

Comparative Study between Organic and Mineral Fertilization of Mulberry Trees and Its Effect on Cocoon Parameters of Silkworm

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Abstract

The work was carried out at the Plant Protection Department, Faculty of Agriculture, AL-Azhar Univ, Nasr City, Cairo, Egypt. In order to carry out comparative study between organic and mineral fertilization for mulberry trees and its effect on cocoon parameters of silkworm. Silkworm is a monophagous insect that drives almost all required nutrients for its growth and development from mulberry leaves. Treated mulberry *Morus albar* (local variety) leaves were offered to Thio1 of silkworm larvae four times per day. The obtained results showed that the feeding of larvae on leaves mulberry of trees treated with green manure increased the fresh cocoon weight (0.796, 0.680g), cocoon shell weight (0.162, 0.126g), pupa weights (0.678, 0.568g), cocoon shell ratio (24.98, 23.10g), silk gland (0.361), cocooning percentages (89.6, 78%) and silk productivity (1.62, 1.29cg/days).

Key words: silkworm- mulberry leaves- fertilization- bombyx mori

Introduction

Mulberry is a perennial, woody and deciduous plant, belonging to the family Moraceae and genus *Morus* native of China (Ramesh *et al.* 2014). Among 150 *Morus* species, only 68 species were given more importance, based on their use in silkworm rearing, medicinal value and sweetness of fruit (Rao *et al.* 2013). Mulberry, the sole food plant of silkworm plays vital role in the growth and the development of silkworm and in turn the silk production, Leaf quality and quantity not only influence the silkworm growth and development, but also the cocoon production, quality and quantity of raw silk. Chemical constituents in plants provide information for determining the host range in phytophagous insects (Chapman 2003). Nutrition plays a vital role in sericulture; it improves the growth, development, health, food consumption and conversion of silkworm thereby improving the commercial traits. Application of the required nutrient in the required amount to mulberry plant is very essential for the successful silkworm growth and cocoon production. The present study is aimed to comparative study between organic and mineral fertilization for mulberry trees and its effect on cocoon parameters and its impact on cocoon parameters of silkworm.

Materials and Methods

The experiment was carried in the Department of Plant Protection, Faculty of Agriculture. AL-Azhar Univ, Nasr City, Cairo, Egypt.

Treatment details:

1- The organic manure is added at 8 m³/fedan for one batch before forming the leaves in the following spring season.

2- Mineral complex fertilizer NP20-K20 (17-19-10) the mineral fertilizer was added at one time 100g/tree and the trees were irrigated. In addition to untreated trees without any fertilizers.

Silkworm rearing technique:

Eggs of the silkworm Thio1 hybrid were imported from Thailand, rearing was carried out under hygienic conditions (26±2 °C and 70±5 RH.) according to Krishnaswami *et al.* (1973). During the spring season of 2017, eggs were incubated at 24°C and 80% RH. The larvae were covered with plastic sheets and surrounded by witted spongy strips to offer suitable conditions for young larval instars (1st- 3rd instars).

The new hatched larvae were fed on *Morus albar* mulberry leaves till pupation. After each moulting, cleaning nets with holes (3mm x 3mm) were used for removing the dried leaves and feces during young larval instars. At the end of the 5th larval stadium, the larvae stop feeding and start to spin cocoon. Collapsible frames were used as montages for cocoon spinning. After ten days of spinning, cocoons were collected.

Fresh cocoon weight: Fifty fresh cocoons were cut and pupae were sexed.

Cocoon Shell weight: The previous cocoons, after removing the pupae and cleaning them from exuviae, were weighed and the average weight was calculated.

Cocoon shell ratio %: was calculated for both sexes in each treatment according the formula adopting by (Krishnaswami *et al.* 1973).

Cocoon Shell weight (g)

Cocoon Shell ratio (%) = x 100

Fresh Cocoon weight (g)

Pupae Weight: Pupae of the previous cocoons of each treatment after being sexed, were removed from

cocoons and weighed separately, the average weight was calculated.

Silk productivity: was calculated using the following formula and expressed as cg/day (**Iyengaret al. 1983**).

Silk productivity per day (cg/day) =

$$\frac{\text{Cocoons shell weight (cg)}}{\text{Fifth instar duration (day)}} \times 100$$

Statistical analysis of data:

Economical parameters data were statistically analyzed using **DUNCAN, D. B. (1955)** implemented by the (**Costat, 1988**) software program.

