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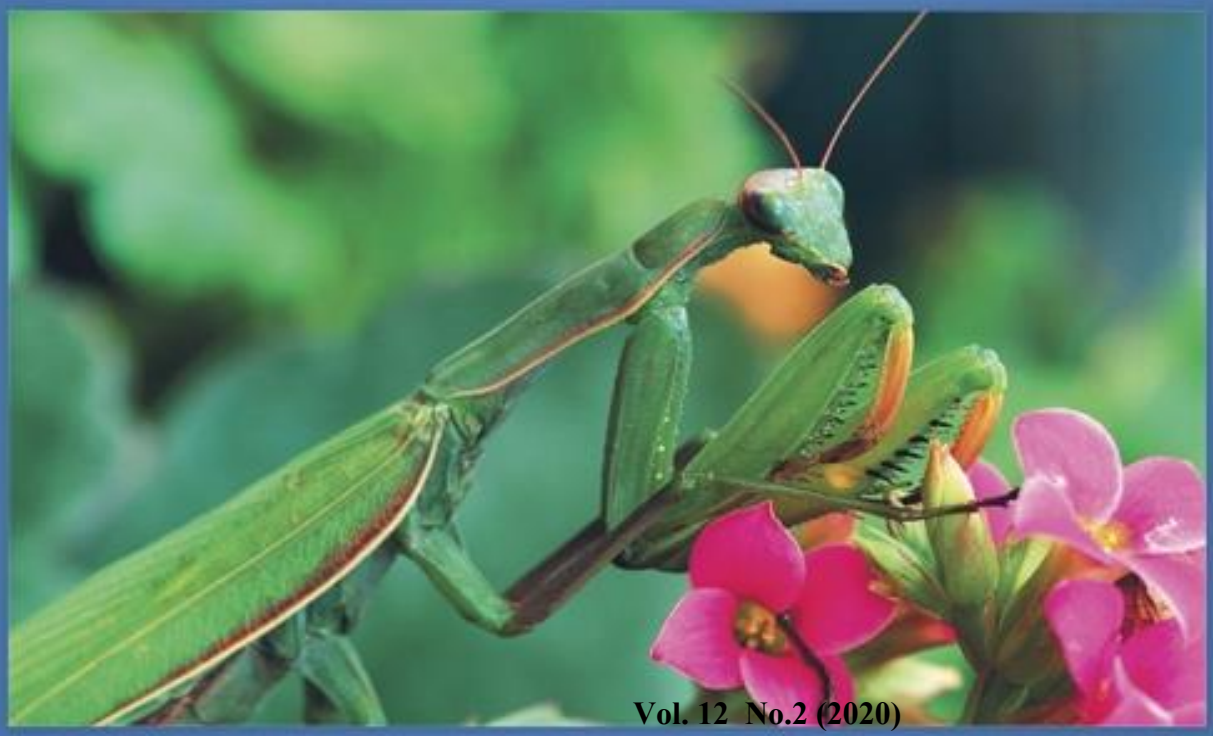

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Nitrogen Fertilizer on Mulberry Leaves and Effect on Larval and Cocoon Characteristics of Silkworm, *Bombyx mori* L.

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ABSTRACT

Egyptian hybrid of silkworm, *Bombyx mori* L. was obtained from the Seric. Res. Dept., Plant Protec. Res. Inst, Agric. Res. Center. Dokki, Giza. Larvae of *B. mori* were fed on mulberry leaves treated with nitrogen fertilizer daily during 4th & 5th instar and reared under laboratory conditions of 27 ± 2 Celsius, 80 ± 5 % relative humidity. Concentrations were 0.01, 0.03,0.05 and 0.07 mg/ml. Results showed that the best concentration was 0.07 mg/ml., as parameters were 1.111g for fourth stadium larval weight and 2.207 g for fifth stadium larval weight. Mortality percentage was 28.00%. Cocoon weight, cocoon shell weight and cocoon shell ratio were 1.201g, 0.229g and 19.06% respectively. Cocooning percentage was 95.40%, silk productivity was 1.83 cg/day and absolute silk yield was 16.48g. Larval duration, pupal weight and pupation ratio were 34.40 day, 0.841g and 95.00% respectively. According to the previous study, Silkworm growth and silk characteristic were enhanced when they were fed mulberry leaves treated with nitrogen fertilizer. Thus this fertilizer appears to be worthwhile suggestion for breeder.

