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Growth and Foliar Constituents of Mulberry (M_5) Cultivated under Organic Based Nutrient Management

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A field experiment to evaluate the effect of application of different organic manures and inorganic fertilizers on growth, yield and quality of leaf was studied during 2004-05 has showed that, the application of 10 kg each of *Azospirillum brasilense* and *Aspergillus awamori* + 20% each of recommended N through compost + green manure (Glyricidia maculata) + castor cake + vermicompost + Urea and remaining P and K through fertilizers (T_{11}) has recorded significantly higher leaf yield (250 g/ plant and 34.70 tonnes/ha/yr, respectively) with improvement in growth characters as compared to control. Leaf quality status was also improved in terms of N (3.19%), P (1.97%), K (1.28%), total soluble protein (8.39 mg/ml), total soluble sugars (14.40 mg/ml), secondary nutrients viz., Ca (3.00%), Mg (0.60%), S (0.35%) and micronutrients viz., Cu (0.410 ppm), Mn (0.454 ppm) and Zn (0.112 ppm) contents. The mulberry grown with 20 tonnes of compost + 300: 120: 120 Kg of NPK/ha/year through fertilizer ranked second for growth and foliar constituents.

Key words: Mulberry Variety, Organic manures, Biofertilizers, Chemical fertilizers.

Introduction

Mulberry (*Morus spp*) is an important food plant of the 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 growth and quality of mulberry leaf as influenced by several factors such as variety, agronomic practices, method of leaf harvest, abiotic and biotic factor (Narayan *et al.,* 1967; Krishnaswami *et al.,* 1970). Proper soil management is the prerequisite for soil health to achieve higher productivity. It is well known that, continuous usage of chemical fertilizers affecting soil health in addition to environmental pollution, impair the balanced availability of different plant nutrients and results in wide spread deficiencies including those of micronutrients (Krishna and Bongale, 2001). This kind of situation can be improved by enriching the soil with organic residues. It is highly essential to use organic manures in addition to chemical fertilizers to safeguard the soil health and crop quality (Shivashankar, 1995). Organic manures are eco-friendly, help in improvement of soil health, supply balanced nutrients for plant growth and maintain soil fertility for a longer period. Many advanced countries have started using organics to improve the tilth, fertility and productivity of soils, in terms of supplying major and minor nutrients for crop production. In this direction, this experiment was carried out to evaluate the effect of combined use of organic manures (as a source of N) and inorganic fertilizers on growth parameters and foliar constituents of M_5 variety of mulberry.

Materials and Methods

The present study was conducted during 2004-05 in an established M_5 mulberry garden with 60×60 cm spacing under irrigated condition situated at main research station, UAS, Hebbal, Bangalore. It was laid out in a randomized

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complete block design with thirteen treatments of three replication each. The experimental soil had an initial organic carbon content of 0.6%, nitrogen (200 kg/ha), phosphorous (50 kg/ha), potassium (86 kg/ha). The soil pH was 6.8. In the experiment all the cultivation practices for mulberry was followed as suggested by Dandin *et al.* (2003). The treatment details are as follows; **T_1:** 100% recommended N through compost and remaining P and K through fertilizer; **T_2:** 50% recommended 'N' through compost+50% recommended 'N' through Urea and remaining P, K through fertilizer; **T_3:** 100% recommended N through green manure (*Glyricidia maculata*) and remaining P and K through fertilizer; **T_4:** 50% recommended N through green manure+50% recommended N through Urea and remaining P and K through fertilizer; **T_5:** 100% recommended N through castor cake and remaining P and K through fertilizer; **T_6:** 50% recommended N- castor cake+50% recommended N through Urea and remaining P and K through fertilizer; **T_7:** 35% recommended N through compost+30% recommended N through castor cake+35% recommended N through green Manure and remaining P and K through fertilizer; **T_8:** 100% recommended N through vermicompost and remaining P and K through fertilizer; **T_9:** 50% recommended N through vermicompost+50% recommended N through Urea and remaining P and K through fertilizer; **T_{10}:** Bio-fertilizer 10 kg each of *Azospirillum brasilense*+*Aspergillus awamori* +25% recommended N through compost, green manure, castor cake, vermicompost; **T_{11}:** Bio-fertilizer 10 kg each of *Azospirillum brasilense*+*Aspergillus awamori*+20% each recommended N through compost+green manure+castor cake+vermicompost+Urea+remaining P and K through fertilizers; **T_{12}:** Recommended 20 tonnes FYM+300:120:120 NPK kg/ha/year through fertilizer (control); **T_{13}:** Only fertilizer 300:120:120 NPK kg/ha/year (control).

