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Path Coefficient Analysis for Larval and Cocoon Traits of Silkworm, *Bombyx Mori* L. (Lepidoptera : Bombycidae)

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Abstract

Larval and cocoon traits of silkworm hybrid PM × CSR_2 reared on mulberry leaves enriched with seven biosafe feed additivies were subjected to path coefficient analysis (PCA) using GENERES software. The PCA for qualitative traits of PM × CSR_2 hybrid indicated that silk gland weight (3.4879) and fifth instar larval duration (0.1738) exhibited positive direct effect on mature larval weight, whereas effective rate of rearing (-0.2407), silk gland tissue somatic index (-2.2282) and total larval duration (-0.1017) showed negative direct effects. Among the quantitative traits, shell weight (1.9422), filament length (0.0193), denier (0.0034), fibroin content (0.2456), sericin content (0.1733) registered positive direct effect on cocoon weight. However, pupal weight (-0.0212) and shell ratio (-1.0502) had negative direct effect.
Key words : Path coefficient analysis (PCA), *Bombyx mori* L., Foxtail millet, Larval traits, Cocoon traits.

Cocoon yield is a complex character influenced by a number of characters, which creates complex situation to a breeder while making selection. Path coefficient analysis (PCA) is a statistical tool employed to one variable over another dependant variable and provides a realistic picture of relationship between characters. The traits are themselves interrelated interdependency of the contributing factors often affects their relationship with yield and makes correlation coefficient as unreliable selection indices. Path coefficient analysis can be effectively done by using advanced software package GENERES. The PCA is useful in identifying the component characters of a genotype for breeding purpose (Lili 1983). The information of this type on silkworm appears to be meager. The present investigation was an attempt to analyze the association between silk cocoon and its related components in silkworm by PCA method to assess the extent and nature of direct and indirect effect for economic traits (Wright 1921).

Methods

Seven biosafe feed additives, namely spirulina, yeast, mushroom, grain amaranthus, Kodo millet, Proso millet and Foxtail millet through sieve were dusted separately on mulberry leaves (M_5) 1 : 10 (Flour : leaf). The fortified leaves were fed to fourth instar

Table 1. Path coefficient analysis showing direct and indirect of qualitative characters on mature larval weight of silkworm hybrid PM × CSR_2.Values in bold are direct effects.

Characters	ERR	Silk gland weight	SGTSI	Fifth instar larval duration	Total larval duration	Correlation coefficient (*r*)
ERR	**-0.2407**	3.4639	-2.2245	-0.1638	0.0865	0.921
Silk gland weight	-0.2390	**3.4879**	-2.2139	-0.1672	0.0903	0.958
SGTSI	-0.2403	3.4655	**-2.2282**	-0.1656	0.0881	0.920
Fifth instar larval duration	0.2267	-3.3557	2.1224	**0.1738**	-0.0992	0.932
Total larval duration	0.2045	-3.3095	1.9294	0.1695	**-0.1017**	-0.893

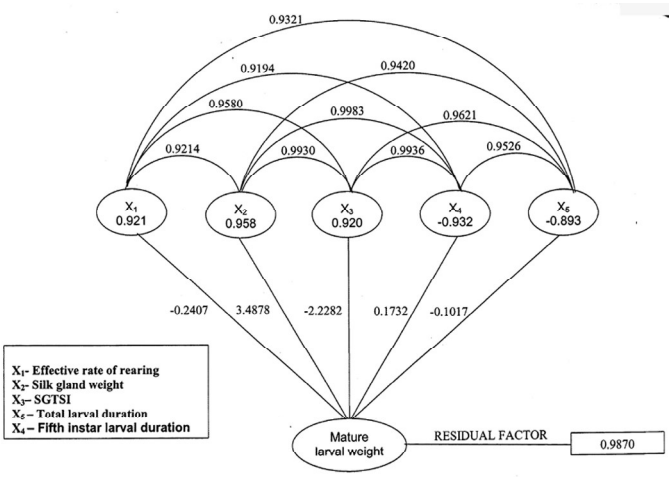

Figure 1. Path diagram of important qualitative traits influencing mature larval weight of PM × CSR_2.

silkworm larves upto spinning once of four feedings a day. Each treatment was reared with one DFL of silkworm hybrid PM × CSR_2 and replicated thrice. During rearing period observations on economic traits were recorded in three replication. Path coefficient analysis using GENERES software package was carried out with only those characters which were found to influence the cocoon yield, PAC was worked out by adopting the formula suggested by Deway and Lu (1957).

