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Effect of Different Organic Mulches on Available Soil NPK and Biochemical Constituents of M_5 Mulberry (*Morus indica* L.) under Rainfed Condition

K. R. SHASHIDHAR[1], R. N. BHASKAR[2], S. CHANDRASHEKAR[1], H. L. CHANDRAKUMAR[1]
K. RASHMI[1] AND M. MANJUNATH[1]

[1]*Department of Sericulture, University of Agricultural Sciences, GKVK, Bangalore 560065, India*
[2]*University of Agricultural Sciences, College of Sericulture, Chintamani, India*
E-mail : rn_bhaskar@rediffmail.com

Abstract

An investigation was carried out to assess the impact of different organic mulches on available soil NPK and biochemical constituents of M_5 mulberry under rainfed condition during 2003-04. The results revealed that available nitrogen content was highest in sunhemp mulched plots (280.40 kg/ha) and available phosphorus and potassium contents were more in paddy straw mulched plots (38.36 and 218.20 kg/ha). However, application of sunhemp recorded significantly highest content of leaf nitrogen and magnesium (2.245 and 0.331%), while phosphorus and sulfur contents were more in *Cassia sericea* and enriched coirpith mulched plots (0.387 and 0.362%). Similarly, the potassium and calcium contents of mulberry leaves were found to be maximum in paddy straw mulched plots (1.968 and 2.965%). Further, the chlorophyll *a b* and total chlorophyll contents of mulberry were recorded more with paddy straw mulched plots (1.452, 0.518 and 2.193 mg/g) compared to other treatments than no mulched plots.
Key words : Mulberry, Mulching materials, Soil NPK, Biochemical constituents.

Mulberry (*Morus* spp) is in important food plant of silkworm, *Bombyx mori* L. It is a perennial crop and continuous to grow throughout the year in tropics. The continuous production of mulberry for a long time results in gradual reduction in leaf yield and quality. The mulberry leaf yield and quality depend on the soil type, plant variety, availability of plant nutrients and agro-ecological conditions, which reflects on the quality of silk production. Hence, native soil fertility alone cannot be relied upon for quantity and quality of mulberry leaf productivity, unless the soil is replenished with external sources through fertilizers. Mulberry leaf productivity is highly dependent on plant nutrients like NPK and is known to respond well to the addition of organic manures (1). Mulberry leaf forms basic food material for silkworm *Bombyx mori* L. and nutrition is the most important growth regulating factor in silkworm *Bombyx mori* L. Nearly 70% of silk protein produced by silkworm is directly derived from proteins of mulberry leaves. Hence, silkworm should be fed with good quality mulberry leaves in abundant quantity for the successful cocoon production. Mulberry is basically a high biomass producing foliage crop and grows throughout the year enabling 5–6 harvest per year. Tropical climate characterized by the abundance of sunlight is generally favorable for the plant growth. The mulberry leaf production become meager under rainfed condition, due to prolonged dry non-raining periods (November to May months) for want of adequate soil moisture in the field and low utilization of nutrients from soil by plants. However, the associated hot and dry weather and unfavorable soil conditions result in the inhibition of assimiation processes leading to yield reductions and the wastage of resource inputs. Short duration of precipitation and scanty rainfall being the associated constraints, result in fast depletion of soil moisture, soil organic matter, soil microbial populations and related fertility parameters (2). Hence it is essential to restore the fertility of soil in the mulberry field to enhance yield and quality leaves . Many organic mulches contain components that can contribute significantly to improve the crop yield, by providing major nutrients, secondary nutrients and micronutrients. The organic mulches not only conserve the soil moisture, they also increase the soil nutrients through organic matter addition, microbial and soil fauna (3, 4). The present experiment was thus initiated to study the effect of different organic mulches on available soil NPK and biochemical constituents

of M_5 mulberry under rainfed condition.

Methods

The present study was conducted during 2003-04 in an established M_5 mulberry garden with 90 × 90 cm spacing under rainfed condition situated at Department of Sericulture, GKVK, Bangalore. It was laid out in a randomized complete block design with three replications and eight treatments viz. silkworm bedwaste, groundnut haulm, *Cassia sericea*, *Chromolena oderata,* paddy straw, enriched coirpith, sunhemp, and control (no mulch).

