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GROWTH ASSESEMENT OF POPULAR CLONES OF NATURAL RUBBER (*Hevea brasiliensis*) UNDER WARM DRY CLIMATIC CONDITIONS OF CHATTISGARH STATE, CENTRAL INDIA

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ABSTRACT

Two natural rubber (*Hevea brasiliensis*) most popular and widely planted clones RRIM 600 and RRII 105 in the traditional region of India, were evaluated for immature growth performance in warm dry climate of Bastar region in chattisgarh state. The state is a non-tradional rubber growing region and the crop experiences severe drought in the summer months. Prolonged high temperature, low rainfall and soil moisture are the major environmental constraints affecting the performance of clones in the region. Growth performance, effect of seasonal changes on the growth in terms of girth and morphological characters of the clones was assessed. Both the clones observed satisfactory growth in the region. RRIM 600 showed over all superiority and better adaptability in the region. The mean annual girth increment of clones was 6.2 cm. highest girth contribution for both clones was recorded in the wet season, while the lowest was observed during the summer. RRIM 600 also showed more vigorous morphological growth in terms of stem height and canopy structure. Clones attain a tappable girth after the nine years of field planting in the region. Various growth parameter, overall clones performance and adaptability in the region has been discussed. The present study may provide information on the feasibility of rubber cultivation and performance of clones under adverse climate with further support in the identification of suitable best clones for such nontraditional regions.

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1 Introduction

Natural rubber (*Hevea brasiliensis*) is traditionally cultivated in the zone lying between latitude 8° to 12° N covering the states of Tamil Nadu, Kerala and Karnataka in India, mostly area lies to the west of the Western Ghats. In view of the limited scope for further expansion of the area in this zone and ever increasing industrial demand and towards planned research under warmer regions due to climate change, cultivation of the crop was extended to less congenial areas (Sethuraj et al., 1989). One of the regions selected was the Bastar region in Madhya Pradesh state (present Chattisgarh state) of central India. In this region, high temperature during the summer months, low rainfall confined to a few months in a year, low relative humidity and soil moisture deficit in summer and heavy winds are the major constraints curtailing the growth and productivity of the crop (Sethuraj et al., 1989 ; Krishan et al., 2007).

In *Hevea* the stem girth of the trees is the most important evaluation parameter based on which the degree of maturity of the plantation is decided for harvesting the latex, the product of commercial importance and ideally a rubber plantation is considered mature and tappable if the trees have attained a girth of 50 cm at a height of 125 cm (Sethuraj & George, 1980; Paardekooper, 1989). The time a plantation takes to attain maturity is also important because it determines how long it will take to commence tapping to yield latex and to generate income.

Further growth performance evaluation can provide information on the clonal differences on the growth performance and its relationship with the seasonal growth and possible adaptability in the region of introduction. Though some information is available about the juvenile growth of the few clones in the region (Krishan, 2007), information on the performance of the immature phase of widely planted popular clones (RRII 105 and RRIM 600) is lacking in the region. The present study reports the growth, relationship between the seasons and girth performance and clone morphological characteristics.

2 Materials and Methods

Study was conducted at the Regional Research Station of Rubber Research Institute of India at Sukma (Lat: 19°5'N, Long: 82°2'E, Alt: 202 m above MSL) in warm, dry climatic conditions of Bastar region in Chattisgarh state located in central India. Two most popular, widely planted clones RRIM 600 and RRII 105 were included in this study. The field planting was laid out in single tree single plot completely randomized design. Brown budded stumps were used as planting material and the tree spacing adopted in the field planting was 4.6 m x 4.6 m. In the initial years, partial life saving irrigation was provided during summer months. The planting was done on plain land with uniform stand and soil status. The fertility status shows that soils are acidic in nature (pH 5.5) and low in organic carbon (00.53%). Available Phosphorus, Potassium and Magnesium were 0.20, 4.25 and 4.62 mg per 100 g soil, respectively.

The recommended cultural practices were followed (Rubber Board, 1990). The Growth was recorded as the girth of the trunk at 1.50 m at regular intervals. The observation recorded during the eight to ten years after planting has been included in the present study. In order to assess the seasonal growth performance, a year has been grouped into three seasons based on rainfall pattern and temperature. The wet season from June to September, the cold season from October to January and the dry hot season from February to May had rainless summer months with very low soil moisture levels. Observations on plant height, canopy height, number of branches, branching height and bark thickness were recorded in the tenth year from thirty two trees per clone. The growth parameters were analyzed following standard statistical procedures (Sukhatme & Amble, 1989).

3 Results and Discussion

Bastar region in Chattisgarh state experiences a warm, dry sub-humid climate and less congenial for rubber cultivation. The Annual total rainfall in the region is about 1470 mm with only 67 rainy days. About 60 per cent of it was received during monsoon period (June - September), least during winter (October – January). The distribution of rainfall is far from satisfactory which results in long dry spells extending from November to May, during which the drought conditions become severe. The summer months exhibited severe soil moisture stress conditions. This is one of the contributing factors for severe moisture stress during the major part of the year. The minimum rainfall required for rubber cultivation is 1500 mm but the preferred average is 2500 – 4000 mm with a total of 100 – 150 rainy days per year (Pushparajah, 1983). The initial rains received after the summer season recharged the soil and subsequent heavy rainfall in monsoon resulted in surface runoff and deep percolation.

The daily maximum temperature also exceeds 35° C during March, April, May and June. During the month of April and May, the mean maximum temperature recorded was around 40° C (Table 1). Adverse weather conditions resulted in a general reduction in the growth of the plants.

