

Effect of Antibiotic (Norfloxacin) Administration on Commercial Characters of New Bivoltine and Cross Breed Hybrid Silkworm (*Bombyx mori* L)

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The impact of antibiotic (Norfloxacin) administration at different concentration (50 ppm and 100 ppm) on commercial characters of bivoltine (CSR₂ × CR₄) and the cross breed race (BL₆₇ × CSR₁₀₁) was studied. The result indicated that antibiotic administration with different concentrations significantly improved the rearing and cocoon parameters like larval duration, larval weight, growth index, single cocoon weight, single shell weight and shell ratio. The post cocoon parameters like average filament length, non-breakable filament length, raw silk percentage, raw silk recovery percentage, denier, reelability and neatness were recorded significantly higher in antibiotic treated batches. The better performances of these parameters were recorded with the increase of antibiotic concentration.

Key words: Antibiotic administration, Cocoon parameters, Reeling parameters, *Bombyx mori* L.

Introduction

The productivity and quality in sericulture depends on the healthiness, growth of the larvae and the suitable environmental conditions. Growth and development affect the productivity, which depends on the intricate physiological processes of silkworm. The quality of silk is affected by cocoons reelability, neatness, non-breakable filament length, neatness etc. to certain extent.

The quantity of available dietary protein is important in herbivorous insect for its growth, survival and population dynamics. It has been proved that a nutritionally unbalanced diet will reduce the insect growth rate by promising

a metabolic load (Naik and Delvi, 1987). Fortification of mulberry leaves is considered as one of the effective methods to enrich the silkworm diet. In recent years attempts have been made to fortify the leaves with nutrients like proteins, amino acids, vitamins, minerals, carbohydrates, crude extracts of jaggery and molasses to harvest better quality of cocoon and yield.

Various antibiotics are extensively employed in the nutrition of non-herbivorous animals for raising their productivity. The beneficial effect of the antibiotics has been attributed to their activity in conditioning the composition of intestinal flora, to their potential role as possible growth factors, to their biological efficiency in increased turning over of the feed into body weight and to their potential disease control activity (Goldberg, 1959; Walton, 1977). Various workers has extensively studied antibiotic administration and its effect on cocoon production by using different antibiotics (Murthy and Sreenivasaya, 1953; Tayade *et al.*, 1988; Sailaja *et al.*, 1991; Aftab Ahamed *et al.*, 2001). The mechanism of action of antibiotics in biomass accumulation and higher productivity in sericulture is still incompletely understood. There is a controversy as to whether the antibiotic acts entirely through its antibacterial property or by favorably affecting the physiology and metabolism of silkworm by an increase in the feed efficiency or by the activation of enzymes or through hormonal action (Shyamala *et al.*, 1960; Verma and Kushwaha, 1971; Aftab Ahamed *et al.*, 2001). The administration of antibiotic along with mulberry leaves causing the physiological changes in silkworm has directly affecting the leaf consumption and its further conversion to cocoon.

As a part of promotion and popularization of the productive bivoltine and improved cross breeds in the field. The new bivoltine hybrid (CSR₂ × CSR₄) and new cross breed (Cauvery) are tested in the farmer's field of southern sericulture states of India. Most of the farmers are unable to maintain their mulberry garden properly and it affects

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the quality of leaf required for higher production. In this respect researchers and sericulturist should concentrate to improve the quality and quantity aspect of cocoon production by supplementing extra nutrients or chemicals along with mulberry leaves. So all efforts are to be worked out to improve the productivity and quality of cocoon. Present study has been planned to observe the effect of feeding mulberry leaves supplemented with antibiotic (*Norfloxacin*) on rearing, cocoon and post cocoon parameters of the bivoltine hybrid and cross breed.

