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EFFECT OF ORGANIC MANURES ON QUANTITATIVE AND QUALITATIVE PARAMETERS OF MULBERRY PRODUCTION

P. Sujathamma[1]*, G. Savithri[1], N. Vijaya Kumari[1], V. Asha Krishna[1], T.Vijaya[1], K.V. S. S. Sairam[2] and N. Sreerama Reddy[3]

[1]*Department of Sericulture, S.P. Mahila Visvavidyalayam (Women's University) Tirupati-517502, A.P., India*

[2]*Prathista Industries Limited, Hyderabad, India*

[3]*Faculty of Agriculture, ANGR Agricultural University, Hyderabad, India*

**E-mail:sujathatpt@yahoo.co.in*

ABSTRACT : Mulberry is the sole food source of silkworm *Bombyx mori* L. In sericulture the quality of mulberry leaf plays a major role as it influences the quality of silk cocoons. In mulberry, organic carbon and soil moisture have a tremendous influence on leaf yield and quality. In light of the above as well as growing need for maintaining soil fertility and health for sustainable sericulture, the present study was undertaken. In this study six treatments comprising of organic nitrogen, organic phosphorus and organic potassium were applied and the effect of all these inputs on the yield and quality parameters of mulberry were studied in comparison with chemical fertilizers. Studies revealed that T_6 and T_4 have shown positive results compared to control. Application of *Aishwarya* as basal dose followed by the foliar application of the organic nutrients resulted in positive increase in the yield and quality parameters. Significant increase in average length of shoot, weight of 100 fresh leaves and leaf yield were noticed in all the treatments with organic manures over control involving only chemical fertilizers. In respect of the biochemical composition of mulberry leaf, organic manure treatments showed significantly higher values in respect of moisture content, moisture retaining capacity after 12 hours, total chlorophyll content, protein percentage and carbohydrate percentage over the application of chemical fertilizer.

Keywords : *Mulberry, organic fertilizers, quality, yield.*

Sericulture is an agro-based industry and India enjoys a unique status by growing all the four varieties of natural silks, namely, Mulberry, Tasar, Eri and Muga of which mulberry silk accounts for 90% of India's total production. Since the mulberry silkworm *Bombyx mori* L. is monophagous, feeding only on mulberry, this plant has been patronized by sericulturists from time immemorial. Mulberry belongs to the genus *Morus* of the family Moraceae and is believed to be a native of either India or China and probably originates from the slopes of the Himalayas. It is a fast growing deciduous perennial plant, and is widely distributed in tropical, sub-tropical and temperate regions of both the hemispheres. Mulberry as a plant has multiple uses. Besides being the sole food source for the silkworm *Bombyx mori*, mulberry has been in use as fodder for the cattle; leaves can be used in poultry ration; fruits of the mulberry are eaten raw or made into juices, jam and wine; mulberry wood is used for furniture, sports goods; pruned branches of this plant serve as a major fuel resource in most of the sericulture areas. Quite significantly, mulberry is honored by being called as *"Kalpavriksha"* because of its multipurpose uses.

India being a tropical country and following the decline of many traditional management practices, soil fertility has been reduced due to oxidation loss of organic matter in the soil. In spite of growing awareness among the farming communities about the potential threat of continuous application of heavy doses of inorganic fertilizers, the beneficial effects of various organics such as green manures, bio-fertilizers, vermicompost and application of certified organic fertilizers need to be highlighted adequately for increasing the yields in mulberry and consequent silk quality. In mulberry, organic carbon and soil moisture have a tremendous influence on leaf yield and quality. The optimum level (> 0.75%) of organic carbon and soil moisture (~70%) is maintained in the soil to keep higher leaf productivity in mulberry. In addition to macro-nutrients (NPK), mulberry plants also require various micro-nutrients. All this can be achieved only by the application of organic fertilizers.