The mulch material was collected and dried in the sun, then the mulberry plants were pruned to the middle level in the last week of October and the plots were hand hoed and weeded. All the plots supplied with N : P : K at 50 : 25 : 25 kg/ha in the form of urea (46% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O), respectively. All the mulching materials were applied 5 cm thickness along the inter and intra row space of mulberry so as to give complete coverage. At the end of fourth crop (after decomposition of the mulching materials) the mulberry leaves and soil samples were used for biochemical analysis. The soil samples were chemically analyzed for available nitrogen (5), available phosphorus (6) and available potassium (7). Leaf qualitative studies were carried out by conducting chemo-assay studies viz. N, P, K, Ca, Mg and S (6) and chlorophyll (8).

Results and Discussion

Chemical composition of soil and biochemical constituents of M_5 mulberry differed significantly due to application of different organic mulches (Tables 1 and 2).

Available Nitrogen

Among different mulches, sunhemp mulched plots significantly increased higher soil nitrogen content (280.40 kg/ha), the next best in order was *Cassia sericea* (272.10 kg/ha) and silkworm bed waste mulched plot (265.15 kg/ha) over other treatments than control (192.80 kg/ha). The available nitrogen content of the soil was having direct relationship with organic matter content (9, 10).

Available Phosphorus

Table 1. Changes in chemical properties of soil as influenced by application of different organic mulches. *Significant.

Treatments	Available soil nutrients N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1 Silkworm bed waste	265.15	36.27	171.35
T_2 Groundnut haulm	238.25	34.15	174.15
T_3 *Cassia sericea*	272.10	38.22	185.24
T_4 *Chromolena oderata*	246.15	37.45	168.44
T_5 Paddy straw	258.20	38.36	218.29
T_6 Enriched coir paith	260.35	32.85	196.70
T_7 Sunhemp	280.40	38.22	205.42
T_8 No mulch (control)	192.80	29.46	153.33
F-test	*	*	*
SE ±	0.32	0.15	0.60
CD at 5%	0.96	0.44	1.81

The available phosphorus content of soil was significantly high in paddy straw mulched plot (38.36 kg/ha) followed by sunhemp mulch (38.22) and *Cassia sericea* (38.22 kg/ha)mulched plots. The least was recorded in no mulched plot (29.46 kg/ha). The increase in available P may be due to P content of organic mulches and also increasing the solubility of native P by the organic acids produced during the decomposition of the organic mulches. Similarly, availability of phosphorus was more under wheat straw and sunhemp mulched plots compared to other mulched treatments (11).

Available Potassium

The available potassium content of soil was significantly highest with paddy straw mulched plots (218.29 kg/ha) and next best was sun hemp mulched plot (205.42 kg/ha) over other treatments and least was recorded in no mulched plots (153.3 kg/ha). The increased organic matter might have provided more exchangeable complex, on which potassium would have been observed in the available form. Ning and Hu (12) reported that higher available K under rice straw mulch.

Biochemical Constituents of Rainfed M_5 Mulberry

The data on N, P, K, Ca, Mg and S contents of mulberry leaves differed significantly due to applica-

Table 2. Biochemical constituents of rainfed M_5 mulberry as influenced by different organic mulches. *Significant.

Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)	Chl *a* (mg/g)	Chl *b* (mg/g)	Total chlorophyll (mg/g)
T_1 Silkworm bed waste	2.115	0.290	1.750	2.582	0.322	0.346	1.448	0.5151	2.157
T_2 Groundnut haulm	1.902	0.241	1.782	2.584	0.315	0.330	1.431	0.499	2.142
T_3 *Cassia sericea*	2.124	0.387	1.784	2.667	0.323	0.340	1.430	0.530	2.149
T_4 *Chromolena oderata*	2.085	0.294	1.725	2.531	0.319	0.325	1.428	0.510	2.156
T_5 Paddy straw	2.105	0.369	1.968	2.965	0.324	0.355	1.452	0.518	2.193
T_6 Enriched coipith	1.880	0.224	1.815	2.459	0.321	0.362	1.431	0.512	2.129
T_7 Sunhemp	2.245	0.310	1.848	2.749	0.331	0.341	1.445	0.514	2.142
T_8 No mulch (control)	1.724	0.221	1.614	2.363	0.316	0.305	1.419	0.498	2.113
F-test	*	*	*	*	*	*	*	*	*
SE ±	0.060	0.004	0.011	0.002	0.001	0.003	0.004	0.001	0.015
CD at 5%	0.182	0.011	0.033	0.006	0.004	0.008	0.013	0.004	0.045