Materials and Methods

The silkworm larvae of bivoltine hybrid ($CSR_2 \times CSR_4$) and cross breed hybrid Cauvery ($BL_{67} \times CSR_{101}$) was reared up to fourth moult in recommended environmental and feeding conditions (Krishnaswami, 1978; Rajan *et al.*, 2001) by feeding with V-1 mulberry variety. The freshly moult 5th instar larvae (16th day of larval lifecycle) were grouped into three batches for each hybrid. Each batch with three replications of 250 larvae was reared at the temperature of $25 \pm 1^\circ\text{C}$ and a relative humidity of $75 \pm 5\%$. The antibiotic used for the present study Norfloxacin (E. Merck) is generally used for anti dysentery treatments and it is effective an antibiotic for intestinal fauna of organism. The antibiotic dissolved in distilled water and was made two concentrations [50 ppm (T1) and 100ppm (T2)] and sprayed on known quantity of mulberry leaves and these leaves were fed to silkworm batches (T1 and T2) as per 3 feeding schedule up to spinning. Another batch of larvae was considered as carrier control fed with mulberry leaf sprayed with distilled water. The quantum of feeding was same for all the treatment and replication in a breed. The treatment was initiated from the first day of 5th instar and was continued till spinning. The details of the treatments are given below.

Race	Treatments with antibiotic conc. (Norfloxacin)		Control
	50 ppm (T1)	100 ppm (T2)	
Bi. \times Bi. ($CSR_2 \times CSR_4$)	50 ppm (T1)	100 ppm (T2)	Distilled water sprayed
Mul. \times Bi. Cauvery ($BL_{67} \times CSR_{101}$)	50 ppm (T1)	100 ppm (T2)	Distilled water sprayed

The larval duration, larval weight, growth index, single cocoon weight, single shell weight, shell ratio percentage, melting percentage, effective rate rearing (ERR) by number and weight were recorded for all the replications of treatments and control. Cocoon samples from each replications and each treatments were subsequently subjected for reeling tests and calculated post cocoon parameters like average filament length, non-breakable filament length, denier, raw silk percentage, raw silk recovery percentage, renditta, reelability percentage and neatness.

The experiment was repeated three times and the pooled data was statistically analyzed by adopting analysis of variance (ANOVA) test to find out the significance of variation among treatments and between the treatments and control.

Results and Discussion

It was found that in case of $CSR_2 \times CSR_4$ race, the larval duration in T1 was on par with control, but in T2 significant reduction of larval duration in 5th instar was recorded (Table 1). In case of Cauvery the same trend of result was obtained (Table 2). From the above result it was clear that the higher concentration of antibiotic administration reduces the larval duration significantly. Earlier studies of Verma and Kushwaha (1971), Radhakrishna Rai and Devaiah (1988) reported no influence of antibiotic administration on larval duration.

The fully matured larval weight of silkworm was

Table 1. Effect of antibiotic administration on rearing parameters of bivoltine silkworm hybrid ($CSR_2 \times CSR_4$)

Treatments	5 th instar larval duration (hrs.)	Single larval weight (g)	ERR by number	ERR by weight (kg)	Melting percentage (%)	Growth index	Single cocoon weight (g)	Single shell weight (g)	Shell ratio (%)
T1 (50 ppm)	144	6.46	9700	21.19	2.50	648.94	2.15	0.514	23.91
T2 (100 ppm)	138	6.65	9954	21.63	0.24	675.30	2.22	0.556	25.02
Control	144	6.14	9364	20.75	5.74	623.66	2.04	0.465	22.79
SE \pm	0.333	0.083	88.635	0.074	0.714	7.933	0.019	0.006	0.283
CD@ 5%	1.10	0.261	239.8	0.234	2.249	25.00	0.060	0.019	0.893
CD@ 1%	1.49	0.261	303.8	0.332	3.199	35.55	0.085	0.027	1.271
F-test	**	*	**	**	*	**	**	**	**

**Significant at 1% level; *Significant at 5% level; SE \pm - Standard error; CD - Critical difference.

Table 2. Effect of antibiotic administration on rearing parameters of cross breed hybrid silkworm (Cauvery)

