

## EVALUATION OF FOUR MULBERRY VARIETIES BY LEAF BIOCHEMICAL ANALYSIS AND BIO-ASSAY WITH *BOMBYX MORI* L.

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Four mulberry varieties viz., Kanva-2, DD, S<sub>54</sub> and TG were studied with respect to growth, yield, leaf moisture content, total protein soluble protein, sugars and chlorophylls, along with bio-assay evaluation of the leaf quality. Observations were made for 3 crops representing three seasons of the year 1991-92. Significant differences were recorded with respect to the varieties and seasons as also their interaction with respect to both biochemical and bio-assay evaluation. Lower values of total and soluble protein and chlorophyll content in DD variety was associated with poor rearing performance compared to other varieties. The TG variety with highest total protein and sugar content of leaf recorded highest cocoon shell ratio. The seasonal influence was more pronounced than the varietal effect on the rearing performance.

**Key Words :** Mulberry leaf quality, *Bombyx mori*, Biochemical, Bio-assay.

Information on the evaluation of mulberry varieties with respect to leaf biochemical constituents is extremely scanty since majority of the studies are related to silkworm rearing performances and do not deal with leaf constituents of feed value. (Horie and Watanabe 1980; Thangamani and Vivekanandan, 1984; Sandhya *et al.*, 1988). Present study was undertaken keeping in view this lacuna.

### MATERIALS AND METHODS

Four mulberry varieties viz., Kanva-2 (popular improved variety), S<sub>54</sub> (a recently approved high yielding variety), DD and TG (improved varieties selected recently at KSSDI) of South India were selected. Six year old plantation raised with two replications for purpose of yield trial studies was maintained with package of practices under irrigated conditions. The soil was of red sandy loam type with pH 7.2 in the Institute campus in Bangalore which is situated at 800-900 m above MSL. Annual five crop schedule was followed for purpose of fertilizer application and other practices. Three crops representing the three seasons of the year (1991-92) were taken for purpose of rearing performance study by extending mulberry crop period to 90-100 days after pruning each time. Growth and leaf yield data and composite leaf samples for estimation of biochemical constituents were collected from ten individual plants selected randomly from among the two replicate plots after 60th day of pruning. The leaf was analysed for moisture content, total N (total protein) by Kjeldahl method (using Kjeltach automatic nitrogen analyser),

soluble protein (Lowry *et al.*, 1951), total sugar (Dubias *et al.*, 1956) and chlorophyll content (Arnon, 1949) using UV-365 Model Shimadzu double-monochromator recording spectrophotometer. Rearing trials were conducted simultaneously following standard method of rearing (Krishnaswami 1978) with NB<sub>18</sub> pure bivoltine silkworm race with 4 replicates each in cellular beds. Observations on selected parameters of rearing were recorded. The data was statistically analysed and presented as average of crops. (Table-1, 2 and 3).

### RESULTS

*Growth and yield of mulberry* (Table 1) : The varieties differed significantly in respect of plant height, fresh weight and dry weight of 50 leaves and moisture content; plant height was maximum in TG variety (121.5 cm) followed by M<sub>5</sub> (101.6 cm) which was significantly higher than DD and S<sub>54</sub> varieties (93.3 and 92.0 cm respectively). Fresh weight and dry weight of leaf were highest in case of DD variety (123.5 and 31.2 g per 50 leaves respectively) which differed significantly with other three varieties (103.50 to 110.8 g and 26.9 to 29.7 g respectively). The leaf moisture content in M<sub>5</sub> variety (73.2%) was significantly lower than other 3 varieties (74.1 to 74.7%). Similarly in the individual crops the TG variety recorded significantly higher plant height in all the three crops (followed by M<sub>5</sub> in crop-I being significantly higher than DD and S<sub>54</sub>); significantly highest fresh weight and dry weight of 50 leaves in case of DD in crop-III (followed by significantly higher dry

