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Soils of Tripura. II- Suitability for Rubber

T.Bhattacharyya[*], *D.Sarkar*[**], *S.K.Gangopadhyay, P.N.Dubey*[*], *U. Baruah, G.S. Chamuah, S. Mukhopadhyay, D.C. Nayak*[**], *A.K. Maji*[***], *R.K. Saxena*[***], *A.K. Barthwal*[***], *N.D.R. Krishna*[***], *C. Mandal*[***], *J.Sehgal*[****]

National Bureau of Soil Survey and Land Use Planning, Regional Centre, Assam Agricultural University Campus, Jorhat-785 013, Assam, India.

K.R.Bhowmick, K.Sinha, R. Chakrabarty, S.Nandi Majumdar, P.K. Pal

Department of Agriculture and Horticulture, Govt. of Tripura, Agartala.

A.K.Krishna Kumar

The Rubber Board, Kottayam-686 002, Kerala.

and M.R.Sethuraj

Rubber Research Institute India, The Rubber Board, Kottayam - 686 009, Kerala.

Abstract

The state of Tripura was surveyed in 1:250,000 scale to have the basic information of the natural resources with a view to finding out the soil suitability for rubber under the overall rubber expansion project of the World Bank. The soil information was compiled and a soil map was prepared. On the basis of soil-site characteristics and the optimum requirements of rubber for soils and sites all the soil units on the soil map were rated for overall suitability of rubber. The study indicates that most of the soils of the Tripura state are moderately suitable for rubber which is estimated to be about 91,000 ha forming 8.3 per cent of the total area of the state.

Additional Key words: Soil suitability, rubber, moderately suitable.

Introduction

Soil survey data and the soil maps have been widely used for interpretative purposes by defining relative suitability or limitations of various soil types for different land uses. Such interpretations are essentially based on practical experience of soil surveyors as gained from their extensive contact with farmers, extension workers, local officers and the existing literature. As a consequence, these interpretations are quite valuable because they usually reflect the current level of knowledge (Bouma, 1989).

It is in this context the soil survey data and the soil map of Tripura (Bhattacharyya *et al* 1998) are used for working out the suitability of the soils for rubber with a view to expand the area under rubber cultivation.

Efforts have earlier been made to evaluate soil-site criteria for rubber in the traditional tracts in India (Vilas Chandran *et al.* 1992; Kharche *et al.* 1995). However, no comprehensive document on the soil-site parameters for the suitability of rubber in the Non Traditional areas in India has yet been reported.

[*] Present Address: National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur-440 010.

[**]National Bureau of Soil Survey and Land Use Planning, Regional Centre, Calcutta-700 091.

[***]National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur-440 010.

[****]EA-220, SFS Flats, Maya Enclave(Harinagar), New Delhi-110064.

Materials and methods

Soil suitability of rubber in Tripura has been worked out in two steps. In the first step suitability criteria for rubber crop (Table 1) have been evolved with the help of existing literature with special reference to north-eastern region of India. Emphasis was placed on land characteristics or land qualities (FAO, 1976, 1983; Bouma and van Lanen, 1987; Sys, 1985; Landon, 1984; Sehgal, 1986) which determine the limitations. Together, these diagnostic features (limitations) determine soil suitability when matched with crop or ecological requirements. In the second step, the defined suitabilities are shown on soil maps according to the map legend (soil composition) to prepare a relative suitability map for rubber in Tripura (Bouma, 1989).

Table 1. Degree of limitations of soil-site characteristics for rubber (*Hevea sp.*) in Non Traditional areas

Soil-site Characteristics	Degree of limitations				
	0	1	2	3	4
	None	Slight	Moderate	Severe	Very severe
		S1	S2	S3	N
CLIMATE					
- Annual Rainfall (mm)	2000-4000	1700-2000	1500-1700	1250-1500	<1250 & >4500
- No. of dry days	<30	<90	<120	<150	-
- Temperature (°C)[1]					
Mean Annual	25-28	28-34	34-40	-	-
Mean Maximum	29-34	26-29	22-26	20-22	<20
Mean Minimum		>20	17-20	14-17	10-14 <10
- Relative Humidity (%)[2]	66-90	-	<66	-	-
TOPOGRAPHY & LANDSCAPE					
- Slope (%)[3]	3-8	8-15	15-30	30-50	>50
WETNESS					
- Drainage	Well	Well	Mod. well	Imperfect	Very poor
- Flooding	No	-	-	Occasional	Severe
- Ground water depth (m)	>10	5-10	5-10	2-5	<2
SOIL PHYSICAL CONDITIONS					
- Texture	loam /clay loam	Sandy loam/ sandy clay loam	Silty clay loam	Loamy sand	Sand/clay/ silty clay
- Depth (cm)	>150	100-150	50-100	-	<50
SOIL FERTILITY					
- pH	4.3-5.5	3.8-4.3 5.5-6.0	6.0-7.0	< 3.8 > 7.0	-
- Cation exchange capacity cmol(+) kg^{-1}	3-13	-	<3	-	-
- Organic matter (%)	>1.0	0.7-1.0	-	-	-

1. Temperature per se is not important. It is the duration of temperature (maximum or minimum) which controls the growth of rubber.

