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EFFECT OF BLUE GREEN MICRO ALGAE (SPIRULINA) ON COCOON QUANTITATIVE PARAMETERS OF SILKWORM (*Bombyx mori* L.)

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ABSTRACT

Spirulina is blue-green micro algae. It contains 18 amino acids and vital vitamins like biotin, tocopherol, thiamine, riboflavin, niacin, folic acid, pyrodozoic acid, beta-carotene and vitamin B12 etc. These nutrients which are very easy to digest protein (biliprotein), carbohydrates (mucopolysaccharides, rhamnose and glycogen), 50 different minerals and trace minerals, beta-carotene, chlorophyll, GLA omega-3 fatty acid, and many other nutrients found in spirulina. Under the present investigation the effect of blue green algae (Spirulina) on cocoon quantitative parameters (cocoon weight, shell weight, pupal weight, shell percentage and silk filament length) of silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae) was studied. Three treatments (100ppm, 200ppm and 300ppm foliar spray) one control were taken for the study. Data were collected and subjected to the statistical analysis on comparative analysis of the results. Differences between the treatments were found significant in all the quantitative cocoon characters except shell percentage. Single cocoon weight, single shell weight, pupal weight, and silk filament length are significantly higher at 300ppm concentration compared to control, 100ppm and 200ppm.

Keywords: algae, silkworm, spirulina, foliar, cocoon, mulberry.

INTRODUCTION

Mulberry (*Morus* species) leaf is the solo food and source of nutrition for the silkworm, *Bombyx mori* L. due to the presence of morin (Tribhuwan, *et al*., 1989). The growth and development of larva, and subsequent cocoon production are greatly influenced by nutritional quality of mulberry leaves. Supplement in silkworm nutrition like protein substitute fortified with food stuff are needed for nutritional requirement among several insects (House, 1996). In recent years attempts have made in sericulture with nutrient such as proteins, carbohydrates, amino acids, vitamins, sterols, hormones, antibiotics etc. for better performance and get higher yield, quantity and quality cocoons (Sannappa, 2002).

Mulberry leaf supplemented with spirulina as a feed to *Bombyx mori* L. (Lepidoptera: Bombycidae) oraly found to be effective in enhancing the larval and cocoon characters (Venkataramana, 2003). Spirulina, blue-green algae contains 18 amino acids viz., glutamine, glycine, histidine, lysine, methionine, creatine, cysteine, phenylalanine, serine, proline, tryptophan, asparagine, pyruvic acid and vital vitamins like biotin, tocopherol, thiamine, riboflavin, niacin, folic acid, pyrodozoic acid, beta-carotene and vitamin B12 etc.

Various researches have been carried out on the diet supplementation of mulberry leaves fed to silkworms. These supplementation include vitamins such as ascorbic acid, thiamine, niacin, folic acid and multivitamins (Etebari *et al.*, 2004). Its nutrients are very easy to digest protein (biliprotein), carbohydrates (mucopolysaccharides, rhamnose and glycogen), 50 different minerals and trace minerals, beta-carotene, chlorophyll, GLA omega3 fatty acid, and many other nutrients. The presence of vitamins is appropriate for growth of larvae and the reproduction in many insects (Ishii 1971; Yazgan 1972; Baker 1975; Ritter and Johnson 1991; Levinson 1992; Ozalp and Emre 1992; Chang and Li 2004). The elimination of niacin (nicotinic acid) from *Ceratitis capitata* diet causes the increased mortality of larvae and decrease in the proportion of pupal to adult emergence. Deficiency of vitamin B3 in the diet structure does not improve by adding tryptophan, but nicotinamide, NAD and NADP are proper substitutes for resumption of normal larval growth.

The dietary supplements like protein, vitamins, lipids etc. evincing their specificity at specific dose for various metabolic activities of silkworm (Horie, 1980). Amino acid such as aspartic acid and glutamic acid are considered to be essential for silkworm growth (Ito and Inokuchi 1981). Nutritional study on silkworm is an essential prerequisite for its proper commercial exploitation. Nutrition of silkworm is sole factor which almost individually augment quality and quantity of silk (Laskar and Datta 2000).

The current investigation highlights the effect of different concentrations of spirulina, blue green algae on the quantitative cocoon parameters viz., cocoon weight, shell weight, pupal weight, shell percentage and silk filament length.

MATERIALS AND METHODS

Rearing

The present study was conducted in the year 2007 at the experimental lab of Babasaheb Bhimrao Ambedkar Central University, Lucknow, India. The eggs of bivoltine hybrid silkworm (CSR2XCSR4) were obtained from Silkworm Seed Production Centre, Dehradun, India. Further silkworms were reared in sophisticated rearing house in natural conditions and late age healthy silkworms (100 each) from fourth instar onwards were undertaken for the study.