The quantity of manure and chemical fertilizers recommended for mulberry cultivation is quite high compared to that of other agricultural crops. Excessive use of chemicals and improper selection of fertilizers in mulberry cultivation cause great concern on the survivability of soil fauna and flora besides soil health. Ultimately, the soil pH in most of the mulberry gardens is getting alkaline. Increase in soil pH has also resulted

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Table 1 : Details of the treatments

T_0	**Control**	Chemical fertilizer NPK @ 350:140:140 kg/ha + FYM 40 MT/ha as recommended for the V-1 mulberry variety, applied in 5 split doses.
T_1	**1st Application**	Aishwarya granules @ 75 Kg/ha (2 or 3 days after every pruning)
	2nd Application	Biophos granules @ 37.5 Kg/ha + Biopotash granules @ 37.5 Kg/ha (15-20 days after every pruning)
	3rd Application	Biophos granules @ 37.5 Kg/ha + Biopotash granules @ 37.5 Kg/ha (30-35 days after every pruning)
T_2	**1st Application**	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (15 -20 days after pruning)
	2nd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (30-35 days after pruning)
T_3	**1st Application**	Aishwarya granules @ 37.5Kg/ha (2 or 3 days after pruning)
	2nd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (15 -20 days after every pruning)
	3rd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (30-35 days after every pruning)
T_4	**1st Application**	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (15 -20 days after every pruning)
	2nd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha + Megacol@ 312.5 ml/ha (30-35 days after every pruning)
T_5	**1st Application**	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (15 -20 days after every pruning)
	2nd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha + Biopotash @ 312.5 ml/ha (30-35 days after every pruning)
T_6	**1st Application**	50% of RDF: NPK @175:70:70 kg/ha + Aishwarya granules @ 37.5 Kg/ha + Biophos granules @ 37.5 Kg/ha + Biopotash granules @ 37.5 Kg/ha (2 or 3 days after pruning)
	2nd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (15 -20 days after every pruning)
	3rd Application	Organic NPK @ 312.5 ml/ha + New Suryamin @ 312.5 ml/ha (30-35 days after every pruning)

Note **:** FYM : 40 tonnes/ha common for all treatments
Granules : Solely or mixing with sand or soil
Liquid fertilizer concentration : 0.25% (2.5 ml/ltr)

in widespread deficiencies of both macro and micro nutrients (Krishna and Bongale, 8). Babu *et al.* (2) have emphasized about ample scope of organic farming in mulberry cultivation to make sericulture more sustainable and remunerative. The traditional farming in India was based on harmony with the nature. Such an agricultural production management system promotes and enhances bio-diversity, biological cycles and biological activity of the soil. But in mulberry cultivation, the idea of maintaining and enhancing ecological harmony has not been much emphasized. Further, due to escalating cost of chemical fertilizers and their poor use in mulberry cultivation by farmers, a sustained yield of cocoons has not been possible. Thus, it is imperative to study the effects of organic inputs *vis-a-vis* chemical fertilizers.

In light of the above and as well as growing need for maintaining soil fertility and health for sustainable sericulture, the present investigation was undertaken to study the effects of organic manures on quantitative and qualitative characters of mulberry leaf in comparison with chemical fertilizers.

MATERIALS AND METHODS

The experimental fields of sericulture farmers of V.Kota and Kuppam of Chittoor district of Andhra Pradesh were established with the improved mulberry variety V-1 with a cultivating spacing of (90 cm + 150 cm) x 60 cm. Organic manures as per the treatments (Table 1) were supplied by Prathista Industries, Hyderabad .

A total of one acre field was maintained for the study with four replications. Chemical fertilizers and organic manures were applied as per recommendations. A total number of five crops were harvested in a year at intervals of 70 days. Data on quantitative parameters viz., length (cm) and number of primary branches, weight of 100 fresh leaves (g) and leaf yield/plant and qualitative parameters viz., moisture content of leaves (%), moisture retaining ability (%), chlorophyll content (mg/g), protein content (%) and total carbohydrate content (%) were recorded.

All the leaves of the plant were harvested between 60-70th day and the total leaf weight is expressed as leaf yield/plant. The leaves harvested in the plot were weighed and expressed as leaf yield/plot in Kg.

