Pedigree of Multivoltine [V₃] Silkworm Breeds (*Bombyx mori* L.) developed at CSRTI, Mysore

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SILKWORM BREEDING LABORATORY  
Central Sericultural Research & Training Institute,  
[An ISO 9001: 2008 Certified]  
Central Silk Board (Ministry of Textiles: Govt. of India)  
Manandavadi Road, Srirampura, Mysore – 570 008  
June, 2014
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Preface

Though India is a second largest producer of silk only next to China, still there is a vast gap between the production and demand for silk. The productivity and quality of Indian silk needs great improvement and silkworm breeds have to contribute significantly in the quality improvement and silk productivity for which the role of silkworm germplasm is vital to provide the basic breeding resource material to the silkworm breeders. The selection of initial parents to be used as breeding resource material is of prime importance and determines the degree of success of any breeding programme to a large extent. Therefore, proper and appropriate identification of suitable parents, their judicious utilization and choice of mating to generate ample genetic variability for facilitating enough scope for selection are crucial for the breeders.

In order to make Indian silk industry globally competitive in the current scenario, thrust is given to enhance the production as well as quality of silk in the country. Towards this goal the emphasis on the production of quality silk from bivoltine hybrids needs to be continued and intensified further. However, the pace at which bivoltine is picking up in the country is in adequate and the increasing demand for bivoltine silk is being met with imported raw silk. Since around 90% of the Indian silk is cross breed oriented, there is an urgent need to improve the quality of silk of multivoltine x bivoltine hybrids.

Recent efforts in silkworm breeding have led to the development of many productive polyvoltine breeds, which have the potential to produce gradable silk. Even though they are known for their productive merit, absence of genetic plasticity to buffer against the tropical environmental stress act as a constraint to exploit the full potential of the breeds in the field. However, polyvoltine races/breeds of indigenous origin in tropical countries are known to have relatively higher tolerance for biotic/abiotic stresses, which is not true
with evolved polyvoltine breeds that have been developed specially for their productivity. With the expansion of sericulture there is a pressure on Indian silkworm breeders to evolve breeds for region/seasons specific, tolerant to biotic/abiotic stress and superior fibre quality. Therefore silkworm breeders have a tremendous task of developing breeds of silkworm with different characters required by the industry. This necessitates a continuous programme of silkworm breeding for which diverse silkworm genetic resources are required.

Central Sericultural Research and Training Institute (CSRTI), Mysore has developed many polyvoltine breeds endowed with improved qualitative and quantitative traits. This document comprises of information on salient features and economic traits of fifteen evolved polyvoltine silkworm breeds of CSRTI, Mysore, which will be useful to the silkworm breeders for planning and designing of appropriate breeding strategies. The lines, which are identified through selection for their productivity, quality and robustness, could be effectively utilized as breeding resource material by the research institutions. I am very much sure that, the information available in this document finds its way as a handy tool which will help the silkworm breeders of other research institutions in selecting the breeding resource material in their breeding programme for the development of polyvoltine breeds of specific features and subsequent identification of suitable cross breed combinations.

25th June 2014

[Dr. B.B. Bindroo]
DIRECTOR
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<th>Page</th>
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<td>Breeders and experts contributed towards development of silkworm breeds</td>
<td>33</td>
</tr>
</tbody>
</table>
1. Pure Mysore

**Parentage:**

- Indigenous race

**Characteristics:**

- Indigenous race quite popular with the farmers of South India
- Eggs are light yellow in color with white Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour and having longer larval duration
- Cocoons are greenish yellow in colour, spindle in shape, having no grains and contain high floss
- Adults exhibit bimodal emergence and creamy white in color
- Low productive race with inferior pre and post cocoon parameters
- A very good combiner with bivoltine breeds. Being used as female parent for popular cross breed PM x CSR2

