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Effect of Pruning Height on Quality Parameters of V-1 Mulberry

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Abstract **– Mulberry (Morus spp.) foliage forms a sole food to silkworms, Bombyx mori L. Its quality plays a pivotal role in superior silk fiber production. The present experiment was conducted at Department of Sericulture, UAS, GKVK, Bengaluru during the year 2020-21 by introducing different pruning techniques to the V-1 mulberry variety. For this study six treatments were laid out in RCBD with four replications. The results revealed that, the leaf moisture content of 78.59, 73.88 and 73.12 per cent in V-1 mulberry was found maximum in 30 cm above the ground level pruned plants. The minimum was in 150 cm above ground level pruned plants (72.77, 67.00 and 66.65). The maximum leaf moisture retention capacity (96.36, 94.95 and 90.64 %) and dry matter production (27.23, 33.41 and 33.00 %) was noticed in T_6 and minimum was in T_1 at 30, 45 and 60 days after pruning, respectively. The chlorophyll "a" (1.77, 1.50 and 1.31 mg/g), chlorophyll "b" (0.57, 0.38 and 0.25 mg/g) and total chlorophyll (2.32, 1.88 and 1.56 mg/g) content in V-1 mulberry was found high in T_1 followed T_2 at 30, 45 and 60 days after pruning. The biochemical constituents of mulberry viz., nitrogen (3.90, 3.83 and 2.83 %), phosphorus (0.58, 0.42 and 0.37 %), potassium (2.04, 1.99 and 1.95 %), calcium (1.20, 1.17 and 1.20 %), magnesium (0.13, 0.12 and 0.12 %) and sulphur (0.17, 0.16 and 0.14%) content of mulberry leaves maximum in T_1 followed by T_2 and minimum was noticed in T_6 at 30, 45 and 60 days after of pruning.**

Keywords **– Mulberry Leaves, Biochemical, Moisture, Nutrient Elements, Chlorophyll.**

I. INTRODUCTION

Mulberry leaf is the sole food for silkworm, Bombyx mori L. and gets all its nutritional requirements from mulberry leaf. The quality and quantity of leaf has direct influence on silkworm health and the quantity of cocoon produced. The quality and quantity of mulberry leaf was influenced by the nutrition and periodic pruning (Dandin and Giridhar, 2014) Pruning is one of the cultural activity includes methodical removal of certain branches with an objective of giving proper size and shape to increase the leaf quality and yield (Bhaskar et al., 2020). This cultural practice plays a vital role in maintaing the vigorous of young shoot and foliage with optimum biochemical constituents improving both quality and quantity of mulberry leaf.

The mulberry leaves suitable as food for silkworms must contain several biochemical constituents such as water (80 %), protein (27 %), carbohydrate (11 %), minerals (8.44 %) and vitamins and must have favorable physical features, such as tenderness, thickness, in order to render them acceptable by silkworms (Rajan and Himantharaj, 2005).

In silkworm rearing, disease level increases due to poor nutritive value of mulberry which weakens the silkworm and increases the susceptibility to diseases. The quality of mulberry *viz*, protein, sugar and cellulose level plays an important role in enhancing the defense response of silkworm (Watanabe et al., 1990).

The pruning height and quality of leaf produced in the shoots will definitely help for successful silkworm rearing. It is further reported that, pruning height has marked effect on utilizing stored nutrition in the stem help for growth and shoot height which showed positive relation with yield and quality of mulberry leaves (Dandin and Giridhar, 2014).

The pruning height of 30 cm (high bush) above the ground level of BM-3 mulberry variety increases the protein and carbohydrate content in the leaf, on the other hand moisture and mineral content decreases (Shakhawat Hossain et al., 2016). Further, increased pruning height of 45- 60 cm above the ground level increases per cent moisture content (78.42 and 79.56 %) and moisture retention capacity (77.58 and 80.82 %) in S-36 variety of mulberry at 15 and 30 days after pruning, respectively (Bhaskar et al., 2020).

II. MATERIAL AND METHODS

A field experiment was conducted during 2020-21 in well-established Victory- 1(V-1) mulberry garden planted with a spacing of 4' x 4' under protective irrigated condition was selected for the experimentation. The experiment was laid out in RCBD with six treatments, each treatment replicated four times. The treatment details are given below.

