# EFFECT OF DIFFERENT SEASON ON CROP PERFORMANCE OF PARENTAL STOCK RACES OF BIVOLTINE SILKWORM (*BOMBYX MORI* L.)

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**[Rahmathulla, V. K., Kishor Kumar, C. M., Manjula, A. & Sivaprasad, V.** 2011. Effect of different season on crop performance of parental stock races of Bivoltine silkworm (*Bombyx mori* L.). Munis Entomology & Zoology, 6 (2): 886-892**]**

ABSTRACT: Study analyzed the various seasonal (summer, rainy and winter) effects on important cocoon and seed production parameters of parental silkworm stock race rearing conducted during the period of 2007- 2010 at basic seed farm. Popular elite bivoltine pure silkworm races like CSR2, CSR4, CSR6, CSR26, CSR27 and traditional bivoltine pure race NB4D2 were reared. Performances of the different races were analyzed and studied the seasonal effects. All the races showed better productivity and quality in rainy and winter season when compared to summer season. The results indicated that rearing performance and seed production parameters were comparatively better for CSR2, CSR6, CSR26 and CSR27 during rainy season. The traditional bivoltine dumb-bell race NB4D2 and elite bivoltine dumb-bell race CSR4 performed well during winter season for rearing as well as seed production parameters. During summer most of the rearing and seed parameters of NB4D2 recorded higher when compared to all other races and the rearing parameters like yield /100 dfls (76.61kg), pupation rate (94.29%) and recovery percentage of Dfls (32.75%) recorded comparatively higher than other races. The results of the study conclude that the races NB4D2 and CSR2 have performed well in all the seasons for most of the parameters studied and indicated the stabilized expression for the racial characters.

KEY WORDS: Parental stock races, seasonal effect, rearing and seed production parameters.

Maintenance and multiplication of bivoltine parental stock races of silkworm is very much important in the quality silk production. If proper maintenance and management is not followed in seed crop rearing, the racial characters will show variation and there by affecting seed cocoon quality. Though, a 3 tier system of multiplication of race is practiced in India, the quality of the cocoons produced are not in conformity with the breed characters in many occasions, this may be due to the various factors including the exposure of breeds to adverse environmental conditions. Unlike temperate climate, the tropical climate of India is characterized by wide fluctuation in temperature, humidity and associated micro and macro environmental conditions. The hot environmental conditions of tropics prevailing particularly in summer are not conducive to high yielding productive breeds. However, in order to introduce bivoltine silkworm races in a tropical condition like India, it is highly necessary to have stability in cocoon crop performance under varied agro- climatic conditions. The basic seed farms under Government sectors are established for the purpose of stock maintenance, true to the breed characters and it is most important link in the entire chain of basic seed multiplication. Maintenance of racial characteristics is always a difficult task because in each life–cycle of silkworm, the environmental condition of rearing are different and also varies quality and nutritive value of leaf. Several workers already pointed out the importance of optimum temperature and humidity conditions favorable for seed crop rearing (Reddy et al. 2001; Palit et al. 2003).

Researchers assessed the seasonal effect on seed crop rearing (Bhat, 1989; Kumar et al., 2003; Jaiswal & Gangwar). The present study analyzed the various seasonal effects on important cocoon and seed production parameters of parental stock silkworm rearing.

## MATERIAL AND METHODS

**Study location**- The study area P3 basic seed farm is located in Mysore, Karnataka, India and it has situated at 12° 18'N 76°39'E 12.30°N 76.65° E and has an average altitude of 770 meters (2,526 ft). It is in the southern region of the state of Karnataka, at the base of the famous Chamundi Hills and spreads across an area of 128.42 km². The summer season is from March to middle of June, followed by the monsoon season from middle of June to October and the winter season from November to February middle. The highest temperature recorded in Mysore was 38.5° c (101 ° F) and in winter, temperatures as low as 9.6 °C (49 ° F) have been recorded. The average annual rainfall received by the city is 798.2mm (Fig. 1).

**Study material**. The parental silkworm races like CSR2, CSR4, CSR6, CSR26, and CSR27 used for the present study were evolved by silkworm breeders of Central Sericulture Research and Training Institute, Mysore with the collaboration of Japanese experts. These breeds are popular for high survivability, high yield and high silk ratio and these races are suitable to rear under Indian environmental conditions. These pure races are using for producing popular bivoltine hybrids and double hybrids and cocoon from these hybrids are producing superior quality bivoltine silk matching with the international standards. The NB4D2 is a traditional bivoltine race in India and commonly used for producing cross breed hybrid (multivoltine x bivoltine).

