Indian Journal of Natural Rubber Research, 9(1) : 40-43, 1996

ESTIMATION OF BIOMASS IN *HEVEA* CLONES BY REGRESSION METHOD : 2. RELATION OF GIRTH AND BIOMASS FOR MATURE TREES OF CLONE RRIM 600

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Dey, S.K., Chaudhuri, D., Vinod, K.K., Pothen, J. and Sethuraj, M. R. (1996). Estimation of biomass in *Hevea* clones by regression method : 2. Relation of girth and biomass for mature trees of clone RRIM 600. *Indian Journal of Natural Rubber Research*, 9(1): 40-43.

Determination of biomass in tree crops like *Hevea* is cumbersome and a most viable alternative method is to estimate the biomass as a function of a common measure of growth, like girth. In the present study relationships were worked out with girth at 150 cm from bud union and above ground biomass for trees of clone RRIM 600. Both power as well as exponential regression equations fitted were found to be reliable in all classes of girth from 45 to 93 cm. The relationships are $W = 0.0202\ G^{2.249}$ (power) and $W = 24.8486\ e^{0.0343G}$ (exponential).

Key words : *Hevea brasiliensis*, girth, biomass, regression

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INTRODUCTION

Determination of biomass is an essential part of crop response studies. In field crops, this can easily be done by the destructive method of harvesting the entire plant and recording its weight. Biomass determination in tree crops like *Hevea* by destructive sampling is not feasible since the labour, space and time requirement for actual biomass determination is considerable. The best and most viable alternative is to identify an easy method to determine any growth component which can be related to the biomass. Such method can be used to estimate the biomass of any number of trees at any time without destroying them.

Some growth components are reported to have direct relationship with biomass in many tree crops including *Hevea*. The relationship between girth and biomass, the most commonly used growth measurement in *Hevea* research, has already been proved (Constable, 1955; Shorrocks, 1965; Shorrocks *et al.*, 1965). The relationship is expressed as :

Shoot weight in kg(W)=0.002604 $G^{2.7826}$ ....(1)

where, shoot is defined as all above ground parts of the plant and G is the girth in cm at 150 cm height.

However, this generalised equation has limitations when different agroclimatic conditions are taken into consideration (Mo and Liang, 1980; Chaudhuri *et al.*, 1995). It is therefore more appropriate to develop clone specific and region specific relationships. Moreover, Shorrocks *et al.* (1965)

Table 1. **Power and exponential equations of biomass on girth**

Girth class	Power regression	R^2	Exponential regression	R^2
45 - 62 cm	$W = 0.06267\ G^{1.3851}$	0.715***	$W = 38.2671\ e^{0.0260G}$	0.714***
63 - 82 cm	$W = 0.00237\ G^{2.7903}$	0.802***	$W = 19.4157\ e^{0.0381G}$	0.871***
83 - 93 cm	$W = 0.00675\ G^{2.5034}$	0.968***	$W = 40.0344\ e^{0.0286G}$	0.974***
Pooled	$W = 0.02020\ G^{2.492}$	0.961***	$W = 24.8486\ e^{0.0343G}$	0.971***

*** Significant at P=0.001 level

has cautioned about the reliability of their equation beyond the girth of 60 cm. Chaudhuri *et al.* (1995) has used power regression equations to relate girth and biomass in different *Hevea* clones at their juvenile stage upto a girth of 32 cm at 15 cm above bud union.

An attempt was made in this paper to find out a more reliable equation relating girth and biomass of *Hevea* clone RRIM 600 grown in a non-traditional rubber growing region of North East India where climatic extremes like winter and summer influence the growth considerably.

MATERIALS AND METHODS

Thirty four trees of the clone RRIM 600 of *Hevea brasiliensis* planted in a clonal block garden at the regional research farm of the Rubber Research Institute of India located at Taranagar, Agartala (23° 53'N; 90° 15'E; 30 m MSL) uprooted by a heavy wind in April 1994 were chosen for the study. The age of the plants varied from 7 to 14 years. All trees had received normal recommended cultural practices. The girth of the trees was recorded at 150 cm above bud union. The samples of leaves and shoots from each tree were dried to constant weight (at 80°C) separately and the total biomass of individual trees computed based on the dry weight / fresh weight ratio of the biomass components. The best fit regression lines were derived using standard procedures (Gomez and Gomez, 1984).