**Rearing and reeling traits:**

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H) Total</th>
<th>5th age</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>450 ±25</td>
<td>27:00 ±1:00</td>
<td>8:00 ±1:00</td>
<td>90.00</td>
<td>0.00</td>
<td>1.020 ±0.17</td>
<td>0.145 ±0.04</td>
<td>14.19 ±0.78</td>
<td>14.78 ± 0.5</td>
<td>0.877 ± 0.1</td>
<td>65.00 ±5.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neat- ness (%)</th>
<th>BOL (%)</th>
<th>Coc. /kg</th>
<th>Egg recovery %</th>
<th>Hib. %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 ±25</td>
<td>2.10 ±0.2</td>
<td>9.00 ±1.0</td>
<td>60.00 ±5.0</td>
<td>85.00 ±1.0</td>
<td>28.00 ±1.0</td>
<td>985 ±25</td>
<td>40 ± 2</td>
<td>60 ± 5</td>
<td>2000 ±100</td>
<td>11:00 ±1:00</td>
</tr>
</tbody>
</table>

**Larvae and Cocoons:**

![Larvae and Cocoons Image]
2. BL24

Parentage:
- [Hosa Mysore x Nistari] x [NB7]

Characteristics:
- Developed during 1995
- Developed for better productivity over PM
- Eggs are light yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are greenish yellow in colour, elongated oval in shape with coarse grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color
- Female parent for BL24 x NB4D2 and BL24 x C.Nichi (Varuna), authorized crossbreeds for irrigated and rainfed mulberry respectively.

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Fec (no)</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>501 ±20</td>
<td>22:18 ±1:00</td>
<td>5:16 ±0:13</td>
<td>89.13 ±4.83</td>
<td>00</td>
<td>1.070 ±0.16</td>
<td>0.188 ±0.03</td>
<td>17.49 ±0.87</td>
<td>6.50 ±1.00</td>
<td>0.883 ±0.13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>430 ±50</td>
<td>2.47 ±0.09</td>
<td>10.04 ±0.87</td>
<td>68.41 ±7.79</td>
<td>86.00 ±2.00</td>
<td>27.50 ±1.00</td>
<td>900 ±25</td>
<td>35.00 ±2</td>
<td>60 ±5</td>
<td>00</td>
<td>1815 ±100</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

Hosa Mysore X Nistari

F1

F2

Selection of plain larvae, greenish yellow oval cocoons and non-diapause layings

F3

Mid-way evaluation

F4

F5

F6

F7

F8

F9

Combining ability Test

Mass non-selected

Mass selected

Cellular selected

Cellular non-selected
3. BL67

Parentage:
- BL24 x BL27

Characteristics:
- Developed during 1998
- Developed for its high cocoon shell weight and tolerant to high temperature
- Eggs are yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape with medium to coarse grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color
- Female parent for BL67 x CSR101 (Cauvery), authorized crossbreed for irrigated mulberry.

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>519 ±48</td>
<td>22.04 ±1:06</td>
<td>90.90 ±4.35</td>
<td>2.00 ±1.00</td>
<td>1.240 ±0.15</td>
<td>0.223 ±0.03</td>
<td>17.98 ±0.89</td>
<td>7.50 ±1.00</td>
<td>1.017 ±0.12</td>
</tr>
<tr>
<td>5th age</td>
<td>±0:10</td>
<td>±4.35</td>
<td>±1.00</td>
<td>±0.15</td>
<td>±0.03</td>
<td>±0.89</td>
<td>±1.00</td>
<td>±0.12</td>
<td>±11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>641 ±48</td>
<td>2.24 ±0.39</td>
<td>11.46 ±1.62</td>
<td>65.24 ±8.16</td>
<td>86.00 ±1.00</td>
<td>25.74 ±1.50</td>
<td>800 ±10</td>
<td>37.00 ±2</td>
<td>63 ±5</td>
<td>1.06 ±0.67</td>
<td>1855 ±100</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

BL24  X  BL27
F1
BC
X
BL24

F2  F2  F2  F2  F2

Selection of Plain Larvae, Greenish Yellow Oval Cocoons

Mid-Way Evaluation
Combining Ability Test

Cellular Selected  Cellular Non-Selected  Mass Selected  Mass Non-Selected
Parentage:
- BL33 x BL27

Characteristics:
- Developed during 1998
- Developed for its high cocoon shell weight and tolerant to high temperature
- Eggs are yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in color
- Cocoons are light greenish yellow in colour, elongated oval in shape with medium to coarse grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>5th age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>545 ±34</td>
<td>22:18</td>
<td>5:16 ±0:13</td>
<td>91.52 ±3.73</td>
<td>1.00 ±0.03</td>
<td>1.228 ±0.13</td>
<td>0.229 ±0.03</td>
<td>18.68 ±0.80</td>
<td>8.10 ±1.00</td>
<td>0.999 ±0.11</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

