IDENTIFICATION OF SUITABLE BIVOLTINE FOUNDATION CROSS FOR SUSTAINABLE BIVOLTINE SILKWORM SEED CROP IN TROPICS

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ABSTRACT
The success of rearing with presently available conventional bivoltine breeds are unpredictable in some of the seed crop seasons in West Bengal and similar regions of India because of prevailing of highly fluctuating adverse climatic conditions. Thus, it is very much essential to have a bivoltine breed, which can give stable cocoon crop under variable environments. As single bivoltine parent shown poor cocoon yield in those seasons, as an alternative, foundation crosses (FC) were tried. Out of nine FCs evaluated, D6 (P) N x SK4C shown higher cocoon yield of 12.8kg/10000 larvae with 91% pupation (average of three seasons) compared to 9.8kg cocoon yield/10000 larvae with 67% pupation in control, NB18 x P5. Thus the identified FC can be utilized as a male parent for preparation of three way cross, multi x bi hybrid for utilization in commercial crop.

KEY WORDS
Foundation cross
Seed crop
Evaluation index

INTRODUCTION
Sericulture, being rural based agro industry is suited for improving the social and economic conditions of rural poor. Indian Sericulture is mostly multivoltine oriented and more than 95% of the silk is produced by multivoltine x bivoltine hybrids. Eastern India, especially West Bengal, one of the major sericulture practicing states in India, experiences wide fluctuation in temperature, humidity and precipitation rate (Moorthy and Das, 2007). In general, the areas located in the plains of West Bengal are very hot and humid during summer and fairly cold and dry during the winter. These conditions affect both growth of mulberry and silkworm rearing. In the plains of West Bengal, rearing of seed and commercial crops is a round the year process, while in the hills of Darjeeling district, it is restricted to spring(Apr-May), summer (June-July) and autumn (Sep-Oct) seasons only. Five commercial crop silkworm rearing are carried out in a year out of which, multivoltine x bivoltine hybrids can successfully be reared during three seasons i.e., Autumn (Oct-Nov), Spring (Feb-Mar) and Early summer (Mar-Apr) and in other seasons viz., Summer (June-July) and rainy (Aug-Sep), multivoltine x multivoltine hybrids are reared. Multivoltine x bivoltine hybrid yield more cocoon and fetch more prize as the silk reeled from multivoltine x bivoltine are qualitatively better than multivoltine x multivoltine. However for preparing multivoltine x bivoltine hybrid layings, bivoltine seed cocoons are required, but raising of bivoltine seed cocoons are difficult in tropical climate as they are susceptible to temperature and pathogens.

Especially, the seed crop of autumn (the major commercial crop when 30% dfls consumption annually) has to be conducted during Sept-Oct, when both temperature (>35ºC) and humidity (>90%) are high which threat rearing of bivoltine parent silkworms, resulting unsuccessful raising of bivoltine seed cocoon which in turn affects production of multi x bi silkworm eggs (Das et al., 1994).

On the other hand foundation crosses may not be a true hybrid; however because of two (similar types of) parents involved they are tolerant to environmental condition and easy to rear than the single parent. Hence in this study, as an alternative to single bivoltine parent, bivoltine foundation crosses(FCs) are tried during different seed crops to find out suitable foundation cross (FC) which can give sustainable yield and can be used for multi x bi dfls production.

MATERIALS AND METHODS
Four bivoltine breeds spinning oval shape cocoon (CSN, CSC, SK3N, SK3C) and four spinning dumbbell shape cocoon [D6(P)N, SK4N, D6(P)C, SK4C] were used to prepare nine bivoltine foundation crosses viz., CSN x SK3N, CSN x SK3C, SK3C x SK3N, SK3C x CSC, SK3N x CSC (Oval-FC), D6(P)N x SK4C , D6(P)N x SK4N , SK4C x SK4N and SK4C x D6(P)C (Dumbbell FC). These foundation crosses were evaluated during three seed crop seasons viz., Sep-Oct, Dec-Jan and Feb-Mar, for two years. Data on the economically important traits were collected from each seasons are pooled and analyzed. The ranking of the foundation crosses was done as per Mano’s et al. (1993) evaluation index.
Table 1: Mean performance of bivoltine foundation crosses during Sep-Oct seed crop season

