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# NUTRIENT STATUS OF HOST PLANTS AND COCOON PARAMETERS OF ANTHERAEA MYLITTA D –A CORRELATION STUDY

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**ABSTRACT**

The growth and development of the silkworms and the parameters of cocoons produced by them are greatly influenced by the nutrient content of leaves. The nutrient content of leaves to which tasar silkworm larva consumes as food is one of the contributing factors for built up of cocoon and its silk content. An investigation was carried out to know the impact of consumption of leaves of primary tasar host plants of *T. tomentosa* having varied status of nutrient content by tasar silkworm, *Antheraea mylitta* on its cocoon parameters. Nutrient status of soil and its contents in leaf of primary tasar host plant of *Terminalia tomentosa* were estimated for N, P, K, Ca, Mg, S, B and Zn by the methods as described in the book of H L S Tandon. On the basis of chemical analysis of leaf samples collected from three important tasar growing areas of three different states namely Jharkhand, Odisha and Chhattisgarh, it was inferred that built of cocoon shell and its silk content of tasar depends on the suitable range of nutrient content in leaf consumed by the silkworm. Leaf nutrient parameters viz. N, P, K, Ca, Mg and Zn have significant positive correlation with leaf yield, cocoon yield, cocoon weight and shell weight and hence the higher content of these nutrient elements has a greater role in formation of compact cocoon shell of tasar.

***Keywords***: nutrient content, silk content, host plant, cocoon and *Terminalia tomentosa*

## Introduction

In tropical belt of India, various sericigenous flora are abundantly found in forest areas. Sericigenous insect, *Antheraea mtlitta* D feeds on leaves of particular plants called tasar host plants. Tropical Tasar silkworm host plants thrive well in warm and humid climatic conditions, where the average maximum temperature varies from 35 to 47$^0$C and the minimum from 0 to 15$^0$C with rainfall ranging from 750 to 2000 mm. Tasar silkworm *Antheraea mylitta* D. is polyphagous in nature. It feeds on a number of host plants. The host plants, which silkworm normally prefers are known as primary host plants. *Terminalia arjuna* (Arjun), *T. tomentosa* (Asan) *and Shorea robusta* (Sal) come under the category of primary tasar host plants. However, it has been found that *Terminalia arjuna* (Arjun) and *Terminalia tomentosa* (Asan) are best among all the other food plants for commercial rearing which have since been adopted for large scale exploitation for tasar rearing in India. Nutrient content in tasar host plant foliage is one of the important factors for sustainability of tasar silkworm, *Antheraea mylitta* D. Tropical Tasar is produced mainly in states of Jharkhand, Chhattisgarh, Odisha, West Bengal, Bihar, Andhra Pradesh, Telengana, Maharashtra, Madhya Pradesh and Uttar Pradesh. Out of many ecological and biological factors which influence the crop production, the quality of tasar food plants used for rearing is one of the most contributing factors. Growth and development of the silkworms depend on the quality of leaves of the host plants. Better the quality of leaves, greater is the possibility of obtaining good cocoon crops (Sinha *et al*., 1986).

The leaf nutrient status influences on various metabolic activities of silkworm resulting in variation in cocoon traits. Several studies have been carried out on foliar constituents of tasar food plants (Sinha *et al*., 1971; Agarwal *et al.*, 1980; Sinha *et al*., 1989; Sinha

*et al*., 1992 and Sinha *et al*., 2005). In mulberry; mineral nutrition deficiency and requirement were studied by several workers (Krishnaswami *et al*., 1971; Singhal *et al*., 1999; Singhvi *et al*., 2002 and Singhal *et al*., 2004).The criteria of choosing a sampling time for diagnostic leaf analysis is that during that phase of plant development, variation of nutrient content in a particular part of the plant should be minimum (Poovarodom *et al*., 2002). It has also been reported (Demirsoy *et al*., 2010) that the nutrient contents in leaf, crown and root changed according to different treatments and plant growth periods in case of Sweet Charlie, strawberry. However, correlation study of nutrient content in leaf of primary tasar host plants and cocoon parameters have least been undertaken. Hence, a study was undertaken to know the correlation between nutrient content in leaf of primary tasar host plants and cocoon parameters of *Antheraea mylitta* D.