INTRODUCTION

The Silkworm, *Bombyx mori* Linnaeus (Lepidoptera: Bombycidae), is one of the most important an economically insect for silk production and the additional nutrients can be added to mulberry leaves to promote larval growth and improve cocoon properties. One of the most labor-intensive cottage industries is sericulture, and the most crucial element affecting the mulberry silkworms' ability to successfully produce cocoons is the quality of the mulberry leaves they are fed (Sengupta *et al.,* 1992). Foliar nutrition significantly contributes to improved growth, higher yield, and enhanced biochemical properties of mulberry leaves, as well as to the overall quality of silk (Dhiraj and Kumar, 2012). As foliage crop mulberries react positively to foliar sprays that apply nutrients at the right time (Geetha, 2019). Growing mulberries and raising silkworms to create cocoons for the silk reeling industry are the two main activities that make up sericulture practices (Simi and Asiya, 2022). Micronutrients play a significant role in improving the energy efficiency of silkworms, serving as cofactors for various enzymes that boost energy levels, ultimately impacting the silk production in these insects (Chamundeswari and Radhakrishnaiah, 1994). A key element influencing the growth and development of insect species is their nutritional needs and metabolic processes within the body (Pattnaik and Pattnaik 2017). Food quality

has a direct impact on an insect's growth and development which in turn affects the amount and calibre of product the insect produces (Dutta 2002, Geetha *et al.,* 2016 and Nanita *et al*., 2024). The current authors recently reported on the impact of micronutrient on the biochemical traits of *B. mori* larvae (Marin *et al.,* 2021). The production of high-quality leaves in mulberry is significantly influenced by the availability of different inputs, particularly nitrogen fertilizers (Nasreen *et al.*, 1999). Previous studies suggest that mulberry reacts to nitrogen because it is a key component of plant proteins, nucleic acids, and vitamins (Singheal *et al*., 1999). Nano nitrogen fertilizer enhancement larval growth, cocoon weight, cocoon shell weight, cocoon shell ratio and silk productivity of *B. mori* Bharath *et al*. (2024). Therefore, the current study emphasizes how nitrogen fertilizer affects the silkworm *B. mori* characteristics.

MATERIALS AND METHODS

Egyptian hybrid of *Bombyx mori* was obtained from the Seric. Res. Dept., Plant Protec. Res. Inst, Agric. Res. Center. Dokki, Giza. Larvae reared on leaves of mulberry only till third stadium. At the begging of fourth instar larvae were divided into four groups and one control. Each group contained three replicates. Each replicate contain fifty larvae. Larvae were fed on treated leaves daily during 4^{th} & 5^{th} instar. Larvae reared under laboratory conditions of 27 ± 2 Celsius, 80 ± 5 % relative humidity, during spring season of 2023.

Urea fertilizer 46% nitrogen, biuret maximum limit 1%, moisture maximum 0.5%. Granular urea was produced by Helwan Fertilizers Company. Granular urea was dissolved in distilled water to prepare different concentrations (0.01, 0.03, 0.05 and 0.0 7 mg/ml). Leaves of mulberry were dipped in concentrations for 15 minute. Mulberry leaves were dipped in distilled water only as a control.

All treatments and control replications had tested characters documented. Larval weights and the mortality percentage were noted for the fourth and fifth instars. Calculations were made for cocoon weight, cocoon shell weight, and cocoon shell ratio. Absolute silk yield, cocooning percentage, and silk productivity were all low. Calculations were made for pupal weight, pupation ratio, and larval duration.

According to Berkowitz and Allaway 1998, the statistical package for social science (SPSS) was used to analyze the data using one-way analysis of variance (ANOVA) in order to determine the significance of the differences between the treated and control groups. The L.S.D at 0.05% was used to separate the means.