Results and Discussion

The obtained results in table (1) show that fresh cocoon weight, cocoon shell weights and cocoon shell ratio differed from male to female, being heavier for male than female. Also, feeding on treated mulberry leaves with organic and mineral supplements resulted heavier cocoons in both sexes. The weights of fresh cocoons recorded 0.796, 0.680 and 0.714, 0.707gm for male and female as feeding on leaves fertilized by mineral and manure fertilizers; respectively. Whereas the means were 0.657 and 0.645g in untreated for male and female; respectively.

Results of cocoon shell weights and cocoon shell ratio had the same trend of the cocoon fresh weights. Supplementation with mineral fertilization led to increasing in cocoon shell of male and female. The obtained means were 0.162, 0.126g and 0.159, 0.124g with mineral and organic fertilization treatments, and 0.133, 0.120g in untreated for male and females; respectively, the cocoon shell ratio recorded 24.98, 23.10% for male and female with mineral fertilization treatments, and 22.82, 22.28%; respectively, compared to untreated; 18.08, 16.95%; respectively. Statistical analysis showed significant difference between treatments.

Application of organic fertilizers to mulberry had a significant influence on cocoon yield, shell ratio, silk productivity and single cocoon filament length (**Sannappaet al. 2005**). 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 is a monophagous insect that drives almost all required

nutrients for its growth and from mulberry leaf. Application of the required nutrient in a balanced amount to mulberry plant is, therefore, very essential for the successful silkworm growth and cocoon production **Mary and Saravanan (2010)** and **Waktole and Bhaskar (2012)**.

Chemical, bio-fertilizers and their mixture increased 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 in better values for cocoon shell ratio, cocoon percentage, larval weight, total larval duration, silk gland length and filament length. Both chemical and bio fertilizers exhibited better values for pupal weight. From the previous mentioned results fertilizers may be arranged from the side of its importance to mulberry trees and silkworms as follows: Bio-fertilizers, mixture of both (chemical and bio-fertilizers) and finally the chemical fertilizers (**El-Khayat et al., 2013**).

Pupa weights (g) and Silk productivity (cg/days).

Male pupal weights resulted from larvae fed on leaves obtained from trees treated mineral manure and organic manure fertilizers were 0.678 and 0.591g; respectively. While female pupal weights were 0.568 and 0.550g; respectively. However, pupal weights were 0.512 & 0.490g for male and female in untreated; respectively. Statistical analysis showed significant difference between treatments.

Silk productivity of *B.mori* larvae fed on mulberry leaves treated with mineral fertilization were 1.62 and 1.29 (cg/days) for male and female; respectively. While the mean percentages in leaves treated with organic manure were 1.36 and 1.25 (cg/days) for male and female; respectively, compared to untreated which were 1.13 and 1.10 (cg/days) for male and female; respectively. The differences were significant.

Observed that combined application of sericulture by-products along with fertilizers registered highest silk productivity, Maximum cocoon yield was obtained in T12 (53.96 kg) followed by T11 (51.76 kg). But, other treatments such as T1 (43.52 kg), T5 100 % recommended N through Castor oil cake (43.95 kg) and T7 (43.91 kg) were on par with each other with respect to cocoon yield (**Rajanna et al., 2000**).

Table1. Effect of silkworm larvae feeding on mulberry trees treated by organic and mineral fertilizers on some economical parameters of silkworm

Treatments	Economical parameters								Silk productivity (cg/days) (Silk prod)		Cocooning Percentage % (CP)	
	Fresh cocoon weights/g (F.C.W)		Cocoon shell weights/g (C. S .W)		Cocoon shell ratio% (C.S.R)		Pupae weight/g		Male	Female	Male	Female
	Male ♂	Female ♀	Male ♂	Female ♀	Male ♂	Female ♀	Male ♂	Female ♀	♂	♀	♂	♀
Organic manure	0.714ab	0.707a	0.159a	0.124a	22.82	22.28	0.591b	0.550a	1.36b	1.25a	80.5	71
Mineralfertilizer	0.796a	0.680a	0.162a	0.126a	24.98	23.10	0.678a	0.568a	1.62a	1.29a	89.6	78
Un-treated	0.657b	0.645a	0.133b	0.120a	18.08	16.95	0.512c	0.490a	1.13c	1.10b	68	68
L.S.D.	0.092	0.085	0.012	0.018			0.053	0.075	0.136	0.139		

Means followed by the same letter in the same column are not significantly differently.

Cocooning Percentages

Cocooning Percentages of silkworm larvae fed on mulberry leaves treated with mineral fertilization were 89.60 and 78% for male and female; respectively, while they were 80.5 and 71% for male and female; respectively, in case of organic fertilization. While the mean percentages in untreated leaves were 68.00% for male and female; respectively, statistical analysis showed un-significant difference between treatments.