Table 1: Growth and yield of mulberry varieties

Parameters	Plant height (cm)	Number of shoots/plant	Number of leaves/shoot	Weight of leaves/plant (g)	Fresh wt 50 leaves (g)	Dry wt 50 leaves (g)	Leaf Moisture (%)
<b>I. Varieties</b>							
M <sub>5</sub>	101.6	14	19	487.1	110.8	29.7	73.2
DD	93.3	13	18	562.7	123.5	31.2	74.7
S <sub>54</sub>	92.0	14	21	540.0	107.8	27.5	74.7
TG	121.5	13	30	490.0	103.5	26.9	74.1
CD at 5%	5.88	--	--	--	7.99	1.91	0.66
CD at 1%	7.74	--	--	--	10.53	2.52	0.87
<b>II Seasons</b>							
I Crop 1.6.91 to 1.8.91	102.7	12	23	507.7	105.2	26.7	74.6
II Crop 19.8.91 to 19.10.91	100.1	13	19	558.9	112.7	28.5	74.9
III Crop 14.1 to 14.3.92	103.5	14	24	492.8	116.3	31.2	72.9
C.D at 5%	--	--	--	--	6.93	1.66	0.57
C.D at 1%	--	--	--	--	9.12	2.18	0.76

weight of M<sub>5</sub> in crop-III over TG and S<sub>54</sub>) while the leaf moisture content was significantly lower in M<sub>5</sub> for crop-II and III.

The three crops differed significantly with each other in respect of fresh weight, dry weight and moisture content, while the other parameters studied did not differ significantly between the crops. The interaction between varieties and seasons was highly significant in respect of plant height, leaf yield, fresh weight and dry weight of 50 leaves and percentage moisture, while it was non-significant in respect of number of shoots and leaves. Fresh weight and dry weight of 50 leaves were significantly higher in II and III crop over the 1st crop, while the reverse was true in respect of moisture content which were significantly lower in III crop (73%) compared to I and II crop (74.6% and 74.9% respectively).

**Leaf biochemical constituents (Table 2):** The DD variety recorded lowest values of total protein and soluble protein (25.9% and 23.8% respectively) and differed significantly with other three varieties which among themselves did not differ significantly except with respect to total proteins between M<sub>5</sub> and TG. The TG variety recorded highest value of total sugar and differed significantly with M<sub>5</sub> and S<sub>54</sub> varieties. The S<sub>54</sub> and TG varieties recorded highest values of total chlorophyll, chlorophyll-a, chlorophyll-b and dif-

ferred significantly with M<sub>5</sub> and DD varieties. Similarly in the individual crops, the DD variety recorded lowest values of total protein and soluble protein in all the three crops. The TG variety had highest sugar content in crop-I and crop-II. The chlorophyll content was significantly higher in S<sub>54</sub> in crop -I.

The 3 crops differed significantly with respect to all biochemical parameters studied. The interaction between varieties and seasons was significant with respect to total protein and soluble protein. The post-winter to pre-summer period appeared to be most favourable since crop-III compared to crop I and II recorded significantly higher values of all the leaf biochemical constituents studied.

**Silkworm rearing performance (Table 3):** The M<sub>5</sub> variety gave significantly higher values of larval weight, shell weight, and cocoon shell ratio. The varieties did not differ significantly with respect to the cocoon weight. The TG variety which recorded significantly higher values of leaf biochemical constituents studied was also found to be significantly superior with respect to CSR which is an important rearing parameter. The DD variety which had significantly lower values of total and soluble proteins and chlorophyll content of leaf also gave significantly lower shell weight and CSR. Among the individual

Table 2: Evaluation of mulberry varieties by leaf biochemical constituents.

Parameters	Total protein %	Soluble protein %	Soluble sugars %	Total chlorophyll mg/g	Chlorophyll-a mg/g	Chlorophyll-b mg/g
<b>I. Varieties</b>						
M <sub>5</sub>	27.83	25.87	8.03	2.99	2.14	0.86
DD	25.94	23.83	8.73	2.56	1.83	0.73
S <sub>54</sub>	28.94	26.27	7.54	3.58	2.53	1.05
TG	29.43	25.84	8.99	3.14	2.22	0.92
CD at 5%	1.39	1.10	0.93	0.56	0.38	0.19
CD at 1%	1.86	1.48	1.25	0.75	0.51	0.25
<b>II. Seasons</b>						
Crop-I 1.6.91-1.8.91	27.0	24.5	5.9	2.81	1.98	0.83
Crop-II 19.8.91-19.10.91	27.2	24.4	9.7	2.36	1.64	0.71
Crop-III 11.1.92-14.3.92	29.9	27.4	9.4	4.03	2.91	1.12
CD at 5%	1.20	0.96	0.80	0.49	0.34	0.16
CD at 1%	1.61	1.28	1.08	0.65	0.44	0.23

crops, the larval weight was significantly higher in TG in crop-I, while the single cocoon weight was significantly lower in this variety in crop-III. The M<sub>5</sub> variety recorded highest shell weight in all the three crops and differed significantly with DD and TG in crop-I and with DD and S<sub>54</sub> in crop -II.