Tree growth is an important factor for early good yield, as only possible for a tree which grows vigorously when young (Simmonds, 1989). Further, the growth during the initial years is crucial for *Hevea* especially with respect to the attainment of tappable girth (Sethuraj and George, 1980; Paardekooper, 1989). The growth of trees in term of girth from eighth to tenth years of planting and mean annual girth increment is depicted in Table 2.

Table 1 Meteorological parameters of experiment site during the study period

Month	Temperature (°C)		Relative humidity (%)	Rainfall (mm)
	T max	T min		
January	28.2	10.6	63.5	14.0
February	31.4	13.8	55.7	5.5
March	34.8	18.1	46.6	6.9
April	36.8	22.1	44.6	30.6
May	39.3	24.2	48.1	85.9
June	32.1	23.4	68.1	210.9
July	28.5	22.9	81.3	395.0
Aug	28.0	22.4	84.1	361.3
September	29.6	22.3	80.5	214.3
October	29.8	20.2	74.9	120.0
November	28.5	15.6	71.2	23.8
December	27.1	9.7	65.7	2.8
Mean/Total	31.1	18.7	65.3	1470.4

The two clones showed very limited differences in girth and mean girth increment. The highest girth has been recorded in RRIM 600. Both the clones attain a tappable girth in the ninth year after planting. RRIM 600 and RRII 105 attained girth of 49.51cm and 48.97 cm respectively, after the ninth year of planting. The higher mean annual girth increment of 7.28 cm was recorded in RRIM 600; though RRII 105 also showed an almost comparable girth increment of 5.26 cm. Stem annual girth increment is widely used in *Hevea* cultivation as a parameter of growth, particularly during the immaturity period (Shorrocks et al., 1965); and good girthing is an important in sustaining yield in high yielding clones and also reducing wind damage losses through trunk snap (Tan, 1987).

Growth of the clones during the wet and cold seasons was higher and declined subsequently. Mean wet season girth increment of 3.22 cm was recorded highest, while dry, hot season recorded least mean girth increment 0.99 cm. RRIM 600 showed a comparatively higher girth increment. In spite of life saving irrigation in the early phase of trees during summer, seasonal growth was low in dry hot season (Figure. 1). Growth inhibition was earlier reported when rubber was cultivated in a climate having distinct dry season (Chandrashekar et al., 1998; Gupta et al., 2002; Krishan et al., 2007; Krishan, 2013). High growth performance of RRIM 600 indicated that the clone is likely to more suited to stress conditions of the region.

The study has revealed inter clonal variations in tree height, canopy height, canopy breadth, branching height and number of branches (Table 3). RRIM 600 recorded superiority for all these traits as, tree height (9.75 m), canopy height (7.38 m), canopy breadth (5.40 m), branching height (2.59 m) and number of branches (7.80). The present findings are in agreement of other few studies in almost similar climatic conditions (Nazeer et al., 1992; Gupta and Edathil, 2001; Krishan et al., 2007; Krishan, 2013). The primary branches contributes a significant role in the formation of the canopy and a balanced canopy plays an important role in wind resistance besides timber contribution and other physiological importance. In the present study both RRIM 600 and RRII 105 showed satisfactory growth under the dry hot climatic condition. Though, among the popular clones, RRIM 600 showed better seasonal growth, morphological characters and adaptability in the region, which indicated that the clone could be comparatively better adapted in a less favorable suited climatic conditions. The good growth performance of clones in the region suggests the possible scope of cultivation of natural rubber in stressful conditions of the Chattisgarh state.

Table 2 Growth performance of *Hevea* popular clones

Clones	Girth (cm)			Annual girth increment (cm)
	8 YAP	9 YAP	10 YAP	
RRIM 600	42.23	49.10	56.80	7.28
RRII 105	44.60	48.97	55.12	5.26
Mean	13.41	49.24	55.96	6.27
Coefficient variation (CV)	3.86	0.77	2.12	22.78

YAP: Year after planting

Table 3 Growth characteristics of popular clones after ten years of field planting in a dry sub humid region.

Growth Characters/ Clones	RRIM 600	SEM	CV	RRII 105	SEM	CV
Tree height (m)	9.75	0.16	7.30	9.09	0.15	7.87
Canopy height (m)	7.38	0.15	9.50	6.71	0.11	7.50
Canopy breadth (m)	5.40	0.09	7.81	4.60	0.08	8.23
First branching height (m)	2.59	0.27	4.67	2.33	0.04	7.71
Number of primary branches	7.80	0.40	23.38	6.65	0.31	21.42

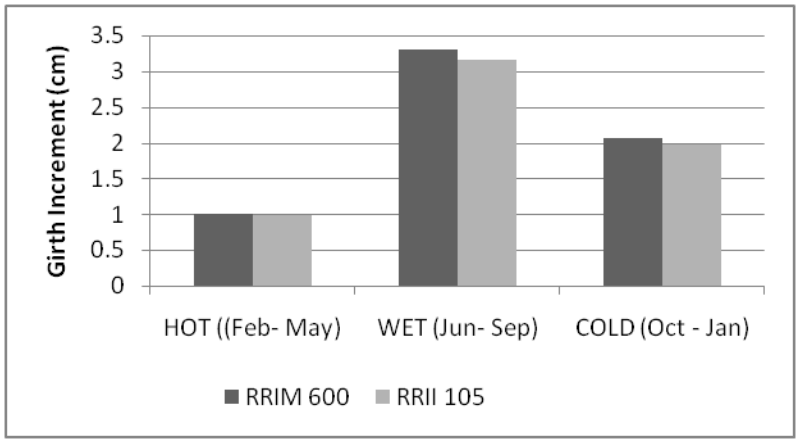

Figure 1 Seasonal girth growth performance of *Hevea* clones

Conflict of interest

The authors declare no conflict of interest.

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