tion of different organic mulches (Table 2). Among the treatments, sunhemp mulched plots recorded significantly highest leaf nitrogen content (2.245%), which is followed by silkworm bed waste, *Cassia sericea* and paddy straw mulched plots (2.115, 2.124 and 2.105% respectively) over other treatments and control (1.724%). However, phosphorus content of mulberry leaf was significantly more in *Cassia sericea* mulch (0.387%), followed by paddy straw (0.369%), sunhemp (0.310%) and *Chromolena oderata* (0.294%) over other treatments. The less phosphorus content of mulberry was recorded in no mulch (0.221%).

Application of paddy straw as a mulch recorded significantly highest potassium and calcium content of mulberry (1.968 and 2.965%) followed by sunhemp (1.848 and 2.749%), enriched coirpith (1.815%) and *Cassia sericea* (2.667%) respectively over other treatments, and control recorded (1.614 and 2.363%) lowest potassium and calcium contents of mulberry. However, the magnesium content of leaf was maximum with sunhemp mulched plots (0.331%), followed by *Cassia sericea* (0.325%), silkworm bed waste (0.322%) and enriched coirpith (0.321%) over other treatments and control recorded (0.316%). Similarly, enriched coirpith mulched plots recorded highest sulfur content of leaf (0.362%) the next best in order was paddy straw (0.355%), silkworm bed waste (0.346%), sunhemp (0.341%) and *Cassia sericea* (0.340%) mulches respectively over other treatments and control (0.305%). The present study revealed that quality of mulberry directly correlated with soil moisture content and decomposition products of organic mulches add soil nutrients and increases the soil fertility through nitrification and mineral activity, which improves soil structure. The present study confirms the observation made earlier (13) that green manuring in mulberry with cowpea, horsegram and dry weed mulches increased the total leaf nitrogen content by 17.9, 22.2 and 9.8% over no mulch. Bhogesha et al. (14) reported that field application of the compost prepared out of sericultural wastes indicated a significant increase in mulberry leaf productivity and NPK contents of leaf. However, Giri and Singh (4) reported that straw mulch increased N and P uptake by 24.9 and 28.6% in wheat, respectively. Similarly, Nagesha (15) reported that Ca, Mg and S contents of mulberry were significantly higher when 100% recommended nutrients were applied through green manure (2.826, 0.512 and 0.341%) compared to control.

The chlorophyll contents of mulberry leaves significantly increased in all the mulched plots over no mulch. Among the treatments paddy straw mulched plots recorded maximum chlorophyll a, b and total chlorophyll contents (1,452, 0.518 and 2.193 mg/g) respectively compared to silkworm bed waste (1.448, 0.515 and 2.157 mg/g) over other treatments, and control recorded (1.419, 0.498 and 2.133 mg/g, respectively). The increase in chlorophyll content may be due to adequate supply of nutrients to the plants through different organic mulches, inorganic fertilizers and also by application of biofertilizers. These observations are in agreement with earlier findings (16), where nitrogen helped in harvesting solar energy through chlorophyll synthesis, as it is an essential constituent of chlorophyll. The leaf chlorophyll content of Assam lemon recorded highest in water

hyacinth mulch (1.025 mg/g) over control (17). Integrated organic manure application equally improved the moisture, total chlorophyll content of mulberry (18).

The results of present study indicated that organic mulches enhance the soil fertility providing balanced supply of nutrients to the plant without affecting the growth, yield and quality character of mulberry for seed crop rearing.

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