Bulletin of the Rubber Research Institute of Sri Lanka, (2000) **42**, 29-37

SEASONAL VARIATIONS IN METEOROLOGICAL FACTORS AT DARTONFIELD

Wasana Wijesuriya, Chintha Munasinghe and Vidura Abeywardene

INTRODUCTION

Being a regional meteorological station in the agro-ecological zone WL_1; the records collected at the Dartonfield station of the Rubber Research Institute are mainly employed in research activities on-farm and its surrounding vicinity. Meteorological records are kept on daily basis from the year 1968 onwards for this station. The objectives of this study were to develop a database for the interested parties to use them in their research in different disciplines and to use them in documenting the climatic variability at Dartonfield station. The latter aspect is presented in this article.

METHODOLOGY

Data

Data on; rainfall (RF), maximum (Tmax) and minimum (Tmin) temperatures, morning (RH1) and evening (RH2) relative humidity values, sunshine hours (SS), wind velocity (WV) and Evaporation (Ep), for the period 1968 to 1998 were used in analyses.

Statistical method

Descriptive statistics for the above mentioned variables were generated through summary statistics using GENSTAT 4.0. Standard probability theories were applied to calculate probability levels for rainfall data. Correlation analysis was employed in identifying the relationships between evaporation and other meteorological parameters.

RESULTS AND DISCUSSION

(a) Rainfall

The most widely used method of presenting monthly or weekly rainfall is the exceedance probability at the 25% level (75% expected); the value which can be

expected in 3 times out of 4 years' cycle. The mean, 25% and 75% expected rainfall values for different months are presented in Fig. 1.

The rainfall distribution follows a usual bimodal pattern as depicted in Fig. 1, with peaks coincide with months, May and October. The coefficients of variability are generally higher in low rainfall months during the initial part of the year, as depicted in Fig. 2.

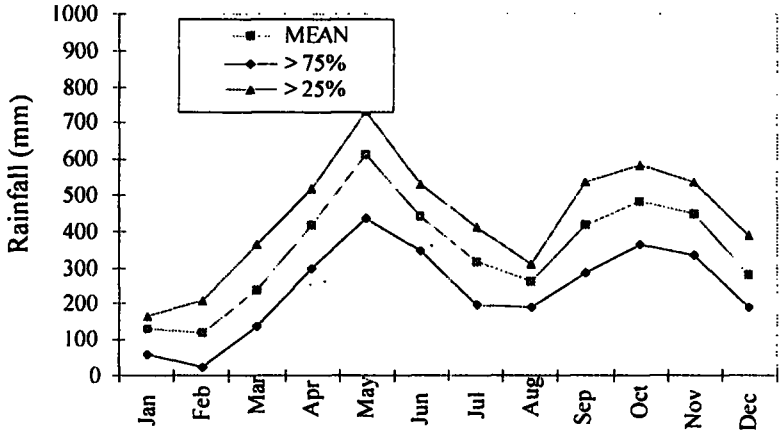

Fig. 1. Rainfall distribution at Dartonfield

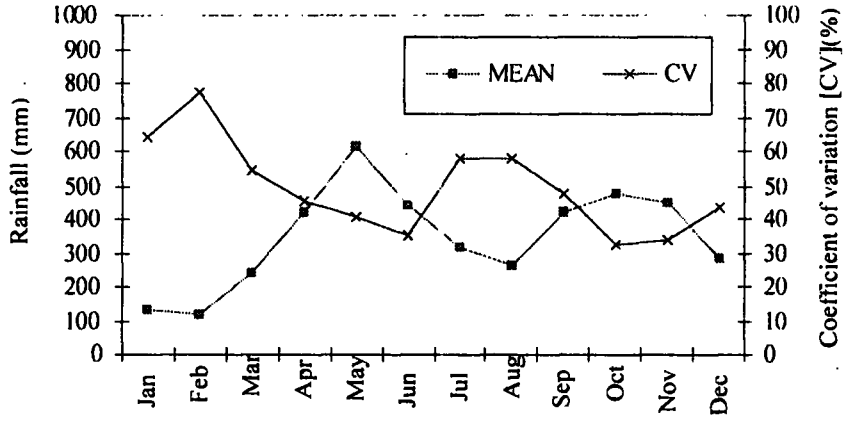

Fig. 2. Coefficient of variation in monthly rainfall for the Dartonfield station

Seasonal behaviour of rainfall

The rainfall at Dartonfield is characterized by a typical bimodal pattern caused by monsoon influence. The North East rains are usually experienced during

the North-East monsoon during the period of end November to mid January at full strength (NEF) followed by a period of 2 months at partial strength (NEP). In general, the first inter-monsoon period (IM1), commences from late March and extends to early May. South-West rains initiate during late May at partial strength (SWP1), persists for 2 months at full strength (SWF) and continues until the end of August (SWP2) and followed by the second inter-monsoon period (IM2) until mid November.