## Material and Methods

**Soil sampling and analysis:** The composite soil samples were collected from forest plantation of *T. tomentosa* of tasar producing areas viz. Talaburu in West Singhbhum district of Jharkhand, Chadheipahari in Mayurbhanj district of Odisha and Rampur in Korba district of Chhattisgarh from each 0-60 cm depth of the land as described in the book of H.L.S. Tandon (2001). All samples were air dried ground and passed through 2 mm sieve before analysis. Important soil characteristics viz. pH, Soil moisture % and Organic carbon % were determined as follows:

| Soil characteristics | Method |
|---|---|
| pH | 1: 2.5 soil water suspension (Jackson, 1973) |
| Organic Carbon % | Walkley and Black (1934) |
| EC (dS/m) | 1: 2.5 soil water suspension (Jackson, 1973) |

Following methodologies were followed as described in the book of "Soil Analysis Working Manual" Second edition (2006) Published by All India Soil and Land Use Survey for estimation of plant nutrients in the soil of tasar host plants.

| Parameter | Method |
|---|---|
| Available N | Alkaline $KMnO_4$ method (Subhiah & Asija, 1956) |
| Available P | Bray and Kruz (1945) |
| Available K | Ammonium acetate extracts (using flame photometer). |
| Available Fe, Cu, Zn & Mn | DTPA extractable, Lindsay and Norvell (1978) (Using Atomic Absorption Spectrometer) |

**Leaf sampling and analysis**

The composite leaf samples of primary host plants of forest plantations were also collected during the month of July from tasar growing areas of Talaburu (Jharkhand), Chadheipahari (Odisha) and Rampur (Chhattisgarh). As such, a total of 360 leaf samples of primary tasar host plants were analyzed. The samples were thoroughly washed with tap water followed by 0.1N HCl solution and double distilled water. The washed samples were air dried and then kept in hot air oven at 70ºĊ.The dried leaves were ground to powder and stored in plastic bottles for chemical analysis. Total nitrogen in leaf samples was determined by the Kjeldahl method using Kelplus system. For estimation of nutrients other than nitrogen, 1.00 g each leaf sample was digested in 10 ml 9:4 mixture of $HNO_3$: $HClO_4$ at 200º C until the liquid became colourless (Bhargava and Raghupathi; 1993). Phosphorous, Potassium, Calcium, Magnesium, Sulphur, Boron and Zinc were estimated by the methods as described in the book of H.L.S Tandon (2001).

**Correlation Analysis: Leaf parameters Vs. Soil parameters and Bio-assay**

Correlation analysis of data between leaf nutrient content of *T. tomentosa* versus soil parameters and nutrient content in leaf of *T. tomentosa* versus data on bio-assay was carried out to study the relation amongst different parameters of three different places of tasar growing areas of Talaburu in West Singhbhum district of Jharkhand, Chadheipahari in Mayurbhanj district of Odisha and Rampur in Korba district of Chhattisgarh by using Microsoft Excel statistical tools.

## Results

Nutrient status of soil and leaf for *T. tomentosa* plants of experimental plots at farmers' fields in three different tasar growing areas viz. Talaburu (Jharkhand), Chadheipahari (Odisha) and Rampur (Chhattisgarh) were evaluated. The data on soil characteristics and nutrient status are in Table-1.Nutrient contents in leaf of *T. tomentosa* growing in same plots were determined for N, P, K, Ca, Mg, S, Zn & B. The data on the same are in Table-2.

Correlation analysis on pooled data of three different places was carried out to study the combined effect on the relationship of different parameters; the figures of correlation factor and its significance value on different parameter are shown in Table: 3.

**Table 1 :** Soil characteristics and nutrient status of experimental plots in different areas.

| Parameter | Talaburu (Jharkhand) | | Chadheipahari (Odisha) | | Rampur (Chhattisgarh) | |
|---|---|---|---|---|---|---|
| Depth of soil sample collected from → | 0-1 | 1-2 | 0-1 | 1-2 | 0-1 | 1-2 |
| pH | 6.18 ±0.14 | 6.09 ±0.12 | 6.27 ±0.21 | 6.21 ±0.29 | 5.64 ±0.17 | 5.62 ±0.15 |
| O.C.% | 0.58 ±0.18 | 0.51 ±0.15 | 0.43 ±0.07 | 0.37 ±0.06 | 0.54 ±0.10 | 0.44 ±0.07 |
| Av. Nitrogen (kg/ha) | 182.40±17.53 | 136.80±30.59 | 202.12±22.24 | 146.71±38.22 | 247.67±34.92 | 229.23±41.32 |
| Av. Phosphorous (kg/ha) | 10.61 ±3.31 | 8.85 ±2.55 | 7.45 ±2.36 | 5.89 ±2.13 | 6.10 ±1.88 | 4.91 ±1.85 |
| Av. Potassium (kg/ha) | 190.20±54.07 | 152.73±50.62 | 125.44±67.24 | 109.56±69.33 | 139.49±87.87 | 112.51±57.99 |
| Av. Sulphur (mg/kg) | 13.47 ±6.18 | 10.58 ±4.52 | 25.32 ±9.84 | 15.90 ±5.60 | 14.27 ±4.38 | 10.67 ±3.01 |
| Av. Zinc (mg/kg) | 1.52 ±0.43 | 1.07 ±0.36 | 1.52 ±1.05 | 1.20 ±0.22 | 1.11 ±0.25 | 0.99 ±0.15 |
| Av. Boron (mg/kg) | 0.56 ±0.16 | 0.14 ±0.07 | 0.28 ±0.13 | 0.10 ±0.05 | 0.54 ±0.32 | 0.11 ±0.06 |