- **BL33** × **BL27**

**F1**

**F2**

**F3**

**F4**

**F5**

**F6**

**F7**

**F8**

**F9**

**F10**

Selection of Plain Larvae, Greenish Yellow Oval Cocoons

Mid-way evaluation at F8

Combining ability test

Cellular selected

Cellular non-selected
**5.BL69**

**Parentage:**
- PM x CSR2

**Characteristics:**
- Developed during 1998
- Developed for its productivity with better pre and post cocoon parameters over PM
- Eggs are yellow in color with white chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Total larval duration 22-23 days with 5-6 days of 5th age duration
- Cocoons are light greenish yellow in colour, elongated oval in shape with medium to coarse grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

**Rearing and reeling traits:**

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H) Total</th>
<th>5th age</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>504 ±44</td>
<td>22:18 ±1:00</td>
<td>5:16 ±0:13</td>
<td>89.95 ±7.19</td>
<td>0.33 ±0.01</td>
<td>1.193 ±0.10</td>
<td>0.207 ±0.02</td>
<td>17.35 ±0.85</td>
<td>8.00 ±1.00</td>
<td>0.986 ±0.08</td>
<td>77.85 ±7.82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>529 ±63</td>
<td>2.14 ±0.29</td>
<td>10.75 ±1.40</td>
<td>62.77 ±8.56</td>
<td>86.00 ±1.00</td>
<td>26.00 ±1.50</td>
<td>800 ±25</td>
<td>36.00 ±2</td>
<td>65 ±5</td>
<td>00</td>
<td>1865 ±100</td>
</tr>
</tbody>
</table>

**Larvae and Cocoons:**
Breeding Plan:

PM \times CSR2

F1

F2

F3

F4

F5

F6

F7

F8

F9

F10

Selection of Plain Larvae, Greenish Yellow Oval Cocoons

Selection of non- hibernated layings

Selection of only hard cocoons

Mid-way evaluation

Combining ability Test

Cellular selected

Cellular non-selected
**Parentage:**
- BL61 x CSR2

**Characteristics:**
- Developed during 1998
- Developed for its high cocoon shell weight and fiber characters
- Eggs are yellow in color with white Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, short oval in shape with medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

**Rearing and reeling traits:**

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>482±24</td>
<td>5.12±0.15</td>
<td>88.20±6.65</td>
<td>1.15±0.51</td>
<td>1.220±0.17</td>
<td>0.221±0.04</td>
<td>18.08±0.78</td>
<td>7.00±1.00</td>
<td>0.999±0.04</td>
</tr>
<tr>
<td>5th Age</td>
<td>22:14±1:02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>577±66</td>
<td>2.26±0.34</td>
<td>10.63±1.00</td>
<td>57.92±4.68</td>
<td>87.00±1.00</td>
<td>25.00±1.50</td>
<td>800±20</td>
<td>38.00±3</td>
<td>65±5</td>
<td>2.95±0.10</td>
<td>1850±100</td>
</tr>
</tbody>
</table>

**Larvae and Cocoons:**
Breeding Plan:

Selection of Plain Larvae, Greenish Yellow Oval Cocoons

Selection of non-hibernated layings

Mid-way evaluation

Combining ability Test

Cellular selected

Cellular non-selected
**Parentage:**
- BL65 x CSR2

**Characteristics:**
- Developed during 1998
- Developed for its high cocoon shell weight and fiber characters
- Eggs are yellow in color with white Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape with medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

**Rearing and reeling traits:**

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>519 ±41</td>
<td>22:09 ±1:18</td>
<td>5:11 ±0:13</td>
<td>90.57 ±5.01</td>
<td>00</td>
<td>1.217 ±0.13</td>
<td>0.223 ±0.02</td>
<td>18.31 ±0.86</td>
<td>7.01 ±1.00</td>
<td>0.994 ±0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>484 ±56</td>
<td>2.40 ±0.31</td>
<td>9.42 ±0.24</td>
<td>50.70 ±5.78</td>
<td>86.00 ±1.00</td>
<td>25.00 ±1.00</td>
<td>800 ±22</td>
<td>36.00 ±4</td>
<td>64 ±4</td>
<td>17.30 ±3.0</td>
<td>1800 ±100</td>
</tr>
</tbody>
</table>