2. In the rubber growing area of Tripura mean maximum and minimum relative humidity were found as 90 and 66, respectively. The relative humidity even >95 per cent is no limitation for rubber since high humidity - related diseases have not yet been reported from Tripura.
3. In Tripura apparently flat top tillas have very sharp side slopes (with even >50% slope) where rubber is planted with proper conservation measures.

Results and discussion

Land Suitability Criteria for Rubber Plantation

Climatic limitation:

An annual rainfall of 2000 mm has been observed to be lower limit of rainfall for the optimum growth of rubber (*Hevea* sp.) (Sanjeeva Rao and Vijayakumar 1992). However, rubber can grow without limitation up to 4500 mm of rainfall. Soil moisture stress influences the yield components viz. initial flow rate, plugging index and the dry rubber content besides the direct effect on turgor pressure and water deficit triggering a series of biochemical changes in latex. Rubber gets affected by extreme temperatures. Mean annual temperatures of 25-28°C has been found to be the optimum. The prevailing temperatures in the established rubber growing areas indicate that a mean maximum temperature of 29-34°C and mean minimum of about 20°C is ideal for the growth of rubber. Temperature *per se* is not important. It is the duration of temperature, both maximum and minimum which controls the growth of rubber. In Tripura the mean minimum temperature of 14-17°C prevails for 3-4 months. The fall in winter temperature below 10°C, although for a brief period,is considered to be a very severe limitation for the growth of rubber plant since it affects the production of latex. The state is therefore considered as moderately suitable for rubber plantation so far as degree of limitation for minimum temperature is concerned (Table 1).

Topography and landscape limitations:

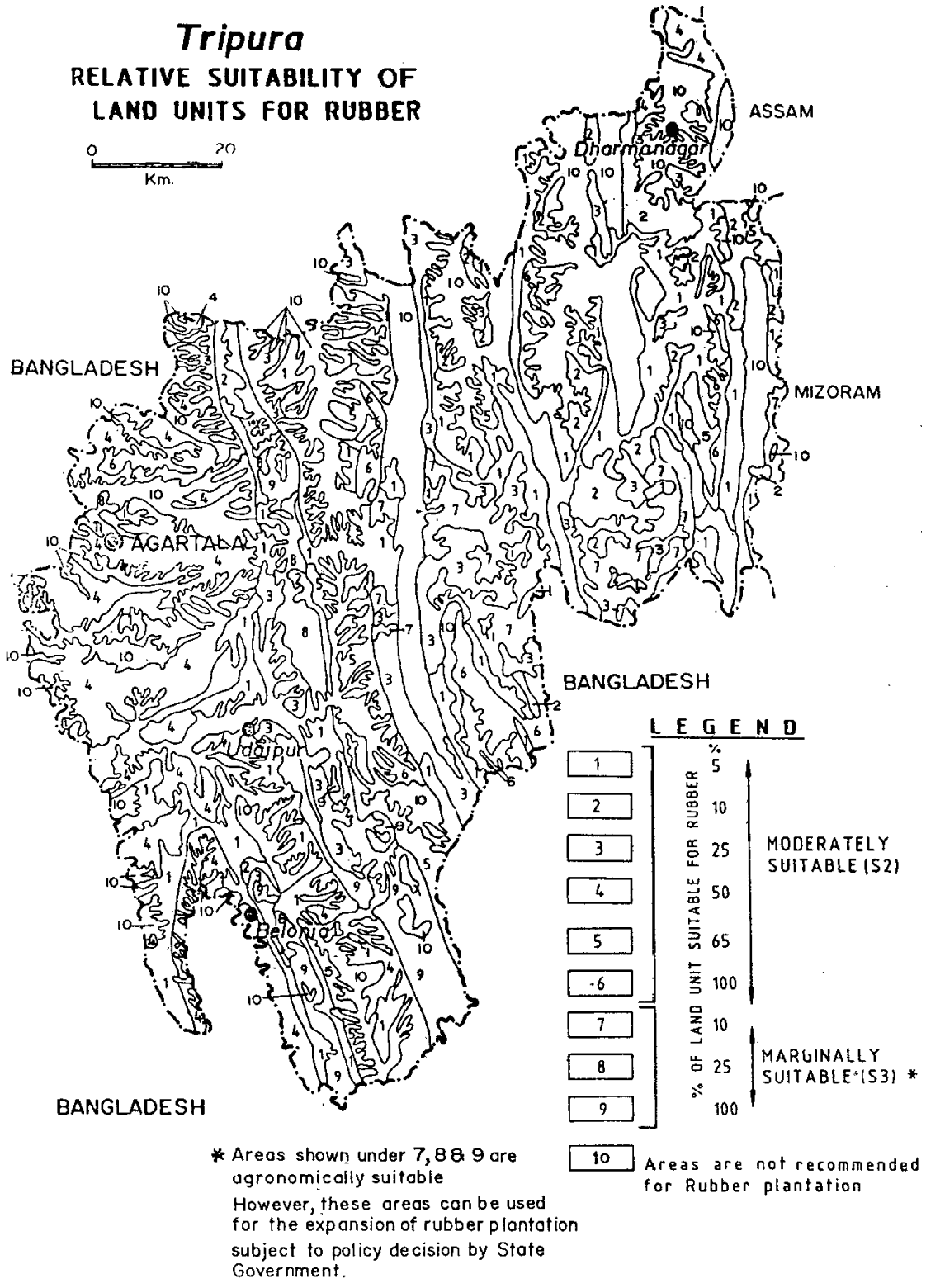
Landform is mostly defined in terms of slope and its relative elevation. By and large, less than 15 per cent slope (and preferably within 8 per cent limit on the lower side) is no limitation for rubber growing in Tripura. The valley lands, however, are unsuitable for rubber due to water stagnation. Steep slopes with slope per cent greater than 30-50 act as a severe limitation for rubber without conservation measures. In Tripura, such areas are marginal for rubber plantation (Table 1) .