The inter-monsoon rains contribute nearly 50% to the total annual rainfall. The second inter-monsoon season (IM2) prior to the North-East rainy season carries more rains which usually lasts for 21/2 months, when compared to the inter monsoon season (IM1) before the commencement of South-West rains. A graphical illustration is given in Fig. 3, prepared from 30 years of rainfall data collected at the Dartonfield meteorological station which is representative of low country wet zone.

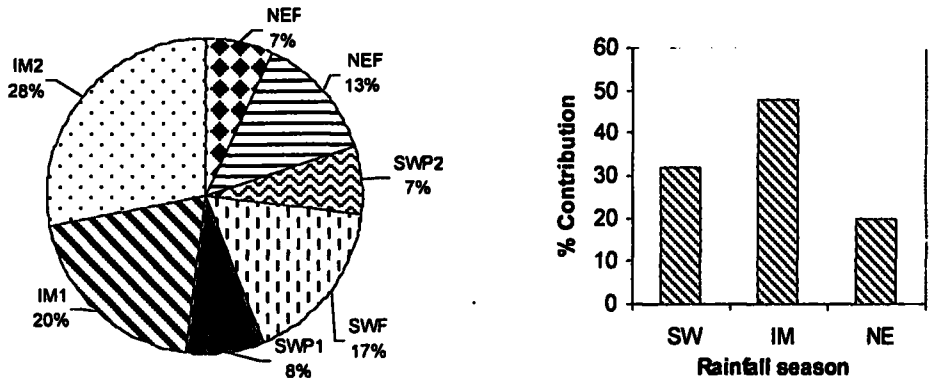

Fig. 3. Seasonal variation in rainfall at Dartonfield

Number of Rainy Days[1]

The number of rainy days is also a major determinant of rubber yield. Higher number of rainy days is observed during April to November which coincide with periods of inter-monsoon and South-West influence (Fig. 4). More attention should be paid during these periods on control of possible disease epidemics, which can take place under wet weather conditions. Number of non-tapping days due to rains can be minimized by fixing of rainguards or replacement of old ones during the dry periods before commencement of rains.

[1] A rainy day is defined as having more than 0.3 mm of rain in a 24 hour period.

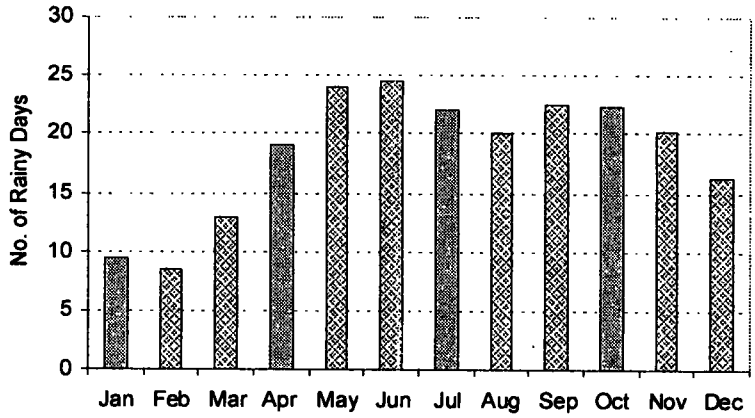

Fig. 4. Number of rainy days in each month for the Dartonfield station on a standard week basis

Occurrence of dry spells

During the first 7 weeks of the year (Fig. 5), there appears a fairly long dry spell which can adversely affect the growth of immature rubber plants, especially when planted with North East rains. This statement is further supported by the analysis of dry spells at Dartonfield over the period, 1968 to 1999. Long dry spells exceeding 10 days have been observed during the first 3 months of the year (Table 1). In other words, the probabilities of exceeding 10 mm and 20 mm of rain in a week (calculated from the period 1968 to 1999) are comparatively low during initial months as depicted in Fig. 6.