Treatments	5 th instar larval duration (hrs.)	Single larval weight (g)	ERR by number	ERR by weight (kg)	Melting percentage (%)	Growth index	Single cocoon weight (g)	Single shell weight (g)	Shell ratio (%)
T1 (50ppm)	144	5.14	9633	20.57	1.37	552.65	2.03	0.362	17.83
T2 (100ppm)	136	5.46	9943	21.15	0.24	582.81	2.07	0.409	19.75
Control	144	4.72	9300	20.25	4.70	506.08	2.01	0.340	16.89
SE±	0.494	0.076	85.635	0.074	0.71	0.933	0.009	0.005	0.243
CD@ 5%	1.60	0.239	269.8	0.234	2.249	24.994	0.029	0.016	0.766
CD@ 1%	2.21	0.340	383.8	0.332	3.197	35.550	0.420	0.022	0.243
F-test	**	**	**	**	*	**	**	**	**

**Significant at 1% level; *significant at 5% level; SE± - Standard error; CD - Critical difference.

recorded for different treatments before ripening. In CSR₂ × CSR₄ significantly higher single larval weight was recorded in T2 (6.65 g) followed by T1 (6.46 g). In Cauvery also similar trend was recorded (5.46 g for T2 and 5.14 g for T1) (Table 2). So, it was clear that there was a highly significance difference between the treatment and the control in both the races. Similarly, increase in larval weight was noticed when administration of other antibiotics on different races *viz.*, chloromycetin (Sharada and Bhat, 1956) and chloramphenicol (Krishnaswami *et al.*, 1981) and chloramphenicol and tetracycline (Radhakrishna Rai and Devaiah, 1988).

Effective rearing rate (ERR) indicates the survivability of silkworm during rearing. In CSR₂ × CSR₄ ERR by number was recorded significantly higher in T2 (9954), followed by T1 (9700) and lower in control (Table 1). The same trend of result was obtained in case of Cauvery (Table 2). Highly significance difference was recorded between treatments and within treatments and control in both the races. In reference to this, Krishnaswami *et al.* (1981) reported that administration of chloramphenicol increases the ERR by no significantly.

In CSR₂ × CSR₄, ERR by weight was recorded significantly higher in T2 (21.63 kg) followed by T1 (21.19 kg). Similar results were obtained in case of Cauvery race. In support of this result, Krishnaswami *et al.* (1981) shown that chloramphenicol act as growth promoter and significantly increases the yield per weight.

Melting percentage indicates the disease incidence and mortality. In case of CSR₂ × CSR₄ the melting percentage was significantly lower in T2 (0.24%) followed by T1 (2.50%) and higher in control (5.74%) (Table 1). Similar trend was obtained in Cauvery also (T2 - 0.24%, T1 - 1.37% and control - 4.70%) (Table 2).

It was shown that there was a decrease of melting percentage with an increase of antibiotic concentration. The supporting references show that the survivability of treated silkworms increased with the concentration of the anti-

biotic specifically (Norfloxacin) improved the rate of pupation. But Afrikion (1960) showed that the survivability was statistically lower compared to control. This may be due to the sudden change of the gut flora in the administered individual.

Growth index represent increase in growth of silkworm in a particular instar. In CSR₂ × CSR₄ significantly higher growth index was recorded in T2 (675.30) followed by T1 (648.94) and control (623.66). In Cauvery, same trend of result was obtained *i.e.*, T2 (582.81), T1 (552.65) and control (506.08). The statistical analysis showed that there was a highly significant difference between the treatments and within treatment and control in both the races (Table 2). So it is clear that antibiotic administration and increase of its concentration causes better growth index in silkworm.

The single cocoon weight of CSR₂ × CSR₄ was significantly higher in T2 (2.22 g) followed by T1 (2.15 g) and lower in control (Table 1). In case of Cauvery, same trend was reported and recorded higher in T2 (2.07 g) followed by T1 (2.03 g) and control (2.01 g). The study result is in agreement with Tayade *et al.* (1988) and they recorded that 25 and 50 ppm of chloramphenicol administration enhance significantly the cocoon weight.