T1: Mulberry pruning at 30 cm height.

T2: Mulberry pruning at 45 cm height.

T3: Mulberry pruning at 60 cm height.

T4: Mulberry pruning at 90 cm height.

T5: Mulberry pruning at 120 cm height.

T6: Mulberry pruning at 150 cm height.

Collection of Leaf Sample

Leaf sample was drawn from labeled five mulberry plants per treatment per replication for recording observations on quality parameters on 30, 45 and 60 days after pruning (DAP).

Quality Parameters of Mulberry

(1) *Leaf Moisture Content (%)*

To know the effect of pruning height on moisture content of leaf the samples were drawn and estimated by taking fresh weight (g) and dry weight (g) (Leaves were dried thoroughly at 60^0C for 72 hours in the oven) and expressed in per cent. It was calculated by using a formula as suggested by Association of Analytical Chemicals (1980).

$$\text{Leaf moisture content (\%)} = \frac{\text{Fresh weight of leaf} - \text{Dry weight of leaf}}{\text{Fresh weight of leaf}} \times 100$$

(2) *Leaf Moisture Retention Capacity (%) after 6 Hours*

The moisture retention capacity of the leaves was calculated using fresh weight, leaf weight after 6 hours and the dry weight of the leaves was expressed in per cent.

$$\text{MRC (\%)} = \frac{\text{Leaf weight after 6 hours} - \text{Dry weight}}{\text{Leaf weight after 6 hours}} \times 100$$

MRC = Moisture retention capacity.

(3) *Dry Matter Production (%)*

Dry matter production is calculated using formula.

Dry matter production = 100 – Moisture content (%).

(4) *Chlorophyll 'a', Chlorophyll 'b' and Total Chlorophyll of Leaf (mg/Fresh Weight)*

Leaf samples were collected from each treatment, washed in distilled water and used for estimation of chlorophyll pigments. Leaf samples of 100 mg were cut into equal segments and immersed in DMSO (Dimethyl sulphonic oxide) mixture. The absorbance was recorded at 663 nm and 645 nm by using spectrophotometer. Chlorophyll a, chlorophyll b and total chlorophyll were calculated as described by Hiscox & Israelstam (1979) and expressed as mg/g of fresh weight.

Chlorophyll 'a' = 12.7 (A663) - 2.69(645) x V / 1000 x W.

Chlorophyll 'b' = 22.9 (A645) - 4.68 (A663) x V / 1000 x W.

Total chlorophyll = chlorophyll a + chlorophyll b.

Where,

A = Absorbance at specific wavelength (645 and 663 nm).

V = Final volume of the chlorophyll extract (ml).

W = Fresh weight of the sample (g).

(5) *Plant Analysis*

Mulberry leaf samples were collected from every treatment at 30, 45 and 60 days after pruning for analysis. The plant samples were collected randomly and were dried thoroughly in hot air oven at 65^0C temperature and representative samples of leaf from each treatment were grinded to fine powder separately in grinder. Then, they were analyzed for N, P, K, Ca & Mg and S.

(1) *Nitrogen (%)*

The nitrogen content of plant sample was determined by modified micro Kjeldahl's method as per the procedure given by Jackson (1967).

(2) *Phosphorus (%)*

The phosphorus content of plant sample was estimated by Vanadomolybdate phosphoric yellow color method (Jackson, 1967) measuring the absorbance of the solution in spectrophotometer at 430 nm.

(3) *Potassium (%)*

The potassium content of the plant sample was determined by using the digital flame photometer as described by Jackson (1967).

(4) *Calcium and Magnesium (%)*

Di acid digested samples were titrated against standard EDTA with EBT indicator for calcium + magnesium and Patton readers indicator for calcium using versena tetitrimetry method (Piper 1966). The magnesium content observed by subtracting calcium value from calcium + magnesium value.

(5) *Sulphur (%)*

Sulphur content in the di acid digested sample was estimated by turbidimetric method as outlined by Jackson (1967).

