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**Research Article**

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# Correlation Coefficient Studies on Certain Quantitative Traits in the Silkworm, *Bombyx mori* L.

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**To understand the relationship among different quantitative traits, correlation studies were performed by utilizing eighty-eight inbred strains of silkworm, *Bombyx mori* L. on twelve economic characters. Analysis resulted in correlation of 5th instar period with total larval period (r = 0.7882), cocoon weight with shell weight (r = 0.8326), shell weight with shell ratio (r = 0.5067), shell ratio with raw silk % (r = 0.7570), raw silk % with filament length (r = 0.3490), filament size (denier) with reelability (r = 0.3193) and boil-off loss % (r = 0.2792). Negative correlation was observed among filament length with filament size (r = 0.7582) and reelability with boil-off loss % (r = –0.3236). Correlation of different quantitative characters for quality silk production is discussed.**

**Keywords**: Correlation coefficient analysis, Quantitative traits, Silkworm, *Bombyx mori* L.

## Introduction

Silkworms are classified into geographic races on the basis of their origin *viz.*, Japanese, Chinese, European and tropical. These are characterized by their distinct voltinism, larval period, survival and quantitative traits. Correlation of voltinism, larval period and quantitative traits have been studied in different races. Univoltine silkworms are diapausing type with longer larval duration having higher cocoon and shell weight. Polyvoltine silkworms are non-diapausing with shorter larval duration having low cocoon weight and shell weight. Nutrition and temperature influences voltinism. Quality of silk is a complex trait which is polygenic in nature. Genes and environment play an important role in silkworm breeding. Heritability values are helpful in selection of silkworm on the basis of phenotypic performance of quantitative characters. The quality and silk productivity are influenced by the raw materials *viz.*, cocoons, reeling devices, processing technique and the technical knowledge. Till 1970, only multivoltine cocoons were produced in India, but after the introduction of bivoltine silkworm for the tropics, improved cross breed cocoons are being produced. The silk quality of these cocoons is no doubt better than the multivoltine cocoons, but variation in the size, weight, shell compactness is still existing in the cocoons. In India, cocoon quality is estimated on empirical method, from the experiences derived from cocoon trade and reeling industry and silk is sold without testing and grading or without determining the conditioned weight of raw silk. Keeping in view of the importance of quality silk production, correlation co-efficient studies were carried out by utilizing 88 bivoltine inbred strains on 12 economic characters to understand the relationship among different quantitative traits.

## Materials and Methods

Six rearing parameters *viz.*, $5^{th}$ instar period, total larval period, pupation rate, cocoon weight, shell weight and shell ratio and six post cocoon parameters *viz.*, raw silk %, filament length, raw silk weight, filament size, reelability and boil-off loss % formed the experimental material for the correlation coefficient analysis.

The rearing and the reeling performance of the eighty-eight parental bivoltine silkworm strains were subjected to

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correlation coefficient analysis. The correlation results is represented by 'r' value. The degree of significance at 1% and 5% levels are determined by the calculation of 't' values. The calculated 't' values are compared with the standard t values from the *t*-table and degree of significance is determined.

The following mathematical calculation was employed for the calculation of cocoon quality.

$$t = r\sqrt{n-2/(1-r^2)}$$

where

'r' is the correlation coefficient value

'n' is the sample number

The standard 't' value at 0.05% probability at degree of freedom 86 is 1.98793 and at 0.01 probability is 2.634206.

