GROWTH STUDIES IN WINTER PRUNED RAINFED MULBERRY, *MORUS* SPP.

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Introduction

Mulberry sericulture being a time bound activity, the farmers need to have before hand information on the availability of leaf in their Mulberry garden for deciding quantum of silkworm to be reared. Leaf yield depends on growth and development of Mulberry plants which in turn is a result of cumulative effect of Mulberry variety, agronomical and cultural practices, incidence of diseases and pests and weather conditions. Out of these factors the first four factors can be managed by farmer but not the last one. Weather influences the Mulberry leaf yield either through its direct effect on the plant physiology or through changing the other factors responsible for leaf production. The growth pattern of Mulberry plant therefore varies from place to place depending upon the agroclimatic conditions.

Sericulture in South Bihar being a recent origin, there in no systematic study on the growth pattern of Mulberry and its impact on the leaf yield. Encouraging results have however been achieved on leaf yield during spring crop by practicing winter pruning during third week of November (Jayaswal *et al.*, 1996). It was therefore proposed to evaluate the growth pattern of Mulberry under different pruning schedules and its impact on the leaf yield.

Materials and Methods

Existing plantation of Mulberry (*Morus alba* L.) variety S1 at Chawki Rearing Centre, Hehal, Ranchi was taken up as experimental material. Garden was pruned under different systems viz, Bottom (15 cm) pruning separately on 7th November, 20th November, 1st December and 1st January, Middle (90 cm) pruning separately on 7th and 20th November, 1st December and 1st January, Middle (90 cm) pruning separately on 7th and 20th November, 120 cm pruning on 10th January and 150 cm pruning on 10th January. Unpruned plot exhibited check. All the unproductive trailing branches at ground level were cut and removed. Plantation was maintained under recommended agronomical and cultural practices for rainfed Mulberry cultivation in South Bihar which included bottom pruning in June, application of FYM @ 10 t/ha in single dose during June and chemical fertilizer @ 150N : 50P : 50K kg/ha/year in two equal split doses each during June and January.

For data collection, leading branches (longest branches) of three plants in each plot were tagged during middle of January, the time when the active growth of Mulberry

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plant after winter dormancy starts in Bihar. Data on shoot length, leading branch length, number of leaves, leaf length and leaf width were recorded at an interval of 10 days. Leaf area was calculated by L x W method (Kashiviswanathan *et al.*, 1966). Data on length of leading branch, foliage area (Average leaf area x No. of leaves in the leading branch), fresh weight and dry weight of leading branch were recorded at five dates. Intention was to take minimum destructive sample for precisely simulation of plant growth and leaf yield. For estimation of biomass and dry matter, separate branches of the size of leading shoot from the other plants of the same plots were cut and fresh weight of twigs and leaves recorded. Dry weight of twigs and leaves was recorded by oven drying method at 80°C till constant weight achieved. At the time of leaf harvest, data were recorded on the total number of leaves, leaf weight and twig weight of the plant where leading branches were tagged. The different growth rates were estimated as follows :

$GR = \Sigma(wi-(wi-i))/(ti-(ti-i))/n$
where i = 2nd, 3rd, 4th and 5th dates of observation.

The following growth rates of leading shoot were worked out :

1. Linear Branch Growth Rate (LBGR) - Elongation of leading branch (cm/day)
2. Foliage Area Growth Rate (FAGR) - Rate of increase in total foliage area (cm^2/day)
3. Fresh Biomass Growth Rate (FBGR)- Rate of increase in fresh weight of twig and leaves (g/day)
4. Dry Biomass Growth Rate (DBGR) - Rate of increase in dry weight of twig and leaves (g/day)
5. Leaf Weight Growth Rate (LWGR) - Rate of increase in fresh weight of leaves (g/day).

Data on various growth rates under different pruning schedules were statistically analysed to find out significant differences. Relationships of these growth rates with leaf yield were studied through correlation and regression analyses.

Results and Discussion

Growth rate under different pruning schedules : Data presented in Table 1 show that linear branch growth rate (LBGR) was at par under bottom and middle pruning in all the dates except that under middle pruning during third week of November which resulted in lower LBGR as compared to that under bottom pruning during third week of November. Other pruning schedules showed lower LBGR. Foliage area growth rate (FAGR) was more under the middle pruning during third week of November and bottom pruning during first week of November followed by that under middle during first week of November. Again the other pruning schedules resulted in lower foliage growth rates. Fresh biomass growth rate (FBGR), dry biomass growth rate (DBGR) and leaf weight growth rate (LWGR), also followed more or less similar trend as did the LBGR and FAGR. Leaf yield under these pruning schedules had also shown similar trend i.e. bottom and middle pruning specially during November month, resulted in higher leaf yield while the pruning at 120 cm or 130 cm during January resulted in lower leaf yield.