The study analyzed the various seasonal (summer, Rainy and winter) effects on important cocoon and seed parameters of parental stock rearing conducted during the period of 2007- 2010. Altogether 26 seed crop rearing was conducted during the period of study and the above-mentioned races were reared cellular batches as per the standard recommendation. Quality mulberry leaves of V1 variety was provided to silkworm and performances of the different races were assessed and cocoon yield, quality parameters and seed production parameters were calculated. The data of different years pooled based on season and analyzed the effects of different season on cocoon and seed production parameters. The below mentioned formulae were used for calculation of important cocoon and seed production parameters.

$$\text{Silk ratio} = \frac{\text{Cocoon shell weight}}{\text{Cocoon weight}} \times 100$$

$$\text{Yield/100 dfls} = \frac{\text{Total cocoon harvested (Kg.)}}{\text{No. of Dfls brushed}} \times 100$$

$$\text{Effective rearing rate (ERR) by no or Weight} = \frac{\text{No of cocoon harvested by No. or Kg.}}{\text{No. of larvae brushed}} \times 10000$$

$$\text{Pupation rate} = \frac{\text{No .of live pupae inside cocoon}}{\text{No. of cocoon counted}} \text{ X100}$$

## RESULTS AND DISCUSSION

**Rearing parameters**. All the races showed better productivity in quality and quantity aspects during rainy and winter season when compared to summer season and detailed results are discussed below and presented in Table 1. Hatching percentage was slightly less during summer season when compared to other season. In winter majority of the races hatching percentage was higher however, highest hatching percentage was observed in NB4D2 (96.57%) during summer season.

Effective rearing rate (E.R.R) (yield /10000 larvae) indicates that survivability of the breed and its quantitative performance in weight. The races like CSR2, CSR27, and CSR26 performed well during rainy season when compared to summer and winter. However, the dumbbell races like CSR4 and NB4D2 performed well in winter season. It was interesting to note that the traditional bivoltine race of India (NB4D2) performed equally well in summer season (Effective rearing rate (ERR) by no 9646). E.R.R. of larvae by weight also showed similar trend except CSR4 and NB4D2 all other races performed well in winter season. Highest weight was recorded for CSR6 (18.26 kg) in rainy season. There is direct correlation between metabolic responses of the poikilothermic silkworm to temperature. Food consumption, utilization and subsequent development are greatly influenced by atmospheric temperature and humidity during the crop (Benchamin et al., 1986).

Yield/100 dfl by no and weight also indicates yield performance of the race. Higher value was recorded for majority of the races (CS6, CSR26, and CSR2 & CSR27) during rainy season. But NB4D2 and CSR4 registered better performance during winter season and higher value yield/100 dfls by no. was recorded for NB4D2 (51116) and this race equally performed well in summer season also (48862). Same trend was recorded for yield /100 dfls by weight.

Single cocoon weight was recorded higher during rainy season for majority of the races (CSR6, CSR26, and CSR2 & CSR27). CSR4 race performed comparatively well in winter and higher cocoon weight was recorded (1.748g). Similarly, higher shell weight was recorded for CSR2 (0.42g) and CSR27 (0.45g) during rainy season. Shell ratio was also followed the same trend and registered higher value during rainy season for the above races. Insects evolved a variety of strategies to acquire and accumulate energy from nutrient and water from food in given environmental condition (Muthukrishnan & Pandian, 1987).

Pupation rate also recorded higher during rainy season for CSR6, CSR26, CSR2 and CSR27 and it was recorded higher for CSR4 and NB4D2 during winter season. Cocoon /litre indicate the voluminous nature of cocoon and it was recorded higher during rainy season for CSR2 and CSR27.

**Seed production parameters**. The study results indicated that melting (dead pupae inside the cocoon) percentage was recorded less for CSR6, CSR26 and CSR27 races during rainy season. CSR4 and NB4D2 recorded less melting percentage during winter season (Table 2). Percentage of pairs and dfls also recorded similar trend and during summer season NB4D2 and CSR4 races were performed well in the above parameters. CSR2 race was performed well in rainy (42.48%) and winter (42.42%). Recovery percentage of dfls was comparatively

low for CSR4 during all the season. However, stabilized performance of rearing recovery percentage of eggs were noticed in CSR2 and NB4D2 races irrespective of season.

## COCLUSION

Emphasis should be given to evolve bivoltine breeds suitable to tropical condition for achieving the primary objective of establishing bivoltine sericulture with good quality layings and subsequent raw silk production.