## Results

The rearing and reeling performance of the eighty eight silkworm breeds for twelve economical characters studied are presented in Table 1 and 2. Different strains showed superiority for different traits. They are: N505 for shorter $5^{th}$ instar period (150.96 hrs), TCS25 for shorter total larval period (534 hrs), TNS25 for pupation rate (97.20%), TC28 for cocoon weight (2.450 g), TN153 for shell weight (0.606 g), NO 1 for shell ratio (27.20% and 23.80 % in raw silk), TC14 for filament length (1,715 m), TN29 for raw silk weight (53.60 g), N505 for thin denier (1.47), TCS9 for thick denier (4.08), TN154 for reelability and TN2 for low boil- off loss % (22.60%). However, the results of the 88 strains for 12 economic traits can be summerised as: $5^{th}$ instar period ranged from 150.96 hrs to 241.92 hrs, total larval period ranged from 534 hrs to 672 hrs, pupation rate ranged from 57.60% to 97.20%, cocoon weight ranged from 1.580 g to 2.450 g, shell weight ranged from 0.321 g to 0.605 g, shell ratio 19.90 to 27.20 %, raw silk ranged from 16.30 to 23.80%, filament length ranged from 753 m to 1,715 m, raw silk weight ranged from 31.10 g to 53.60 g, filament size (denier) ranged from 1.47 to 4.08, reelability ranged from 30 to 100% and boil-off loss % ranged from 22.60 to 31.80%. These results were analysed by using correlation analysis and are presented in Table 3. They are as following: The correlation of $5^{th}$ instar period with total larval period (r = 0.7882**), shell weight (r = 0.2876**) and shell ratio (r = 0.3632**) was significant at 1% level. The correlation of cocoon weight with shell weight (r = 0.8326**), raw silk weight (r = 0.7011**) and denier (r = 0.5712**) was significant at 1% level. The correlation of shell weight with shell ratio (r = 0.5067**), raw silk % (r = 0.4349**), raw silk weight (r = 0.8543**) and filament size (r = 0.4425**) was significant at 1% level. The correlation of shell ratio with raw silk % (r = 0.7570**), filament length (r = 0.2889**) and raw silk weight (r = 0.4353) was significant at 1% level. The correlation of raw silk % with filament length (r = 0.3490**) and raw silk weight (r = 0.6322**) was significant at 1% level. The correlation of raw silk weight (r = 0.4284**) with reelability (r = 0.2364**) was significant at 1% level. The correlation of filament size with reelability (r = 0.3193**) and boil-off loss % (r = 0.2792**) was significant at 1% level The correlation of $5^{th}$ instar period with raw silk weight (r = 0.2656*), cocoon weight with reelability (r = 0.2201*), shell ratio with reelability (r = 0.2291*), raw silk % with boil-off loss % (r = 0.2142*) was significant at 5% level. Negative correlation was observed among filament length with filament size (r = –0.7582**), reelability with boil-off loss % (r = –0.3236**) and filament length with boil-off loss % (r = –0.2512*).

In the order of merit, the correlation results can be put as: Highly significant correlation was observed between shell weight with raw silk weight (r = 0.8543**) > cocoon weight with shell weight (r = 0.8326**) > $5^{th}$ instar period with total larval period (r = 0.7882**) > shell ratio with raw silk % (r = 0.7570**) > cocoon weight with raw silk weight (r = 0.7011**) > raw silk % with raw silk weight (r = 0.6322**) > cocoon weight with denier (r = 0.5712**) > shell weight with shell ratio (r = 0.5067**) > shell weight with filament size (r = 0.4425**) > shell ratio with raw silk weight (r = 0.4353**) > shell weight with raw silk % (r = 0.4349**) > filament length with raw silk weight (r = 0.4284**) > $5^{th}$ instar period with shell ratio (r = 0.3632**) > raw silk % with filament length (r = 0.3490**) > filament size with reelability (r = 0.3193**) > shell ratio with filament length (r = 0.2889**) > $5^{th}$ instar period with shell weight (r = 0.2876*) > filament size with boil-off loss % (r = 0.2792**) > $5^{th}$ instar period with raw silk weight (r = 0.2656*) > filament length with reelability (r = 0.2364**) > shell ratio with reelability (r = 0.2291*) > cocoon weight with reelability (r = 0.2201*) > raw silk % with boil-off loss % (r = 0.2142*).

However, negatively correlated traits are as following : filament length with filament size (r = –0.7582**), filament length with boil-off loss % (r = –0.2512*) and reelability with boil-off loss % (r = –0.3236).

## Discussion

Silk yield is a complex trait which is contributed by many characters. Correlationship between different characters

