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Beneficial Effect of Cyanobacteria *Anabaena variabilis* on Quantitative Traits of Eri Silkworm *Samia cynthiaricini*, Boisduval

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Abstract: The study is to investigate the impact of fortifying Anabaena, a cyanobacteria, on castor leaves for nutritional studies. Anabaena is found in water and soil, having a potential to produce an elaborate array of secondary metabolites which shows metabolic effect on worms besides having antibiotic effect. In the present study, Anabaena at various aqueous concentrations was fortified and orally administrated to Samiacynthia, B. The results indicate that Eri silkworms fed with *Anabaena variabilis* at 500 ppm concentration showed improved larval weight (59.95%), pupation rate (31.83%), cocoon yield (146.88%), ERR (80.87%) and reduced larval mortality (75.60%) while other quantitative parameters were significantly high at 500 and 300 ppm concentrations when compared to control Data is collected and subjected to statistical analysis. It is evident that *Anabaena variabilis* is very efficient feed supplement in increasing the productive traits besides reducing the larval mortality in the Eri silkworm.

Keywords: *Anabaena variabilis*, Eri silkworm, quantitative parameters

INTRODUCTION

Nutrition is an incremental factor which individually augments insect growth and development; subsequently cocoon production (Laskar and Datta, 2000). The physiological potential of an insect is influenced by its food intake, growth regulators and various biotic factors (Slansky and Scriber, 1985; Rath, 2005).

The specific doses of dietary supplements in nutrition viz. proteins, carbohydrates, amino acids and vitamins etc., evinced their effect on various metabolic activities of silkworm (House, 1966; Horie, 1980). Mulberry leaves supplemented with proteins, amino acids, vitamins and antibiotics have improved larval growth, fecundity and silk content in silkworm. Soyabean and Spirulina, blue green algae, containing anarray of bioactive phytochemicals were studied on worms (Subburathinam *et al*., 1990; Devi *et al*., 1981; Murugappa, 1997). Oral administration of foliage of mulberry and eri silkworm supplemented with cyanobacteria enhanced larval and shell weight besides reduction of larval mortality (Jayaprakash *et al*., 2005; Venkataramana *et al*., 2003; Kumar *et al*., 2009; Masthan *et al*., 2011). Babu *et al*. (2005) reported that antiviral protein of *Spirulina platensis* showed 90% resistance to BmNPV of *BombyxmoriL.*

Anabaena sps blue green algae are found in fresh marine water and also in soil profile. They are first photosynthetic organisms filamentous, N2 fixing, morphologically diverse genus of cyanobacteria having 40 common species including *A. wisconsinense* and *A. flosaquae*. As they store reserve food materials, they can be used as sources of proteins, lipids, vitamins and certain secondary metabolites thus can be consumed as food due to their high protein and fibre content (Devi *et al*., 1981; Anupama, 2000; Tan, 2007; Cardozo *et al*., 2007). In addition to these, exudates have also shown to have antibiotic effects (Starr *et al*., 1962; Welch, 1962; Flint and Moreland, 1946).

A broad spectrum antimicrobial antibiotic produced by *Nostoc muscorum* inhibits the growth of bacteria notably multiple resistant *Staphylococcus aureus* and yeasts *Candida albicans* and *C. pseudotrapicales* (Bloor and England, 1989). Therefore, the current investigation highlights the effect of different aqueous concentrations of *Anabaena variabilis* on the quantitative parameter of Eri silkworm *Samia cynthiaricini*, Boisduval.

MATERIALS AND METHODS

Organisms and growth condition: Algal strains selected for the studies belong to cyanobacteria growing in cultures of rice field of Telangana region (A.P) were collected and cultured in BC 11 media with or without nitrogen source at a temperature of 25±1°C under continuous illumination (3000 lux) for 12 days. Therefore, collected (after 12 days) washed with distilled water and the pellets obtained were dried at room temperature.

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Rearing: Mass culture of 25 Eri silkworm disease free layings (dfls) was maintained at rearing house of Sericulture Department, Kakatiya University, Warangal, (A.P.) under controlled (temperature 25-26ºC and RH 85%) condition. Eridfls were incubated and black boxed properly for synchronization of hatching at rearing house during summer season of 2012-13.