Leaf quality of all the varieties was tested by biochemical analysis and bioassay by following the standard procedures.

a. Moisture content of leaves (%)

The moisture content of the leaves was determined on dry weight basis. 100 fresh leaves were harvested and put in a polyethylene cover and then sealed. Fresh weight of the same was taken using an electronic balance. Leaves were then dried in hot air oven at 60°C for 48-72 hours till constant weight was

obtained. Moisture percentage was then calculated as

$$\frac{\text{Weight of fresh leaves} - \text{Weight of dry leaves}}{\text{Weight of fresh leaves}} \times 100$$

b. Moisture retaining ability (%)

100 leaves were collected randomly from all the branches and fresh leaf weight was recorded immediately. The leaves were preserved under ambient conditions and weight was taken at intervals of 3 hours till 12 hours from the time of harvest. These leaves were then dried in an oven at 60°C for 48-72 hours till complete drying was ensured and moisture percentage was calculated as

Moisture retaining capacity (after 12 hours)

$$= \frac{\text{Weight after 12 hours} - \text{Dry weight}}{\text{Weight after 12 hours}}$$

c. Chlorophyll content (mg/g)

Total chlorophyll from treated plant leaves was extracted using 80% acetone and observations were recorded by measuring the absorption at 663nm and 645 nm in a UV spectrophotometer. Using the absorption coefficients, the amount of chlorophyll was calculated using the following equation.

$$\text{Total Chlorophyll mg/g tissue} = 20.2\,(D.645) + 8.02\,(D.663) \times \frac{V}{100 \times W}$$

Where the 'D' represents the optical density at specific wave length; 'V' represents the final volume of the 80% acetone chlorophyll extract and 'W' represents the weight of the leaf tissue taken (grams)

d. Protein content (%)

Protein content was estimated by following the Lowry's method.

$$\text{Percentage of Protein} = \frac{\text{Factor} \times \text{Sample O.D.} \times \text{Volume of extract}}{\text{Vol.of aliquot} \times \text{Wt. of leaf tissue (mg)} \times 1000} \times 100$$

$$\text{Factor} = \frac{\text{Concentration of standard}}{\text{Reading of standard (i.e., OD)}} \times 100$$

e. Total Carbohydrate content (%)

Carbohydrate was estimated by following Anthrone method.

Percentage of Carbohydrate

$$= \frac{\text{Factor} \times \text{Sample O.D.} \times \text{Volume of extract}}{\text{Vol. of aliquot} \times \text{Wt. of leaf tissue (mg)} \times 1000} \times 100$$

$$\text{Factor} = \frac{\text{Concentration of standard}}{\text{Reading of standard (i.e., OD)}} \times 100$$

The data on all the morphological and biological parameters was statistically analyzed.

RESULTS AND DISCUSSION

The results obtained (Table 1 and 2) are the average values of all the observations for a period of one year.

Growth and Yield Parameters

Mean values for six treatments in respect of number of shoots per plant, height of the branch, the weight of 100 fresh leaves and leaf yield (Table 1; Fig. 1) revealed that number of primary branches among different treatments ranged from 7.50 to 10.00. T_6 had the maximum number of branches (10.00) followed by T_4 (9.00) and the minimum number of branches was observed in T_2 (7.50). Treatment 6 had shown a significant increase in the number of primary branches per plant compared to control while all other treatments were at par with control. Average length of the shoot (cm) was variable, ranging from 130.69 (T_2) to 137.30 cm (T_6). Treatments T_6 and T_4 showed significantly longer shoot length compared to control. Other treatments did not show any significant difference with control. Among the treatments, weight of 100 leaves ranged from 363.11g (T_2) to 383.59 g (T_6). Significant variation was observed among the treatments. Treatments T_3, T_4, T_5 and T_6 showed significantly higher leaf weight compared to the control.

The range of variation in leaf yield per hectare (kg) varied from T_2 (61928.12) to T_6 (68225.00). A highly significant difference was noticed among the treatments. Treatments T_3 (67212), T_4 (67421), T_5 (65859) and T_6 (68225) exhibited significantly higher leaf yield compared to control (62525 kg/ha).

The integrated nutrient management system is an alternative and is characterized by reducing the input of chemical fertilizers with organic for sustainable crop production, integrated use of chemical and organic fertilizers has proved to be highly beneficial. Several researchers have demonstrated the beneficial effect of combined use of chemical and organic fertilizers to mitigate the deficiency of many secondary and micronutrients in fields that continuously received the only N, P and K fertilizers for a few years, without any micronutrient or organic fertilizer. Pain (9) and Ray *et al.* (10) indicated that feeding of mulberry leaves obtained by application of FYM resulted in increased silk content and filament length. This further supports the present findings and confirms that organically produced mulberry leaves can supplement the

Table 1 : Effect of different organic fertilizers on growth and yield parameters of mulberry.