**Table 1.** Rearing performance of the eighty eight silkworm strains

| Sl no. | Race | 5thinstar period (hrs) | Total larval period (hrs) | Pupation rate (%) | Cocoon weight (g) | Shell weight (g) | Shell ratio (%) |
|---|---|---|---|---|---|---|---|
| 1 | N137 | 197.04 | 604.08 | 91.80 | 1.650 | 0.405 | 24.50 |
| 2 | N148 | 192.00 | 599.04 | 88.60 | 1.810 | 0.426 | 23.50 |
| 3 | N148 | 192.00 | 575.04 | 83.30 | 1.580 | 0.376 | 23.90 |
| 4 | N148 | 204.00 | 599.04 | 85.00 | 1.490 | 0.368 | 24.70 |
| 5 | N149 | 192.00 | 599.04 | 85.20 | 1.640 | 0.393 | 24.00 |
| 6 | NO1 | 197.04 | 604.08 | 80.50 | 1.840 | 0.500 | 27.20 |
| 7 | NO1 | 190.08 | 580.08 | 89.70 | 1.830 | 0.455 | 24.80 |
| 8 | NO1a | 185.04 | 551.04 | 97.00 | 1.810 | 0.411 | 22.70 |
| 9 | NO1b | 209.04 | 558.96 | 83.30 | 1.760 | 0.425 | 24.20 |
| 10 | NO4 | 167.76 | 534.72 | 81.10 | 2.010 | 0.518 | 25.80 |
| 11 | N505 (N136) | 209.04 | 623.04 | 92.70 | 1.760 | 0.447 | 25.40 |
| 12 | N505 G7 | 150.96 | 558.00 | 90.90 | 1.610 | 0.321 | 19.90 |
| 13 | C137 | 173.04 | 556.08 | 91.70 | 1.670 | 0.415 | 24.90 |
| 14 | C146 | 192.00 | 582.00 | 87.60 | 1.880 | 0.484 | 25.70 |
| 15 | TN1 | 226.80 | 609.84 | 75.30 | 1.630 | 0.413 | 25.40 |
| 16 | TN2 | 202.32 | 618.72 | 80.80 | 1.530 | 0.379 | 24.80 |
| 17 | TC13 | 203.76 | 573.60 | 88.50 | 1.820 | 0.415 | 22.90 |
| 18 | TC14 | 187.68 | 571.68 | 76.50 | 1.670 | 0.371 | 22.20 |
| 19 | TCS2 | 222.96 | 606.96 | 93.00 | 1.760 | 0.478 | 27.20 |
| 20 | MC152 | 196.08 | 574.32 | 87.10 | 1.870 | 0.493 | 26.40 |
| 21 | MC154 | 220.32 | 609.36 | 64.30 | 1.760 | 0.440 | 25.80 |
| 22 | TNS4 | 209.76 | 587.28 | 84.40 | 2.160 | 0.547 | 25.30 |
| 23 | TNS51 | 205.68 | 618.96 | 75.10 | 2.150 | 0.474 | 22.00 |
| 24 | TNS52 | 220.08 | 640.08 | 70.40 | 2.090 | 0.474 | 22.70 |
| 25 | TN153 | 222.72 | 610.32 | 86.90 | 2.300 | 0.605 | 26.30 |
| 26 | TN154 | 209.76 | 611.28 | 82.70 | 2.010 | 0.533 | 26.60 |
| 27 | TCS9 | 207.60 | 619.20 | 69.60 | 2.070 | 0.486 | 23.50 |
| 28 | TNS52 | 197.76 | 564.72 | 88.00 | 1.800 | 0.445 | 24.80 |
| 29 | TCS53 | 181.68 | 540.72 | 88.10 | 1.980 | 0.461 | 23.30 |
| 30 | TNS54 | 209.04 | 576.00 | 82.80 | 1.680 | 0.457 | 27.20 |
| 31 | TNS55 | 204.96 | 610.80 | 81.50 | 2.070 | 0.511 | 24.70 |
| 32 | TC157 | 209.04 | 609.12 | 74.10 | 2.080 | 0.543 | 26.20 |
| 33 | KNS2 | 192.00 | 576.00 | 70.70 | 1.900 | 0.471 | 24.90 |
| 34 | KNS12 | 195.60 | 597.60 | 68.80 | 1.850 | 0.423 | 22.80 |
| 35 | KNS15A | 192.00 | 600.00 | 75.00 | 1.510 | 0.384 | 25.50 |
| 36 | TNS1 | 197.04 | 581.04 | 67.00 | 1.810 | 0.436 | 24.10 |
| 37 | TN101 | 192.00 | 576.00 | 86.70 | 2.080 | 0.504 | 24.30 |
| 38 | MN213 | 197.04 | 581.04 | 74.70 | 1.930 | 0.466 | 24.20 |
| 39 | TCS1 | 175.68 | 559.68 | 87.30 | 1.840 | 0.485 | 26.40 |
| 40 | TCS4 | 196.32 | 586.32 | 86.80 | 1.980 | 0.477 | 24.10 |
| 41 | MCS552 | 197.04 | 581.04 | 90.70 | 1.520 | 0.386 | 25.30 |
| 42 | KCS82 | 192.00 | 576.00 | 80.30 | 1.710 | 0.419 | 24.50 |
| 43 | KC94 | 197.04 | 581.04 | 82.30 | 1.800 | 0.472 | 26.30 |
| 44 | KCS78 | 196.08 | 604.08 | 73.30 | 1.630 | 0.411 | 25.30 |
| 45 | TC153 | 196.08 | 604.08 | 86.00 | 1.670 | 0.447 | 26.80 |
| 46 | TC155 | 216.00 | 624.00 | 74.00 | 1.950 | 0.431 | 22.10 |
| 47 | TC156 | 192.00 | 576.00 | 85.70 | 1.880 | 0.405 | 21.60 |