(6) *Statistical Analysis*

The data recorded on various parameters were subjected to Fisher's method of Analysis of Variance (ANOVA) and interpreted according to Sundarraj *et al.* (1972). The level of significance used in F and t-tests P = 0.05 for RCBD and P = 0.05 for CRD. The critical difference (CD) values were computed where the F test was found significant.

III. RESULTS AND DISCUSSION

The different pruning heights was given to V-1 mulberry noticed significant difference among height of the pruning as well as days on all the quality parameters *viz.*, moisture content, moisture retention capacity and dry matter production.

Table 1. Effect of pruning heights on moisture content (%), moisture retention capacity (%) and dry matter production (%) in V-1 mulberry variety.

Treatments	Moisture Content			Moisture Retention Capacity			Dry Matter Production		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	78.59	73.88	73.12	85.80	84.38	83.18	21.41	26.88	26.13
T_2	78.08	71.51	71.58	94.06	85.07	81.12	21.92	28.49	28.42
T_3	76.78	70.86	70.91	89.45	89.99	84.07	23.22	29.14	29.09
T_4	75.76	70.03	69.66	90.49	86.99	83.13	24.25	29.97	30.34
T_5	75.51	68.65	68.85	90.56	87.66	84.64	24.49	31.35	31.15
T_6	72.77	67.00	66.65	96.36	94.95	90.64	27.23	33.41	33.00
F – test	*	*	*	NS	*	*	*	*	*
S. Em ±	0.69	0.66	0.96	3.55	2.36	2.96	0.69	0.66	0.96
C. D. @ 5%	2.09	2.01	2.90	10.71	7.12	8.93	2.09	2.01	2.90

The moisture content of V-1 mulberry leaves was found significant due to influence of pruning heights (30 – 150 cm) and days after pruning (30, 45 and 60 days). The maximum moisture content of leaf from 72.77 – 78.59 per cent was noticed for 30 DAP which was found decreased from 67.00 - 73.88 and 66.65 - 73.12 per cent moisture content recorded for 45 and 60 DAP. As the days after pruning increased from 30 - 60 days there was a decrease from 85.80 - 83.18 and 96.36 - 90.64 per cent moisture retention was recorded for T_1 and T_6 respectively. In general increased dry matter content from 21.41 – 26.13., 21.92 -28.42., 23.22 - 29.09., 24.25 -

30.34., 24.49 - 31.15 and 27.23 - 33.00 per cent was noticed in T_1, T_2, T_3, T_4, T_5 and T_6 respectively. Decreased dry matter production was noticed with decreased pruning height (30- 150 cm above the ground level) (Table 1). The findings are in the line of Choudhury *et al.* (1984) bottom pruning to mulberry recorded significantly higher moisture content of leaf at 54, 61, 68 days after pruning (70.72 %, 68.73 % and 67.8 % respectively). Further, Shakhawat Hossain *et. al.* (2016) also confirmed that, different cultivation forms of mulberry variety BM - 3 (*Morus alba*) on leaf nutrition, the results revealed that, leaf harvested from the high bush and bush contains higher amount of moisture 70.48 per cent, 69.77 per cent compare to low-cut and tree. Bhaskar *et al.* (2020) studied the pruning height on different varieties of mulberry in eastern dry zone of Karnataka. The result revealed that, the maximum leaf moisture content of 78.42 per cent was recorded for S-36 followed by S-54 (76.95%) and S-34 (76.31%) pruned at 90 cm above the ground level. Choudhury *et al.* (1984) showed bottom pruning to mulberry recorded significantly highest moisture content of leaf at 54, 61, 68 days after pruning (70.72 %, 68.73 % and 67.80 %, respectively) (Table 1).

Table 2. Effect of pruning heights on chlorophyll 'a', chlorophyll 'b' and total chlorophyll (mg/g) content of V-1 mulberry.

