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Drought in Rubber (*Hevea brasiliensis*) Plantations in Tripura

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The meteorological data collected at the Rubber Research Institute of India, Regional Research Station, Agartala, Tripura during the period 1983 through 1990 have been subjected to water balance analysis to identify and characterise the climatological drought experienced by the mature rubber trees in the area. Drought in the area was found to be seasonal in nature and was confined to the pre-monsoon (summer) months of March, April and May. During the period 1983-1990, the station experienced 2 disastrous, 2 severe and one moderate drought years. The year 1986 was identified to be the worst drought year for the rubber plantations with the soil moisture falling well below wilting point for four consecutive months from March to June. The study revealed that, in general, there is no soil moisture stress to mature rubber trees in the area during the winter months of December, January and February even though the rainfall received is scanty. The mean water requirement per tree to meet the moisture deficit in the soil during drought years was 26 litres/ day.

Key words **:** Drought, soil moisture, wilting point, water requirement

INTRODUCTION

Of the many factors limiting the crop production, drought stands out as the most important one in crops where water relations is of particular relevance. Drought is a relative rather than an absolute condition (Subramanyam 1967) and can be broadly defined as a period of dryness due to lack of precipitation. According to Hoyt (1938), when in an area that is ordinarily classified as humid, natural vegetation becomes desiccated or defoliates unseasonally or when precipitation is insufficient to meet the needs of established human activities drought onditions may be said to prevail. Scientific informaon on the nature and characteristics of the drought would go a long way in planning agricultural and allied activities.

The performance of Hevea tree is known to be greatly influenced by water relations and the cultivation of the crop is mainly confined to the humid tropics akin to its place of origin where hardly any stress conditions prevail. However, to cope with the increase in demand of the elastomer the tree produces, and considering the limited scope of expansion of the crop in its favoured traditional belt, the cultivation of the crop has been extended to areas of marginal to medium suitability, when the tree confronts stress conditions such as low temperature, soil moisture deficit etc. quite often effecting the performance of the crop. North Eastern region is one of the near prominent non-traditional rubber tracts in the country and of the seven states in the region, Tripura is the pioneer.

The North Eastern region of India generally and Agartala region in particular has humid climate (Das 1982). In the present study, utilizing the water balance procedure (Subramanyam and Subramanyam 1964, 1965) an attempt has been made to assess and characterise the droughts, if any, experienced by the rubber trees in the state of Tripura utilising the soil climatic data collected at Rubber Research Institute of India, Regional Research Station, Taranagar, Agartala during 1983-1990.

MATERIALS AND METHODS

Data

The meteorological data collected at the agrometeorological observatory of the Rubber Research Institute, Regional Research Station, located at its farm at

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Taranagar (23°53'N, 91°51'E; altitude: 166 m) was made use of for the present study.

Water balance methods for the drought study

Thornthwaite (1947) laid the basis for water balance methods. Palmer (1956, 1957) studied the droughts in Kansas state of USA and defined a drought index using the general book-keeping procedure of Thornthwaite (1948) for determining water deficit. In India application of water balance for a general study of drought was first suggested by Subramanyam (1958). Since the water balance procedure as given by Subramanyam and Sastri (1969) enables a realistically quantitative evaluation of water deficiency which is the root cause of all droughts, that has been adopted in the present investigation.

Potential evapotranspiration assumed as 0.8 of U S Class-A pan evaporation values (Doorenbos and Pruitt 1977) was made use of for water balance computations. A root depth of 130 cm was adopted for the rubber plantations based on observations. Field capacity of the soil in the rubber plantations in the area was estimated using pressure plates to be about 400 mm and wilting point equal to 219 mm.

RESULTS AND DISCUSSION

Climate

The climatological data of the station under study is presented in table 1. The area receives a mean annual rainfall of the order of 2027 mm in about 135 days. About 60% of the annual rainfall was received during the South West Monsoon season (June to September). Pre-monsoon (March to May), Post-monsoon (October to November) and Winter (December to February) seasons contribution to annual rainfall were 26%, 13% and 2% respectively. Mean monthly minimum temperature during winter season ranged from 6.2°C to 8.3°C with a recorded daily minimum of 3.8°C. Summer season mean monthly maximum temperature ranged from 35.5°C to 36.7°C.

Water balance and drought

Using the water balance procedure as adopted in the present study, Das (1982) found that Agartala (station located in a meteorologically homogeneous region at about 15 km from the station under study) had passed through 3 disastrous, 2 severe, 1 large, and 5 moderate droughts in a span of 23 years (1953-1975). The medium and standard deviation of aridity index arrived at was 6.3% and 5.2% respectively, these values were utilised for the analysis of drought in rubber plantations at Agartala in the present study.

The results of the present analysis in drought in the rubber plantations showed that, during the period 1983-1990, the trees experienced 2 disastrous, 2 severe and one moderate drought years (Table 2).