**Table 1.** Continued

| Sl no. | Race | 5thinstar period (hrs) | Total larval period (hrs) | Pupation rate (%) | Cocoon weight (g) | Shell weight (g) | Shell ratio (%) |
|---|---|---|---|---|---|---|---|
| 48 | TC159 | 192.00 | 600.00 | 70.70 | 2.130 | 0.489 | 23.00 |
| 49 | KNSY3 | 231.12 | 632.16 | 81.20 | 1.830 | 0.436 | 23.90 |
| 50 | KNSY4 | 213.84 | 620.64 | 88.40 | 2.020 | 0.489 | 24.30 |
| 51 | TNSY2 | 209.76 | 618.96 | 86.80 | 1.960 | 0.471 | 24.00 |
| 52 | TNSY7 | 203.04 | 604.08 | 94.50 | 1.820 | 0.436 | 23.90 |
| 53 | KCSY51 | 210.48 | 586.08 | 81.80 | 1.760 | 0.508 | 28.90 |
| 54 | TCSY1 | 183.12 | 575.04 | 81.70 | 1.660 | 0.443 | 26.70 |
| 55 | TCSY3 | 241.92 | 643.68 | 88.10 | 1.820 | 0.516 | 28.30 |
| 56 | TCSY7 | 193.20 | 564.72 | 85.10 | 1.820 | 0.471 | 26.00 |
| 57 | TCSY8 | 214.08 | 581.04 | 90.90 | 2.000 | 0.533 | 26.60 |
| 58 | TCSY9 | 240.00 | 624.00 | 80.00 | 2.080 | 0.549 | 26.40 |
| 59 | TN21 | 203.28 | 601.68 | 91.30 | 1.750 | 0.428 | 24.50 |
| 60 | TNS22 | 165.12 | 556.08 | 96.30 | 1.790 | 0.394 | 22.00 |
| 61 | TNS24 | 206.64 | 202.64 | 94.60 | 2.120 | 0.517 | 24.40 |
| 62 | TNS25 | 193.68 | 581.04 | 97.20 | 2.060 | 0.455 | 22.20 |
| 63 | TNS26 | 207.60 | 627.60 | 79.30 | 1.950 | 0.470 | 24.10 |
| 64 | TNS27 | 209.04 | 648.00 | 86.50 | 1.590 | 0.385 | 24.10 |
| 65 | TN153 | 240.00 | 672.00 | 86.30 | 2.170 | 0.571 | 26.30 |
| 66 | TN154 | 197.04 | 653.04 | 80.00 | 2.200 | 0.596 | 27.10 |
| 67 | TNS28 | 188.64 | 555.12 | 88.90 | 2.160 | 0.545 | 25.20 |
| 68 | TN29 | 192.72 | 558.96 | 88.00 | 2.340 | 0.569 | 24.30 |
| 69 | TN30 | 209.04 | 558.96 | 76.00 | 2.190 | 0.544 | 24.80 |
| 70 | TNS31 | 190.08 | 581.04 | 93.00 | 1.770 | 0.395 | 22.30 |
| 71 | TCS23 | 199.20 | 595.20 | 85.70 | 2.010 | 0.450 | 22.80 |
| 72 | TNS24 | 192.00 | 600.00 | 96.00 | 1.980 | 0.482 | 24.40 |
| 73 | TSC25 | 168.00 | 534.00 | 86.30 | 1.780 | 0.428 | 24.00 |
| 74 | TCS26 | 185.04 | 551.04 | 94.00 | 1.960 | 0.474 | 24.20 |
| 75 | TC27 | 197.04 | 556.08 | 80.30 | 2.160 | 0.507 | 23.50 |
| 76 | TC28 | 168.00 | 534.00 | 57.60 | 2.450 | 0.566 | 23.10 |
| 77 | TC31 | 172.08 | 556.08 | 96.70 | 1.850 | 0.405 | 21.90 |
| 78 | TC32 | 168.00 | 559.20 | 96.70 | 1.780 | 0.379 | 21.30 |
| 79 | TC33 | 233.04 | 648.00 | 87.00 | 1.850 | 0.396 | 21.50 |
| 80 | TCS51 | 168.00 | 534.00 | 95.70 | 1.960 | 0.446 | 22.80 |
| 81 | N145 | 209.04 | 623.04 | 92.50 | 1.780 | 0.453 | 25.50 |
| 82 | N145 | 231.84 | 647.04 | 81.40 | 1.710 | 0.429 | 25.10 |
| 83 | TC12 | 191.52 | 561.36 | 84.90 | 1.710 | 0.408 | 23.90 |
| 84 | TNS7 | 216.00 | 623.28 | 72.10 | 2.060 | 0.464 | 22.60 |
| 85 | MNS8 | 201.60 | 603.60 | 77.70 | 1.730 | 0.457 | 24.90 |
| 86 | TCS202 | 195.12 | 579.12 | 78.70 | 1.910 | 0.499 | 26.20 |
| 87 | KCS83 | 186.00 | 564.00 | 84.00 | 1.970 | 0.508 | 25.70 |
| 88 | KCS88 | 198.00 | 582.00 | 85.80 | 1.770 | 0.452 | 25.60 |