Results and Discussion

The results obtained are given in Tables 1 and 2. PAC for qualitative traits on mature larvel weight in PM× CSR_2 hybrid (Table 1 and Fig.1) indicates that silk gland weight (3.4879) and fifth instar larval duration (0.1738) proclaimed positive direct effects on mature larval weight, whereas ERR (-0.2407), silk gland tissue somatic index (-2.2282) and total larval duration (-0.1017)registered negative direct effects on mature larval weight. Silk gland weight and fifth instar larval duration and ERR showed positive indirect effects amongst themselves and via other traits on mature larval weight. Silk gland tissue somatic index and total larval duration exhibited negative indirect effects via other traits. These findings are in harmony with Sundar Raj et al. (2002) who observed silk gland volume, silk gland ratio and ERR had positive effects on mature larval weight of PM, NB_4D_2 and PM × NB_4D_2. The results are contray to findings of Rangaiah et al. (1996) and Satenhalli et al. (1992) who observed maximum larval weight that had a positive correlation with cocoon weight even though it had

Table 2. Path coefficient analysis showing direct and indirect effects of qualitative characters on cocoon weight of silkworm hybrid PM × CSR_2. Values in bold are direct effects.

Characters	Pupal weight	Shell weight	Shell ratio	Filament length	Denier	Fibroin	Sericin	Correlation coefficient (*r*)
Pupal weight	**-0.0212**	1.8686	-0.9674	0.0191	-0.0032	0.2291	-0.1616	0.963
Shell weight	-0.0204	**1.9422**	-1.0276	0.0191	-0.0031	0.2372	-01673	0.980
Shell ratio	-0.0195	1.9003	**-1.0502**	0.0185	-0.0031	0.2437	-0.1719	0.918
Filament length	-0.0209	1.9209	-1.0077	**0.0193**	-0.0032	0.2354	-0.1660	0.978
Denier	0.0207	-1.8500	0.9896	-0.0189	**0.0034**	-0.2353	0.1657	-0.925
Fibroin	-0.0197	1.8754	-1.0418	0.0185	-0.0032	**0.2456**	-0.1734	0.901
Sericin	0.0197	-1.8751	1.0416	-0.0185	0.0031	-0.2458	**0.1733**	-0.902

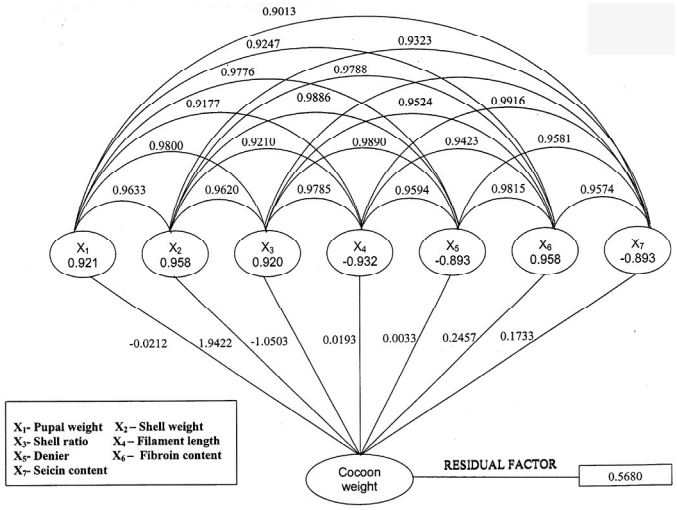

Figure 2. Path diagram of important qualitative traits influencing cocoon weight of PM × CSR_2.

maximum negative direct effect, it was perhaps neutralized by high positive indirect effects via cocoon shells and pupal weights.However, genetic path coefficient network figure estimated by Liw (1992) revealed that larval duration makes positive contribution to cocoon weight and larval characters have a higher degree of association for increasing the mature larval weight, which is also valued in this study.

The quantitative traits in PM × CSR_2 hybrid (Table 2 and Fig. 2) indicate that shell weight (1.9422), filament length (0.0193), denier (0.0034), fibroin content (0.2456) and sericin content (0.1733) registered positive direct effects on cocoon weight. However, pupal weight (-0.0212) and shell ratio (-1.0502) recorded negative effect on cocoon weight. Pupal weight, shell weight, filament length and fibroin content proclaimed positive indirect effects on cocoon weight by themselves and via other traits. However, the shell ratio, denier and sericin content showed negative indirect effects via shell weight, filament length and fibroin content on cocoon weight.

Similar trend and conclusion were drawn by Sundar Raj et al. (2002), and according to Rahman and Rahman (1992), shell percentage also had a high positive direct effect and significant positive correlative with shell weight. The economic parameters like pupal weight, shell weight and denier are mainly responsible for the increased cocoon weight in PM × CSR_2 hybrid. Hence, more importance should be given to given to these characters in the future breeding programme while making selection of brees.

The information generated by this techniques helps in selection of traits of direct and indirect contribution for genetic improvement of the breed in respect of higher cocoon yield, ERR, silk gland ratio, pupal weight, shell weight and denier were most important traits in PM × CSR_2 hybrid.

The component traits namely, mature larval weight, cocoon weight, pupal weight, shell ratio that were strongly correlated with cocoon yield. As the basis for cocoon yield selection would minimize the effect of epistasis, the linkage will not influence the progeny mean for any of these traits.

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