Correlation data presented in Table 2

Table 1

Various plant growth rates under different winter pruning schedules of rainfed Mulberry in South Bihar

Treatment	LBGR	FAGR	FBGR	DBGR	LWGR	LYLD/pl
T1	0.987	30.963	1.033	0.343	0.567	755.11
T2	1.033	29.610	0.893	0.253	0.530	608.09
T3	0.993	19.110	0.543	0.210	0.300	906.98
T4	1.050	15.900	0.390	0.113	0.237	150.27
T5	1.153	21.330	0.453	0.153	0.297	399.19
T6	0.927	33.240	1.023	0.303	0.637	665.17
T7	0.420	12.660	0.253	0.093	0.170	301.96
T8	0.117	7.470	0.200	0.067	0.137	260.02
T9	0.100	5.290	0.110	0.047	0.080	160.64
CD at 5%	0.358	3.098	0.081	0.022	0.067	51.09

T1 = Bottom (15 cm) pruning during 1st week of November, T2 = Bottom pruning during 3rd week of November, T3 = bottom pruning during 1st week of December, T4 = Bottom pruning during 1st week of January, T5 = Middle (90 cm) pruning during 1st week of November, T6 Middle pruning during 3rd week of November, T7 = 120 cm pruning during 2nd week January, T8 = 150 cm pruning during 2nd week of January and T9 = Control (No pruning)

LBGR = Laner branch growth rate (cm/day), FAGR = Foliage area growth rate (cm^2/day), FBGR = Fresh biomass growth rate (g/day) DBGR = Dry biomass growth rate (g/day), LWGR = Leaf weight growth rate (g/day), LYLD = Leaf yield (g/plant)

All growth rates are based on single branch analyses.

Table 2

Correlation coefficient within dependent variable and between dependent and independent variable

	LBGR	FAGR	FBGR	DBGR	LWGR	LYLD
LBGR	1.000	0.743	0.668	0.639	0.643	0.520
FAGR		1.000	0.966	0.944	0.961	0.884
FBGR			1.000	0.973	0.984	0.935
DBGR				1.000	0.950	0.908
LWGR					1.000	0.965
LYLD						1.000

Abbreviations as given in Table 1

All the correlation coefficient values are significant at p = 0.01

Table 3

Step down regression analysis

Regression equation	R-SQ	F cal
Y = 87.62 - 103.17 X1 + 4.66 X2 + 435.52 X3 + 1238.51 X4 - 397.07 X5 (55.83) (7.73) (368.29) (684.10) (497.67)	0.898	37.15**
Y= 98.68 - 84.31 X1 + 463.10 X3 + 1320.54 X4 - 288.37 X5 (36.78) (45.57) (360.11) (660.68) (457.13)	0.897	47.73**
Y=89.97 - 80.81 X1 + 274.59 X3 + 1399.94 X4 (33.64) (44.64) (198.30) (640.03)	0.895	65.21**
Y = 78.11 - 64.57 X1 + 2244.78 X4 (33.14) (43.89) (197.07)	0.886	93.3**
Y = 60.03 + 2059.62 X4 (31.49) (155.16)	0.876	176.21**

Y = LYLD, X1 = LBGR, X2 =FAGR, X3 = FBGR, X4 =DBGR, X5=LWGR

**significant at p=0.01

Parentheses values indicate standard errors for regression coefficient.

show that inspite of practically independent observations all the growth rates except LBGR had strong and positive correlation with each other as indicated by higher values. Correlation of different growth rates with leaf yield revealed strongest positive relation of DBGR followed by FBGR, LWGR and then FAGR. LAGR showed least relationship with leaf yield. When the data were put to step down multiple regression analysis (Table 3), three growth rates viz. LBGR, FBGR and DBGR together explained 89.5% variation in leaf yield which was at par with that explained by all the five growth rates (89.8%). Dropping one more variable (FBGR) in the next step R^2 was found to be 0.866, which was only 0.09 point less than that for three variables and finally single variable DBGR was found to be the best associated explaining 87.6% variation in leaf yield. In fact three growth rates viz. DBGR, FBGR and LWGR individually explained above the 80% variation in leaf yield and any of these variables, can be used in predicting leaf yield.