RESULTS AND DISCUSSION

Table 1, displays that, the fourth stadium larval weights were 1.011, 1.039, 1.086 and 1.111g for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 1.000 g for control. Weights of fifth instar larva e were 1.983, 2.028, 2.134 and 2.207g for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 1.901 g for control. Mortality of *B. mori* fed on mulberry leaves treated with different concentrations of nitrogen fertilizer decreased with increasing each of concentrations, where 36.00,35.66, 32.66 and 28.00 % for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 36.66 % for control. The results obtained generally concur with the conclusion of Rasool (1995) who reported that, the growth and development of silkworms as well as the improvement in larval characters were enhanced by feeding them on mulberry leaves treated with 0.2% nitrogen. Etebari *et al*. (2007) recorded significant improving in larval parameters of silkworm *B. mori* when fed on treated mulberry leaves with 0.1% nitrogen. This result is somewhat consistent with that of Kamel (2014), who discovered that

larvae fed on balanced nitrogen fertilized mulberry plantation leaves increased the weight of larvae. Meena *et al.* (2017), reported that improving in larval weight and mortality when using fertilizer of nitrogen on the 25th day following pruning as foliar application by 50%, may be because nitrogen fertilizer contain higher amounts of essential nutrients than untreated. Pooja *et al*. (2022) reported that, improving in larval traits of silkworm *B. mori* when using Nano nitrogen fertilizer as foliar application to mulberry.

Table 1: Impact of treating mulberry leaves with nitrogen fertilizer on fourth & fifth instars larval weights and mortality percentage of silkworm, *Bombyx mori* L.

Concentrations (mg/ml.)	4th instar larval weights(g)	5th instar larval weights(g)	Larval mortality (%)
0.01	1.011±0.0211	1.983±0.1101	36.00±0.2011
0.03	1.039±0.0111	2.028±0.1344	35.66±0.1333
0.05	1. 068±0.0021	2.134±0.1221	32.66±0.2331
0.07	1.111±0.0122	2.207±0.1333	28.00±0.1244
control	1.000±0.0200	1.901±0.1655	36.66±0.2111
Significance	**	**	**
LSD at 0.05%	0.012	0.040	3.000

According to information in Table 2, larval durations were, 36.40, 36.00, 35.40 and34.40 day for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 36.50day for control. pupal weight were 0.786,0.790,807 and 0.841g for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 0.780g for control. While pupation ratio recorded 92.00, 92.82, 93.32% and 95.00% for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 91.00% for control. The previous data take the same trend with many researchers such as Etebari *et al.* (2007) recorded significant improving in larval parameters of silkworm *B. mori* when fed on treated mulberry leaves with 0.1% nitrogen. This result is somewhat consistent with that of Kamel (2014), who discovered that, larvae fed on balanced nitrogen fertilized mulberry plantation leaves increased the weight of larvae. Meena *et al.* (2017) reported that, improving in larval weight and mortality when using fertilizer of nitrogen on the 25th day following pruning as foliar application by 50%, may be because nitrogen fertilizer contain higher amounts of essential nutrients than untreated. Pooja *et al*. (2022) reported that, improving in larval traits and significantly shorter larval duration of silkworm *B. mori* when using Nano nitrogen fertilizer as foliar application to mulberry.

Table 2: Impact of treating mulberry leaves with nitrogen fertilizer on larval duration, pupal weight and pupation ratio of Silkworm, *Bombyx mori* L.

Concentrations (mg/ml)	Larval duration (day)	Pupal weights (g)	Pupation ratio (%)
0.01	36.40±0.1411	0.786±0.0322	92.00±1.344
0.03	36.00±0.1122	0.790±0.0231	92.82±1.111
0.05	35.40±0.1233	0.807±0.0311	93.32±1.211
0.07	34.40±0.1112	0.841±0.0111	95.00±1.300
control	36.50±0.1223	0.780±0.0211	91.00±1.211
Significance	*	**	**
LSD at 0.05%	1.008	0.068	1.670

Data in Table (3), show that, the mean of each of the cocoon weights, cocoon shell weights and cocoon shell ratio, increased with increasing concentrations. The mean weight of cocoon was, 1.018, 1.045, 1.096 and 1.201g for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 1.003g for control. For cocoon shell weight was 0.179, 0.190, 0.200 and 229 g for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 0.170g for control. For cocoon shell ratio was 17.58, 18.18, 18.24 and 19.06% for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 16.94% for control. The results obtained generally agreement with some authors such as Maqbool (1991) who reported that, the cocoon production (weight of cocoon and shell ratio) was improved when *B. mori* fed on mulberry leaves treated with nitrogen fertilizer. Zaman (1995) noticed that, feeding silkworm larva on treated mulberry with 0.2% nitrogen improved cocoon, silk filaments and silk length quantity and quality. Ashfaq *et al*. (1998) reported that, improving in cocoon parameters of *B. mori* when larvae were fed on leaves treated with nitrogen. Pramila *et al.* (2019) observed increasing in cocoon weights, cocoon shell weights and cocoon shell ratio of *B. mori* when used nitrogen fertilizer as foliar application on mulberry. Bharath *et al*. (2024) recorded that, cocoon weight, cocoon shell weight and cocoon shell ratio were enhanced when insect fed on treated leaves with Nano nitrogen.

