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Effect of Secondary Nutrients on the Leaf Yield and Biochemical Constituents of *Terminalia tomentosa*

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Studies on the effect of different secondary nutrients in different doses on the leaf yield and biochemical constituents of *Terminalia tomentosa* revealed that secondary nutrients have promotary effect in increasing the leaf yield and foliar constituents of *Terminalia tomentosa*. Among all the treatments under study, foliar application of magnesium sulphate (2 g / plant, w/v) is the best in respect of leaf yield and biochemical constituents of *T. tomentosa*. This treatment gave 29.15% increase in leaf yield over control. Chemoassay results further confirmed significant improvement in biochemical constituents. Except crude fibre, moisture, minerals, crude protein and total carbohydrate increased significantly over control.

Key words: Secondary nutrients, Terminalia tomentosa, Leaf yield, Foliar constituent

Introduction

Deterioration in soil fertility is often observed in crops/ cropping system, even with adequate use of NPK fertilizers. It has been found to be associated with the deficiency of micro and secondary nutrients (Sarkar and Singh, 2003). Several studies have been carried out to improve the quality and quantity of leaves of tropical tasar food plants through application of major and micronutrients (Sinha *et al*., 1999, 2002, 2006). But, no study has so for been undertaken for the improvement of leaf yield and quality of tasar food plant through application of secondary nutrients. According to Sarkar and Singh (2003), secondary nutrients are the key nutrients responsible for low productivity of crops in acid soils. Soils of tropical tasar producing areas are generally acidic. Hence, the present study has been undertaken with a view to study the effect of secondary nutrients on the leaf yield and biochemical constituents of *Terminalia tomentosa*, an important primary food plant of tropical tasar silkworm *Antheraea mylitta* Drury.

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Materials and Methods

The experiment was conducted in earthen pots having height ~40 cm and diameter ~50 cm at Central Tasar Research and Training Institute, Ranchi. Soils were collected from uniform piece of land. It was mixed thoroughly after removing the weeds and filled in pots. The soil was sandy loam laterite having pH 5.4, organic carbon 0.37%, available phosphorus 14.6 kg/ha and available potassium 62.0 kg/ha. Secondary nutrients status of the soil is as follows: available calcium, 2.9 $Cmol(P^{+})kg^{-1}$; available magnesium, 0.95 $Cmol(P^{+})kg^{-1}$; and available sulphur, 8.7 ppm.

Soil analysis was done following the method of Hesse (2002). Three months old seedlings were transplanted in pots. The usual package of practices of major nutrients for younger plants i.e. urea (24 g/plant/yr) in three split doses, Single Super Phosphate (23 g/plant/yr), Murate of Potash (6 g/plant/yr) and FYM (1 kg/plant/yr) in one dose was followed. Randomized Block Design with three replications was followed for each treatment. A sample size of 10 plants per replication was considered suitable for the experiment. Ten treatments including control are as follows: T_1, calcium carbonate (30 g /plant /yr) as basal application; T_2, calcium carbonate (45 g/plant /yr) as basal application; T_3, calcium carbonate (60 g/plant/yr) as basal application; T_4, calcium sulphate dihydrate (2 g/plant/yr) as basal application; T_5, calcium sulphate dihydrate (3 g/plant/yr) as basal application; T_6, calcium sulphate dihydrate (4 g/plant/yr) as basal application; T_7, magnesium sulphate (1 g/plant/yr) as foliar application; T_8, magnesium sulphate (2 g/plant/yr) as foliar application; T_9, Magnesium sulphate (3 g/plant/yr) as foliar application; and T_{10}, control i.e., without secondary nutrient.

All the treatments of secondary nutrients were applied in single dose except Magnesium sulphate whose foliar application was done in three split doses with an interval of fifteen days. The experiment was conducted for two years to study the leaf yield of one year and two years old plants of *T. tomentosa.* Simple Random Sampling method was followed for collecting the samples for the study under reference. Leaf samples were collected excluding too tender and over mature leaves from each treatment in three replications. All the biochemical constituents of leaves except moisture were determined on oven dry basis. Moisture, total minerals, total carbohydrates and crude fibre were estimated by the method of AOAC (1955). Kjeldahl's method as described by Vogel (1978) was followed for the determination of total nitrogen. Crude protein was calculated by multiplying the estimated value of the nitrogen content by 6.25. The method suggested by Arunachalam and Bandyopadhyay (1984) was followed to decide the ranking of different treatments of secondary nutrients under study for leaf yield and biochemical constituent of *T. tomentosa.*

Results and Discussion

The leaf yield of two years and also the gain in leaf yield over control are given in Table 1 Results indicate that there has been significant increase in leaf yield over control in case of all the secondary nutrients, the highest being 29.15% over control for treatment T_8 (foliar application of Magnesium sulphate, 2 g/plant). It was followed by T_2 (basal application of Calcium carbonate, 45 g/plant) and T_5 (basal application of Calcium sulphate, 3 g/plant). In these treatments leaf yield increased by 23.42% and 20.68% respectively over control.

The increase in leaf yield due to the application of Magnesium sulphate may be due to the fact that magnesium, the central atom of chlorophyll with its specific electron resonance properties to which the organic compound of chlorophyll is responsible for photoreduction and the photochemical breakdown of water are attuned, is vital for the process of photosynthesis. Apart from this, magnesium is of importance mainly as a cofactor and activator for many enzymes and substrate transfer reactions. According to Rai (1981), various enzymatic reactions are influenced by Mg ions e.g. hexose phosphorylating enzymes, kinases, phosphorases, phosphomutages etc. Magnesium is component of carboxylase enzyme which fixes CO_2 and peptidases enzyme which hydrolyses simple proteins. Sulphur is essential for the growth and development of all crops. It is also involved in the formation of chlorophyll & activation of enzymes (Tandon, 2002). Similar trend of increased yield of potato (21.00 to 41.60%) and tea (20.2%) have been reported by Sarkar and Singh (2003) by the application of magnesium sulphate and sulphur respectively.

