**Impact of treatments of Bio and inorganic fertilizer on economic traits of mulberry silkworm *Bombyx mori* L.**

##### El-Shewy, A. M1,. Gaaboub, I. A1., Omer, R.1, El-Khayat, E. F1. and Gahzey, U. M.2

**1Department of Plant Protection, Faculty of Agriculture Moshtohor, Benha University**

##### 2Plant Protection research Institute Agricultural Research Center, Dokki, Giza, Egypt

##### Abstract

Silkworm, *Bombyx mori* L., is a monophagous insect that drives almost all required nutrients for its growth and development from mulberry leaf. Nutration plays a pivotal role in sericulture. It improves the growth, development, health, feed consumption and conversion of silkworm thereby improving the commerical traits. Application of the required nutrient in the required amount to mulberry plant is, therefore, very essential for the successful silkworm growth and cocoon production. The present investigation was carried out at the Department of Plant Protection, Faculty of Agriculture Moshtohor, Benha University. Chemical, Bio fertilizers and its mixture caused increase in traits of fresh cocoon weight, cocoon shell weight, cocoon shell ratio, total larval duration, hatchability, silk gland weight, filament length, and filament weight and filament size. While, application by bio fertilizer resulted better values for cocoon shell ratio, cocooning percentage, larval weight, total larval duration, silk gland length and filament length. Both chemical and bio fertilizes exhibited better values for pupal weight. Also, bio fertilizer acquired best values for pupation ratio and cocooning percentage. Control and chemical were earned highest values for fecundity and fertility traits. Mixture and bio fertilizers acquired best values for silk gland length.

##### Introduction

Chemical constituents in plants provide information for determining the host range in phytophagous insects Chapman, (2003), Schoonhoven and van Loon (2002) . Among various factors, taste information is key for initiating food intake Chapman, (2003), Dether (1976). The domesticated silkworm, *Bombyx mori* L., is a monophagous insect that can be raised on fresh mulberry leaves (*Morus alba* L.). Several silkworm feeding stimulants have been isolated from mulberry leaves Hamamura et al., (1962), Mori (1982) among them, sucrose is a powerful feeding stimulant Ito (1960) and myo-inositol synergizes the effect of sucrose Ishikawaw and Hirao (1966). Genetic Analysis of the Electrophysiological Response to Salicin, a Bitter Subst ance, in a Polyphagous Strain of the Silkworm *B. mori,* Tetsuya et al. (2012).

Mulberry, *Morus alba* L., is a sole food plant for silkworm, *B. mori* L. Good quality leaf production in mulberry is high dependent on supply of various inputs especially nitrogen and phosphorus fertilizers **(Nasreen *et al*., (1999).** Theapplication of organic fertilizers to mulberry had a significant influence on cocoon yield, shell ratio, silk productivity and single cocoon filament length Sannappa *et al.,* (2005) and Raje Gowda (1996). **Singheal *et al*. (1999)** opined that quality of mulberry leaf fed to silkworms is the most important factor that influences successful cocoon production by mulberry silk worm, use of in organic fertilizers has increased mulberry yield leading to better silk worm productivity **(Bose and Majumder, (1999).** But it has been realized that, in the past, this was achieved at the expense of soil health, moreover, some portions of the nutrients applied to the soil are still bound to be unused as they are not available to the plant.

Bio fertilizers and mixture between chemical and bio fertilizers can be used to reduce amount of Nitrogen and Phosphors fertilizers. Rao *et al.,* (2007) registered that, the influence of VAM fungi and bacterial biofertilizer (BBF) with 50% reduction in the recommended dose of (N and P) chemical fertilizers on leaf quality traits of mulberry variety (S-13) and its impact on silkworm (PM x NB4D2) growth and cocoon characters were studied under semi-arid conditions. Bio-inoculants are carrier based preparations containing beneficial micro-organisms in a viable form intended for soil or seed application and designed to improve the soil fertility and help the plant growth by increasing their number and biological activity in the rhizosphere **(Rao, 1998).** Usage of a combination of organic and inorganic fertilizers, the carbohydrate and crude protein percentage of the mulberry leaves increased, which in turn, significantly increased the larval body weight, silk gland weight and ultimately the cocoon yield etc. **(Jadhav and Glaraddi, 2000).** Quality of mulberry leaves specially scatter along the canals road sides is inferior. When, rearing silkworm larvae on these leaves leads to decrease silk production. As well as, decrease the pollution resulted from using chemical fertilizers by decrease the amounts uses.

The present studies were aimed to determine the impact of applied the Bio fertilizers, inorganic fertilizers and the mixture between them, to increase quality of mulberry leaves and the effect on the larval body weight, silk gland weight and ultimately the cocoon yield.

**Material and Methods**

The native mulberry leaves, *Morus alba* var rosa was used to feed the mulberry silkworm larvae. Mulberry trees were fertilized through roots. Treatments of bio fertilizes, chemical fertilizers and the mixture between its.