Table 3: Impact of treating mulberry leaves with nitrogen fertilizer on cocoon indices (cocoon weight, cocoon shell weight and cocoon shell ratio) of silkworm, *Bombyx mori* L.

Concentrations (mg/ml.)	Cocoon weights (g)	Cocoon shell weights (g)	Cocoon shell ratio (%)
0.01	1.018±0.0345	0.179±0.0200	17.58±0.3111
0.03	1.045±0.0522	0.190±0.0300	18.18±0.5122
0.05	1.096±0.0311	0.200±0.0100	18.24±0.1222
0.07	1.201±0.0101	0.229±0.0200	19.06±0.2110
control	1.003±0.0411	0.170±0.0211	16.94±0.2114
Significance	**	**	**
LSD at 0.05%	0.077	0.048	0.540

As shown in Table 4, cocooning percentage was 90.40, 92.02, 93.00 and 95.40 % for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 90.09% for control. Silk productivity was 1.69,1.81,1.75 and 1.83cg/day for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 1.61 cg/day for control .Absolute silk yield was 11.45,12.22,13.46 and 16.48g for 0.01, 0.03, 0.05 and 0.07mg/ml concentrations, respectively, compared with 10.88g for control . Ashfaq *et al.* (1998) reported that, the growth and development of silkworm as well as the improvement in silk yield were enhanced by feeding them nitrogen treated mulberry leaves. Etebari *et al.* (2007) recorded significant change in parameters of silkworm as cocoon yield and filament length in comparison to other treatments when larvae fed on 0.1% nitrogen. This result is somewhat consistent with that of Kamel (2014), who discovered that larvae fed on balanced NPK fertilized mulberry plantation leaves increased the weight of fresh cocoons and cocoon shells. Additionally, the cocoon shell ratio, cocooning percentage, silk productivity, filament length, and filament weight and size may be because NPK fertilization contains higher amounts of essential nutrients than untreated. Patil *et al.* (2016) also showed that improving in productivity in yield of cocoon, filament length and filament weight. Meena *et al*. (2017) reported that, using nitrogen fertilizer on mulberry as foliar application was improved

cocoon yield. Pramila *et al.* (2019) observed better silk production when worms fed mulberry leaves with foliar application of nitrogen. Saleemali *et al*. (2023) stated that, enhancing in cocoon traits, silk yield and silk productivity when worms fed on treated mulberry with Nano fertilizers.

Table 4: Impact of treating mulberry leaves with nitrogen fertilizer on cocooning percentage, silk productivity and absolute silk yield of silkworm, *Bombyx mori* L.

Concentrations (mg/ml.)	Cocooning percentage (%)	Silk productivity (cg/day)	Absolute silk yield (g)
0.01	90.40±1.322	1.69±0.145	11.45±0.411
0.03	92.02±1.132	1.81±0.143	12.22±0.233
0.05	93.00±1.311	1.75±0.122	13.46±0.244
0.07	95.40±1.211	1.83±0.123	16.48±0.331
control	90.09±1.122	1.61±0.122	10.88±0.322
Significance	*	*	**
LSD at 0.05%	1.788	0.168	1.085

CONCLUSION

Using nitrogen fertilizer with mulberry leaves as nutritional supplement led to an improvement in larval weight, pupal weight, pupation ratio, mortality, duration, cocooning, cocoon weight, cocoon shell weight, cocoon shell ratio, silk yield. Therefore, this fertilizer seems like a good recommendation for rearing of mulberry silk worm (*Bombyx mori*).

Declarations

Ethics Approval and Consent to Participate: Since the experimental effort was limited to invertebrate pest species (*Bombyx mori*), ethics committee approval was not necessary for this study. The authors have all confirmed that this work is unique and hasn't been published anywhere else.

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