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Evaluation of fertilizers for ideal growth of *Terminalia arjuna* and enhancement of economic parameters of Tropical Tasar silkworm *Antheraea mylitta drury*

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ABSTRACT

Antheraea mylitta drury a Tropical tasar silkworm derives almost all the essential nutrients for its growth from the primary host plant Terminalia arjuna and convert it into animal biomass. A field experiment was conducted for three crops to identify the suitable fertilizer among Urea and NPK(19:19:19) for Terminalia arjuna leaf nutrient levels and Antheraea mylitta drury's larval and cocoon characters. The treatment comprised of T1- Urea treated plants, T2-NPK treated plants, T3- Untreated plants (Control) and B1-Larvae reared on T1, B2-Larvae reared on T2, B3-Larvae reared on T3.The pooled results indicated that total soluble proteins, free amino acids, total soluble sugars, total reducing sugars and chlorophyll content were recorded maximum in T2. Maximum larval weight ,silk gland weight and minimum larval duration, larval loss were recorded in B2 batch. Cocoon weight, shell weight, shell ratio, filamentlength, reliability, reeled silk weight, denier and cocoon yield were also recorded high in B2 batch cocoons.

Key words: Urea, NPK fertilizer, *Terminalia arjuna*, *Antheraea mylitta drury*

INTRODUCTION

Nutrition plays an important role in the productivity of a crop along with plant variety, management practices and the environmental factors like seasons [1]. Nutrients are mainly supplied to plant as soil applicants. An alternative to this is supplementing them as foliar spray for immediate and effective incorporation of it into the system [2]. Plant response to foliar applicants depends on species, concentration, frequency of application etc. Under given conditions with the best management practices the possibilities of increasing the productivity exists through application of foliar nutrients[3].Many scientists have observed that the growth and development of silkworm are greatly influenced by the nutritional content of the leaf. It has also been demonstrated that the dietary nutritional management has a direct influence on quality and quantity of silk production in *B. mori* [4].The nutritional elements of mulberry leaves determine the growth and development of the larvae and cocoon production [5].The quality of the leaves has a profound effect on the superiority of silk produced. In this regard, the production of good cocoon crop is totally dependent on the quality of leaves. Leaves of superior quality enhance the chances of good cocoon crop [6]. Nearly 70 per cent of the silk produced by silkworm is directly derived from proteins of mulberry leaves. Hence, silkworm should be fed with good quality mulberry leaves in abundant quantity for the successful cocoon production[7]. *Antheraea mylitta drury (Daba T.V)* is a polyphagus insect derives almost all the essential nutrients for its growth from the primary plant *Terminalia arjuna* and convert it into animal biomass. Application of manures and fertilizers is one of the important inputs for increasing leaf yield and the nutritive In the present work an effort

was made to study the effect of application of water soluble NPK fertilizer and Urea as foliar spray on *Terminalia arjuna* nutrient composition and consequent impact on *Antheraea mylitta drury (Daba T.V)*growth, development and cocoon production.

MATERIALS AND METHODS

The present work was performed by collecting *Daba T.V* cocoons as per the standard norms such as weight, colour, size of cocoons and length of the peduncle from the forest patches ofJakaram, Warangal District, during the third crop. The cocoons were preserved in the wire mesh cages of size 2 ft x2 ft x2 ft under temperature of 29±1 ºC and humidity 70 % ± 1 %. The emerged moths were tested for *pebrine* disease by a method derived from that used in sericulture[8]. In this method, the abdomen of an adult is severed with scissors, placed in a small mortar, mixed with water and crushed with pestle. A drop of the smear is placed on a clean slide and examined under a microscope of 600x magnification for Nosema sp., spores. Disease free layings were collected and incubated at 25- 30^{o}C temperature and 70- 75% humidity. *Terminalia arjuna* plants which are the main food plants of *Daba T.V* had been raised in the field with 4ft x 4ft distance and a height of six feet for good foliage. Rearing site was kept free from weeds, insects, and unwanted leaves to prevent the pests. For the present study Urea (Nagarjuna company, containing only Nitrogen) and water soluble NPK fertiliser (19:19:19, Coromandel Company) were used for foliar spray. The plants were divided into three treatments as T1- Urea treated,T2-NPK treated plants and T3- Untreated plants(Control).The first instar larvae of *Daba T. V*ecorace hatched from the eggs laid by the healthy moths were divided into three batches and reared as, B1-Reared on T1,B2-Reared on T2 and B3-Reared on T3. Each treatment has three replications of 50 larvae each and reared till cocooning by following standard procedure. Total sugars, Reducing sugars, Total Proteins, Larval duration, Larval weight and cocoon characters for T1, T2, T3 and B1, B2, B3 were recorded.