Treatments	Number of primary branches	Average length of the shoot(cm)	Weight of 100 fresh leaves (g)	Leaf yield/ha (Kg)
T_1	8	134.50	368.92	63821.87
T_2	7.5	130.69	363.11	61928.12
T_3	8	134.01	372.37**	67212.50**
T_4	9	137.05**	377.11**	67421.87**
T_5	8.5	132.08	374.62**	65859.37**
T_6	10	137.30**	383.59**	68225.00**
T_0 Control	8.5	133.43	367.16	62525.00
CD (P=0.01)	1.260	0.714	2.115	898.6775
CD (P=0.05)	1.288	0.729	2.160	918.0625

**Significant at 1% level

Table 2: Effect of different organic fertilizers on biochemical composition of mulberry leaves.

Treatments	Moisture content (%)	Moisture retaining capacity after 12hrs (%)	Total chlorophyll (mg/g)	Protein (%)	Carbohydrate (%)
T_1	74.26	69.04	3.23	20.69	11.03
T_2	73.31	66.99	3.15	19.70	11.21
T_3	76.03**	70.91**	3.43	20.13	12.06*
T_4	77.61**	73.39**	4.31**	21.94**	12.20*
T_5	78.52**	73.10**	3.69	21.52**	11.32
T_6	79.03**	76.86**	4.41**	23.94**	12.38**
T0 (control)	75.01	70.11	3.67	20.90	11.66
CD (P=0.01)	0.991	0.445	0.204	0.445	0.382
CD (P=0.05)	1.012	0.445	0.208	0.455	0.390

**Significant at 1% level, *Significant at 5% level

nutritional requirement of silkworm by virtue of producing nutritionally balanced mulberry leaf. Jayaraj *et al.* (6) also confirmed the possibility of reducing NPK application by 25% after the first year and by 50% after the second year in mulberry cultivation, besides improving the chemical, physical and biological properties of soil. Thippeswamy *et al.* (11) validated through an experiment that it is possible to harvest quality mulberry leaf ranging from 55 – 60 metric tonnes per year by adoption of the integrated technology package (ITP).

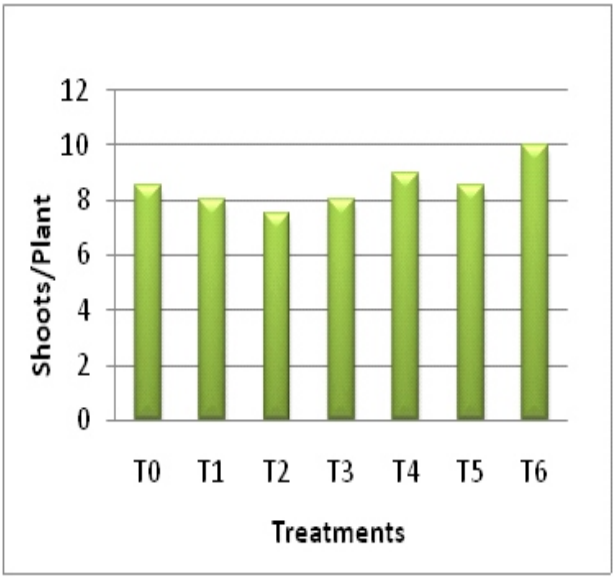
It can be conferred from the above results that all the treatments involving PRATHISTA organic fertilizers have shown significantly higher values in respect of different growth and yield parameters compared to recommended doses of inorganic fertilizers.