have been worked out by selection experiments (Hirobe, 1967; Rajanna and Sreerama Reddy, 1990; Yokoyama, 1973, 1979). These characters are influnced by genetic factors and environment. Selection of one trait has correlation with the genetic changes with the another quantitative characters. Studies have found negative correlation of the floss ratio and lousiness ratio with the cocoon shell weight, cocoon shell ratio and filament length and positive correlation of the cocoon shell weight and cocoon shell ratio with silk filament and denier. All characters that con-

**Table 2.** Reeling performance of the eighty eight silkworm strains

| Sl no | Race | Raw silk (%) | Filament length (m) | Raw silk wt (g) | Filament size denier | Reelability (%) | Boil off loss (%) |
|---|---|---|---|---|---|---|---|
| 1 | N137 | 20.30 | 1243.00 | 34.40 | 2.50 | 89.00 | 27.10 |
| 2 | N148 | 19.10 | 1059.00 | 35.60 | 3.05 | 76.00 | 24.60 |
| 3 | N148 | 20.70 | 1074.00 | 33.30 | 2.81 | 84.00 | 25.80 |
| 4 | N148 | 20.90 | 977.00 | 31.20 | 2.90 | 76.00 | 29.00 |
| 5 | N149 | 19.20 | 1092.00 | 31.40 | 2.61 | 75.00 | 28.20 |
| 6 | NO1 | 23.80 | 1188.00 | 43.50 | 3.32 | 83.00 | 25.20 |
| 7 | NO1 | 21.50 | 1189.00 | 39.00 | 2.96 | 85.00 | 24.80 |
| 8 | NO1a | 20.30 | 1232.00 | 37.70 | 2.76 | 83.00 | 24.90 |
| 9 | NO1b | 20.10 | 1180.00 | 36.60 | 2.81 | 85.00 | 25.50 |
| 10 | NO4 | 20.40 | 1312.00 | 40.50 | 2.81 | 30.00 | 28.10 |
| 11 | N505 (N136) | 20.50 | 1354.00 | 37.00 | 2.49 | 79.00 | 25.10 |
| 12 | N505 G7 | 16.80 | 1659.00 | 27.00 | 1.47 | 74.00 | 28.10 |
| 13 | C137 | 20.80 | 1091.00 | 34.00 | 2.82 | 76.00 | 27.60 |
| 14 | C146 | 22.60 | 1263.00 | 42.10 | 3.01 | 84.00 | 26.50 |
| 15 | TN1 | 20.35 | 1414.00 | 36.30 | 2.32 | 85.00 | 26.00 |
| 16 | TN2 | 20.70 | 1454.00 | 32.70 | 2.05 | 67.00 | 22.60 |
| 17 | TC13 | 18.30 | 1710.00 | 34.80 | 1.85 | 68.00 | 25.80 |
| 18 | TC14 | 17.60 | 1715.00 | 30.90 | 1.64 | 64.00 | 27.10 |