Treatments

Blue green algae (spirulina) were procured from the Department of Botany, University of Allahabad, India. Further spirulina was dissolved in distilled water and diluted into 100ppm, 200ppm and 300ppm concentrations. Fourth instar larvae were divided into five experimental groups including control, each group consisting 100 larvae. Four replications were maintained for each of the treatments. Fresh mulberry leaves were soaked with aqueous extract of spirulina, and then leaves were dried under fan before feeding to the silkworms till end of the fifth instar. The cocoon quantitative parameters like cocoon weight (grams), shell weight (centigrams), pupal weight (grams), silk filament length (meters) were recorded (Nirwani and Kaliwal, 1996). Shell ratio (percentage) was also computed.

Statistical analysis

The data were subjected to statistical analysis of variance for identifying significant differences among the treatments using standard method under MS Excel software. Significant tests were carried out using Dunnett's comparison method.

RESULTS AND DISCUSSIONS

Average cocoon weight was highest under 300ppm concentration (1.08gm), followed by 200ppm (0.94gm), 100ppm (0.91gm) and control (0.81gm). The data are shown in Figure-1. Average shell weight of cocoons recorded was highest with 300ppm concentration (24.50cg) followed by, 200ppm (22.25cg), 100ppm (22.25cg) and control (20.50cg). The variability of average shell weight of cocoons at different concentrations are shown in Figure-2. The pupal weight of silkworm was again found to be highest with 300ppm treatment of spirulina (0.83gm) followed by 200ppm (0.68gm), 100ppm (0.65gm) and control (0.59gm) as shown in Figure-3. The shell percentage indicated that it was highest in respect of control (25.98%), followed by 100ppm (25.25%), 200ppm (24.62%) and 300ppm (22.64%), data indicated in Figure-4. Silk filament length was highest (866.61m) in case of 300ppm concentration followed by 200ppm (682.20m), 100ppm (664.58m), and control (661.94m) as shown in Figure-5.

The Analysis of Variance has indicated high significant differences (at p = 0.01) between the treatment values in respect of single cocoon weight, single shell weight, pupal weight and silk filament length are shown in Table-1. The treatment with 300ppm concentration spirulina has very significantly increased the single cocoon weight, single shell weight, pupal weight and silk filament length when compared with control. As the effect of the treatment is consistent over all the characters except shell ratio and further as the shell ratio did not exhibit significant differences. Therefore, the 300ppm concentration has shown high impacts on the cocoon characters. Secondly, the differences between 300 ppm concentration and other two concentrations namely 100 and 200 ppm are also significant. The differences between 100 and 200 ppm concentrations are not found to be significant except for filament length. Analysis of the results as discussed indicates that the 300 ppm concentration treatment is found to be significant in increasing the cocoon characters.

The results of the present study correlate with Govindan *et al*., 1988 that growth promoting effect of water soluble proteins and vitamins viz., B2, B6 and C are found in spirulina and it is treated on silkworm boisduval with vitamins and amino acids enhance the larval weight, cocoon weight, shell weight, filament length. Therefore, in the end, the study recommends that 300ppm concentration of aqueous solution of spirulina as feed to silkworm found to effectively and increases single cocoon weight, single shell weight, pupal weight and silk filament length. The specific dose of spirulina with 300ppm concentration contain maximum amount of essential amino acids and vitamins which determines the specificity for various metabolic activities in silkworm.

Table-1. Mean value of quantitative cocoon characters of silkworm under different concentrations of spirulina.

S. No	Treatments Concentration (ppm)	Cocoon weight (gm)	Shell weight (cgm)	Pupal weight (gm)	Shell percentage	Silk filament length (m)
1	100	0.905*	22.250*	0.645*	25.250	664.575
2	200	0.935*	22.250*	0.675*	24.615	682.203*
3	300	1.083**	24.500**	0.828**	22.640	866.605**
4	Control	0.805	20.500	0.590	25.975	661.943
F Test		HS	HS	HS	NS	HS
CD @ 5%		0.080	1.585	0.081	-	14.192
CD @ 1%		0.112	2.208	0.113	-	19.770

Note: HS-Highly Significant (p = 001); NS-Not Significant
**-Significant at 1% level; *-Significant at 5% level
CD-Critical Difference