**Larvae and Cocoons:**
Breeding Plan:

- BL65 \( \times \) CSR2

F1

F2

F3

F4

F5

F6

F7

F8

F9

F10

Selection of Plain Larvae, Greenish Yellow Oval

Selection of non-hibernated layings

Mid-way evaluation

Combining ability Test

- Cellular selected
- Cellular non-selected
8. 2000H

Parentage:
- 96H x CSR18

Characteristics:
- Developed during 2000
- Developed for its high cocoon shell weight and fiber characters
- Eggs are yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape with coarse to medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Df</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>483 ±40</td>
<td>22:09 ±1:18</td>
<td>5:11 ±0:13</td>
<td>90.57 ±4.42</td>
<td>03</td>
<td>1.208 ±0.14</td>
<td>0.220 ±0.03</td>
<td>18.21 ±1.10</td>
<td>6.80 ±1.00</td>
<td>0.988 ±0.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Cocc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>524 ±15</td>
<td>2.28 ±0.37</td>
<td>11.26 ±0.60</td>
<td>60.80 ±2.26</td>
<td>87.00 ±1.00</td>
<td>25.50 ±1.00</td>
<td>800 ±25</td>
<td>37.00 ± 3</td>
<td>7.87 ±2.23</td>
<td>1900 ±100</td>
<td>12:00 ±1:00</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

96H X CSR18

F1

F2

F3

F4

F5

F6

F7

F8

F9

F10

Selection of Plain Larvae, Greenish Yellow Oval Cocoons

Selection of non-hibernated layings

Mid-way evaluation

Combining ability Test

Cellular selected

Cellular non-selected
**9. ND7**

**Parentage:**
- BL67 (BL24 x BL27), larvae with two prominent black eye spots on 2nd thoracic segment were selected and inbred

**Characteristics:**
- Developed during 2003
- Developed for superior fiber quality (A-2A) and tolerant to high temperature
- Eggs are light yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain with black eyespot on 2nd thoracic segment and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape and having medium to coarse grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color
- Female parent for ND7 x CSR2 (Jayalakshmi), identified as improved crossbreed for irrigated mulberry.

**Rearing and reeling traits:**

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>Total</th>
<th>5th age</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>549 ±38</td>
<td>22:04 ±1:10</td>
<td>5:08 ±0:13</td>
<td>91.74 ±3.57</td>
<td>3.45 ±0.60</td>
<td>1.325 ±0.110</td>
<td>0.235 ±0.02</td>
<td>17.77 ±0.52</td>
<td>8.50 ±1.00</td>
<td>1.090 ±0.09</td>
<td>77.63 ±5.99</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>554 ±69</td>
<td>2.45 ±0.42</td>
<td>10.94 ±1.22</td>
<td>62.41 ±6.52</td>
<td>86.00 ±1.00</td>
<td>25.35 ±1.15</td>
<td>750 ±20</td>
<td>37.00 ±2</td>
<td>63 ±5</td>
<td>1.06 ±0.67</td>
<td>1855 ±100</td>
</tr>
</tbody>
</table>

**Larvae and Cocoons:**
Breeding Plan:

Selection of plain larvae with two prominent black eyespots on second thoracic segment

Mass Selected

Cellular selected

Cellular non-selected
10. NDV6

Parentage:

- 2000H x C.Nichi

Characteristics:

- Developed during 2005
- Developed for tolerant to BmDNV1 (Denso Nucleosis Virus)
- Eggs are light yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, short oval in shape and having medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color
- Female parent for NDV6 x CSR2 and NDV6 x CSR51, identified as improved crossbreeds for irrigated mulberry