The increase in leaf yield of *T. tomentosa* due to the application of calcium carbonate (T_2) is mainly due to the fact that calcium carbonate provides calcium to the soil in

Table 1. Effect of different treatments of secondary nutrients on the leaf yield of *T. tomentosa*

Treatment	Leaf yield (kg/plant)		% Gain in leaf yield over control		
	Year I	Year II	Year I	Year II	Average
T_1	0.670 de	1.460 bc	14.53	10.60	12.57
T_2	0.730 b	1.611 a	24.79	22.05	23.42
T_3	0.640 fg	1.450 c	9.40	7.58	8.49
T_4	0.660 ef	1.460 bc	12.82	14.00	13.41
T_5	0.710 bc	1.584 ab	21.36	20.00	20.68
T_6	0.630 g	1.450 c	7.69	12.00	9.85
T_7	0.690 cd	1.470 bc	11.11	15.00	13.01
T_8	0.762 a	1.690 a	30.26	28.03	29.15
T_9	0.650 efg	1.480 bc	17.95	16.00	16.98
T_{10} (control)	0.585 h	1.320 d	-	-	-
CD at 5%	0.020	0.129	-	-	-

Figures with different alphabets differ significantly.

Table 2. Biochemical composition of *T. tomentosa* leaf as influenced by different treatments of secondary nutrients

Treatment	Moisture (%)	Total mineral (%)	Crude fibre (%)	Crude protein (%)	Total carbohydrate (%)
T_1	72.00 c	9.00 e	8.53 a	15.00 d	16.50 e
T_2	73.00 a	9.73 b	8.33 a	16.25 bcd	17.00 cd
T_3	72.20 bc	8.80 e	8.30 a	15.00 d	16.40 e
T_4	72.00 c	9.50 bcd	8.75 a	15.00 d	16.80 d
T_5	72.50 b	9.63 bc	8.73 a	17.50 ab	16.90 cd
T_6	72.10 c	9.43 cd	8.35 a	15.63 cd	16.50 e
T_7	72.10 c	9.00 e	8.40 a	16.25 bcd	17.10 bc
T_8	73.24 a	10.06 a	8.80 a	18.75 a	18.00 a
T_9	72.30 bc	9.30 d	8.70 a	16.88 bc	17.30 b
T_{10} (Cont.)	71.04 d	8.00 f	8.30 a	12.50 e	15.00 f
CD at 5%	0.36	0.23	NS	1.65	0.25

NS, Non significant.
Figures with different alphabets differ significantly.
Average values are based on two years data.

Table 3. Scores allotted to ten different treatments of secondary nutrients for leaf yield and biochemical constituents of *T. tomentosa*

Treatment	Leaf Yield	Moisture	Total mineral	Crude fibre	Crude protein	Total carbohydrate	Total scores	Rank
T_8	0.19	0.25	0.17	1.00	0.20	0.17	1.98	I
T_2	0.25	0.25	0.33	1.00	0.60	0.58	3.01	II
T_5	0.35	0.50	0.42	1.00	0.30	0.58	3.15	III
T_9	0.69	0.63	0.67	1.00	0.50	0.33	3.82	IV
T_7	0.54	0.75	0.83	1.00	0.60	0.42	4.14	V
T_4	0.66	0.75	0.50	1.00	0.80	0.67	4.38	VI
T_6	0.82	0.75	0.58	1.00	0.70	0.83	4.68	VII
T_1	0.60	0.75	0.83	1.00	0.80	0.83	4.81	VIII
T_3	0.78	0.63	0.83	1.00	0.80	0.83	4.87	IX
T_{10}	1.00	1.00	1.00	1.00	1.00	1.00	6.00	X

available form to plants. Calcium is extremely important mineral in plant nutrition. It is required for the growth of the meristematic tissues and for the functioning of the root tip. It also maintains the shape of the cell. Our findings corroborates with the findings of Sarkar and Singh (2003) who also reported that basal application of 2~4 q ha^{-1} of calcium carbonate increases the yield of Soya bean to the tune of 26.70%. Further, the improvement in leaf yield due to application of calcium sulphate is mainly due to calcium and sulphur.

Table 2 shows the average biochemical composition of *T. tomentosa* leaf under different treatments. It is evident from the table that application of secondary nutrients has improved the quality of leaf. Except crude fibre, content of moisture, crude protein, total carbohydrate and total minerals are significantly higher in treated plant leaves than control. Maximum increase in biochemical constituents has been observed in treatment T_8 followed by T_2 and T_5. The increase in chemical constituents may be due to the beneficial role of secondary nutrients in plant metabolism. Calcium is an important mineral for plant growth whereas; Magnesium activates a number of enzymes. Sulphur is involved in the formation of amino acids essential for protein synthesis (Pasricha and Sarkar, 2002).

Data in Table 3 indicates the scores allotted to ten different treatments of secondary nutrients under study for leaf yield and biochemical constituents by the method of Arunachalam and Bandyopadhyay (1984) where lower values signify higher ranking. It is evident from the table that among different treatments of secondary nutrients, treatment T_8 (foliar application of Magnesium sulphate, 2 g/plant) is the best treatment in respect of all the characters under study.

From the present study it is, therefore, inferred that among all the treatments of secondary nutrients under study, treatment T_8 i.e., foliar application of Magnesium sulphate (2 g /plant, w/v) is the best for increasing the leaf yield and biochemical constituents of younger plants of *T. tomentosa.*

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