The hot climatic condition of tropic prevailing particularly in summer are contributing to the poor performance of the bivoltine breeds and the most important aspects is that many quantitative characters such as viability and cocoon traits decline sharply when temperature is higher. The study also observed that the traditional bivoltine race NB4D2 and elite race CSR2 irrespective of the season performed well and recorded higher value of yield/100dfls, single cocoon weight and pupation rate during extreme condition of summer. This indicated stable performance of the races and the potentiality of races can be exploited in favourable and unfavourable seasons of southern India.

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Table 1. Performance of silkworm stock races during different seasons.

| Season/Race | Fecundity | Hatching (%) | Yield / 10000 larvae (ERR) | | Yield / 100 dfls | | Single Cocoon Wt.(g) | Single Shell Wt.(g) | Silk ratio (%) | Pupation Rate (%) | No. of cocoons per Liter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | By No. | By Wt. (kg) | By No. | By Wt. (kg) | | | | | |
| **Summer** | | | | | | | | | | | |
| CSR4 | 495 | 92.07 | 8802 | 13.77 | 38008 | 60.20 | 1.64 | 0.34 | 20.73 | 91.04 | 120 |
| NB4D2 | 536 | 96.57 | 9646 | 15.12 | 48862 | 76.61 | 1.65 | 0.35 | 21.18 | 94.25 | 107 |
| CSR6 | 478 | 88.55 | 7953 | 10.20 | 28295 | 35.75 | 1.57 | 0.35 | 22.01 | 86.35 | 124 |
| CSR26 | 497.5 | 90.65 | 7918 | 10.05 | 28335 | 35.25 | 1.51 | 0.33 | 22.14 | 86.15 | 126 |
| CSR2 | 529.95 | 93.78 | 8845 | 13.54 | 43038 | 64.86 | 1.70 | 0.39 | 23.09 | 91.93 | 78 |
| CSR27 | 464.5 | 90.55 | 9066 | 12.31 | 42205 | 58.02 | 1.52 | 0.35 | 22.96 | 86.45 | 95 |
| | | | | | | | | | | | |
| **Rainy** | | | | | | | | | | | |
| CSR4 | 492.5 | 92.91 | 9173 | 14.83 | 40485 | 65.97 | 1.70 | 0.37 | 21.68 | 92.67 | 116 |
| NB4D2 | 548 | 95.32 | 9634 | 16.31 | 48544 | 82.49 | 1.87 | 0.40 | 21.32 | 94.50 | 97 |
| CSR6 | 454 | 94.10 | 9954 | 18.26 | 42526 | 78.00 | 1.81 | 0.38 | 21.03 | 94.50 | 108 |
| CSR26 | 462 | 94.89 | 9923 | 17.56 | 43500 | 77.00 | 1.77 | 0.37 | 21.10 | 94.80 | 116 |
| CSR2 | 537.87 | 95.57 | 9448 | 16.11 | 47457 | 80.88 | 1.77 | 0.42 | 23.79 | 94.60 | 71 |
| CSR27 | 476 | 93.85 | 9562 | 17.00 | 42555 | 75.54 | 1.84 | 0.45 | 24.28 | 92.55 | 70 |
| | | | | | | | | | | | |
| **Winter** | | | | | | | | | | | |
| CSR4 | 490 | 93.75 | 9543 | 15.89 | 42962 | 71.75 | 1.74 | 0.38 | 21.88 | 94.29 | 112 |
| NB4D2 | 528 | 96.44 | 9809 | 17.40 | 51116 | 90.67 | 1.81 | 0.39 | 21.34 | 97.50 | 85 |
| CSR6 | 507 | 95.56 | 8178 | 12.13 | 39040 | 57.90 | 1.57 | 0.36 | 22.65 | 87.00 | 118 |
| CSR26 | 471 | 93.75 | 7792 | 11.96 | 36423 | 55.90 | 1.61 | 0.37 | 22.64 | 86.00 | 112 |
| CSR2 | 529.38 | 96.03 | 9157 | 14.60 | 46284 | 73.85 | 1.72 | 0.40 | 23.47 | 90.44 | 80 |
| CSR27 | 470 | 91.25 | 9089 | 15.69 | 42145 | 69.56 | 1.70 | 0.40 | 23.52 | 90.34 | 78 |

Table 2. Seed production performance of stock races during different seasons.