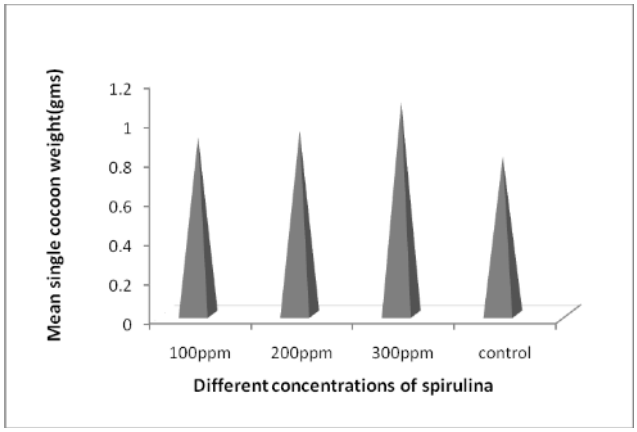

Figure-1. Effect of spirulina on cocoon weight.

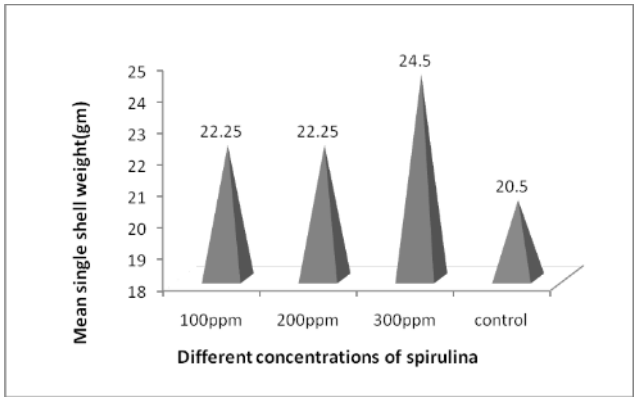

Figure-2. Effect of spirulina on shell weight.

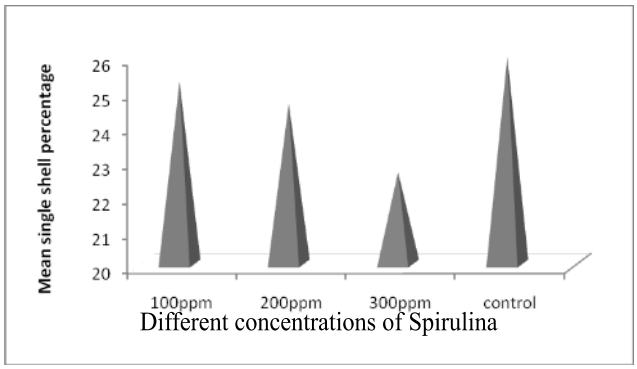

Figure-3. Effect of spirulina on shell percentage.

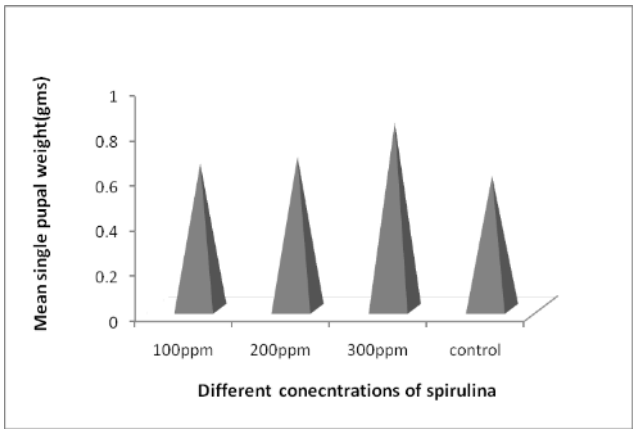

Figure-4. Effect of spirulina on pupal weight.

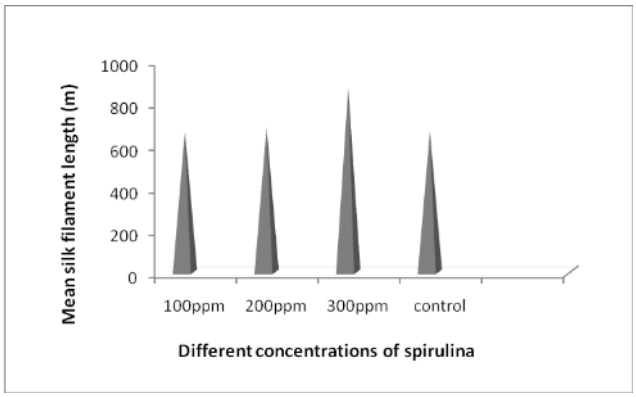

Figure-5. Effect of spirulina on silk filament.

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