<table>
<thead>
<tr>
<th>Foundation cross</th>
<th>Fecundity (no.)</th>
<th>Pupation %</th>
<th>Cocoon yield /10000 larvae (kg)</th>
<th>Cocoon wt (g)</th>
<th>Shell wt (g)</th>
<th>Shell%</th>
</tr>
</thead>
<tbody>
<tr>
<td>D6(P)N x SK4C</td>
<td>456</td>
<td>85.56</td>
<td>13.476</td>
<td>1.575</td>
<td>0.325</td>
<td>20.63</td>
</tr>
<tr>
<td>SK3C x SK3N</td>
<td>468</td>
<td>85.00</td>
<td>13.260</td>
<td>1.560</td>
<td>0.315</td>
<td>20.19</td>
</tr>
<tr>
<td>D6(P)N x SK4N</td>
<td>440</td>
<td>87.67</td>
<td>13.501</td>
<td>1.540</td>
<td>0.310</td>
<td>20.13</td>
</tr>
<tr>
<td>SK4C x SK4N</td>
<td>451</td>
<td>86.06</td>
<td>12.720</td>
<td>1.478</td>
<td>0.295</td>
<td>19.96</td>
</tr>
<tr>
<td>SK4C x D6(P)C</td>
<td>469</td>
<td>73.78</td>
<td>10.551</td>
<td>1.430</td>
<td>0.279</td>
<td>19.51</td>
</tr>
<tr>
<td>CSN x SK3C</td>
<td>457</td>
<td>84.60</td>
<td>11.506</td>
<td>1.360</td>
<td>0.265</td>
<td>19.49</td>
</tr>
<tr>
<td>CSN x SK3N</td>
<td>422</td>
<td>75.67</td>
<td>10.669</td>
<td>1.410</td>
<td>0.255</td>
<td>18.09</td>
</tr>
<tr>
<td>SK3C x CSC</td>
<td>458</td>
<td>77.00</td>
<td>10.472</td>
<td>1.360</td>
<td>0.249</td>
<td>18.31</td>
</tr>
<tr>
<td>SK3N x CSC</td>
<td>464</td>
<td>74.00</td>
<td>9.916</td>
<td>1.340</td>
<td>0.235</td>
<td>17.54</td>
</tr>
<tr>
<td>NB4D2 (Control)</td>
<td>450</td>
<td>12.98</td>
<td>1.623</td>
<td>1.250</td>
<td>0.220</td>
<td>17.60</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>15.2</td>
<td>8.56</td>
<td>1.032</td>
<td>0.044</td>
<td>0.011</td>
<td>0.72</td>
</tr>
<tr>
<td>CV%</td>
<td>8.45</td>
<td>4.26</td>
<td>6.455</td>
<td>1.897</td>
<td>2.533</td>
<td>2.328</td>
</tr>
</tbody>
</table>

DISCUSSION

It is well documented that F1 silkworm hybrids are superior to single parent in respect of many quantitative and qualitative characters (Gamo and Hirobayashi, 1983). However foundation crosses are not a true hybrid, since they are crossing between similar types of parents to avoid segregation in the commercial level. In this study two types of foundation crosses are made i.e., oval FC (crossing between oval and oval cocoon with plain larvae) and dumbbell FC (crossing between dumbbell and dumbbell cocoon with marked larvae), so that no variation in cocoon shape occurred at F1. Results of the present study clearly indicated that foundation crosses are superior over single parent (NB4D2) in respect of cocoon yield and other economically important parameters. Out of nine new FCs evaluated, D6 (P) N x SK4C out yielded control (NB4D2) as well as other FCs in all seed crop seasons. The parents of these FCs are developed through introgression survival character from multivoltine breed (Moorthy et al., 2007a, b) for improving survival, thus proving their capacity to tolerate the prevailing environmental impediments. This study also inferred that bivoltine FCs can be recommended instead of single bivoltine parent for bivoltine seed crop stabilization.

In silkworm, Bombyx mori, the silk yield is contributed by more than 21 traits (Thiagarajan et al., 1993) and there exists an interrelationship between multiple traits in silkworm. Any effort to improve the yield requires consideration of cumulative effect of the major traits which influences the silk yield. It has also been established that selection pressure applied for one character results in correlated changes in other quantitative traits of economic importance. So in order to judge the superiority of the silkworm breed/ hybrid impartially, a common index method was found very much essential (Bhargava et al., 1994). The evaluation index (E.I) method developed by Mano et al., (1993) was found to be very useful in selecting potential parents/ hybrids in silkworm breeding programme. In this method characters are given equal weightage because in hybrids expression of traits will be uniform, in other words no variability within traits. Many workers used this E.I for selecting potential hybrid (Kumaresan et al., 2000; Rao et al., 2006; Moorthy et al., 2007a, b; Rayar, 2007). The selection of the hybrids ultimately depends on the excellence and performance of hybrids in many individual
traits. By considering the higher average EI value of all the traits, D6 (P) N x SK4C (EI value: 61.38) emerged as potential one.

**CONCLUSION**

Among the nine foundation crosses, D6 (P) N x SK4C found best considering its better performance in all the three seed crop seasons, especially the target seed crop Sep-Oct. Therefore it can be utilized as a male parent for preparation of three way cross, multi x bi hybrid for utilization in commercial crop.

**REFERENCES**