Results of the water balance analysis for the period 1983-1990 are presented in Fig. 1. The study revealed that the water stress to the rubber trees (soil moisture content falling below wilting point) generally starts in the month of March and continues upto May, confining to the summer season (March to May). Thus the drought experienced by the rubber trees in the area are seasonal in nature, confined to the summer months. The year 1986 was the worst drought year with the soil moisture content remaining below wilting point from

Table 1. Mean of 8 years (1983-1990) climatic data collected at Regional Research Station, Agartala

Months	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainfall (mm)	2.4	21.4	53.0	164.7	303.4	353.2	284.0	278.2	304.2	196.6	57.1	8.1
Rainy days	1	2	5	9	15	17	16	21	15	8	9	1
T(max) C	28.4	31.2	36.1	36.7	35.3	35.3	33.9	35.4	33.9	33.4	32.1	29.9
T (min) C	6.2	8.3	13.2	17.9	18.7	21.6	23.1	22.6	21.9	17.3	16.8	8.2
R H (%)												
0625 hr	96	94	91	88	87	90	91	92	94	94	95	97
1325 hr	42	41	40	54	67	76	77	77	78	70	54	54

Table 2. Drought years in rubber plantations in Agartala

Years of drought in different categories		
Disastrous	Severe	Moderate
1984, 1986	1983, 1989	1987

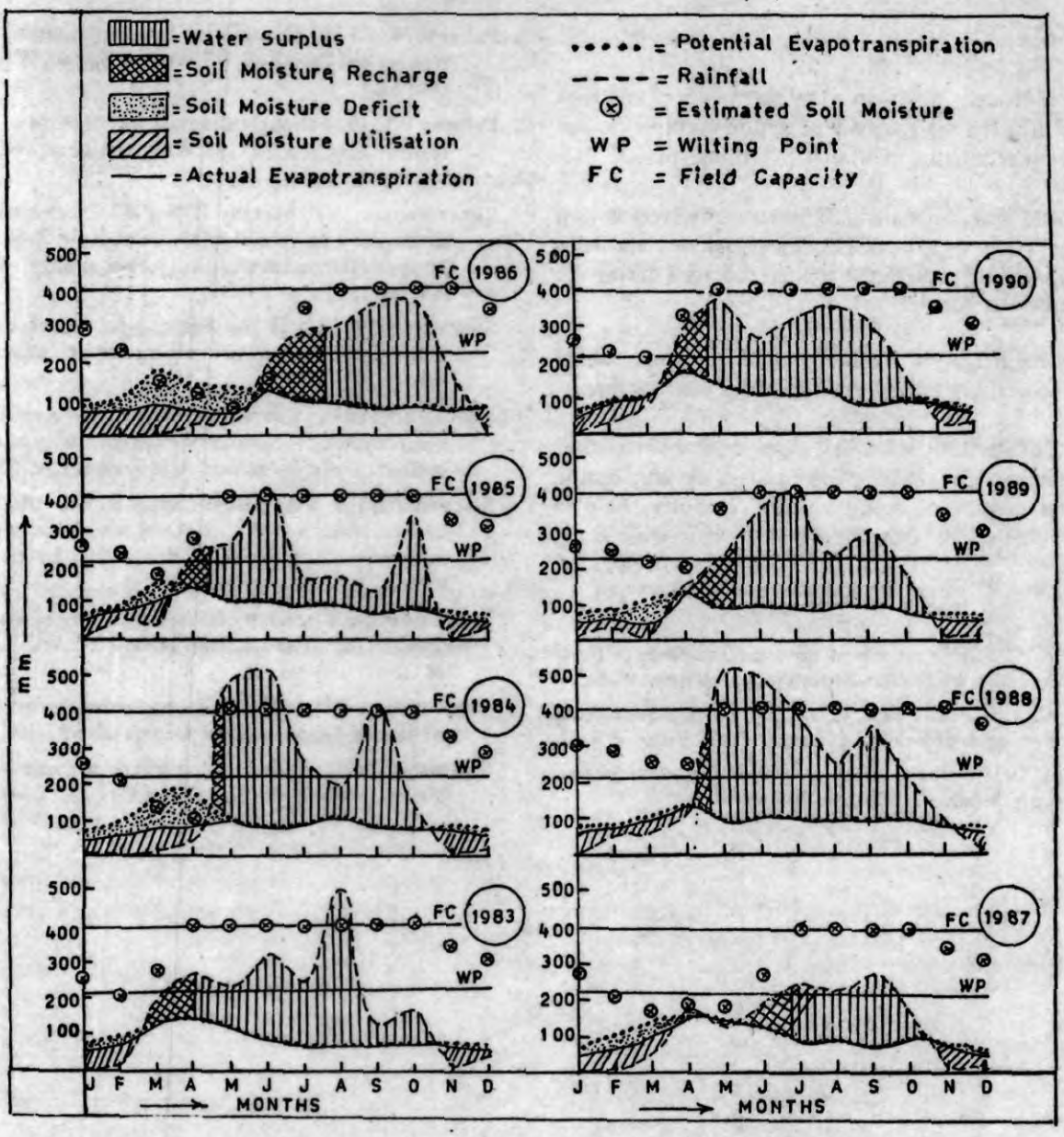

Fig. 1. Water balance for Agartala

March to June. According to Thornthwaite (1947), the seasonal droughts are common in humid climates were wet and dry seasons are clearly defined.

The annual water deficit at the station varied between 41 mm and 292 mm with an average of 149 mm, during the study period. During drought years the range was between 115 mm (moderate drought year) and 292 mm (disastrous drought year) with an average of 200 mm. Thus the water requirement per tree for meeting the moisture deficit in the soil during drought years, considering a basin area of 12 sq. m (20% of the feeder roots of the tree are confined within this area) worked out to be 26 litres, ranging from 15 litres to 38 litres in drought years.

Moisture content of the soil under rubber plantation was found to remain at field capacity from June to October and drops down to wilting point by the end of February.

To conclude

a) The drought experienced by the rubber plantations in the area are seasonal in nature confined to the summer months of March, April and May.

b) Little soil moisture deficit was observed during the winter months of December, January and February, even though the rainfall received during the season is scanty.

c) Mean irrigation requirement of a mature rubber tree per day during drought years was 26 litres.

Results of the study show that supplementary irrigations are necessary for rubber plantations in the area during summer months of drought years. This may help in improving the yield from these plantations in these areas.

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