Quality Parameters

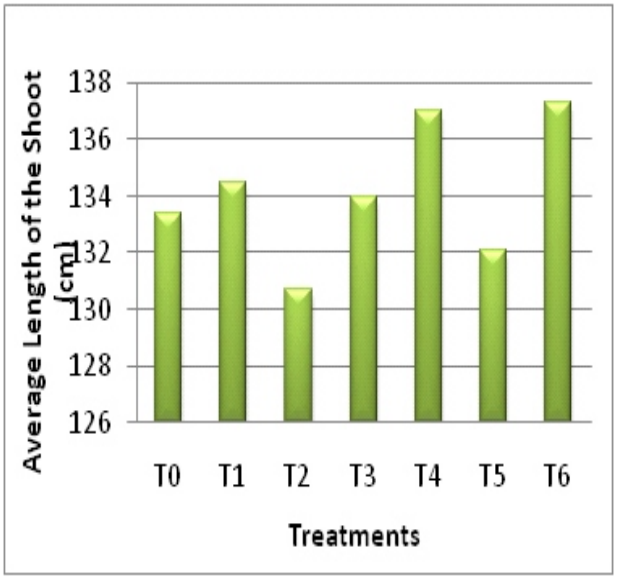
Leaves of different treatments were analyzed for moisture content of leaves, moisture retaining ability, protein, carbohydrate and chlorophyll contents (Table 2). Among the six treatments studied the moisture content percentage varied from 73.31% (T_2) to 79.03% (T_6). A significant increase in the moisture content was noticed in the treatments T_3, T_4, T_5 and T_6 compared to the control. Among the six treatments studied the moisture retaining ability after 12 hours varied from 66.99% (T_2) to 76.86% (T_6). Among different treatments studied T_3 (70.91%), T_4 (73.39%), T_5 (73.10%) and T_6 (76.86%) showed higher moisture retaining ability than control (70.11%).

Total chlorophyll content varied from T_2 (3.15 mg/g) to T_6 (4.41 mg/g). The highest chlorophyll content was noticed in T_6 (4.41 mg/g) and the lowest was in T_2 (3.15 mg/g). Treatments T_4 (4.31 mg/g) and T_6 (4.41 mg/g) showed significantly higher chlorophyll content compared to control (3.67 mg/g).

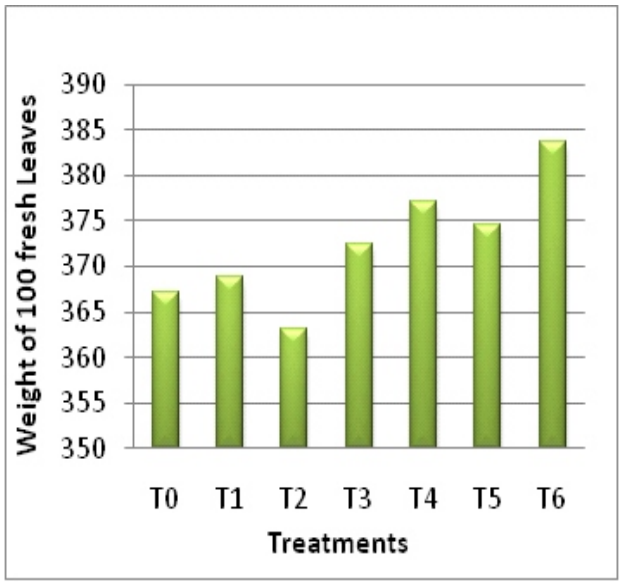
Protein content in the leaves (Fig. 2) ranged from 19.70% (T_2) to 23.94% (T_6). Significantly higher leaf protein content was noticed in T_4 (21.94%), T_5 (21.52%) and T_6 (23.94%) compared to the control (20.90%) and all other treatments. Sugar content (soluble carbohydrate per cent) varied from 11.03% (T_1) to 12.38 (T_6). Significantly maximum value was recorded in T_6 (12.38%) followed by T_4 (12.20%) and T_3 (12.06%) compared to the control (11.66%) .



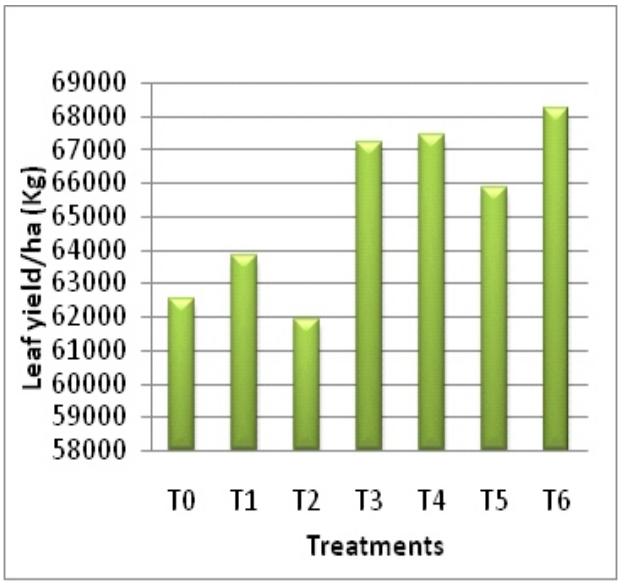
No. of Shoots/plant



Average length of the shoot (cm)