Six thousand (6000) first instar larvae of Eri silkworm were grouped into six treatments including control treatment. Each treatment was replicated four times to have 250 worms/replication to observe the effect of *Anabaena variabilis* extracts an economic trait. Aqueous (distilled water) solution of *Anabaena variabilis* 100 ppm (T_1) 200 ppm (T_2), 300 ppm (T_3), 400 ppm (T_4), 500 ppm (T_5) and control (T_6) were prepared daily for soaking of castor leaves for 10 min in each treatment. Soaked leaves were shade dried and fed five times (0.6 AM, 02 PM, 06 PM and 10 PM) a day under room conditions to the worms. The control batches of worms were fed with castor leaves soaked in distilled water.

Larval count was done daily in each treatment of four replications for computing the larval mortality. Twenty five mature larval (V th instar) weight was recorded.

There after the matured larvae were mounted on bamboo (Chandrikas) mountages for spinning of cocoons. The experiments on the effect of *Anabaena variabilis* were conducted based on the methodology of Venkataramana *et al*. (2003) and Jayaprakash *et al*. (2005). Data on larval weight (g), larval mortality (%), larval period (days), pupation rate (%), single cocoon weight, single shell weight, single pupil weight and silk ratio (%) were recorded. Recorded data was statistically analyzed for variance among the treatments.

RESULTS

The observations recorded on the effect of feeding of different concentration of *Anabaena variabilis* on the productive and cocoon traits Eri silkworm *Samia cynthiaricini* Boisduval were statistically analyzed and presented in Table 1 and 2. Mean larval weight (g), pupation rate (%), cocoon yield (kg/100 dfl) and ERR (%) were found the highest under concentrations 500 ppm (T_5) followed by 400 ppm (T_4) and 300 ppm (T_3) concentrations (Table 1). Castor leaves foliated with 500 ppm (T_5) concentrations of *Anabaena variabilis* significantly increased the larval weight, pupation rate, cocoon yield and ERR by 59.95, 31.83, 146.88 and 80.87%, respectively over control lots (Table 1). It is observed that the larval mortality was significantly reduced by 75.60% in 500 ppm (T_5) treated eriworms followed by 71.76% (400 ppm) and 66.35% (300 ppm) over the distilled water treated (control) lots.

However, *Anabaena variabilis* treatments had no significant effect on larval duration throughout the life span; the larval duration is reduced from 18 days 50 min. in the control lot to 16 days 50 min in 500 ppm (T_5) and 200 ppm (T_2).

The analysis of variance has indicated high significant differences (at 1 and 5% level) between treatment values in respect of single cocoon weight, single shell weight and silk ratio are shown in Table 2. The treatments with 500 ppm (T_5) and 300 ppm (T_3) have very significantly (1% level) increased the single cocoon weight, shell weight and silk ratio when compared with control. The effect of the said concentrations *Anabaena variabilis* was consistent

Table 1: Effect of *Anabaena variabilis* on productive parameters of eri silkworm, *Samia cynthiaricini*, boisd

Treatment	Larval weight (g)	Larval mortality (%)	Larval period (days)	Pupation rate (%)	Cocoon yield (kg) 100 DFL	ERR (%)
T_1	5.46 (20.80)	37.50 (-11.45)	17.00 (-8.11)	61.50 (6.68)	22.32 (32.46)	42.47 (6.76)
T_2	6.25 (38.27)	30.28 (-28.50)	16.50 (-10.81)	70.00 (21.42)	28.90 (71.51)	62.90 (58.12
T_3	6.46 (42.92)	33.65* (-20.54)	17.00 (-8.11)	67.50* (17.08)	37.36* (121.100	64.52* (62.19)
T_4	6.95** (53.76)	28.24** (-33.20)	17.00 (-8.11)	71.75** (24.45)	37.80** (124.33)	67.74** (70.28)
T_5	7.23** (29.95)	24.41* (-42.36)	16.50 (-10.81)	76.00** (31.83)	41.60** (146.88)	71.95** (80.87)
T_6 (cont)	4.52	42.35	18.50	57.65	16.85	39.78
F-value	12.57	281.80	3.38 (NS)	28.99	70.41	720.78
C. D at 5%	6.47	4.88	5.67	8.65	-4.75	-4.34
C. D at 1%	7.52	5.67	6.25	9.05	-5.10	-5.70

*: Significant at 5%; **: Significant at 1%; Values in parenthesis are percent increase (+) decrease (-) over control