| 19 | TCS2 | 22.80 | 1499.00 | 40.40 | 2.43 | 70.00 | 27.20 |
| 20 | MC152 | 22.75 | 1541.00 | 42.80 | 2.52 | 75.00 | 28.10 |
| 21 | MC154 | 20.15 | 1400.00 | 37.20 | 2.41 | 58.00 | 29.30 |
| 22 | TNS4 | 21.35 | 1105.00 | 46.70 | 3.83 | 81.00 | 24.00 |
| 23 | TNS51 | 18.55 | 753.00 | 40.90 | 4.95 | 84.00 | 25.10 |
| 24 | TNS52 | 19.15 | 699.00 | 38.70 | 5.02 | 81.00 | 23.10 |
| 25 | TN153 | 21.85 | 1377.00 | 52.30 | 3.43 | 84.00 | 27.00 |
| 26 | TN154 | 22.00 | 1134.00 | 46.20 | 3.69 | 77.00 | 23.50 |
| 27 | TCS9 | 17.20 | 802.00 | 35.70 | 4.08 | 55.00 | 27.30 |
| 28 | TNS52 | 19.95 | 968.00 | 35.30 | 3.33 | 58.00 | 26.20 |
| 29 | TCS53 | 19.95 | 1084.00 | 38.90 | 3.28 | 68.00 | 26.90 |
| 30 | TNS54 | 20.85 | 1021.00 | 35.80 | 3.17 | 70.00 | 26.10 |
| 31 | TNS55 | 20.60 | 1195.00 | 42.90 | 3.26 | 81.00 | 26.40 |
| 32 | TC157 | 20.25 | 1411.00 | 43.50 | 2.80 | 75.00 | 27.50 |
| 33 | KNS2 | 20.83 | 1190.00 | 41.40 | 3.17 | 79.00 | 23.10 |
| 34 | KNS12 | 19.58 | 1231.00 | 37.30 | 2.76 | 78.00 | 26.40 |
| 35 | KNS15A | 20.30 | 1153.00 | 32.70 | 2.61 | 63.00 | 27.40 |
| 36 | TNS1 | 19.60 | 1246.00 | 35.90 | 2.63 | 71.00 | 26.20 |
| 37 | TN101 | 20.30 | 1329.00 | 40.50 | 2.78 | 72.00 | 26.70 |
| 38 | MN213 | 19.70 | 1242.00 | 39.60 | 2.91 | 81.00 | 27.20 |
| 39 | TCS1 | 22.73 | 1566.00 | 42.10 | 2.44 | 77.00 | 25.70 |
| 40 | TCS4 | 20.75 | 1416.00 | 41.40 | 2.66 | 76.00 | 28.10 |
| 41 | MCS552 | 21.20 | 1072.00 | 31.10 | 2.64 | 53.00 | 25.00 |
| 42 | KCS82 | 20.60 | 1304.00 | 37.30 | 2.61 | 73.00 | 27.30 |
| 43 | KC94 | 22.70 | 1368.00 | 40.10 | 2.67 | 61.00 | 26.30 |
| 44 | KCS78 | 18.40 | 1051.00 | 29.60 | 2.57 | 61.00 | 27.80 |
| 45 | TC153 | 21.30 | 1332.00 | 35.60 | 2.45 | 69.00 | 27.00 |
| 46 | TC155 | 14.50 | 927.00 | 29.40 | 2.89 | 54.00 | 31.80 |
| 47 | TC156 | 16.30 | 1107.00 | 31.80 | 2.63 | 56.00 | 25.90 |
| 48 | TC159 | 19.10 | 1333.00 | 39.80 | 2.71 | 62.00 | 28.30 |