Where Nitroben is contains of *Azotolacter* sp and *Azosprillum* sp . And, phosphoren contains *Bacillus* *Magatherium* . Two Bio fertilizers obtained from General organization for agric. Equalization Fund (G.O.A.E.F) - Public Authority for Agricultural Fund budget- Ministry of agriculture

Also, urea 46% obtained from Abu Qir fertilizers company, super phosphate 16% obtained from Abu Zaabal fertilizers company and **sulphate potash 48%** obtained from Margunas-Ukraina**.**

Treatments of bio fertilizes, chemical fertilizers and mixture were prepared as follows:

Control treatment without fertilization.

Bio fertilizer Nitroben was coded as Bio-N, while Biofertilizer phosphoren was coded as Bio-P.

Bio fertilizers treatments (Nitroben + phosphoren) divided into three treatments as follows:

T 1 = 700g Bio-N + 300g Bio-P

T 2 = 500g Bio-N + 150g Bio-P. (Recommended dose)

T 3 = 250g Bio-N + 75g Bio-P

Chemical fertilizers (urea 46% + super phosphate 16% + sulphate potassium 48%) with three treatments as follows:

T4 = 800g N + 600g P + 500g K

T5 = 400g N + 300g P + 250g K. (Recommended dose)

T 6 = 200g N + 150g P + 125g K.

Mixture between Bio and chemical fertilizers as follows.

T7 = 520g N + 390g P + 500g K + 700g Bio-N + 300g Bio-P

T8 = 260gN+ 195gP + 250gK + 500g Bio-N+ 150g Bio-P. (Recommended dose)

T9 = 130g N + 97.5g P + 125g K + 250g Bio-N + 75g Bio-P

The newly hatched silkworm larvae were divided to ten treatments including control. Each treatment represents three replicates each of which had one hundred larvae. Chopped leaves were offered four times daily of young silkworm (first, second and third instars). While whole leaves were offered for grown silkworm (fourth and fifth instars).

The investigate characters were fresh cocoon weight (FCW), cocoon shell weight (CSW), pupal weight (PW), cocoon shell ratio (CSR), pupation ratio (PR), cocooning percentage (CP), larval weight (LW), fecundity number of eggs per female (Fecu), fertility fertile eggs per female (fert), total larval duration (LD), hatchability (Hatch), silk gland weight (SGW), silk gland length (SGL), filament length (Fila L), filament weight (Fila W) and filament size (Fila S).

Hatchability percentage (%).

Hatchability percentage of eggs was (estimated according to the following formula of Lea (1996).

|  |  |  |
| --- | --- | --- |
| Hatchability (%) = | Number of hatched larvae | X 100 |
| Number of fertilized eggs |

4- Cocoons and reeled silk filament characters:

A: Fresh cocoon weight (g).

B: Cocoon shell weight (g).

C: Cocoon shell ratio = (B/A) x 100

**(Tanaka, 1964).**

Also the weight (mg) and length (m) of reeled silk filament were measured and recorded. The size of the reeled filament (denier) was estimated according to **(Tanaka, 1964)** formula:

|  |  |  |
| --- | --- | --- |
| The size of filament = | Weight of reeled filament (mg) | X 9000 |
| Length of reeled filament (m) |

The study was carried out during the two spring seasons of 2011 and 2012 in the laboratories of plant protection Department, Faculty of Agric., Moshtohor Benha University.

Mulberry silkworm *Bombyx mori* L., eggs was obtained from the Sericulture Research Department of Plant protection Research Institute, Agriculture Research center, Ministry of Agriculture and Land Reclamation in Giza, Egypt.

The Statistical analysis was carried out using ANOVA with two factors under significance level of 0.05 for the whole results using SPSS (ver. 19) and Data were treated as complete randomization design according to **Steel *et al.* (1997).** Multiple comparisons were carried out applying LSD.

**RESULTS AND DISCUSSION**

Effect of different fertilizers and its mixtures on some economic characters of mulberry silkworm is found in Table 1 and 2. There weren’t significant differences between control, chemical, bio fertilizers and its mixture for weights of fresh cocoon, cocoon shell, larvae and silk gland, pupation ratio and fertility. On the other hand the remaining characters showed significant difference.

Chemical, Bio fertilizers and its mixture caused increase in traits of fresh cocoon weight, cocoon shell weight, cocoon shell ratio, total larval duration, hatchability, silk gland weight, filament length, and filament weight and filament size. While, application by bio fertilizer resulted better values for cocoon shell ratio, cocooning percentage, larval weight, total larval duration, silk gland length and filament length. Both chemical and bio fertilizes exhibited better values for pupal weight. Also, bio fertilizer acquired best values for pupation ratio and cocooning percentage. Control and chemical were earned highest values for fecundity and fertility traits. Mixture and bio fertilizers acquired best values for silk gland length.

These results are in agreement with those found by Rao *et al.,* (2008), Mary and Saravanan (2010) and Waktole and Bhaskar (2012) who reported that nutrition plays a pivotal role in sericulture. It improves the growth, development, health, feed consumption and conversion of silkworm thereby improving the commercial traits. Silkworm, *Bombyx mori* L., is a monophagous insect that drives almost all required nutrients for its growth and development from mulberry leaf. Application of the required nutrient in the required amount to mulberry plant is, therefore, very essential for the successful silkworm growth and cocoon production. Objective is determining the effect of bio-inoculants application to mulberry plant on silkworm growth, development and cocoon traits. The result revealed that the larval growth variables and cocoon traits were significantly better when developing worms were fed on mulberry leaves raised by applying the recommended doses of nutrients.