Treatment	Chlorophyll 'a'			Chlorophyll 'b'			Total Chlorophyll		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	1.77	1.50	1.31	0.57	0.38	0.25	2.32	1.88	1.56
T_2	1.67	1.40	1.21	0.43	0.33	0.21	2.10	1.73	1.41
T_3	1.61	1.32	1.15	0.52	0.35	0.20	2.20	1.67	1.34
T_4	1.59	1.31	1.13	0.38	0.29	0.16	1.88	1.60	1.29
T_5	1.51	1.29	1.10	0.46	0.27	0.15	2.13	1.61	1.25
T_6	1.41	1.17	1.07	0.30	0.18	0.13	1.72	1.35	1.19
F – test	*	*	*	*	*	*	*	*	*
S. Em ±	0.05	0.05	0.02	0.04	0.03	0.008	0.10	0.07	0.025
C.D. @ 5%	0.15	0.15	0.06	0.14	0.09	0.024	0.32	0.22	0.075

The chlorophyll content of V-1 mulberry leaves was found significant due to influence of pruning height (30 – 150 cm) and days after pruning (30, 45 and 60 days). The maximum mean chlorophyll 'a', chlorophyll 'b' and total chlorophyll content of 1.77, 1.50 and 1.31 mg/g., 0.57, 0.38 and 0.25 mg/g and 2.32, 1.88 and 1.56 mg/g was noticed in T_1 (30 cm above the ground level) after 30, 45 and 60 days of pruning. The minimum mean chlorophyll 'a', chlorophyll 'b' and total chlorophyll content of 1.41, 1.17 and 1.07 mg/g., 0.30, 0.18 and 0.13 mg/g and 1.72, 1.35 and 1.19 mg/g of leaf was noticed in T_6 (150 cm above the ground level) at 30, 45 and 60 days after pruning, respectively. The pruning heights *viz.*, 45, 60, 90 and 120 cm above the ground level to V-1 mulberry is also followed the same trend in chl. 'a', chl. 'b' and total chl. content. It was vivid from the data that, the increased pruning height from 30 -150 cm noticed decreased chl. 'a' chl. 'b' and total chl. content. The increase days after pruning and height of pruning registered significant results. The above results are in agreement with the findings of Ratna Sen *et al. (*1991) according to them quality of leaf under two pruning systems. The mulberry plants pruned at ground level (basal pruning) and at 35 cm above the ground level (high stem pruning) resulted significant difference in nutritive quality of mulberry leaf with respect to significant increased chlorophyll content was observed in the leaf of plant pruned at ground level compared to high stem

pruning (Table 2). Chaluvachari and Bongale (1994) also recorded same type of observation with respect to chlorophyll 'a', chlorophyll 'b' and total chlorophyll content of 1.66, 0.82 and 2.48 mg/g FW respectively in leaves of Kanva-2 variety harvested at 45 days after pruning. The same trend was observed in the present study where in increased pruning height was noticed decreased chlorophyll content of V-1 *viz.*, 1.77, 1.50 and 1.31., 0.57, 0.38 and 0.25 and 2.23, 1.88, 1.56 mg/g followed by 1.41, 1.17and 1.07, 0.30, 0.18 and 0.13, 1.72, 1.38 and 1.99 mg/g in chl. a, chl. b and total chl. after 30, 45 and 60 DAP in T_1 and T_6.

Table 3. Effect of pruning heights on nitrogen (%), phosphorous (%) and potassium (%) content in leaf of V-1 mulberry.

Treatments	Nitrogen			Phosphorous			Potassium		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	3.90	3.83	2.83	0.58	0.42	0.37	2.04	1.99	1.95
T_2	3.78	3.57	2.58	0.53	0.41	0.36	1.96	1.98	1.90
T_3	2.58	3.54	2.40	0.51	0.39	0.36	1.89	1.93	1.86
T_4	2.30	3.03	2.25	0.51	0.38	0.31	1.89	1.85	1.74
T_5	1.92	2.18	2.12	0.51	0.36	0.31	1.82	1.82	1.73
T_6	1.96	2.13	1.58	0.49	0.35	0.30	1.73	1.80	1.69
F – test	*	*	*	*	*	*	*	*	*
S. Em ±	0.10	0.09	0.13	0.009	0.008	0.01	0.02	0.02	0.03
C. D.@ 5%	0.32	0.28	0.40	0.026	0.02	0.04	0.06	0.06	0.08