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/Dfl</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>5th age</td>
<td>5th age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>536</td>
<td>22:05</td>
<td>5.10 ±0.12</td>
<td>92.23 ±2.35</td>
<td>5.26 ±0.26</td>
<td>1.279 ±0.13</td>
<td>0.234 ±0.02</td>
<td>18.33 ±0.66</td>
<td>7.50 ±1.00</td>
<td>1.045 ±0.11</td>
</tr>
<tr>
<td>±38</td>
<td>±1:07</td>
<td>±0.12</td>
<td>±2.35</td>
<td>±0.26</td>
<td>±0.13</td>
<td>±0.02</td>
<td>±0.66</td>
<td>±1.00</td>
<td>±0.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>528</td>
<td>2.39</td>
<td>10.76</td>
<td>56.06</td>
<td>86.00</td>
<td>24.35</td>
<td>760</td>
<td>39.00 ±2</td>
<td>65</td>
<td>5.92 ±1.00</td>
<td>1856 ±100</td>
</tr>
<tr>
<td>±95</td>
<td>±0.53</td>
<td>±1.81</td>
<td>±8.50</td>
<td>±1.00</td>
<td>±1.25</td>
<td>±20</td>
<td>±5</td>
<td>±5</td>
<td>±1.00</td>
<td>±1:00</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

Back Crossing with recurrent parent and inoculation in alternate generations and selection of survived progeny
Parentage:

- BL67 x MAR

Characteristics:

- Developed during 2005
- Developed for robustness and tolerant to high temperature
- Eggs are light yellow in color with white Chorion and ellipsoidal in shape
- Larvae are plain and bluish tinge in colour
- Cocoons are greenish yellow in colour with oval round ends in shape and having medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>5th age</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>512 ±50</td>
<td>21:22 ±1:06</td>
<td>5:07 ±0:11</td>
<td>90.75 ±3.65</td>
<td>3.25 ±0.20</td>
<td>1.306 ±0.11</td>
<td>0.226 ±0.02</td>
<td>17.33 ±0.70</td>
<td>8.50 ±1.00</td>
<td>1.08 ±0.09</td>
<td>78.07 ±7.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Wt. (g)</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>535 ±124</td>
<td>2.59 ±0.26</td>
<td>11.52 ±1.80</td>
<td>65.94 ±10.00</td>
<td>87.00 ±2.00</td>
<td>25.30 ±1.20</td>
<td>750 ±20</td>
<td>39.00 ±2</td>
<td>62 ±3</td>
<td>0.00</td>
<td>1865 ±100</td>
<td>12:00 ±1:00</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

BL67  X  MAR

F1

F2

F3

F4

F5

F6

F7

F8

F9

F10

F11

F12

36±1°C, 85±5%RH

25±1°C, 65±5%RH

36±1°C, 85±5%RH

25±1°C, 65±5%RH

36±1°C, 85±5%RH

36±1°C, 85±5%RH

Hybrid evaluation

Cellular non-selected

Mass non-selected

Cellular selected

Mass selected
12. NP1

Parentage:
- BL69 x MAR

Characteristics:
- Developed during 2005
- Developed for tolerant to high temperature and BmNPV
- Eggs are yellow in color with yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, elongated oval in shape with medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H) Total</th>
<th>5th age</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>488 ±60</td>
<td>21:21 ±1:05</td>
<td>5:09 ±0:11</td>
<td>90.95 ±4.21</td>
<td>1.33 ±0.08</td>
<td>1.232 ±0.14</td>
<td>0.224 ±0.03</td>
<td>18.18 ±0.90</td>
<td>8.30 ±1.50</td>
<td>1.008 ±0.12</td>
<td>74.14 ±11.28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>523 ±90</td>
<td>2.62 ±0.5</td>
<td>11.23 ±2.07</td>
<td>64.36 ±12.00</td>
<td>86.00 ±2.00</td>
<td>24.98 ±1.21</td>
<td>800 ±20</td>
<td>40.00 ±4</td>
<td>1.50</td>
<td>1900 ±100</td>
<td>12:00 ±1:00</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