The diagnostic experiment showed that N, K, and P were the most important nutrients with respect to mulberry-leaf yield, leaf sugar, and leaf essential and total amino acid concentrations. Although reducing the supply of Mg, S, and B did not significantly decrease leaf yields, it significantly impaired the concentrations of leaf sugars and essential and total amino acids. These reductions may affect cocoon quality by reducing silkworm larval and cocoon weight. Treatments with reduced N- and P-fertilizer application resulted in decreased leaf fat concentrations, while a reduced K supply slightly increased it. In contrast, when Mg, S, and B fertilization was reduced, this significantly increased leaf fat concentration, **Fang Chen (2009)**.

Chemical analysis

Table 2. Composition between treated and untreated leaves as regard the amounts of total protein, chlorophylls a and b in treated and untreated mulberry leaves and total protein in silkworm larvae.

Treatments	Total protein (mg/g) in silkworm larvae	Chlorophyll (mg/g) in mulberry leaves	
		Chlorophyll a	Chlorophyll b
Mineral manure	9.37	26.98	27.41
Organic fertilizer	8.37	23.04	20.96
Untreated	6.78	20.07	19.78

Chemical analysis was carried out to estimate Chlorophylls a and b by using the method of **Lichtenhaler and Wellburn (1983)**. Total proteins were estimated in leaves and larvae according to **Chapman Pratt (1962)**. The data in table (2) show that the total protein in larvae of Thio1 hybrid fed on Mineral manure and organic fertilizers 9.37, 8.37 compared to untreated 6.78 mg/g; respectively. The data in table (2) clarify that the Chlorophyll (a and b) were differed in both treated and untreated mulberry trees by organic manure. Chlorophyll a and b in treated mulberry leaves with mineral manure and organic manure was (26.98, 27.41 mg/g; and 23.04, 20.96 mg/g compared to untreated were 21.07 and 20.78 mg/g; respectively, it was higher than that of mulberry leaves treated with mineral manure (23.04, 20.96 mg/g, respectively, and affect consequently. the total protein in larvae of Thio1 hybrid fed on mineral manure and organic fertilizers and untreated 6.78 mg/g; respectively

Recommendation, results indicate that poor soil fertility and unbalanced fertilization were the main factors limiting mulberry leaf yield and quality in. The results obtained during this work indicate the superiority of larvae on mulberry leaves treated with organic or mineral fertilizer.

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دراسة مقارنة بين التسميد العضوي والمعدني لأشجار التوت وأثرها على صفات شرائق دودة الحرير .

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من خلال النتائج المتحصل عليها يتضح أن إضافة الأسمدة العضوية (السماد البلدى) والمعدنية (17-19) complex fertilizer NP2o-K2o (10) لأشجار التوت له تأثيره على محصول الأوراق من حيث الجودة والكمية حيث ان السماد يوفر للشجرة العناصر الغذائية الناقصة فى التربة أو الموجودة فى صورة غير ميسرة لامتصاص النبات والتي يحتاجها النبات وينعكس ذلك على يرقات دودة الحرير من حيث وزن اليرقات حيث يعطى يرقات كبيرة الحجم وذات قدرة جيدة وغدة حرير كبيرة الحجم ممثلثة بالسائل الجيلاتينى الذى يتكون منة خيط الحرير النهائى وبالتالي زيادة الحرير الناتج من اليرقات.

تم إنجاز هذا البحث بمزرعة التوت الخاصة بقسم وقاية النبات بكلية الزراعة بالقاهرة جامعة الأزهر - بمدينة نصر. تم جمع الأوراق المعاملة واستخدامها فى تغذية يرقات دودة الحرير التوتية من العمر اليرقى الاول الى العمر اليرقى الخامس وتم تغذية اليرقات بمعدل أربع وجبات يوميا وتم اختيار هجين Thio1 من يرقات دودة الحرير التوتية تم الحصول عليهم عن طريق الاستيراد من تايلاند. تم تغذية يرقات دودة الحرير على أوراق أشجار التوت من الصنف البلدى المزروع بالكلية التى أضيف اليها السماد العضوى (البلدى) والمعدنى.

أظهرت النتائج التى أسفرت عنها التجربة أثناء الدراسة أن أشجار التوت التى أضيف لها السماد المعدنى كان أفضل فى النتائج من السماد العضوى (البلدى) ولكن لا تغفل نقطة مهمة جدا عن السماد البلدى الذى يكون معقد تربة والذى يفيد خاصة فى الاراضى حديثة الاستصلاح مما على مسك مياة الرى لفترة أطول وهذه ميزة لا يمكن اغفالها عن السماد البلدى، وكانت الأفضلية من ناحية زيادة الصفات الاقتصادية والتكنولوجية ليرقات دودة الحرير .