**Table-2**: Nutrient contents in leaf of *T. tomentosa* of experimental plots in different areas.

| Parameter | Talaburu (Jharkhand) | Chadheipahari (Odisha) | Rampur (Chhattisgarh) |
|---|---|---|---|
| Nitrogen (N)% | 1.27±0.09 | 1.19±0.13 | 1.35±0.14 |
| Phosphorous (P)% | 0.12±0.03 | 0.09±0.03 | 0.12±0.02 |
| Potassium (K) % | 0.88±0.07 | 0.92±0.27 | 1.21±0.20 |
| Calcium (Ca) % | 3.09±0.48 | 3.07±0.38 | 2.72±0.66 |
| Magnesium (Mg) % | 0.63±0.04 | 0.60±0.09 | 0.59±0.11 |
| Sulphur (S) % | 0.30±0.10 | 0.24±0.09 | 0.34±0.17 |
| Zinc (Zn) in ppm | 35.52±7.02 | 30.90±3.14 | 42.58±5.55 |
| Boron (B) in ppm | 47.60±14.19 | 39.77±12.74 | 41.03±17.26 |

**Table 3:** Correlation analysis between Leaf parameters vs. Soil parameters and Bio-assay (pooled over places)

| | Nutrient content in Leaf of *T. tomentosa* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **N** | **P** | **K** | **Ca** | **Mg** | **S** | **Zn** | **B** |
| **Soil Parameters** | | | | | | | | |
| pH | 0.831** | 0.598** | 0.801** | 0.507* | 0.678** | 0.506* | 0.548* | 0.300 |
| Moist% | 0.846** | 0.675** | 0.771** | 0.394 | 0.560* | 0.381 | 0.582** | 0.206 |
| OC% | 0.819** | 0.598** | 0.749** | 0.581** | 0.625** | 0.390 | 0.583** | 0.261 |
| N | 0.781** | 0.610** | 0.741** | 0.583** | 0.468* | 0.331 | 0.586** | -0.069 |
| P | 0.827** | 0.676** | 0.741** | 0.716** | 0.508* | 0.452* | 0.644** | 0.076 |
| K | 0.817** | 0.489* | 0.702** | 0.596** | 0.339 | 0.391 | 0.664** | 0.288 |
| S | 0.436 | 0.144 | 0.443 | 0.331 | 0.143 | -0.115 | 0.184 | 0.151 |
| B | 0.200 | -0.018 | 0.049 | 0.127 | 0.030 | 0.275 | 0.276 | 0.670** |
| Zn | 0.468* | 0.447* | 0.481* | 0.148 | 0.454* | 0.191 | 0.410 | 0.049 |
| **Bio-assay** | | | | | | | | |
| Leaf Yield (kg/plant) | 0.782** | 0.443 | 0.710** | 0.368 | 0.482* | 0.312 | 0.551* | 0.141 |
| Yield (cocoon/dfl) | 0.845** | 0.547* | 0.758** | 0.402 | 0.607** | 0.305 | 0.596** | 0.168 |
| SCW(g) | 0.593** | 0.632** | 0.592** | 0.442 | 0.567** | 0.566** | 0.520* | 0.175 |
| SSW(g) | 0.823** | 0.532 | 0.727** | 0.448* | 0.462* | 0.263 | 0.404 | -0.063 |
| SR% | 0.469* | 0.095 | 0.366 | 0.173 | 0.085 | -0.152 | 0.058 | -0.186 |

*- significance at $p<0.05$, and ** - significance at $p<0.01$

## Discussion

Leaf nutrient parameters viz. N, P, K, Ca, Mg and Zn have significant positive correlation with leaf yield, cocoon yield, cocoon weight and shell weight. The nutrient in leaf comes from the soil and hence these significant figures depend on the value of available nutrients in the soil of the tasar host plant.