F1  BL69  X  MAR

Inoculation with BmNPV*

F2  X  BL62

36±1°C, 85±5%RH
Inoculation with BmNPV**

F3

36±1°C, 85±5%RH
Inoculation with BmNPV**

F4

Inoculation with BmNPV**

F5

F6

25±1°C, 65±5%RH
Inoculation with BmNPV**

F7

Inoculation with BmNPV**

F8

25±1°C, 65±5%RH
Inoculation with BmNPV**

F9

Inoculation with BmNPV**

F10

25±1°C, 65±5%RH
Inoculation with BmNPV**

F11

Inoculation with BmNPV***

F12

Hybrid evaluation

*: 1.5x 10^7 POB/100 larvae; **: 2.5x 10^7 POB/100 larvae; ***: 3.0x 10^7 POB/100 larvae

Cellular non-selected
Mass non-selected

Cellular selected
Mass selected
13. AGL3

**Parentage:**
- BL68

**Characteristics:**
- Developed during 2008
- Developed through application of Androgenesis coupled with conventional breeding
- Eggs are yellow in color with yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape with medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

**Rearing and reeling traits:**

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H)</th>
<th>Pupation (%)</th>
<th>TM (%</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>513 ±45</td>
<td>22.03 ±1:09</td>
<td>88.84 ±5.71</td>
<td>0.17 ±0.06</td>
<td>1.279 ±0.15</td>
<td>0.227 ±0.03</td>
<td>17.73 ±0.90</td>
<td>7.00 ±1.00</td>
<td>78.72 ±6.75</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>615 ±84</td>
<td>2.61 ±0.28</td>
<td>11.82 ±1.45</td>
<td>66.64 ±3.40</td>
<td>85.00 ±1.00</td>
<td>25.91 ±1.25</td>
<td>780 ±20</td>
<td>38.00 ±2</td>
<td>62 ±4</td>
<td>0.35 ±0.22</td>
<td>1850 ±100</td>
</tr>
</tbody>
</table>

**Larvae and Cocoons:**
Breeding Plan:
14. AGL5

Parentage:
- DNP5

Characteristics:
- Developed during 2008
- Developed through application of Androgenesis coupled with conventional breeding
- Eggs are yellow in color with yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape with medium grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/Dfl</th>
<th>LD (D: H) Total</th>
<th>5th age</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>507 ±40</td>
<td>22.03 ±1:09</td>
<td>5:10 ±0:12</td>
<td>89.68 ±4.12</td>
<td>0.05 ±0.01</td>
<td>1.251 ±0.12</td>
<td>0.227 ±0.03</td>
<td>18.11 ±0.92</td>
<td>7.20 ±1.00</td>
<td>1.025 ±0.10</td>
<td>77.08 ±7.74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery % Wt. (g)</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>634 ±38</td>
<td>2.45 ±0.22</td>
<td>12.56 ±1.64</td>
<td>65.11 ±9.86</td>
<td>87.00 ±2.00</td>
<td>26.91 ±1.30</td>
<td>780 ±20</td>
<td>39.00 ±2</td>
<td>62 ±3</td>
<td>1.04 ±0.5</td>
<td>1849 ±100</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

- **Breeding lines:**
  - BL
  - BC1
  - BC6
  - AGL5

- **Female kept as genetic marker:**
  - F2
  - A1
  - A2
  - A6

- **Androgenic male:**
  - P
Parentage:

- [ND7 x NDV6] x [NP1 x 2000H]

Characteristics:

- Developed during 2011
- Developed for superior fiber quality
- Eggs are light yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in colour
- Cocoons are light greenish yellow in colour, oval in shape with medium to fine grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color
- Good combiner with CSR2 and CSR50 for the production of L14 x CSR2 and L14 x CSR50, improved cross breeds with superior fiber quality (2A~3A)

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D:H)</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>538 ±45</td>
<td>21:22 ±1:10</td>
<td>5:09 ±0:05</td>
<td>91.84 ±2.78</td>
<td>3.14 ±2.33</td>
<td>1.310 ±0.120</td>
<td>0.244 ±0.02</td>
<td>18.48 ±0.63</td>
<td>7.41 ±1.00</td>
<td>1.059 ±0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D:H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>645 ±81</td>
<td>2.35 ±0.36</td>
<td>12.44 ±1.24</td>
<td>62.77 ±6.18</td>
<td>86.36 ±1.49</td>
<td>25.00 ±1.00</td>
<td>675 ±25</td>
<td>40 ± 2</td>
<td>70 ±5</td>
<td>5.60 ±5.2</td>
<td>1800 ±100</td>
</tr>
</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