Weight of 100 fresh leaves (g)



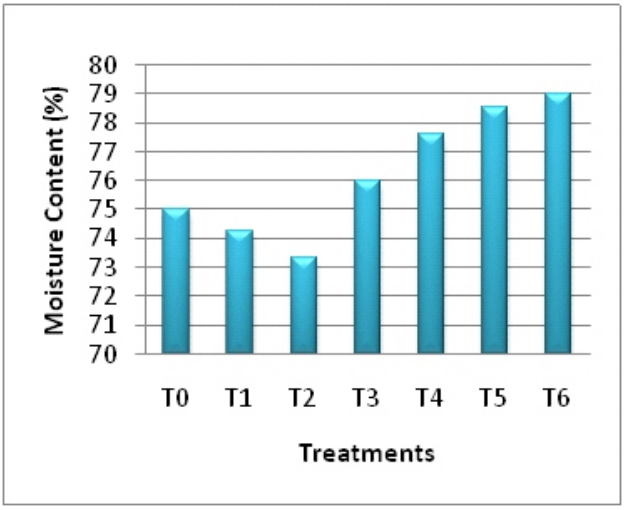
Leaf yield/ha (Kg)

Figure 1 : Effect of different organic fertilizers on growth and yield parameters of mulberry.

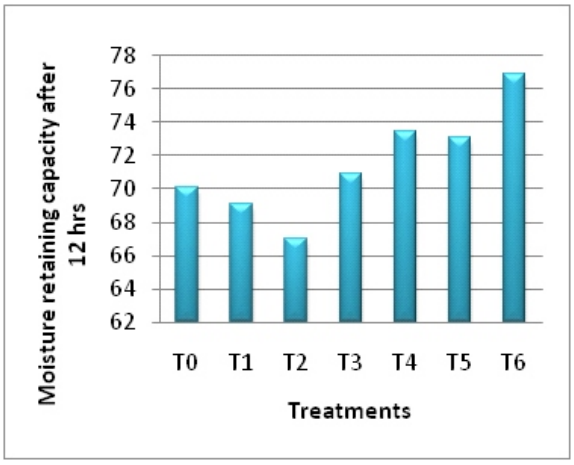
Results of biochemical analysis of mulberry leaves for different parameters indicated that the treatments involving organic fertilizers namely T_3, T_4 and T_6 showed significantly higher values compared to the control with inorganic fertilizers (Fig. 2).

The use of inorganic fertilizers and intensive tillage farming have greatly increased crop production, but the high energy, intensive nature of these systems and their adverse effects on soil productivity and the environment has led to increased interest in organic farming systems as they reduce some of the adverse effects of chemical fertilizers on soil fertility and the environment.

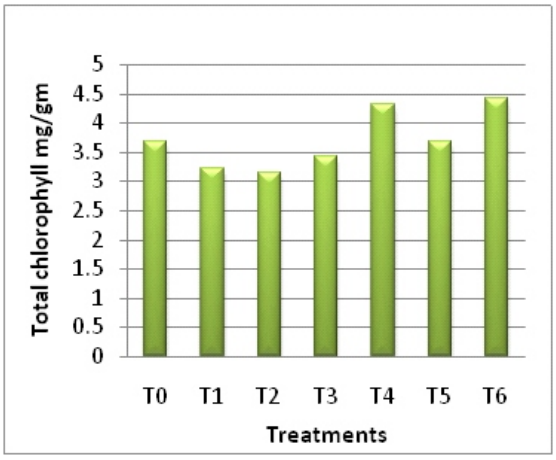
Traditional organic manures *viz.,* Cow dung, Farm Yard Manure etc. do not supply all the plant nutrients in required quantities for good crop growth and yield compared to chemical fertilizers. The innovative fermentation technology provides an opportunity to manufacture the third generation Organic Manures embedded with required plant nutrients equivalent to chemical fertilizers, the application of which gives even more yields (15-20%) over the application of chemical fertilizers. Adapting this technology Prathista Industries manufactures certified organic manures for all major (NPK) and micronutrients (Zn, Mg, Ca, B, etc.,) which supplies total plant nutrients to the crop. These organic manures are eco friendly, Bio available, improves the