Table 2: Effect of *Anabaena variabilis* on cocoon character of eri silkworm

Treatments	Cocoon weight (g)	Pupil weight (g)	Shell weight (g)	Silk ratio (%)
T_1	2.826 (23.41)	2.373 (19.25)	0.457 (51.82)	16.16 (22.89)
T_2	2.721 (18.82)	2.304 (15.77)	0.417 (38.53)	15.33 (16.58)
T_3	3.140** (37.37)	2.629 (32.11)	0.511** (69.77)	16.28** (23.80)
T_4	3.024* (32.05)	2.571 (29.19)	0.453* (50.49)	14.97* (13.84)
T_5	3.156* (37.82)	2.720 (36.68)	0.436* (44.85)	13.82* (5.09)
T_6 (cont)	2.290	1.990	0.301	13.15
F-value	36.110	141.000 (NS)	10.00	35.51
C. D at 5%	7.550	3.820	0.340	-2.15
C. D at 1%	8.650	4.410	0.422	-3.00

*: Significant at 5%; **: Significant at 1%; Values in parenthesis are percent increase (+) /decrease (-) over control

overall cocoon characters except pupil weights and further as the pupil weight did not evince significant differences. The maximum improvement in shell weight (69.77%), silk ratio, (23.80%) and cocoon weight (37.37%) was recorded significantly (1% level) with 300 ppm (T_3) (Table 2).

Analysis of overall results indicated that 500 ppm (T_5) concentration treatment is found to be significant in increasing the productivity traits of eri silkworm, *S.c. ricini*, boisd.

DISCUSSION

The parameters viz. larval weight, pupation rate, cocoon yield, ERR, single cocoon weight, single shell weight and silk ratio analyzed in the present investigations clearly indicated the impact of *Anabaena variabilis* on the economic traits of *S.c. ricini* boisd. Castor leaves supplemented with aqueous solution of *Anabaena variabilis* at 500 ppm (T_5) concentration significantly (1%) increased the larval weight, pupation rate and cocoon yield, ERR and reduced the larval mortality considerably when compared to control lots. The reduction in larval mortality might also be due to antibiotic activities of cyanobacterium that is evinced antibacterial, antiviral and antifungal effect on test insect (Bloor and England, 1989). The present findings on the effects of *Anabaena variabilis* on physiology of Eri silkworms are in close conformity with those results observed in *Bombyxmori* L., by Venkataramana *et al*. (2003). Further, Jayaprakash *et al*. (2005) reported that castor leaves feed supplemented with 300-400 ppm concentration of *Spirulinaaqueous* extract to *S.c. ricini* Boisd found to be effective in reducing larval mortality and increasing the larval weight, pupation rate, pupil weight and silk ratio. Narayanaswamy and Ananthanarayana (2006) also reported similar findings in case of *B. mori* L.

It was observed that oral administration of *Anabaena variabilis* extracts at 500 ppm (T_5) and 400 ppm (T_4) has significantly increased the single cocoon weight, shell weight and silk ratio. Similar results were also reported in case of cocoon characters of *B. mori*, L after oral administration of 300 ppm (Kumar *et al*., 2009) spirulina and probiotic microorganisms *Saccharomyces cervisiae* (Masthan *et al*., 2011)

Scientific literature on the effect of blue green algae and plant (botanical) extracts economic characters of eri silkworm was scanty. It is quite obvious from the present investigation that nutritional imbalance occur in castor leaves can be balanced with the fortification of feed supplements like *Anabaena*. Further, the finding of Govindan *et al*. (1988) corroborate the present observations and revealed that spirulinsenriched with water soluble protein and vitamin B2, B6 and C significantly enhanced the larval weight, cocoon weight, shell weight, filament length of eri silkworm, *S.c. ricini*, B. when supplemented with castor leaves. Narayanaswamy and Ananthanarayana (2006) inferred that one time feeding/day with “SERIFEED” a feed supplement containing protein, carbohydrates, amino acids, vitamins B and C antibiotics and minerals was enough to bring considerable improvement in economic characters of *B. mori* L.

Remunerative Eri culture will only be possible as the effective utilization of foliage under rained conditions of castor crop. Supplementation of castor leaves with *Anabaena* extracts is the way for economic utilization of leaves that leads to maximize the eri cocoon and castor bean production.

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