Administration of antibiotic Norfloxacin significantly increased the shell weight. In CSR₂ × CSR₄ at 100 ppm (T2) concentration, higher shell weight was recorded (0.556 g) and followed by T1 (0.514 g) and in control (0.465 g). In Cauvery, same trend of result was obtained as T2 (0.409 g), T1 (0.362 g) and control (0.340 g) (Table 1 and 2). The study results was supported by various workers (Verma and Kushwaha, 1971; Tayade *et al.*, 1988). However, Krishnaswami *et al.* (1981) found no significant difference of shell weight in antibiotic administered silkworm.

In CSR₂ × CSR₄, the shell ratio percentage was significantly higher in T2 (25.02%), followed by T1 (23.91%) and control (22.79%). In case of cauvery, same trend was recorded as T2 (19.75%), T1 (17.83%) and control (16.89%) (Table 1 and 2). So, it was clear that Norfloxacin admin-

Table 3. Effect of antibiotic administration on reeling parameters of bivoltine hybrid silkworm (CSR₂ × CSR₄)

Treatments	AFL (m)	NBFL (m)	Denier	Renditta (kg)	Raw Silk Percentage (%)	Raw Silk Recovery (%)	Reelability (%)	Neatness (%)
T1 (50ppm)	1064	907	2.66	5.74	17.39	73.32	85.22	92
T2 (100ppm)	1230	1073	2.87	4.79	20.52	82.10	86.78	93
Control	974	809	2.49	6.23	16.03	70.39	83.30	91
SE±	9.658	11.327	0.019	0.073	0.144	0.823	0.402	0.258
CD @ 1%	43.29	50.76	0.083	0.326	0.647	3.688	1.801	1.157
F-test	**	**	**	**	**	**	**	**

**Significant at 1% level; SE± - Standard error; CD - Critical difference; AFL - Average filament length; NBFL - Non breakable filament length.

istration to silkworm causes increases in shell ratio percentage. The study result was supported by Aftab Ahamed *et al.* (2001). However, Verma and Kushwaha (1971), Tayade *et al.* (1988) and Krishnaswami *et al.* (1981) reported no significance difference of shell ratio in antibiotic treated batches.

Average filament length denotes length of the bave contained in the cocoon shell. In CSR₂ × CSR₄ (Table 3) the average filament length was recorded significantly higher in treated batches than control and recorded as T2 (1230 m.), T1 (1064 m.) and control (974 m.). In case of cauvery, the same trend of result was obtained as T2 (973 m.), T1 (939 m.) and control (890 m.) (Table 4). Analyzed results shows that there was a significance difference between treatment and control and within treatment in both the races.

The results indicated that the antibiotic Norfloxacin causes an increase in average filament length (AFL) and increase in concentration of antibiotic also causes an increase of AFL. The study results are in support with the earlier studies of Tayade *et al.* (1988) and Verma and Kushwaha (1971).

Non-breakable filament length (NBFL) is the average length of filament that can be unwound from cocoon without break. In CSR₂ × CSR₄, the non-breakable filament length was recorded significantly higher in T2 (1073 m.), followed by T1 (907 m.) and least in control (809 m.). In case of Cauvery the same trend was obtained *i.e.*, higher in T2 (836 m.) followed by T1 (779 m.) and lower in control (707 m.).

It was clear that antibiotic Norfloxacin has a positive impact on increasing NBFL. Also higher concentration of antibiotic causes an increase of NBFL. It was reported by Murthy and Sreenivasaya (1953) that when an adequate quantity of extra nitrogen in the form of amino acids and glycine was provided along with the antibiotic, it resulted increased silk output and NBFL.

Denier is an important factor in quality silk production and it denotes the thickness of yarn. In the present study, the denier recorded in CSR₂ × CSR₄ was significantly

higher in T2 (2.87) followed by T1 (2.66) and control (2.49) (Table 3). In Cauvery, the same trend was obtained and higher in T2 (2.83) followed by T1 (2.66) and lower in control (2.50), The results indicated that the administration of antibiotic has an impact of increasing denier when compared to control.