**Table 2.** Continued

| Sl no | Race | Raw silk (%) | Filament length (m) | Raw silk wt (g) | Filament size denier | Reelability (%) | Boil off loss (%) |
|---|---|---|---|---|---|---|---|
| 49 | KNSY3 | 20.23 | 1340.00 | 37.00 | 2.51 | 65.00 | 26.00 |
| 50 | KNSY4 | 21.40 | 1402.00 | 42.20 | 2.73 | 73.00 | 24.70 |
| 51 | TNSY2 | 18.90 | 1323.00 | 36.20 | 2.49 | 71.00 | 26.70 |
| 52 | TNSY7 | 21.07 | 1361.00 | 38.70 | 2.58 | 74.00 | 24.70 |
| 53 | KCSY51 | 22.73 | 1315.00 | 40.00 | 2.76 | 66.00 | 27.30 |
| 54 | TCSY1 | 19.65 | 1203.00 | 32.70 | 2.49 | 53.00 | 26.00 |
| 55 | TCSY3 | 22.53 | 1407.00 | 40.60 | 2.62 | 60.00 | 27.90 |
| 56 | TCSY7 | 19.90 | 1222.00 | 36.10 | 2.69 | 62.00 | 28.10 |
| 57 | TCSY8 | 22.40 | 1418.00 | 42.90 | 2.75 | 65.00 | 28.60 |
| 58 | TCSY9 | 19.70 | 1252.00 | 40.20 | 2.93 | 61.00 | 26.70 |
| 59 | TN21 | 20.10 | 1193.00 | 37.50 | 2.84 | 85.00 | 24.00 |
| 60 | TNS22 | 19.00 | 852.00 | 33.30 | 3.59 | 83.00 | 23.80 |
| 61 | TNS24 | 20.15 | 1099.00 | 43.50 | 3.61 | 86.00 | 24.80 |
| 62 | TNS25 | 17.60 | 1146.00 | 38.30 | 3.03 | 86.00 | 26.50 |
| 63 | TNS26 | 19.60 | 1101.00 | 38.70 | 3.20 | 80.00 | 24.50 |
| 64 | TNS27 | 19.90 | 1299.00 | 31.10 | 2.18 | 81.00 | 26.40 |
| 65 | TN153 | 20.90 | 1169.00 | 44.90 | 3.49 | 92.00 | 27.40 |
| 66 | TN154 | 21.90 | 1248.00 | 50.30 | 3.65 | 100.00 | 25.00 |
| 67 | TNS28 | 21.40 | 1175.00 | 45.80 | 3.53 | 82.00 | 25.70 |
| 68 | TN29 | 21.80 | 1399.00 | 53.60 | 3.47 | 78.00 | 25.70 |
| 69 | TN30 | 21.90 | 1436.00 | 49.80 | 3.16 | 81.00 | 24.00 |
| 70 | TNS31 | 18.80 | 980.00 | 32.60 | 3.03 | 85.00 | 26.60 |
| 71 | TCS23 | 20.10 | 1282.00 | 41.30 | 2.94 | 78.00 | 25.20 |
| 72 | TNS24 | 20.50 | 1350.00 | 40.20 | 2.69 | 62.00 | 24.70 |
| 73 | TSC25 | 20.10 | 1143.00 | 34.80 | 2.77 | 77.00 | 25.90 |
| 74 | TCS26 | 18.90 | 1147.00 | 36.00 | 2.84 | 87.00 | 27.30 |
| 75 | TC27 | 20.80 | 1240.00 | 42.50 | 3.10 | 91.00 | 25.30 |
| 76 | TC28 | 17.70 | 1041.00 | 32.10 | 2.81 | 85.00 | 25.30 |
| 77 | TC31 | 19.40 | 1035.00 | 35.00 | 3.07 | 84.00 | 24.50 |
| 78 | TC32 | 19.70 | 1233.00 | 35.10 | 2.58 | 87.00 | 25.60 |
| 79 | TC33 | 17.70 | 892.00 | 32.10 | 3.27 | 83.00 | 26.90 |
| 80 | TCS51 | 19.80 | 872.00 | 36.30 | 3.80 | 87.00 | 27.00 |
| 81 | N145 | 20.30 | 1313.00 | 37.10 | 2.56 | 77.00 | 25.50 |
| 82 | N145 | 21.07 | 1519.00 | 37.30 | 2.23 | 74.00 | 25.00 |
| 83 | TC12 | 19.53 | 1720.00 | 34.40 | 1.82 | 77.00 | 26.40 |
| 84 | TNS7 | 18.75 | 825.00 | 39.60 | 4.35 | 87.00 | 24.90 |
| 85 | MNS8 | 21.25 | 1306.00 | 40.80 | 2.86 | 72.00 | 26.70 |
| 86 | TCS202 | 21.45 | 1440.00 | 41.80 | 2.66 | 52.00 | 26.00 |
| 87 | KCS83 | 21.35 | 1450.00 | 41.90 | 2.64 | 57.00 | 22.80 |
| 88 | KCS88 | 21.08 | 1302.00 | 37.80 | 2.64 | 71.00 | 26.00 |

tribute to the silk yield are quantitative in nature and are controlled by polygenes. Hence, any attemp to improve these characters need an understanding of their inheritance, their response to selection, the relationship of the selected traits with the unselected traits.

