) and U-3×U-1 (55.81) respectively. Similar observations were earlier reported by [3] while evaluating silkworm hybrids on the basis of different economic traits including fecundity percentage observed the similar results. and the minimum was found in ND3×PO1 (33.78). Evaluation Index values for hatching percentage reveals variations among the hybrids and highest values were observed in hybrid FC1×FC2 (63.82) followed by PO3×ND5 (59.03), U-3×U-1 (58.52) and ND3×NSP (55.25) and lowest value was recorded in hybrid ND3×PO1 (35.80) while for brushing percentage depicted was also found higher E.I. value in hybrid FC1×FC2 (70.68) followed by PO3×ND5 (64.94), U-4×U-6 (55.06) and U-3×U-1 (51.60) respectively while minimum value was found in hybrid ND3×PO1 (33.61). These findings depicted close conformity with the earlier reports of [19].

The estimates E.I. values of different larval parameters (Figure-2) were worked out in selected bivoltine hybrids of silkworm, total larval duration E.I. value was recorded highest in hybrid ND3×PO1 (66.11) followed by SH6×NB4D2 (54.94) and minimum in FC1×FC2 (32.35) and PO3×ND5 (42.35). Maximum E.I. value for weight of 10 mature larvae (Figure 2) was recorded in hybrid FC1×FC2 (64.03), PO3×ND5 (62.73) followed by U-4×U-6 (61.29) and minimum value was observed in hybrid ND3×PO1 (33.62). These findings lie in strong confirmation with the results described by [5] and [1]. E.I. value for larval survival percentage was recorded highest in hybrid FC1×FC2 (62.86), PO3×ND5 (61.84) followed by U-4×U-6 (61.31) and minimum value was observed in hybrid ND3×PO1 (38.16).

For Cocoon Parameters (Figure-3 & 4), maximum Evaluation Index value for cocoon yield/10,000 larvae by weight and by number was recorded in hybrid FC1×FC2 (68.06 and 65.25) followed by U-3×U-1 (63.58 and 62.40) and PO3×ND5 (60.97 and 62.31) and minimum value for cocoon yield/10,000 larvae by weight in hybrid SH6× NB4D2 (39.25) whereas for cocoon yield/10,000 larvae by number ND3×PO1 (39.02). For pupation per cent maximum E.I. value was recorded in hybrid FC1×FC2 (64.44) followed by PO3×ND5 (61.38) followed by U-4×U-6 (56.83) and minimum in hybrid ND3×PO1 (28.72) whereas for single cocoon weight maximum E.I. was recorded in hybrids FC1×FC2 (64.00) followed by PO3×ND5 (62.00) and minimum in hybrid SH6×NB4D2 (36.00). E.I. value for single shell weight was recorded higher in hybrids FC1×FC2 (65.00) followed by U-3×U-1 (60.00) and PO3×ND5 (58.33) while lower in hybrid U-8×PO1 (38.33), for shell ratio per cent maximum E.I. was recorded in hybrid FC1×FC2 (65.33), U-4×U-6 (64.90) and PO3×ND5 (62.51) while minimum in hybrid ND3×PO1 (36.72). E.I. value for good cocoons per cent (Figure 4.4) was maximum in hybrid FC1×FC2 (63.74) followed by U-3×U-1 (62.47) and PO3×ND5 (61.82) and minimum in hybrid SH6×NB4D2 (39.69). Similar results have earlier been reported by [18] and [5]. Evaluation Index value for flimsy and double cocoons per cent was recorded maximum in hybrid SH6×NB4D2 (63.19 and 62.00) followed by ND3×PO1 (62.50 and 59.28) and minimum in hybrid FC1× FC2 (37.18 and 33.42). These findings are in close findings earlier been reported by [15], [18] and [20].

While maximum E.I. for single shell weight was in FC1×FC2 with E.I. value of 65.33, U-3×U-1 (60.00) and PO3×ND5 (58.00) while minimum in hybrid U-8×PO1 (38.00). On the same hand hybrids namely U-4×U-6 and PO3×ND5 were found to exhibit at par E.I. values for shell ratio percentage above 60 per cent and minimum in ND3×PO1 as 36.72 per cent. These findings are in close conformity with that of the [5]. Moreover, [4] presented results on cocoon parameters depicting E.I. values to be less than 50 for studied hybrids evolved at SKUAST-Kashmir. Similar results have been recorded in current investigation on the basis of various cocoon parameters which were reported to exhibit less than 50 E.I. value for the hybrids evolved at SKUAST- Kashmir by [14]. The reason can be attributed to the under developing nature of the hybrids that are under acclimatization stage.