The observations on the growth parameters were recorded at 30, 45 and 60 days interval and leaf yield was recorded at the end of harvest. The moisture percentage in leaf was estimated as per the procedure of A.O.A.C. (1970) through gravimetric method on fresh weight basis. The chlorophyll content of leaves was estimated by following the procedure of Hiscox and Isracelstam (1979) at a wavelength of 645 and 663 nm using spectrophotometer and was computed as per the formula suggested by Arnon (1949), and expressed in mg/g of leaf on fresh weight basis. The leaves harvested from the middle part of the plant were pooled, oven dried at 70°C for one hour, powdered and used for biochemical analysis. The total soluble sugars, total soluble protein content in the leaf sample were estimated by calorimetric (Dubios *et al*., 1956) and FCR method (Lowry *et al.*, 1951), respectively. The crude protein content was calculated by multiplying total nitrogen content with factor 6.25. Whereas, Nitrogen, Phosphorus and Potassium were analyzed as per the procedure

Table 1. Plant growth parameters of M_5 mulberry as influenced by application of different organic manures and inorganic fertilizers on 30th, 45th and 60th day after pruning

Treatments	Plant height (cm)			No. of shoots/plant			No. of leaves/plant			Fresh leaf yield (g/plants)	Fresh leaf yield (tonnes/ha)
	30th day	45th day	60th day	30th day	45th day	60th day	30th day	45th day	60th day		
T_1	45.28	64.65	74.30	6.10	6.70	7.30	55.20	91.30	114.60	135.00	18.75
T_2	43.44	64.34	80.30	6.00	6.20	6.90	55.60	82.40	120.03	135.00	18.75
T_3	41.65	64.35	79.50	6.30	6.80	7.26	57.20	85.90	129.73	150.00	20.80
T_4	44.65	65.35	77.25	5.70	7.10	7.90	53.30	89.10	117.20	180.00	25.00
T_5	45.02	64.35	75.00	5.00	5.90	7.90	56.40	87.20	135.00	125.00	17.35
T_6	46.98	67.56	89.70	6.80	8.36	8.50	62.20	105.00	137.10	250.00	34.70
T_7	43.17	67.02	77.07	5.90	7.00	7.60	60.90	84.70	110.36	150.00	20.80
T_8	43.24	65.00	78.00	6.00	7.10	6.90	60.80	92.60	121.26	165.00	22.90
T_9	47.68	72.44	81.31	6.30	8.30	8.50	61.00	97.30	131.66	200.00	27.75
T_{10}	44.94	65.64	73.90	6.00	6.80	8.40	59.46	92.90	122.37	190.00	26.35
T_{11}	49.20	79.00	98.10	7.40	9.20	9.92	69.40	111.70	137.80	250.00	34.70
T_{12}	49.17	74.36	94.15	7.00	8.90	9.00	64.50	108.60	137.70	250.00	34.70
T_{13}	40.36	56.96	73.90	5.00	6.10	6.62	53.50	73.00	107.00	120.00	16.65
F test	NS	*	*	*	*	*	*	*	*	*	*
SEm ±	-	2.91	2.85	0.28	0.48	0.67	1.96	6.91	5.86	5.57	4.03
CD at 5%	-	8.49	8.32	0.82	1.43	1.99	5.74	20.17	17.11	16.27	11.77

Table 2. Biochemical constituents of M_5 mulberry leaf as influenced by application of different organic manures and inorganic fertilizers

Treatments	Moisture content (%)	Chlorophyll - a (mg/g)	Chlorophyll - b (mg/g)	Total Chlorophyll (mg/g)	Crude protein (mg/ml)	Total soluble sugar (mg/ml)	Total soluble protein (mg/ml)
T_1	72.03	1.08	0.27	1.33	18.06	12.06	6.73
T_2	72.03	1.11	0.34	1.45	18.12	11.97	6.82
T_3	71.00	1.07	0.32	1.39	17.49	12.13	6.65
T_4	72.52	1.12	0.30	1.42	18.18	12.07	6.82
T_5	72.10	1.05	0.29	1.34	18.68	12.39	6.27
T_6	71.00	1.26	0.40	1.64	19.37	13.86	8.19
T_7	70 .05	1.20	0.28	1.48	18.83	13.20	6.60
T_8	72.02	1.22	0.37	1.59	18.22	12.56	7.24
T_9	72.03	1.25	0.39	1.61	19.35	13.74	7.98
T_{10}	71.01	1.20	0.35	1.60	18.87	12.86	7.96
T_{11}	72.50	1.28	0.44	1.71	19.93	14.40	8.39
T_{12}	72.97	1.27	0.42	1.70	19.62	14.06	8.32
T_{13}	69.97	1.03	0.24	1.27	17.64	11.95	5.28
F test	*	*	*	*	*	*	*
SEm ±	0.43	0.018	0.014	0.016	0.57	0.10	0.18
CD at 5%	1.27	0.054	0.042	0.047	1.66	0.30	0.54

Table 3. Marco, Secondary and Micro nutrient contents in M_5 mulberry leaf as influenced by different organic manures and inorganic fertilizers

Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
T_1	2.89	0.83	1.02	2.70	0.47	0.315	0.360	0.408	0.068
T_2	2.90	0.85	1.00	2.70	0.45	0.305	0.343	0.346	0.005
T_3	2.80	0.74	0.90	2.71	0.50	0.300	0.359	0.367	0.012
T_4	2.91	0.73	1.00	2.70	0.46	0.260	0.351	0.390	0.023
T_5	2.99	0.68	1.00	2.71	0.47	0.303	0.342	0.373	0.040
T_6	3.10	0.95	1.40	2.88	0.52	0.345	0.379	0.436	0.087
T_7	2.96	0.89	1.02	2.80	0.43	0.314	0.358	0.353	0.015
T_8	3.02	0.69	0.89	2.71	0.45	0.260	0.333	0.334	0.036
T_9	3.08	0.94	1.05	2.80	0.51	0.339	0.372	0.420	0.078
T_{10}	3.02	0.89	1.02	2.70	0.52	0.314	0.347	0.380	0.045
T_{11}	3.19	1.28	1.97	3.00	0.60	0.355	0.410	0.454	0.112
T_{12}	3.14	0.96	1.55	2.94	0.56	0.355	0.402	0.447	0.097
T_{13}	2.49	0.46	0.60	2.50	0.42	0.258	0.289	0.321	0.004
F test	*	*	*	*	*	*	*	*	*
SEm ±	0.05	0.07	0.27	0.15	0.04	0.09	0.002	0.001	0.001
CD at 5 %	0.15	0.22	0.80	0.46	0.13	0.28	0.008	0.003	0.003

outlined by Jackson (1973). Calcium and Magnesium content were estimated by EDTA titration method and S content by Turbidometric method. Micronutrient contents were estimated by Atomic absorption spectrophotometer (AAS) method. The data was analyzed statistically by using simple RCBD as outlined by Cochran and Cox (2000).

Results and Discussion

Growth parameters and foliar constituents of M_5 mulberry variety differed significantly due to application of combined use of organic manures and inorganic fertilizers are presented in (Table 1 to 3). The mulberry growth and yield

parameters were significantly superior in the treatment of 10 kg each of *A. brasilense* and *A. awamori* + 20 % each of recommended N through compost, green manure, castor cake, vermicompost, fertilizer + remaining P and K through fertilizers (T_{11}).

Among the different treatments, T_{11} has recorded significantly higher plant height (49.20, 79.00 and 98.10 cm), number of shoots (7.40, 9.20 and 9.92/plant) and number of leaves (69.40, 11.70 and 137.80/plant) on 30th, 45th and 60th day, respectively after pruning. Similar findings were observed by Janardhan (2001), who reported that recommended dose of FYM + fertilizers produced highest plant height compared to control. Similarly Shivakumar *et al.* (1999) were also reported that combined application of organic manures and inorganic fertilizers has increased the number of shoots and leaves per plant as compared to control.

Significantly higher leaf yield per plant and per hectare was also recorded in T_{11} (250 g and 46.42 tonnes respectively) compared to control. Similar findings were also reported earlier by Krishnababu and Shankar (1997), who recorded the highest fresh leaf yield of mulberry, which was due to the application of *A. awamori* with P fertilizers including rock phosphate.

Biochemical constituents of M_5 mulberry mulberry differed significantly due to application of combined use of organic manures and inorganic fertilizers. However, moisture content of M_5 mulberry leaf was recorded significantly higher (72.97%) in 20 tonnes of FYM + 300 : 120 : 120 kg NPK/ ha/yr treated pzlot (T_{12}), whereas, maximum chlorophyll-a (1.28 mg/g), chlorophyll-b (0.44 mg/g), total chlorophyll content (1.71 mg/g), total soluble protein (8.39 mg/ml), total soluble sugar (14.40 mg/ml), crude protein (19.93 mg/ml) nitrogen (3.19%), phosphorus (1.97 %), potassium (1.28%) calcium (3.00%), Magnesium (0.60%), sulphur (0.35%), copper (0.410 ppm), manganese (0.454 ppm) and zinc (0.112 ppm) in mulberry leaf were noticed significantly in T_{11} (Table 2 and 3). These findings are in agreement with findings of Singhal *et al.* (2000) where, nitrogen helped chlorophyll synthesis, as it is essential constituent of photosynthesis. Similarly, These results are in close conformity with the work of Rajanna *et al.* (2000) who reported that, the application of recommended FYM + NPK recorded significantly higher N, P, K, Ca, Mg and S content in leaf followed by sheep manure + recommended FYM. Ray *et al.* (1973) observed that, crude protein content of leaf was increased with increased levels of organic manures. Application of vermicompost has increased the Zn, Fe, Mn and Cu contents of leaf compared to crop grown only with FYM (Singhal *et al.,* 2000).

The present findings revealed that, combined use of different organic manures with smaller doses of inorganic fertilizers has effectively increased the growth, yield, chemical and biochemical parameters of mulberry leaf as compared to individual application of either organic manures or inorganic fertilizers.

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