Kuroda (1979) found correlation of α-ketoglutaric acid in the haemolymph of silkworm races with cocoon weight and shell weight. Petkov (1978) studied the correlation of cocoon weight and silk yield with the reproductive ability of the silkmoth. Jeong (1989) reported the genetic correlation and path coefficient analysis of economic characters in the silkworm, *Bombyx mori* L. Correlation of quanti-

**Table 3.** Correlation coefficiency values of quantitative characters in silkworm, *Bombyx mori* L

| Quantitative characters | 5th instar period (hrs) | Total larval period (hrs) | Pupation ratio (%) | Cocoon weight (g) | Shell weight (g) | Shell ratio (%) | Raw silk (%) | Filament length (m) | Raw silk wt. (g) | Filament size denier | Reelability (%) | Boil-off loss (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5th Instar period (hrs) | 1 | | | | | | | | | | | |
| Total larval period (hrs) | 0.7882** | 1 | | | | | | | | | | |
| Pupation ratio (%) | -0.2059 | -0.1874 | 1 | | | | | | | | | |
| Cocoon weight (g) | 0.1092 | -0.0002 | -0.1841 | 1 | | | | | | | | |
| Shell weight (g) | 0.2876** | 0.1095 | -0.1744 | 0.8326** | 1 | | | | | | | |
| Shell ratio (%) | 0.3632** | 0.1962 | -0.0688 | -0.0513 | 0.5067** | 1 | | | | | | |
| Raw silk (%) | 0.1612 | 0.0139 | 0.1733 | 0.0100 | 0.435** | 0.757** | 1 | | | | | |
| Filament length (m) | 0.0320 | -0.0648 | 0.0870 | -0.1332 | 0.0615 | 0.289** | 0.349** | 1 | | | | |
| Raw silk wt (g) | 0.2656* | 0.0942 | -0.0006 | 0.7011** | 0.8543** | 0.4353** | 0.6322** | 0.1936 | 1 | | | |
| Filament size denier | 0.1485 | 0.1195 | -0.1287 | 0.5712** | 0.4425** | -0.0728 | 0.0138 | -0.7582** | 0.4284** | 1 | | |
| Reelability (%) | -0.0102 | 0.0805 | 0.2044 | 0.2201* | 0.0747 | -0.2291* | 0.1101 | -0.1910 | 0.2364* | 0.3193** | 1 | |
| Boil-off loss (%) | 0.0597 | 0.0114 | -0.1070 | -0.1407 | -0.864 | 0.0704 | -02142* | 0.0903 | -0.2612* | -0.2762** | -0.3336 | 1 |

**, significant at 1% level and *, significant at 5% level.

tative characters in different breeds of silkworm, *Bombyx mori* L. have been reported (Rajanna and Sreerama Reddy, 1990). Our results have shown that the shell weight, cocoon weight, shell ratio, 5th instar period and raw silk % were correlated with raw silk weight. The shell weight, cocoon weight, raw silk weight and filament length were correlated with denier. Inheritance and correlation of feed conversion efficiency in silkworm has also been reported (Yang-Mingguan and Zhenli, 1990). Chung and Shon (1993) studied the combining ability and correlation of quantitative characters of F1 hybrids in the silkoworm. Chatterjee *et al.* (1993) studied the correlation of silk yield and biochemical parameters in the mulberry silkworm, *Bombyx mori* L. Kim and Nho (1992) reported the correlation of egg size and quantitative characteristics in silkworm, *Bombyx mori* L. Zhenli and Mingguan (1993) reported the correlation of diet efficiency with quantitative characters in the 1 – 3 days of 5th instar. Selection strategies in relation to correlation and heritability in the silkworm, *Bombyx mori* L. has also been reported (Singh *et al.,* 1994). Rajendra Singh *et al.* (1994) studied the correlation of quantitative characters in the oak tasar silkworm, *Antheraea prolei*. Giridhar *et al.* (1995) studied the genetic and phenotypic correlation studies on fitness and quantitative traits of bivoltine silkworm, *Bombyx mori* L. In the present study cocoon weight, shell ratio, raw silk weight, denier were related with reelability. The raw silk weight, raw silk %, denier, reelability % were correlated with boil-off loss %. The shell weight, shell ratio were related with raw silk %. The shell weight, 5th instar period were correlated with shell ratio. The cocoon weight, 5th instar period were related with shell weight. The shell ratio, raw silk % were related with filament length. The results are in accordance with the earlier findings.

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