Evaluation Index value for total filament length was recorded to be highest in hybrid U-3×U-1 as of 61.29 followed by PO3×ND5 as 60.4 surpassed by FC1×FC2 as 67.93 while minimum in ND3×PO1 as 33.17. E.I. vales showed FC1×FC2, PO3×ND5 to exhibit maximum non-breakable length of 65.69 and 63.62 respectively followed by U-3×U-1 as 62.53 and minimum in ND3×PO1 as 35.99. E.I. value for filament size revealed FC1×FC2 and U-3×U-1 to exhibit finest denier of 34.66 and 38 denier respectively whereas, ND3×PO1 and SH6×NB4D2 were recorded with moderately courser size of 66 and 62.66 denier respectively. [10], [16] and [11] also presented similar results on post cocoon parameters with some different hybrids (Figure-5).

On the basis of comprehensive Evaluation Index values of the commercial parameters (quantitative and qualitative characters) of silkworm hybrids were graphically presented in Fig. 6. Out of twelve silkworm hybrids reared during autumn six five hybrids FC1×FC2 (59.84), PO3× ND5 (57.48), U-3×U-1 (55.77), U-4×U-6 (54.97), JD6×U-6 (51.47) and ND3 × NSP (50.84) scored cumulative EI value greater than 50. It appears that the six mentioned hybrids indicating their suitability for rearing under the subtropical conditions of Jammu Division. On the other hand, the remaining hybrids did not reach the standard score and may have exhibited lower performance in comparison to the selected hybrids.

4. CONCLUSION: Comprehensive Evaluation Index analysis provided valuable insights into the performance of selected silkworm hybrids. The current study highlights that out of twelve selected silkworm hybrids, six hybrids viz., PO3× ND5, U-3×U-1, U-4×U-6, JD6×U-6 and ND3 × NSP including check i.e., FC1×FC2 exhibited cumulative EI value greater than 50. These superior hybrids have been recognized as promising for future breeding endeavors aimed at enhancing both qualitative and quantitative characters for commercial exploitation. These promising hybrids demonstrate particular adaptability to the subtropical conditions, suggesting their suitability and sustainability for cultivation.

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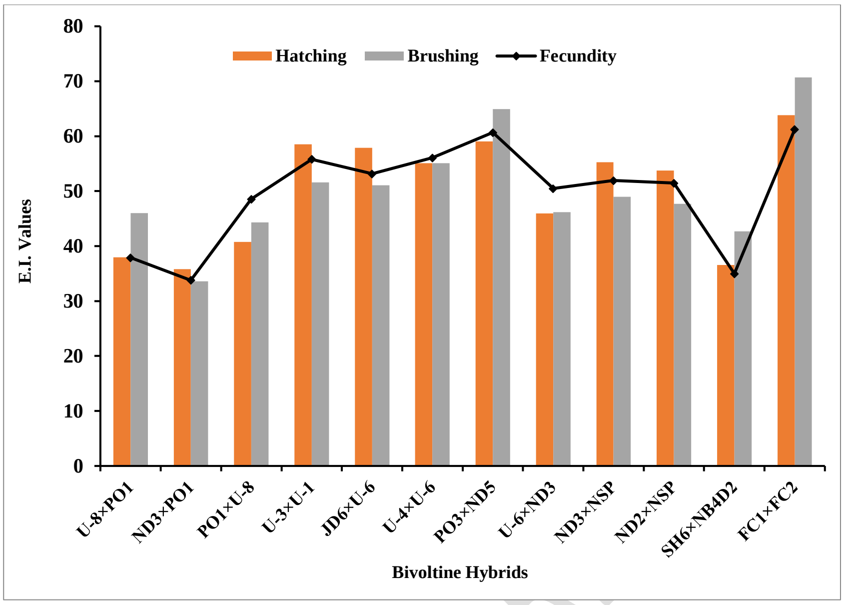

Fig 1: Evaluation Index values of bivoltine silkworm hybrids for egg traits.