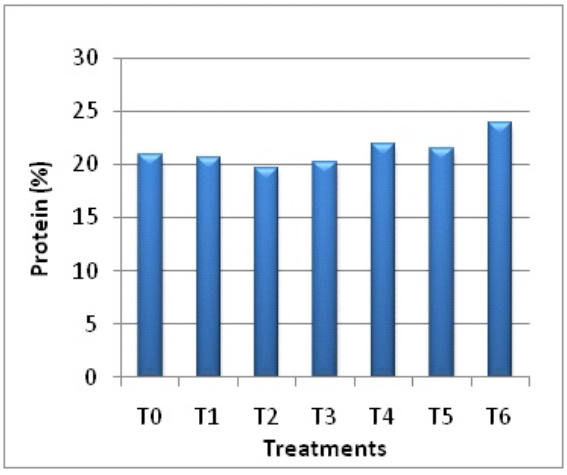
Moisture content (%)



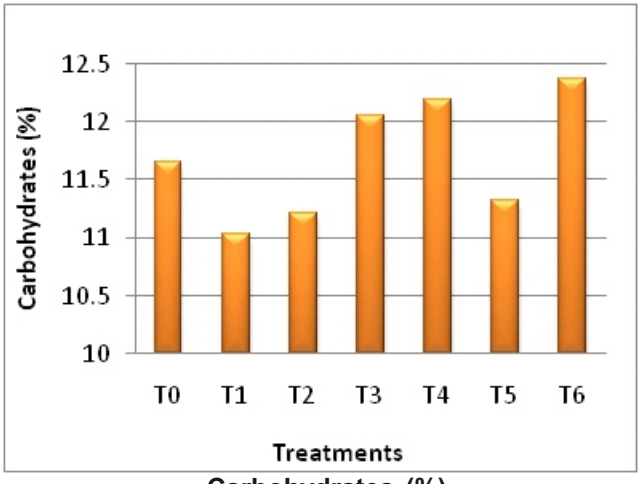
Moisture retaining capacity after 12 h



Total chlorophyll (mg/g)



Protein (%)



Carbohydrates (%)

Figure 2 : Effect of different organic fertilizers on biochemical composition of mulberry leaves.

and qualitative parameters compared to control. A combination of all the five organic fertilizers and 50 % of the recommended dose of inorganic fertilizer (T_6) showed significant higher response both on quantitative and qualitative parameters of mulberry (Fig. 1 and 2). The reason for increased qualitative and quantitative characters due to the application of organic fertilizers is attributed to the availability of balanced nutrients (major and micro nutrients) in the required quantities, increase the organic content of the soil, increase in water holding capacity and microbial activity and efficient uptake of nutrients.

Integrated supply of plant nutrients through FYM (farmyard manure) and fertilizer NPK, along with *Sesbania* green manuring, played a significant role in sustaining soil fertility and crop productivity (Chand *et al.* 4; and Yadav *et al.,* 12). Various growth parameters of mulberry and ber were enhanced due to the application of different organic and biological material as sources of nutrients in the place of chemical microbial and enzymatic activity of the soil for efficient uptake of the nutrients by the plant.

In the present study significant increase was observed in the treatments of T_6 and T_4 in quantitative

fertilizers (Babu, 2; and Katiyar *et al.,* 7). Integrated nutrient management (INM) in mulberry sustains the crop production with quality foliage and quality cocoons (Anil Kumar and John, 1; Bongale, 3; Thippeswamy *et al.,* 11; Jaishankar, 5). The present study also confirms that the application of organic manures alone or in the integrated approach reduces the quantity of chemical fertilizers and increases the yield and quality of mulberry leaf. This would further benefit the sericulture industry and particularly the small and marginal farmers who cannot afford to apply the recommended dose of chemical fertilizers in mulberry cultivation resulting in loss of cocoon crops.

Conclusion

Application of organic manures improves the soil fertility realizing higher yields and quality. The effect of different combinations of organic manures in improving the yield and quality parameters of mulberry leaf and cocoons was studied and the results indicated a significant increase in all the treatments with organic manures in the yield of mulberry leaf and quality of cocoons compared to the application of recommended dose of chemical fertilizers.

These findings are quite useful to sericulture farmers for adapting the applications of organic manures for increasing the yield and quality of cocoons and improving the quality of silk for better remuneration.

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