Renditta is the quantity of cocoon required to produce one kilogram of raw silk. In CSR₂ × CSR₄ significantly lower renditta was recorded in T2 (4.79 kg) followed by T1 (5.74 kg) and Control (6.23 kg) and in Cauvery the same trend of result was obtained and recorded as lower in T2 (6.26 kg), T1 (7.96 kg) and higher in control (9.53 kg). So it was clear that antibiotic Norfloxacin decreases the renditta significantly and has a positive correlation with increase of concentration (Table 3 and 4). The earlier references show that the minimum renditta in auromycin is the best followed by subamycin and terramycin treated batches. (Verma and Kushwaha, 1971).

The raw silk percentage (RS%) is the ultimate percentage of quantity of raw silk reeled in relation to the quantity of fresh cocoon utilized for reeling and has the great importance of quantitative and qualitative production of silk. In CSR₂ × CSR₄ the RS % was recorded significantly higher in T2 (20.52%) followed by T1 (17.39%) and lower in control (16.03%). In Cauvery, the same trend was recorded as T2 (16.07%), T1 (12.57%) and control (10.49%) (Table 4). So the results indicated that antibiotic Norfloxacin and its increase in concentration have an impact in raw silk percentage of both the races (Table 3 and 4).

Raw silk recovery percentage (RSR%) indicates that the silk obtained out of the silk present in cocoon shell. It is also an important factor in silk production. In CSR₂ × CSR₄ the RSR% was recorded significantly higher in T2 (82.10%) followed by T1 (73.32%) and lower in control (70.39%). In Cauvery also same trend was obtained *i.e.*, T2 (80.37%), T2 (70.38%) and control (62.15%). So it was clear that antibiotic Norfloxacin and with increase of its concentrations having a positive correlation in increasing RSR%.

Table 4. Effect of antibiotic administration on reeling parameters of cross breed hybrid silkworm (Cauvery)

Treatments	AFL (m)	NBFL (m)	Denier	Renditta (kg)	Raw Silk Percentage (%)	Raw Silk Recovery (%)	Reelability (%)	Neatness (%)
T1 (50ppm)	939	779	2.66	7.96	12.57	70.38	83.06	89
T2 (100ppm)	973	836	2.83	6.26	16.07	80.37	85.99	90
Control	890	707	2.50	9.53	10.49	62.15	79.49	88
SE±	4.991	8.218	0.019	0.107	0.193	0.804	0.505	0.298
CD @ 1%	22.36	36.82	0.086	0.471	0.864	3.604	2.263	1.336
F-test	**	**	**	**	**	**	**	**

**Significant at 1% level; SE± -Standard error; CD - Critical difference AFL - Average filament length; NBFL- Non breakable filament length.

Reelability denotes the suitability of cocoon for economic reeling. Reelability recorded in CSR₂ × CSR₄ was significantly higher in T2 (86.78%) followed by T1 (85.22%) and lower in control (83.30%). In Cauvery also the same trend was obtained i.e., T2 (85.99%), T1 (83.06%) and lower in control (79.39%) (Table 3). The results clearly indicated that there was a positive impact of antibiotic Norfloxacin on the increase of reelability keeping other factors constant. It was also indicated that there was an increase of reelability with increase of concentration of the antibiotic.

Neatness is an important factor on quality silk production. The neatness recorded in CSR₂ × CSR₄ was significantly higher in T2 (93%) followed by T1 (92%) and control (91%). The same trend was obtained in Cauvery i.e., T2 (90%), T1 (89%) and lower in control (88%) (Table 4). It was clear that antibiotic Norfloxacin has a positive impact on neatness. Also the increase of concentration causes an increase in neatness.

The study results concluded that oral administration of antibiotic (Norfloxacin) along with mulberry leaves enhanced the qualitative and quantitative cocoon production of both bivoltine and cross breed hybrid races. This is may be due to the higher feed conversion efficiency of antibiotic treated silkworm batches and physiological action of antibiotic in the intestine. So, this antibiotic administration can be exploited for higher quality silk production.

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