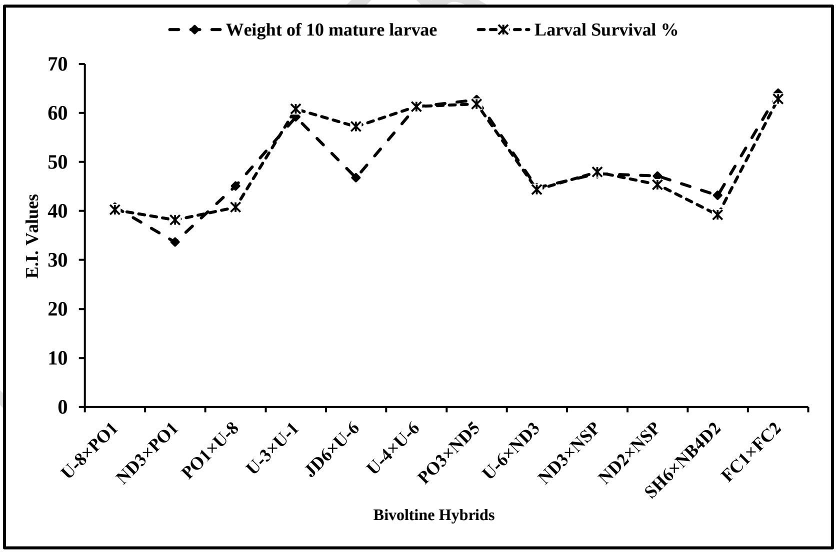

Fig 2: Evaluation Index values of bivoltine silkworm hybrids for different larval traits.

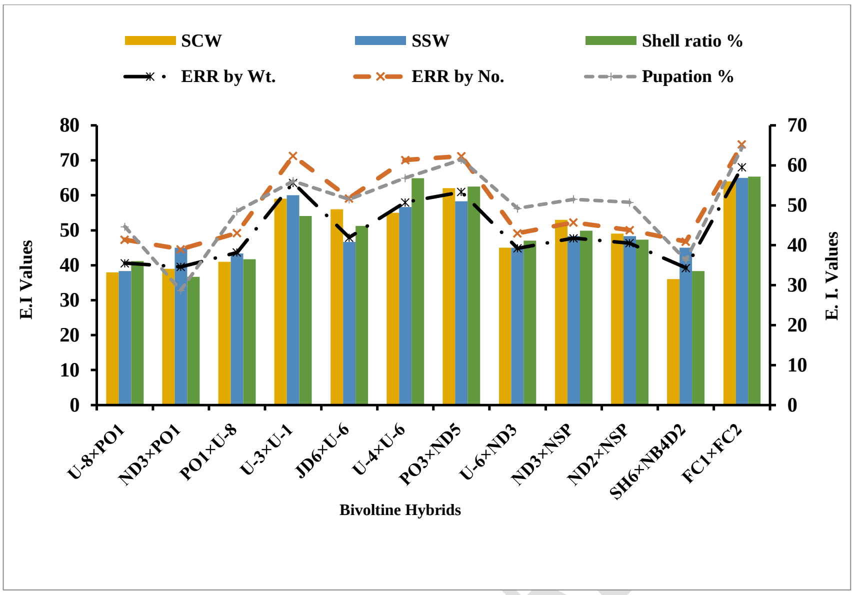

Fig 3: Evaluation Index values of different bivoltine silkworm hybrids for cocoon traits.