Pruning enhances sprouting of lateral buds and accelerates shoot growth (Rangaswamy *et al.*, 1976). Enhanced growth rates of Mulberry during spring under middle pruning conducted during preceding November month are therefore in conformity to above fact. Higher cuts leave a large number of initial branches in the plant which do not get sufficient food material from limited root system to cope up their faster growth. The reason for lower growth rates under middle pruning during November first week as compared to third week may be found out from the incidence of thrips during October-November in South Bihar which attack tender leaves of intact branches thereby arresting their growth.

The dry matter of aerial parts mainly constitute stored food material which is utilized for plant growth particularly during

Spring (Shirate and Takahashi, 1987 a and b). Dry biomass growth rate (DBGR) therefore resulted in better association with leaf yield as compared to other growth rate parameters. This parameter alone could be used to precisely predict the leaf yield of the plant. The exercise supports findings of pruning schedule on South Bihar (Jayaswal *et al.*, 1996) and expresses the need for rescheduling the pruning system in the area for optimising leaf production during spring commercial crop of silkworm.

Acknowledgements

Authors are thankful to Joint Director, Regional Sericulture Research Station, Ranchi (Bihar) for permission of this study and fellow workers for assistance and encouragement.

SUMMARY

Rainfed Mulberry in South Bihar showed better growth rates of shoot length, foliage area, fresh and dry biomass as well as leaf weight during spring season under bottom or middle pruning conducted during preceding November month. All the growth rates had shown strong correlation with each other and their association with leaf yield was of the order of dry biomass growth rate > fresh biomass growth rate > leaf weight growth rate > foliage area growth rate > linear branch growth rate. Leaf yield was well predicted by dry weight growth rate with 87.6% precision.

वर्षा पोषित शहतूत, *मोरस* की जाति, की सर्दियों में छंटाई करने पर उसकी बढ़वार का अध्ययन

एस०के० गंगवार व एस० राय

सारांश

दक्षिण बिहार में वर्षा पोषित शहतूत में प्ररोह लम्बाई, पर्ण क्षेत्र, ताजा और शुष्क जैवपुंज और वसन्त ऋतु में पत्तियों के भार की दरें, पिछले नवम्बर में तली या मध्य भाग तक छंटाई करने पर श्रेष्ठतर पाई गई। सभी वृद्धि दरों का एक दूसरे के साथ सहसंबन्ध बहुत मजबूत दिखाई पडा और पत्तियों की प्राप्ति के साथ उनका साहचर्य इस प्रकार का रहा - शुष्क जैवपुंज बढ़ने की दर > ताजा जैवपुंज बढ़ने की दर > पत्तियों का भार बढ़ने की दर > पत्तियों का क्षेत्र बढ़ने की दर > शाखाओं की रेखीय वृद्धि की दर। पत्तियों की प्राप्ति का पूर्वानुमान शुष्क भार बढ़ने की दर से अच्छी तरह लग गया जिसकी सुस्पष्टता 87.6 % रही ।

References

Jayaswal, J., S.K. Gangwar, B.D. Singh, A.K. Roy, P.S. Sinha, M.K. Singh and P.K. Mishra (1996). Evaluation of winter pruning schedule for Mulberry gardens in South Bihar. *Sericologia* (in press).

Kashiviswanathan, K., P.C. Choudhary, U.P. Bongale and S. Krishnaswami (1981). Effect of top clipping on growth and development pattern of Kanva-2 under irrigated conditions. *Indian J. Seric.*, **20** : 21-26.

Kashiviswanathan, K., M.N.S. Iyengar and N. Natrajan (1966). Simple method for leaf area estimation in Mulberry. *Morus alba* L. *Indian J. Seric.* **5** : 18-24.

Rangaswami, G., M.N. Narshimhanna, K. Kashiviswanathan, C.R. Sastry and M.S. Jolly (1976). *Sericulture manual*. 1 - Mulberry cultivation, FAO, Rome. 150 pp.

Shirata, K. and H. Takahashi (1987). Seasonal change of nitrogen components in grown up Mulberry tree. *J. Seric. Sci. Japan*. **56** (1) : 52-58.

Shirata, K. and H. Takahashi (1987). Seasonal change of carbohydrate components in grown up Mulberry tree. *J. Seric. Sci. Japan*. **56** (2) : 99-105.