ND7 × NDV6

NP1 × 2000H

F1

F2

L13

L14

L15

Stabilization of lines

Hybrid evaluation

Mass Selected  Cellular selected  Cellular non-selected
16. L15

Parentage:
- [ND7 x NDV6] x [NP1 x 2000H]

Characteristics:
- Developed during 2011
- Developed for superior fiber quality
- Eggs are light yellow in color with light yellow Chorion and ellipsoidal in shape
- Larvae are plain and bluish white in color
- Cocoons are light greenish yellow in colour, oval in shape with medium to fine grains.
- Pupae are brown in color and elliptical in shape
- Adults are creamy white in color

Rearing and reeling traits:

<table>
<thead>
<tr>
<th>Eggs/ Dfl</th>
<th>LD (D: H) Total</th>
<th>Pupation (%)</th>
<th>TM (%)</th>
<th>SCW (g)</th>
<th>SSW (g)</th>
<th>Shell (%)</th>
<th>Floss (%)</th>
<th>SPW (g)</th>
<th>Reel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD (D: H)</td>
<td>509 ±52</td>
<td>22:01 ±1:12</td>
<td>5.08 ±0:14</td>
<td>91.06 ±4.52</td>
<td>2.63 ±0.65</td>
<td>1.280 ±0.120</td>
<td>0.235 ±0.02</td>
<td>18.37 ±0.81</td>
<td>8.50 ±1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FL (m)</th>
<th>FS (d)</th>
<th>RS (%)</th>
<th>RSR (%)</th>
<th>Neatness (%)</th>
<th>BOL (%)</th>
<th>Coc /kg</th>
<th>Egg recovery %</th>
<th>Wt. (g)</th>
<th>Hib %</th>
<th>Grains / g</th>
<th>Pupal duration (D: H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>584 ±52</td>
<td>2.54 ±0.22</td>
<td>13.03 ±1.35</td>
<td>63.44 ±6.02</td>
<td>87.00 ±2.00</td>
<td>24.30 ±1.00</td>
<td>700 ±25</td>
<td>38.00 ±2</td>
<td>68 ±6</td>
<td>5.57 ±1.67</td>
<td>1850 ±100</td>
<td>13:00 ±1:00</td>
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</tbody>
</table>

Larvae and Cocoons:
Breeding Plan:

ND7 X NDV6

NP1 X 2000H

F1

F2

L13

L15

F2

L14

Stabilization of lines

Hybrid evaluation

Mass Selected  Cellular selected  Cellular non-selected
# ABBREVIATIONS

<table>
<thead>
<tr>
<th>#</th>
<th>Abbreviation</th>
<th>Expansion</th>
<th>#</th>
<th>Abbreviation</th>
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<tr>
<td>1</td>
<td>LD</td>
<td>Larval Duration</td>
<td>9</td>
<td>FL</td>
<td>Filament length</td>
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<tr>
<td>2</td>
<td>D</td>
<td>Days</td>
<td>10</td>
<td>FS</td>
<td>Filament size</td>
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<tr>
<td>3</td>
<td>H</td>
<td>Hours</td>
<td>11</td>
<td>RS</td>
<td>Raw silk</td>
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<tr>
<td>4</td>
<td>TM</td>
<td>Trimoulters</td>
<td>12</td>
<td>RSR</td>
<td>Raw silk recovery</td>
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<td>5</td>
<td>SCW</td>
<td>Single cocoon weight</td>
<td>13</td>
<td>BOL</td>
<td>Boil off loss</td>
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<tr>
<td>6</td>
<td>SSW</td>
<td>Single shell weight</td>
<td>14</td>
<td>Coc</td>
<td>Cocoons</td>
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<tr>
<td>7</td>
<td>SPW</td>
<td>Single pupal weight</td>
<td>15</td>
<td>Hib</td>
<td>Hibernation</td>
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<td>8</td>
<td>Reel</td>
<td>Reelability</td>
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</table>
Breeders / Experts contributed towards development of silkworm breeds

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2. Dr. S.B. Dandin
3. Dr. C.K. Kamble
4. Dr. S.M.H. Qadri
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26. Dr. P. Sudhakar Rao
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