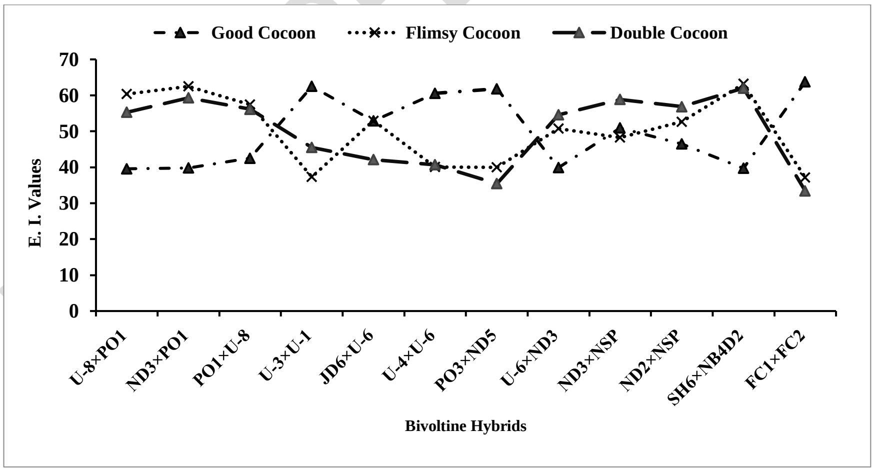

Fig 4: Evaluation Index values of silkworm bivoltine hybrids for different cocoon traits.

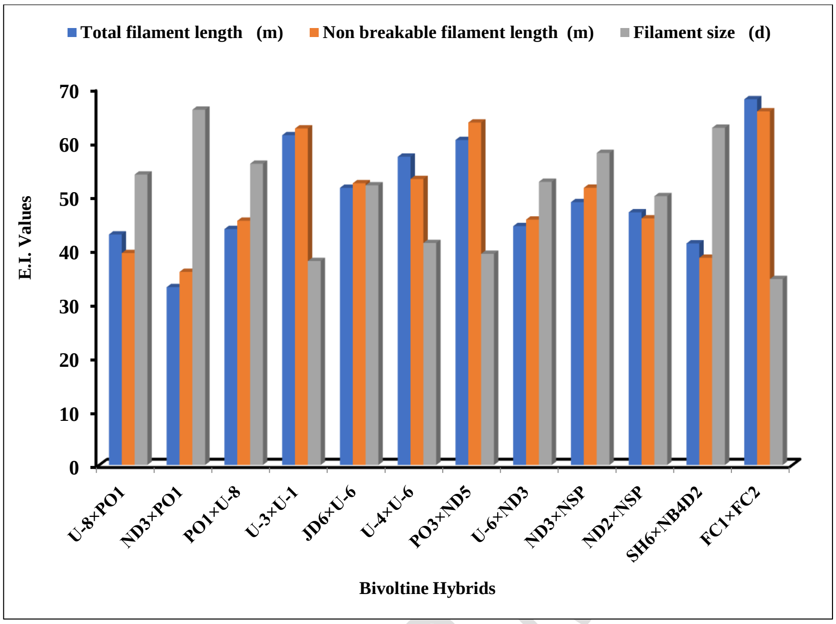

Fig 5: Evaluation Index values of post cocoon traits of different bivoltine silkworm hybrids.

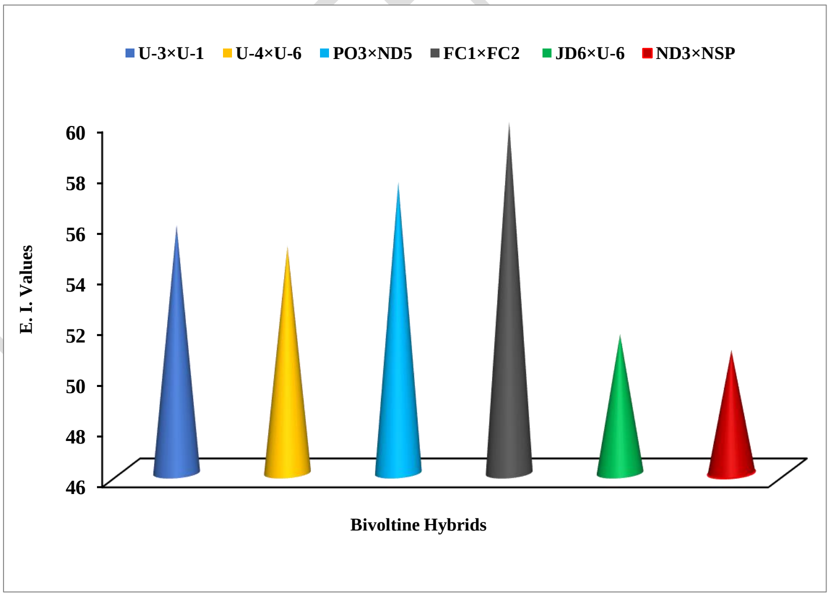

Fig 6: Cumulative Evaluation Index values of promising bivoltine silkworm hybrid for commercial traits.