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VARIABILITY IN RELATIVE GROWTH RATE IN MULBERRY VARIETIES

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SUMMARY

Three varieties of mulberry (*Morus indica* L.) viz. K-2, S-36 and V-1 were considered to study the variability in relative growth rate (RGR) at frequent harvests with an interval of five days starting from 30 days of pruning onwards till 75 days (final harvest) during July – August , 2001 and January – February, 2002. The study indicated that the RGR varied significantly in all the tested varieties. High and low growth phases during the growing period were also identified. Though the genotypes differ in their yield potentiality the varieties being within the same species did not vary significantly among each other with respect to RGR. No seasonal variability in RGR was noticed. The relationship between RGR and time for different mulberry varieties was also worked out.

Key words: **Mulberry, relative growth rate.**

INTRODUCTION

Relative growth rate (RGR) is considered to be one of the important growth determinants of plants. Growth analysis provides insight into avenue for future yield improvement combining the physiological traits with other desirable characters that have been accumulated in elite varietal selection. RGR represents the efficiency of the plant as a producer of new material and provides a measure of the plant's economy in producing dry matter. RGR may be described as the efficiency index of dry weight production. The usefulness of RGR in growth analysis has been well documented previously (Roberts and Wareing 1975, Hurd 1977, Hunt 1978, Lindhout *et al.* 1991, Rechel and Novotny 1996.)

The present paper performs an exitensive comparison by investigating the RGR of three popular mulberry varieties developed in this Institute at different times varying in their yield potentiality and to establish a relationship between the RGR and time in the course of production of leaf in mulberry. Due to the expression of ontogenic drift the RGR when recorded from frequent harvests is expected to show an increase and fall at different harvests. The present investigation further aims to study the variability in RGR at different stage in three mulberry varieties and to identify the high and low growth phases which could be utilized for further manipulating the yield of leaves in mulberry.

MATERIALS AND METHODS

The experiment was conducted in the farm of Central Sericultural Research and Training Institute, Mysore with three varieties of mulberry viz., Kanva-2 (K-2), S-36 and Victory-1 (V-1) having a yield potential of 30-35, 40-45 and 65-70 metric tons ha^{-1} yr^{-1} respectively. All the genotypes were developed at this institute. The soil of the experimental site was red loam with a pH of 7.8. The study was conducted under irrigated condition during two

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season viz., July—August, 2001 and January – February, 2002 in an established mulberry garden with a spacing of 60 x 60 cm. After pruning at ground level, the plants were maintained as per recommended package of practices (Sarkar *et al*. 2001). Record of data was initiated at 30 days after pruning and continued till 75 days at an interval of five days. RGR of different mulberry varieties were determined on dry weight basis. The increment in aerial biomass of selected five plants was estimated by using the mean dry matter weight of unit shoot length of three sample plants of similar type at each harvests. Data were collected at an interval of five days till 75 days (final harvest) by sacrificing three sample plants at each harvest. At each harvest three sample plants were pruned at schedule harvest days of 30, 35, 40, 45, 50, 55, 60, 65 and 70 days after pruning and total length of shoots per plant were measured after discarding weak branches. Leaves and stems were separated and dried in a hot air oven at 60^0C until constant weight. Average dry weight per unit length of shoot was calculated by:

$$\frac{\text{Dry weight of shoots (leaf + stem)}}{\text{Total length of shoots}}$$

At the same day of harvesting, the total length of shoot of the experimental plants from each cultivars was measured. The aerial biomass at a particular harvest for individual varieties was calculated from the sample plants and used to estimate the dry weight of the experimental plants at different harvests. RGR was calculated according to the formula suggested by Hunt (1978).

$$RGR = \frac{\ln W_2 - \ln W_1}{t}$$

Where, RGR = Relative growth rate expressed as increase in plant weight per unit of plant weight per unit of item (gg^{-1} day^{-1})

W_1 and W_2 = Dry aerial biomass at harvest 1 and 2, respectively.

t = Time gap (days) between two harvests.

The dry weight of the plant at 75 days after pruning was recorded directly by complete pruning of the experimental plants.

The difference in RGR in different times and in different varieties was tested through analysis of variance. Comparison of RGR in any two varieties and seasons was made through Student's "t" test. The relationship between RGR and time for different mulberry varieties was studied through regression analysis.