The crops differed significantly with each other with respect to all the rearing parameters except CSR. The 3rd crop representing post-winter to mid-summer season recorded poor performance of silkworms since the weight of larvae, cocoon and shell were significantly lower than crop I and II; crop II which represented prewinter period recorded highest values followed by crop I representing rainy season. Interaction between varieties and seasons was found to be significant with respect to larval and cocoon weight.

**DISCUSSION**

The correlations between leaf biochemical constituents of mulberry varieties and rearing performances were better comparable than between seasonal differences of leaf biochemical constituents in relation to rearing performance. Eventhough crop III gave significantly higher values of protein, sugar and chlorophylls, same was not reflected in better rearing performance since this crop recorded significantly lower values compared to crop-I and crop-II. It was observed that the rearing room environment had lower humidity and higher temperature owing to the

Table 3: Evaluation of mulberry varieties by silkworm rearing performance.

Parameters	Weight of 10 mature larvae (g)	Single Cocoon wt. (g)	Single Shell wt. (g)	CSR Ratio
<b>I. Varieties</b>				
M <sub>5</sub>	42.8	1.80	0.377	21.1
DD	41.7	1.73	0.344	19.9
S <sub>54</sub>	40.8	1.74	0.360	20.7
TG	41.0	1.71	0.359	21.2
CD at 5%	1.41	--	0.016	0.75
CD at 1%	1.90	--	0.022	1.00
<b>II. Season</b>				
I-Crop July-Aug 1991	43.1	1.87	0.39	20.6
II-Crop Oct-Nov 1991	45.8	2.02	0.41	20.6
III-Crop April-May 1992	35.8	1.34	0.28	21.0
CD at 5%	1.23	0.07	0.013	--
CD at 1%	1.64	0.09	0.019	--

prevailing summer during the larval period of crop III compared to I and II crop (average temperature of 24.7°, 26.2° and 28.7°C, and average relative humidity of 74.8%, 87.9% and 68.5% in I, II and III crop respectively). Higher weight of larvae, cocoon and shell were recorded in crop II followed by crop I, which differed significantly with crop III; sugar content was also higher in crop II (followed by crop III) which differed significantly with crop I. Krishnaswami *et al.* (1970) also reported that silkworm

rearing is largely controlled by the rearing environment.

Among the leaf biochemical constituents, the total protein, soluble protein, and sugars are considered to be important parameters favouring larval growth and cocoon yield (Horie and Watanabe, 1989; Horie and Nakosone, 1971). Further, higher levels of leaf chlorophylls is indicative of photosynthetic efficiency of the plant system. The DD variety (with lowest values of chlorophylls) even though recorded higher leaf weight and leaf moisture content, recorded lower values of proteins. This was reflected in its rearing performance. The TG variety with highest total proteins and sugar content, and higher soluble protein and chlorophyll content recorded highest CSR. The highest values of total protein and higher chlorophyll content in TG were associated with maximum plant height suggestive of faster growth rate and efficiency of the plant system. The M<sub>5</sub> variety which had moderately higher levels of leaf biochemical constituents also recorded significantly higher values of rearing performance.

Majority of the reports on the evaluation of mulberry varieties with respect to silkworm rearing performance (Krishnaswami *et al.*, 1970; Koul *et al.*, 1979; Petkov, 1980) take rearing performance as direct index of leaf quality. However, reports enabling the identification of leaf constituents determining its feed value are extremely scanty. Raju *et al.* (1990) found that nutritive quality of Kosen variety was better than that of Kanva-2 (M<sub>5</sub>) and MR<sub>2</sub> varieties with respect to the performance of popular bivoltine silkworm races. The three varieties studied by them did not differ considerably with respect to moisture content (70% to 71%), crude protein (21-23%) and total sugar (10-12%). Thangamani and Vivekanandan (1984) while evaluating seven mulberry varieties found that biochemical analysis and feeding trial results indicated the superiority of MR<sub>2</sub>, C<sub>1</sub>, S<sub>54</sub>, Roso and Kitchili over M<sub>5</sub> variety. They also reported higher chlorophyll content of MR<sub>2</sub> and Japanese variety suggestive of the photosynthetic efficiency.

It could be concluded that the four varieties under study differed significantly with respect to the leaf quality parameters studied. Total protein, soluble protein and sugar content in the leaf influenced the silkworm rearing performance.

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