Mulberry, *Morus alba* L., is a sole food plant for silkworm *B. mori* L. Good quailty leaf production in mulberry is highly dependent on supply of various inputs especially nitrogen and phosphorus fertilizers Nasreen et al., (1999) , Waktole and Bhaskar (2012). The quality of mulberry leaf fed to silkworms is the most important factor that influences successful cocoon production by milberry silkworm. Use of inorganic fertilizers has increased mulberry yield leading to better silkworm productivity Bose and Majumder (1999). But it has been realized that, in the past, this was achieved at the expense of soil health. Morever, some portions of the nutrients applied to the soil are still bound to be unused as they are not available to the plant. This increased the cost of mulberry leaf production. In addition, continuous supplementation of chemical fertilizers to mulberry is hazardous to environment Waktole and Bhaskar (2012)..

Also, Sannappa *et al.,* (2005) and Raje Gowda (1996) recorded that**,** application of organic fertilizers to mulberry had a significant influence on cocoon yield, shell ratio, silk productivity and single cocoon filament length.

Effect of different treatments of different fertilizers on some economic characters of mulberry silkworm was found in Table, 3 and 4. Treatment T1 was better values for all characters with insignificant differences with treatment T2 of cocoon shell ratio, pupation ratio, filament length, filament weight, and larval weight. Also, no significant differences with treatment T3 of total larval duration, hatchability, silk gland weight, silk gland length and filament size Sannappa *et al.,* (2005).

Between chemical fertilizers, treatment T6 acquired best values for cocoon shell ratio, pupation ratio, cocooning percentage, fertility, silk gland length, filament weight and filament size. And there were no significant differences between T6 and T5 for fresh cocoon weight, cocoon shell weight, larval weight and total larval duration. Also, there were insignificant differences for pupal weight, hatchability, filament length, and silk gland weight.

Treatment T7 showed better values for fresh cocoon weight, cocoon shell weight, cocoon shell ratio, silk gland weight, filament length, filament weight and filament size from mixture fertilizers treatments with insignificant differences with Treatment T8 for pupal weight and fecundity. Also, there was no significant between treatment T7 and T9 for hatchability and larval weight.

All fertilizers treatments were better results for Cocoon shell weight, filament length, weight & size, silk gland length & weight and hatchability. And, fresh cocoon weight, cocoon shell ratio and pupal weight showed better values for all treatment except treatment T9.

Generally, Bio fertilizers and mixture between chemical and bio fertilizers can be used to reduce amount of Nitrogen and Phosphors fertilizers. Similar results were founded by Rao *et al.,* (2007) who registered that, the influence of VAM fungi and bacterial biofertilizer (BBF) with 50% reduction in the recommended dose of (N and P) chemical fertilizers on leaf quality traits of mulberry variety (S-13) and its impact on silkworm (PM x NB4D2) growth and cocoon characters were studied under semi-arid conditions. Four different treatments were imposed i.e., T1: Control (only 100% NPK); T2: VAM (50% cut in P); T3: BBF (50% cut in N) and T4: BBF and VAM (50% cut in N and P). The results revealed that reduction (50%) in the dose of chemical fertilizers in T2, T3 and T4 did not affected the leaf quality traits or cocoon parameters, this may be due to the effect of microbial inoculants in these treatments, which had efficiently regulated the normal growth, metabolism and physiological activity in plants. Among the three-biofertilizer treatments, leaf quality, silkworm growth and cocoon parameters were found improved in T4 and was on par with T1 control. The dual inoculation (T4) proved economical and beneficial with regard to saving of 50% cost of chemical fertilizers and improvement in soil fertility, leaf quality and cocoon parameters, thus this technology can be recommended to sericulture farmers of semi-arid conditions.

**Summary**

Mulberry silkworm *Bombyx mori* L. is monophagous. So that, any deficiency of quality and quantity of mulberry leaves leads to reduce the quality and quantity of cocoon production.

Mulberry trees of *Morus alba* var rosa was applied with different treatments of chemical, bio fertilizers )Nitroben and phosphoren( and its mixture. Bio fertilizers Nitroben is contains of *Azotolacter* sp and *Azosprillum* sp . While, phosphoren contains *Bacillus* *Magatherium*. Sixteen economic characters were taken into consideration. Chemical, Bio fertilizers and its mixture caused increase in traits of fresh cocoon weight, cocoon shell weight, cocoon shell ratio, total larval duration, hatchability, silk gland weight, filament length, and filament weight and filament size. While, application by bio fertilizer resulted better values for cocoon shell ratio, cocooning percentage, larval weight, total larval duration, silk gland length and filament length. Both chemical and bio fertilizes exhibited better values for pupal weight. Generally, Bio fertilizers and mixture between chemical and bio fertilizers can be used to reduce amount of Nitrogen and Phosphors fertilizers

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