RESULTS AND DISCUSSION

The changes in total dry weight of the plants with time in different mulberry varieties are presented in Fig. 1. It is observed from the figure that the growth was not very smooth. Following this, the changes in mean RGR with time (gg^{-1} day^{-1}) measured for 5 days period

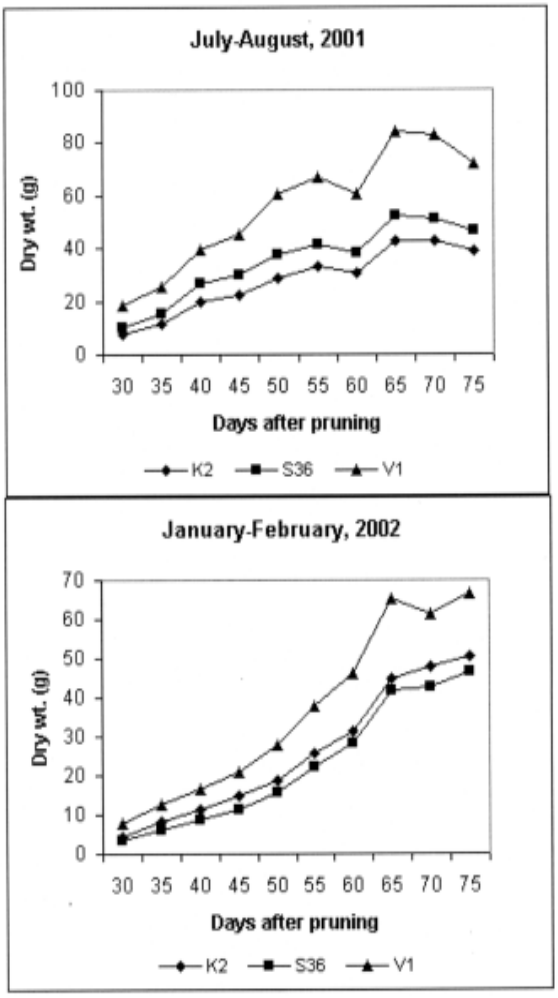

Fig. 1. Aerial dry weight (g) in different mulberry varieties during different seasons.

for three mulberry varieties are presented in Fig. 2. Analyses of variance of RGR data (Table 1) indicated that all the varieties differed significantly in their RGR

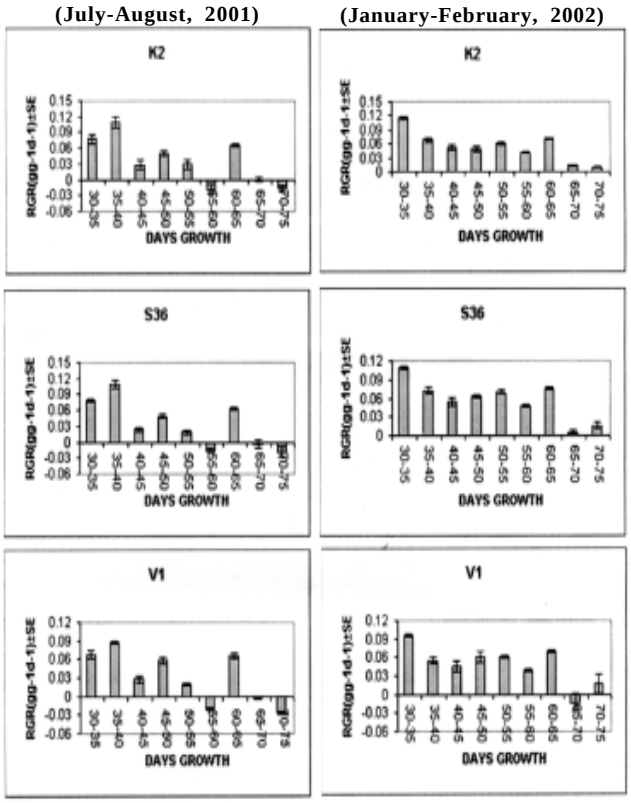

Fig. 2. Changes in RGR with time in different mulberry varieties in different seasons.

measured at different growth phases. The RGR of those three mulberry varieties measured at different growth phases when compared through "t" test revealed that the difference between any two cultivars was not significant except in S-36 and V-1 during January-February season. Similar type of result was also obtained by Causton (1991). He reported that there was rarely any significant difference between the RGRs within one species. As the three mulberry varieties used in this study belong to the same species, probably the RGRs among the varieties were not found significant. When the two seasons were compared the RGRs tend to be similar and the difference was also non-significant though the varieties vary largely in the production of dry matter in different seasons.

Maximum RGR was noticed during the initial stage of growth. In July—August, the highest RGR was noticed between 35-40 day period and this remained the same for all the three varieties. Contrarily, during January – February, maximum RGR was noticed in 30-35 day period in all the varieties and in July – August, the RGR was maximum during 35-40 days growth period. The peak of RGR for mulberry in tropical condition reached within 40 days of pruning. Interestingly, after 55 days of pruning a negative growth phase was observed in all the varieties, while in July – August the growth resumes after 65 days and started declining with the negative RGR after 70 days. In January – February, RGR pattern is different. Low RGR in K-2 and S-36 was observed only after 65 days whereas during this period V-1 showed a negative growth rate. The RGR curve is comparatively smooth in January – February. Mostly, the change in RGR, which occurred within the plant with the passing of time, is an expression of ontogenic drift. Briggs *et al.* (1920) observed that RGR fluctuated considerably from week to week at different stages of growth.