Soil physical condition:

Clay textured soils are generally avoided for rubber plantation. The soil depth determines both the available space for root growth and proliferation, and the amount of soil moisture storage (Krishnakumar and Potty 1992) . It has been observed that for different plantation crops, including rubber, the growth is seriously affected due to shallow depth. Table 1 shows the ratings of important soil physical characteristics for rubber plant.

Soil fertility condition:

Rubber is grown in both the traditional and non-traditional areas experiencing high rainfall. It thrives well under acid environment in the soil. The optimum pH for rubber is reported to be in the range of 4 to 6.5 and it can tolerate up to the pH of 3.8 at the low (Krishna Kumar and Potty 1989) and 7.0 at the higher side (Krishna Kumar and Potty 1992). Rubber is grown in soils with a wide range of CEC. While CEC of 2 to 16 cmol(+) kg^{-1} is reported in Malaysia, it ranges from 3.5 to 18 cmol(+)kg^{-1} in soils under rubber in India (Krishna Kumar and Potty, 1992). In Tripura, the rubber growing soils have a CEC range of 3-13 cmol(+)kg^{-1} (Bhattacharyya et al, 1998). Krishna Kumar and Potty (1992)



* Areas shown under 7, 8 & 9 are agronomically suitable
However, these areas can be used for the expansion of rubber plantation subject to policy decision by State Government.

suggested the maintenance of a relatively higher organic matter status through organic matter recycling coupled with calcium enrichment indirectly by the addition of rock phosphate to alleviate the toxic effect of aluminium through chelation and optimum calcium to aluminium ratio. A range of organic matter content from 1.1 to 3.7 per cent has been reported in soils under *Hevea* in India which is comparable to the organic matter content of Malaysia (Krishna Kumar & Potty 1992). The organic matter content of Tripura soils range from 0.7-2.4 per cent in the surface and 0.1-0.6 per cent in the subsurface horizons. On an average organic matter contents of 0.7 to 1.0 percent and more than 1.0 percent have been found to be slight to no limitation for rubber plantation. The slow rate of oxidation inside the closed canopy of rubber plantation helps to maintain high organic matter status in the later stage.

Soil Unit Evaluation vis-a-vis Suitability of Land Units for Rubber

The overall degree of limitation in a particular soil unit (mapping unit) is worked out using the table 1. Although most of the soil-site parameters considered for rubber in Tripura are suitable the low temperature of <10°C which affects growth of rubber plantation for nearly 3-4 months in winter makes the state of Tripura moderately and marginally suitable (Fig. 1). Most of the areas which are moderately suitable for rubber fall in the undulating plains and uplands without forests. The area of moderately suitable (S2) lands for rubber is 91,000 ha which forms about 8.3 per cent of the total geographical area of the state. It may be mentioned that most of the horticultural crops have soil-site requirements similar to rubber and these crops, therefore, may compete for the expansion of the rubber growing areas in the state (Bhattacharyya *et al.* 1996).

Hence it is suggested to push the rubber plantations to the marginal areas with still higher slopes. The study indicates that about 54000 ha marginal lands may be useful for growing rubber subject to their availability (Fig. 1).

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