Table 2. **Mean square variation component of fitted curves**

Girth class	MS due to regression	MS due to deviation	F-value
Power regression			
45 - 62 cm	0.244	0.006	37.7**
63 - 82 cm	0.317	0.009	36.4**
83 - 93 cm	0.043	0.000	**
Pooled	7.170	0.009	780.9**
Exponential regression			
45 - 62 cm	0.244	0.007	37.5**
63 - 82 cm	0.317	0.009	36.3**
83 - 93 cm	0.043	0.000	**
Pooled	7.244	0.007	1053.9**

** Significant at P = 0.01

Table 3. **Efficiency of the fitted general equation**

Girth class (cm)	No. of samples	Mean girth (cm)	Mean biomass (kg)	Estimated biomass ± mean variation	
				Power*	Exponential*
45 - 62	16	53.54	155.09	156.140±17.599 (0.672)	155.94±14.162 (0.545)
63 - 82	10	70.86	295.33	293.288±27.779 (0.696)	282.489±28.349 (4.546)
83 - 93	8	87.07	485.80	466.149±21.106 (4.216)	492.610±14.471 (1.382)

* Absolute values of percentage bias on estimated value is given in parentheses

All values are non-significant

RESULTS AND DISCUSSION

The girth of the trees ranged from 46.5 to 92.1 cm and biomass from 113.5 to 563.3 kg. Both power as well as exponential regression equations were found to be highly significant for each of the three different girth class, i.e., 45-62 cm, 63-82 cm and 83-93 cm and also for the pooled data (Table 1). The mean squares of regressed and deviation components of each fitted curve are given in Table 2. It has been found that both the equations are equally acceptable, and the precision of the exponential regression is slightly higher for the pooled data. The intercept and slope components of the regression lines showed variation in different girth classes, which may be attributed to less number of trees included in each class. However, this variation was found relatively less in exponential than in power regression. To alleviate the difficulty in handling individual regression equations derived from a limited number of trees for individual classes, the efficiency of the pooled equations(Table 1) was tested and were found to fit well for all the classes. The general equations derived are :

a) power regression equation

$$W = 0.0202\ G^{2.249} \quad \text{.......... (2)}$$

b) exponential regression equation

$$W = 24.849\ e^{0.0343G} \quad \text{............ (3)}$$

Comparison of both the above relationships showed, exponential regression equation to be relatively more appropriate in predicting the biomass than the power regression equation (Table 3). The mean deviation from the observed data and the estimated curve was found non-significant in both the relations, though the mean deviation was relatively low in exponential than in power form, except in the case of girth class 63 - 82 cm.

A graphical comparison of fitted power regression curve with the general equation derived by Shorrocks *et al.* (1965) is given in Figure 1. It is found that for the present experimental material both the curves differ significantly. The deviation was maximum towards higher girth values, and both curves were reliably close only upto 50 cm girth.

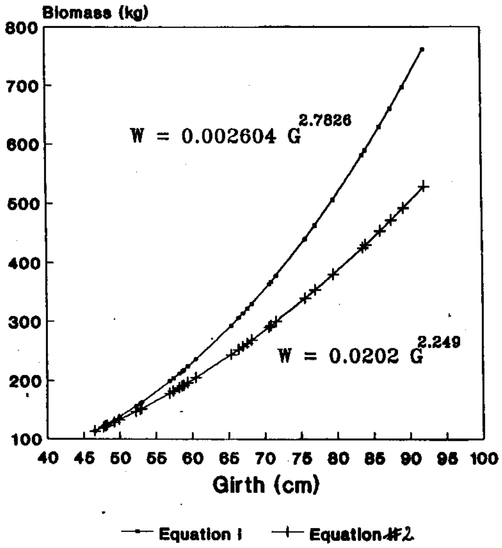

Fig. 1. Comparison of fitted power regression equation of biomas on girth with that of Shorrocks *et al.*, 1965

In conclusion, it can be considered that either of the equations derived in the present study can be used for estimating the above ground biomass of the clone RRIM 600 in Tripura upto a girth of 95 cm at 150 cm height from the bud union. The general equation derived by Shorrocks *et al.* (1965) would not be useful in the present case as both the curves were found to diverge with increase in girth values. Such deviation may be due to variations in the agroclimate, clone x environment interaction and agro-management practices.

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