| Season/Race | Melt ing% | Percentage of PAIRS | Recovery of dfls (%) |
|---|---|---|---|
| **Summer** | | | |
| CSR4 | 2.01 | 42.57 | 22.10 |
| NB4D2 | 2.07 | 47.43 | 32.75 |
| CSR6 | 2.13 | 39.59 | 26.09 |
| CSR26 | 4.75 | 36.01 | 23.56 |
| CSR2 | 3.00 | 41.57 | 30.88 |
| CSR27 | 1.80 | 37.31 | 20.46 |
| | | | |
| **Rainy** | | | |
| CSR4 | 3.51 | 39.81 | 24.82 |
| NB4D2 | 2.52 | 38.62 | 31.01 |
| CSR6 | 1.43 | 60.00 | 45.86 |
| CSR26 | 1.54 | 55.38 | 48.92 |
| CSR2 | 2.62 | 42.48 | 35.51 |
| CSR27 | 1.37 | 48.21 | 37.00 |
| | | | |
| **Winter** | | | |
| CSR4 | 2.75 | 39.46 | 27.55 |
| NB4D2 | 2.79 | 42.83 | 33.71 |
| CSR6 | 3.90 | 42.67 | 27.60 |
| CSR26 | 3.17 | 45.33 | 32.27 |
| CSR2 | 2.49 | 42.42 | 33.81 |
| CSR27 | 1.56 | 41.23 | 32.34 |
| | | | |

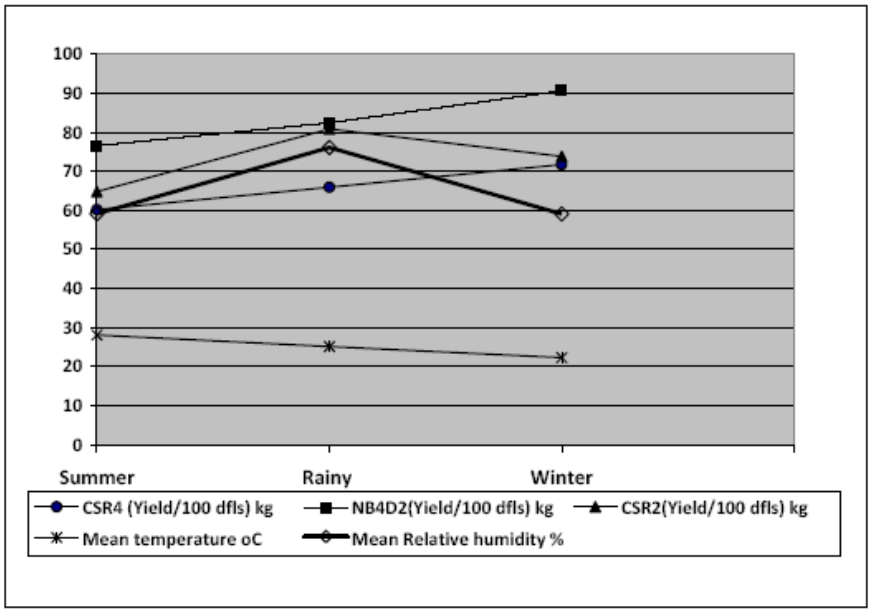


Figure 1. Relation between environmental factors and yield level of different stock races.

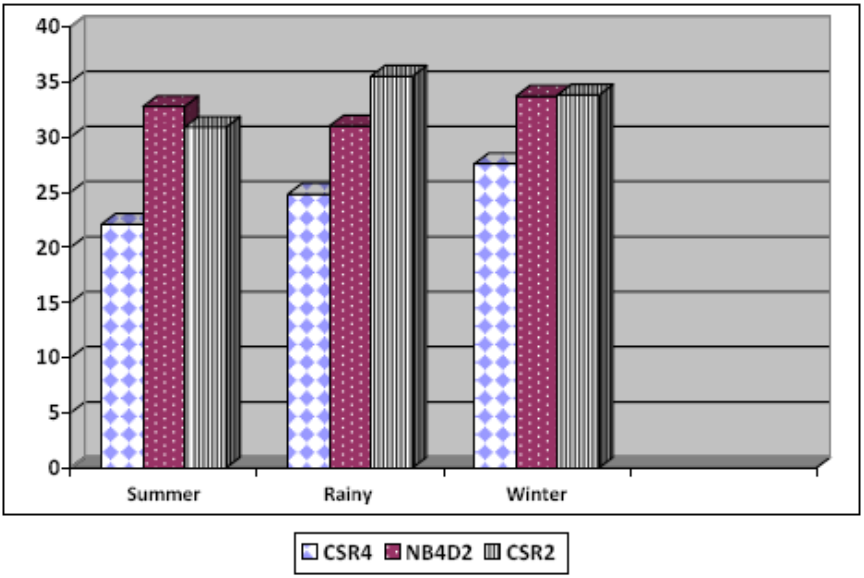


Figure 2. Recovery of DFLs of stock races during different season (%).

Plate 1. Quality mulberry leaves essential for optimum growth of silkworm races.

Plate 2. Matured fifth instar silkworm larva of CSR2 race.


Plate 3. Silkworm moth and laid eggs of CSR2 race.