PREPARATION AND APPLICATION OF FOLIAR SPRAY

Urea spray was prepared by mixing 75gm of Urea in 5000ml of water and NPK spray by mixing 75gm of NPK in 5000ml of water and sprayed twice on *Terminalia arjuna* plants before 20 days of brushing once in 10 days of duration each. For proper incorporation of the nutrient, spraying was done during the morning hours. The leaves were harvested manually after ten days of second foliar spray by plucking individual leaves in each treatment. The leaves were dried at 65-70^{o}C in oven, powdered and 1% homogenate was prepared in distilled water using a mortar and pestle. The homogenatewas centrifuged at 3000rpm for 10 minutes. The supernatant was collected, diluted appropriately and the quantitative estimation of total proteins was done by the method [9] free amino acids by Ninhydrin method of [10], reducing sugars by Dinitro salicylic acid (DNS) method explained by [11] and total soluble sugars were determined as described by Anthrone method[12].Fresh *Terminalia arjuna* leaves were utilised to estimate the photosynthetic pigments (total chlorophyll) [13]. Observations were also recorded on mean total larval duration, matured larval weight, cocoon weight, shell weight, shell ratio, filament length, weight of silk reeled, denier, reelability. Weight of the cocoons, weight of the reeled silk and weight of the cocoon shells were taken on electronic balance of Dhonamake.

Shell ratio= (Shell weight /Cocoon weight) X 100

Reelability= (Weight of the silk reeled/weight of the cocoon) X 100

Filament length= (9/8 met) X No. of revolutions

Denier= (Weight of the silk reeled / Length of the silk reeled) X 9000

STATISTICAL ANALYSIS

To evaluate the suitable fertilizer one way ANOVA was used. Critical difference (CD 5%) was analyzed by Tukeys Post hoc procedure. Data presented in the tables was the average values of three replications.

RESULTS AND DISCUSSION

The results shown in Table 1 depicts that NPK fertilizer profoundly affects the levels of biochemical components of *Terminalia arjuna* leaves ($p \leq 0.05$). A significant variation was observed in total soluble proteins and it was found to be high (18%) in T2 batch.Improvement in protein was mainly attributed to the foliar spray where nutrients were

rapidly absorbed by foliage and the plant metabolism/ assimilation might have been activated thus contributing for healthy green foliage resulting in synthesis of organic contents [7]. Foliar application of Seriboost increases the protein content in mulberry leaves [14] .Application of NPK to soil as well as foliar spray increased the protein in the mulberry leaves [5]. When compared with the control, the levels of free amino acids were significantly increased (37%) in the T2 batch and little high (3%) was recorded in T1 batch. The high amino acid content can be attributed to high proteolytic activity. High amino acid content in the silk gland of virus infected silkworms is due to low transaminase activity or high proteolytic activity [15]. In comparison with control (T3) a drastic increase in total soluble sugars (82.5%) was found in T2 batch whereas in T1 it was 46%.Soil application of DAP and foliar application of seriboost to mulberry increased the total soluble sugars of mulberry leaves [16].Results also show an increase of total reducing sugars (6%) in T2 batch and 3% increase in T1 over the control (T3). The chlorophyll content of T2 batch was found to be 33% high over T3 batch whereas it was 16% in T1 batch.