The figures of correlation factor and its significance value on different parameter altogether for thee different places have been shown below in Table:-3. Correlation analysis on pooled data of three different places reveals the combined effect on the relationship of different parameters. The result of correlation study of pooled data of three places indicated that

- Soil pH is positively correlated with nitrogen, phosphorous, potassium, magnesium and zinc content in leaf with significance value at $p < 0.01$ and is positively correlated with calcium, sulphur and zinc with significance value at $p < 0.05$.
- Similarly, soil moisture is positively correlated with nitrogen, phosphorous, potassium, and zinc content in leaf with significance at $p < 0.01$ and is positively correlated with magnesium with significance value at $p < 0.05$.
- Soil organic carbon is positively correlated with nitrogen, phosphorous, potassium, calcium magnesium and zinc content in leaf with significance value at $p < 0.01$.
- Available nitrogen in the soil is positively correlated with nutrients content of nitrogen, phosphorous, potassium, calcium and zinc in leaf with significance value at $p < 0.01$ and is positively correlated with magnesium with significance value at $p < 0.05$.
- Available phosphorous in the soil is positively correlated with nutrients content of nitrogen, phosphorous, potassium, calcium and zinc in leaf with significance value at $p < 0.01$ and is positively correlated with magnesium and sulphur with significance value at $p < 0.05$.
- Available potassium in the soil is positively correlated with nutrients content of nitrogen, potassium, calcium and zinc in leaf with significance value at $p < 0.01$ and is positively correlated with phosphorous with significance value at $p < 0.05$.
- Available boron in the soil is positively correlated with nutrient content of boron in leaf with significance value at $p < 0.01$.
- Available zinc in the soil is positively correlated with nutrients content of nitrogen, phosphorous, potassium, calcium and magnesium in leaf with significance value at $p < 0.05$.
- Nitrogen content in leaf is positively correlated with leaf yield, cocoon yield, cocoon weight and shell weight with significance value at $p < 0.01$and is positively correlated with silk ratio percentage with significance value at $p < 0.05$.
- Potassium content in leaf is positively correlated with leaf yield, cocoon yield, cocoon weight and shell weight with significance value at $p < 0.01$.
- Calcium content in leaf is positively correlated with shell weight with significance value at $p < 0.05$.
- Magnesium content in leaf is positively correlated with leaf yield and shell weight with significance value at $p < 0.05$ and is positively correlated with cocoon yield, cocoon weight with significance value at $p < 0.01$.
- Sulphur content in leaf is positively correlated with cocoon weight with significance value at $p < 0.01$.
- Zinc content in leaf is positively correlated with cocoon yield with significance value at $p < 0.01$ and is positively correlated with leaf yield, shell weight with significance value at $p < 0.05$.

Leaf nutrient parameters viz. N, P, K, Ca, Mg and Zn have significant positive correlation with leaf yield, cocoon yield, cocoon weight and shell weight. The significant increase in cocoon quality and improvement in production of tasar silk can be achieved by enhancing the available N, P, K, Ca, Mg and Zn in the soil by adopting in-situ rain water conservation and nutrient management. This is more important in tropical and subtropical regions where soils are inherently low in organic carbon content and production is fragile (Mandal *et al.*, 2005). Sustaining or increasing soil organic matter is of great importance in terms of cycling plant nutrients, minimizing the need of inorganic fertilizer and improving soil physical, chemical and biological properties (Kumari *et al.*, 2011).

## Conclusion

Leaf nutrient parameters viz. N, P, K, Ca, Mg and Zn have significant positive correlation with leaf yield, cocoon yield, cocoon weight and shell weight. The significant increases in these parameters can be achieved by adopting suitable nutrient management thereby enhancing the availability of N, P & K, Ca, Mg and Zn in the soil. Hence, development of *in-situ* soil health and nutrient management in tasar growing areas is the need of hour for improvement in production and quality of tasar cocoons.

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## References


Agarwal, S.C., Jolly, M.S. and Sinha, A.K. (1980) Foliar constituents of secondary food plants of tasar silkworm *Antheraea mylitta D. Indian Forester.* **106 (12),** 847-851.

Bhargava, B.S. and Raghupathi, H.B. (1993). Analysis of Plant Materials For Macro and Micronutrients; Methods of Analysis of Soils, Plants, Waters and Fertilisers (Edited by HLS Tandon, 1993)

Bray, R.H. and Kurtz, L.T. (1945). Determination of total, organic and available forms of phosphorus in soils. *Soil Sci.* **59,** 39-45.