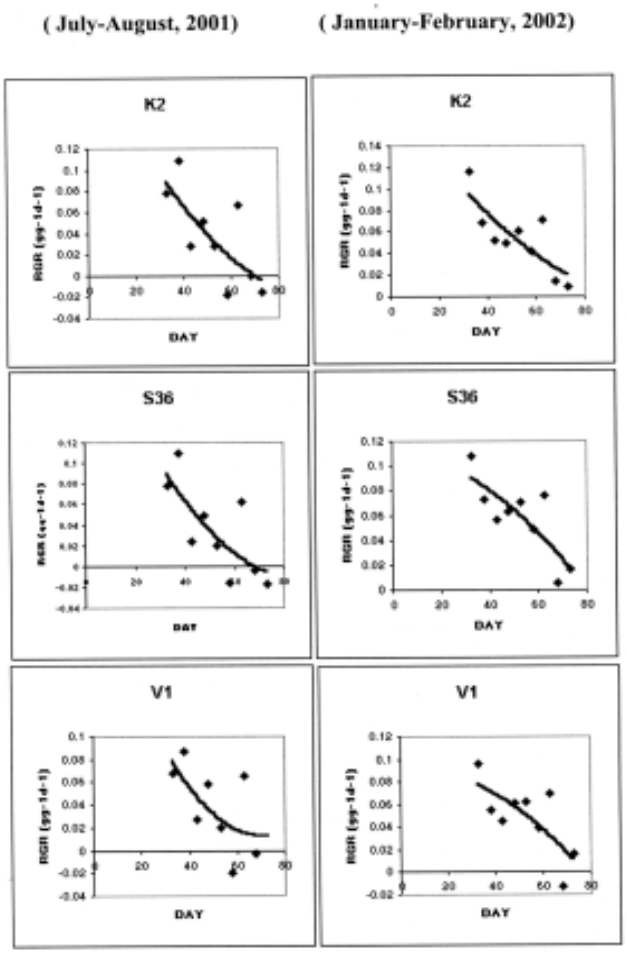

Fig. 3. Relationship between RGR and time in different mulberry varieties in different seasons.

Table 1. Meant relative growth rate ($gg^{-1}d^{-1}$) in different mulberry varieties during different seasons.

	July – August 2001			January – February 2002		
Days growth	**K2**	**S36**	**V1**	**K2**	**S36**	**V1**
30-35	0.0772	0.0780	0.0675	0.1157	0.1082	0.0963
35-40	0.1085	0.1093	0.0869	0.0684	0.0728	0.0552
40-45	0.0276	0.0237	0.0268	0.0518	0.0556	0.0455
45-50	0.0508	0.0482	0.0577	0.0492	0.0630	0.0611
50-55	0.0284	0.0190	0.0197	0.0611	0.0705	0.0617
55-60	-0.0180	-0.0162	-0.0200	0.0417	0.0484	0.0387
60-65	0.0660	0.0619	0.0651	0.0707	0.0763	0.0694
65-70	-0.0002	-0.0040	-0.0031	0.0142	0.0053	-0.0130
70-75	-0.0162	-0.0182	-0.0280	0.0093	0.0162	0.0166
F test	**	**	**	**	**	**
SE	0.0033	0.0023	0.0018	0.0037	0.0046	0.0098
CD (5%)	0.0096	0.0067	0.0052	0.0107	0.0132	0.0283
t-test (paired)		**July-August, 2001**			**January-February, 2002**	
Between						
K-2 and S-36		1.67 NS			1.26 NS	
K-2 and V-1		1.76 NS			1.29 NS	
S-36 and V-1		0.98 NS			2.55**	
t-test (paired) : Between two seasons for different cultivars						
K-2	1.65 NS					
S-36	1.93 NS					
V-1	1.59 NS					

** Significant at 1% level, NS: not significant

Table 2. Fitting of polynomial function for the RGR ($gg^{-1}d^{-1}$) vs. days of growth.

Season	**Variety**	**Regression equation**	**R^2**
July-Aug., 2001	K-2	$Y = 0.226-0.005\ X + 0.00003\ X^2$	0.585
	S-36	$Y = 0.190-0.0034 + 0.00001\ X^2$	0.645
	V-1	$Y = 0.244-0.0066\ X + 0.00005\ X^2$	0.390
Jan.-Feb., 2002	K-2	$Y = 0.091 + 0.0001\ X – 0.00002\ X^2$	0.523
	S-36	$Y = 0.251 – 0.0061\ X + 0.00003\ X^2$	0.557
	V-1	$Y = 0.115 – 0.0003\ X – 0.00001\ X^2$	0.631

Y = RGR, X = Days of growth

Further, the calculation of a growth index like, RGR is more useful when it shows a relationship with time. The choice of mathematical functions that can adequately describe this relationship is critical in the regression procedures of growth analysis. Fig. 3**.** Shows the regression curve where second order polynomial (quadratic curve) was found to be the best fit in all the varieties. The regression equation for different mulberry varieties and R^2 values are presented in Table 2. R^2 values were found to be moderate in all these varieties.

In conclusion, during the growth period of mulberry the RGR is phasic and at one stage tends to be zero or even negative. The fall in RGR between 55-60 days soon recovers within 60-65 days and then gradually declines.

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