Table 1. Effect of foliar sprays on biochemical components of *Terminalia arjuna* leaves

Treatment	Total soluble proteins(mg/mg)	Free amino acids(µg/g)	Total soluble sugars(mg/g)	Total reducing sugars(mg/g)	Total Chlorophyll
Urea Treated (T1)	125.28±3.28	8.12±0.95	2.85±0.05	88.75±3.25	2.15
NPK Treated(T2)	132.65±2.48	11.13±1.05	3.56±0.07	91.46±3.26	2.46
Control(T3)	112.35±2.54	7.89±1.02	1.95±0.08	86.25±2.58	1.85
CD 5%		0.25	0.12	1.16	0.028

CD: Critical difference. All the values are mean values of three replications

Table 2. Effect of foliar spray on larval characters of *Daba TV*ecorace

Treatment	Larval weight (g)	Larval span (Days)	Larval mortality (%)	Silkgland weight (g)
Reared on Urea Treated plants(B1)	34.14±1.15	38	1	12.87
Reared on NPK Treated plants(B2)	36.15±1.16	35	0	13.23
Control (B3)	33.17±1.13	42	3	12.45
CD 5%	-	0.17	0.02	0.05

CD: Critical difference. All the values are the mean values of three replications

Table 3. Effect of various foliar sprays on cocoon characters of *Daba TV*ecorace

Treatment	Cocoon Weight (g)	Shell Weight (g)	SR%	Filament Length (m)	Reelability (%)	Weight Of raw Silk(g)	Denier
Reared on UreaTreated plants(B1)	9.07± 1.02	0.88± 0.03	9.71± 0.05	320.45± 2.07	5.1± 0.13	0.46± 0.05	12.92± 0.25
Reared on NPK Treated plants(B2)	9.68± 1.12	0.97± 0.21	10± 0.08	354.82± 2.87	5.16± 0.25	0.5± 0.08	12.68± 0.15
Control(B3)	8.47± 0.06	0.74± 0.02	8.73± 0.05	270.45± 2.12	5±0.05	0.42± 0.03	13.97± 0.56
CD 5%	0.06	0.03	0.21	0.54	0.3	0.03	0.48

CD: Critical difference. All the values are the mean values of three replications

Table 2 explains the larval characters under the influence of foliar spray($p \leq 0.05$).The larval weight was recorded maximum in B2 followed by B1 and control. In comparison with the control (B3), larval weight of B1 and B2 batches found increase by 3 and 9% .It is observed that larval duration was reduced by 17% in B2 batch and by 10% in B1when compared to B3. Elemental composition in leaves due to NPK might have stimulated the metabolic activities in silkworms fulfilling the requirement of nutrients both qualitatively and quantitatively thus resulting in reduction of larval durationThe administration of chemicals increases the larval life cycle, cocoon weight, shell weight [17].Larval mortality % was recorded maximum in B3 batch and it was recorded zero in B2 batch. It is evident from the results that silk gland weight of B2 batch was significantly high (6%) from control (B3) whereas B1 batch had shown 3% increase over control.

Table 3 explains the effect of various foliar sprays on cocoon characters($p \leq 0.05$). In comparison with the control (B3) weight of B2 and B1 batch cocoons found increased by 14.3 and 7.1% respectively.High protein content effectively increases the quality of cocoon shell [18]. Shell weight of cocoons also reported maximum in B2 batch with an increase of 31% in B2 batch over the B3 whereas 19% increase in B1.Higher values of cocoon weight; shell weight primarily depends upon the larval weight which in turn depends on food plants [19]. Increased cocoon and shell weight will be converted to the end product, the reelable, low denier silk filament [20]. It is evident from the

results that shell ratio of B1 and B2 batch cocoons has increased by 11.2 and14.5% respectively when compared to that of control (B3).The reelability of B1 and B2 batch cocoons was found to increase by 2 and 3% respectively over the control (B3).When compared with the control the weight of the silk reeled of B1 and B2 batch cocoons was more by 9.2% and 9.3%respectively. The filament obtained from cocoons produced by B2 and B1 batch larvae was 31, 18% longer than the filament obtained from the control group(B3).This can be attributed to the significantly fewer reeling breaks recorded in filaments. Increase in filament length and ease of reelability is the most important commercial characters in the improvement of silk quality and yield [21].It is observed that lowest denier value can be attributed to B2 batch cocoons next comes the B1 batch and last B3. *Bombyxmori* fed on mulberry raised with organic manure have produced cocoons with high filament length and low denier values [22]. Cocoons obtained from healthy Tasar larvae fed on healthy fresh Terminalia leaves have high filament length and low denier values[23].

Thus in conclusion NPK fertilizer is more efficient in increase of total soluble proteins, free amino acids, total soluble sugars, total reducing sugars and chlorophyll content of *Terminalia arjuna* leaves and also improves the larval and cocoon characters of *Antheraea mylitta drury(Daba T.V).*

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