The per cent nitrogen, phosphorus and potassium of V-1 leaves registered increase in nitrogen content of 3.90, 0.58 and 2.04 per cent N P K was observed for T_1 followed by T_2, T_3, T_4 and T_5 at 30 DAP. The decreased N P K content of 1.96, 0.49 and 1.73 per cent was noticed when plants received pruning height of 150 cm above the ground level. However, the decreased trend of N P K of 3.83, 0.42 and 1.99 per cent and 2.83, 0.37 and 1.95 per cent was noticed for 45 and 60 DAP, respectively and found significant (Table 3). The present experimental data was in parity with findings of Dube and Mishra, (1969) according to them the nitrogen content of leaf was found more with bottom pruning (2.25 %) compared to middle pruning (2.18 %). Further, Himantharaj *et al.* (2004) studied the effect of shoot thinning on biochemical parameters of mulberry. There was significant improvement in total nitrogen, crude protein, leaf sugars and starch in the shoot thinned plants (Table 3). The same line of findings was observed by Sudradjat (1989) according to him height and frequency of pruning in bush mulberry influence the quality of leaves. Pruning at a height of 70 cm above the ground level contains more protein and phosphorus compared to those pruned at 20 cm and 120 cm above the ground level. This observation was not in parity with 30 cm above the ground level when V-1 mulberry was harvested (3.90, 0.58 and 2.04 N P K %) at 30 DAP.

Table 4. Effect of pruning heights on calcium (%), magnesium (%) and sulphur (%) content in V-1 mulberry variety.

Treatments	Calcium			Magnesium			Sulphur		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	1.20	1.17	1.20	0.13	0.12	0.12	0.17	0.16	0.14
T_2	1.17	1.15	1.14	0.12	0.12	0.12	0.16	0.16	0.13

Treatments	Calcium			Magnesium			Sulphur		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_3	1.14	1.11	1.11	0.12	0.11	0.11	0.12	0.12	0.14
T_4	1.15	1.17	1.12	0.12	0.12	0.12	0.16	0.16	0.12
T_5	1.13	1.13	1.12	0.12	0.11	0.11	0.13	0.13	0.12
T_6	1.11	1.07	1.00	0.11	0.10	0.10	0.12	0.12	0.11
F – test	*	*	*	*	*	*	*	*	*
S. Em ±	0.008	0.01	0.03	0.001	0.002	0.002	0.005	0.004	0.005
C. D.@ 5%	0.02	0.04	0.10	0.003	0.006	0.006	0.01	0.01	0.01

The biochemical constituents of mulberry leaf *viz.*, calcium, magnesium and sulphur content of V-1 mulberry was significantly influenced by days after pruning (30, 45 and 60) and height of the pruning (30 – 150 cm). Significantly higher calcium, magnesium and sulphur percent of 1.20, 0.13 and 0.17., 1.17, 0.12 and 0.16 and 1.20, 0.12 and 0.14 recorded, respectively where plant was pruned at 30 cm above the ground level. On the other hand, the plant received the maximum pruning height of 150 cm above the ground level also recorded, 1.11, 0.11 and 0.12., 1.07, 0.11 and 0.12 and 1.00. 0.10 and 0.11 per cent calcium magnesium and sulphur content at 30, 45 and 65 DAP and found minimum. It was confirmed that, increased height of the pruning and days of harvest of V-1 mulberry noticed decreased trend of all the biochemical constituents as reflected in the findings (Table 4). The above results are similar with the findings of Shakhawat Hossain *et al.* (2016) according to them different cultivation forms of mulberry variety BM-3 (*Morus alba*) on leaf nutrition. The results revealed that, leaf from bush mulberry contains high crude protein (21.25 %) and mineral (8.95 %) contents compared to high bush (Table 4). Further, Sudradjat, (1989) the height and frequency of pruning in bush mulberry influence the quality of leaves. Pruning at different heights *viz.*, 20, 70, 120 cm did not influence the quantity of leaves, pruning at a height of 70 cm above the ground level contains more protein, calcium and phosphorus compared to those pruned at 20 cm and 120 cm above the ground level. The same type of observation was noticed even in the present study when V-1 variety received pruning height of 45 -120 cm above the ground level recorded significant difference at different heights as well as days after pruning.

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