Demirsoy, L., Demirsoy, H., Ersoy, B., Balci, G. and Kizilkaya, R. (2010). Seasonal variation of N,P,K and Ca content of leaf, crown and root of 'Sweet Charlie' strawberry under different irradiation. Zemdirbyste- Agriculture, **97(1)**, 23-32.

Kumari, G., Mishra, B., Kumar, R., Agarwal B.K. and Singh B.P. (2011). Long-term effect of manure. Fertilizer and lime application on active and passive pools of soil organic carbon under maize-wheat cropping system in alfisol. *Journal of the Indian Society of Soil Science*, **59(3),** 245-250.

Mandal, B., Ghoshal, S.K., Ghosh, S., Saha, S., Majumdar, D., Talukar, M.C., Ghosh, T.J., Balaguravaiah, D., Babu, M.V.S., Singh, A.P., Raha, P., Das, D.P., Sharma, K.L., Manual, U.K., Kusuma, G.J., Chaudhury, J., Ghosh, H., Samantaray, R.N., Mishra, A.K., Rout, K.K., Behera, B.B. and Rout, B. (2005). Assessing soil quality for a few long term experiments-In Indian Initiative pp 278-281.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India, Pvt. Ltd., New Delhi.

Krishnaswami, S., Kumarraj, S., Vijayaraghawan, K. and Kasiviswanathan, K. (1971). Silkworm feeding trials for evaluating the quality of mulberry leaves as influenced by variety, spacing and nitrogen fertilization. *Indian J. Seric*, **10(1),** 79-89.

Lindsay, W.L. and Norvell, W.A. (1978). Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal,* **42,** 421-428.

Poovarodom, S., Kanyawongha, P., Lertrat, P. and Boonplang, N. (2002). Leaf age and position on mineral composition of mangosteen leaves.Symposium:17th World Congress of Soil Science, 14-21Aug., Thailand, 2272**(16)**, 1-8.

Sang, J.H. (1956). The quantitative nutritional requirement of *Drosophila melanogaster. J. Exp. Biol.* **33,** 45-72.

Singhal, B.K., Mala, V.R., Sarkar, A. and Datta, R.K. (1999) Nutritional disorders of mulberry (*Morus* spp.) III. Leaf nutrient guide for secondary nutrients. *Sericologia*, **39**, 599-609.

Singhal, B.K., Chakraborti, S., Rajan, M.V. and Thippeswamy, T. (2004). Nutritional disorders, analytical diagnosis and nutrient guide for mulberry, *Morus indica L.,* a review, *Int. J. Indust. Entomol,* **8(1**), 1-15.

Singhvi, N.R., Kodandramaiah, J.R., Munirathanam, M., Katiyar, R.S. and Dutta, R.K. (2002). Study on nutrient deficiency in mulberry variety S36 under field conditions. *Sericologia*, **42(1**), 53-58.

Sinha, A.K. and Jolly, M.S. (1971). Foliar constituents of the tasar food plants of tasar silkworm A. *mylitta. Indian Forester*, **97(5),** 261-263.

Sinha, A.K., Chaudhary, S.K., Brahmachari B.N. and Sengupta, K. (1986). Foliar constituents of the food plants of temperate tasar silkworm *Antheraea proylei. Indian J. Seric*, **251(1),** 42-43.

Sinha, A.K., Sinha, U.S.P. and Sengupta, K. (1989). Studies on the larval cuticles of muga silkworm *Antheraea assama* Westwood. *Indian J. Seric*., **28(1)**, 58-61.

Sinha, U.S.P., Sinha, A.K., Srivastava, P.P. and Brahmachari, B.N. (1992). Studies on the variation of chemical constituents in relation to maturity of leaves in three primary food plants of tropical tasar silkworm *Antheraea mylitta* D. *Indian J. Seric*., **31(1**), 83-86.

Sinha, U.S.P., Sinha, A.K., Chaudhary, S.K., Prasad, J. and Suryanarayana, N. (2005). Comparative study on the nutritive value of the food plants of the tasar silk worm *Antheraea mylitta* Drury Proceedings of the 20th Congress of the International Sericultural Commission, 15th-18th Dec. at Bangalore, **2**, 281-284.

Soil Analysis Working Manual, Second edition (2006). Published by All India Soil and Land Use Survey

Subhiah, B.V. and Asija, G.S. (1956). A rapid procedure for the estimation of available nitrogen in soils Current Science, **25,** 259-260.

Tandon, H.L.S. (2001). Methods of Analysis of Soils, Plants, Waters and Fertilisers (Ed. 2001)

Walkley, A. and Black, T.A. (1934). An experimentation of the vegetative method for determining organic matter and proposed modification of the chromic acid titration method. *Soil Science*, **37,** 38-39.