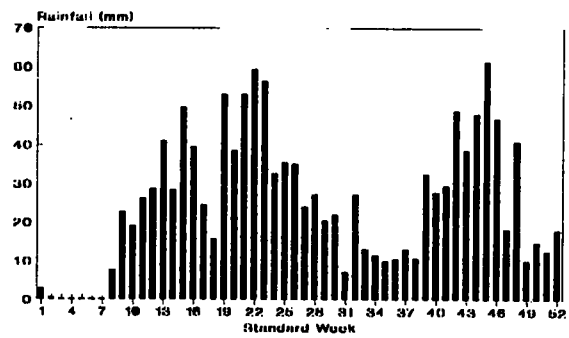

Fig. 5. Rainfall experienced in Dartonfield station on a standard week basis

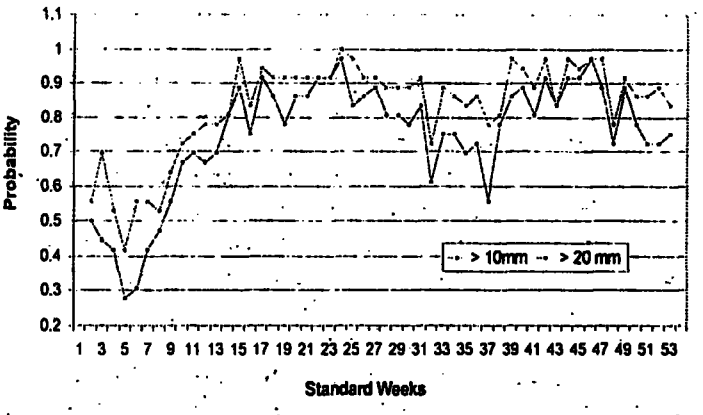

Fig. 6. Probabilities associated with rainfall> 10 mm and >20 mm for the standard weeks of the year

Prolonged dry spells also affect adversely on the establishment of cover crops, which is an important activity during the initial stages. These cover crops may compete for moisture with rubber plants attributable to possible growth retardation during dry periods. In this respect, dead mulch material such as, straw recommended by the Rubber Research Institute would be beneficial to crop growth as it effectively reduce the evapo-transpiration demand while not competing with rubber plants for moisture.

Table 1. *The frequency of dry spells during the period, 1964 to 1998 - Dartonfield station*

Month	Frequency under each category of dry period				
	6-10 days	11-15 days	16-20 days	21-25 days	26-30 days
January	21	9	1	3	1
February	18	5	5	3	1
March	17	4	1	1	1
April	5	5	-	-	-
May	6	-	-	-	-
June	1	-	-	-	-
July	8	-	-	-	-
August	9	2	-	-	-
September	10	1	-	-	-
October	10	2	-	-	-
November	9	3	-	-	-
December	18	7	-	-	-

b) Evaporation

Evaporation from the free water surface or the potential evaporation is a very useful parameter to decide the periods of soil moisture deficits in the absence of direct evapo-transpiration measurements. Evapo-transpiration is determined by the atmospheric conditions, availability of water and crop characteristics. Relative humidity was found to be the most decisive factor governing the rate of evaporation (r=-0.416). Hours of bright sun shine had a significant positive relationship, while temperature and wind velocity had no significant contribution (Table 2).

The average, minimum and maximum evaporation values observed at Dartonfield during the period of investigation are presented in Table 3. High evaporation rates are observed during February to March. As shown in Fig. 7, a period of moisture deficit can be expected with a probability of 75 percent during the initial part of the year. Although, perennial crops can withstand substantial moisture deficit, there can be adverse effects on growth of immature plants, unless proper moisture conservation measures are adopted during the critical periods.

Table 2. *Correlation coefficients between evaporation and other meteorological variables at Dartonfield*

Variable	Correlation coefficient
T max	0.095
T min	0.005
T average	0.103
RH1	-0.308**
RH2	-0.386**
RH average	-0.416**
SS – Sun shine hours	0.290**
WV – Wind velocity	0.084

** - Significant at the probability level, 0.01. No. of observations (n) = 210

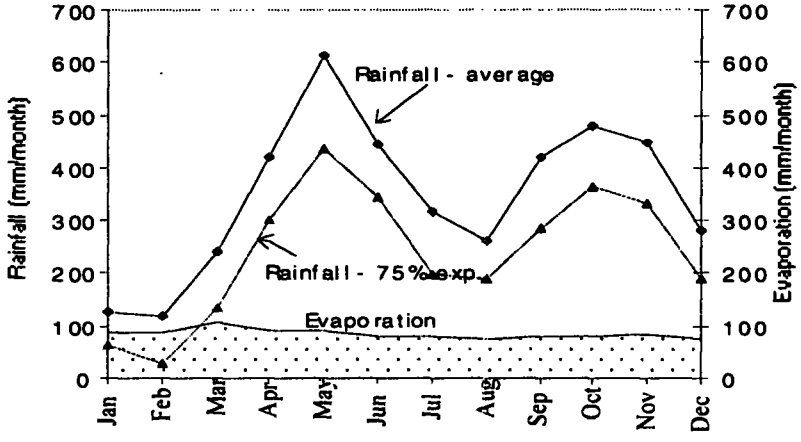

Fig. 7. Total evaporation loss compared to rainfall at Dartonfield

Table 3. *Monthly means, minimum and maximum values of evaporation observed at Dartonfield Station*

Month	Evaporation (mm/day)		
	Average	Minimum	Maximum
January	2.8	2.0	4.1
February	3.1	1.8	4.2
March	3.4	2.6	4.3
April	3.1	2.0	4.1
May	2.9	1.4	4.3
June	2.8	1.6	4.3
July	2.5	1.5	3.3
August	2.5	0.9	3.3
September	2.7	0.6	3.9
October	2.7	1.4	3.7
November	2.7	1.8	3.7
December	2.5	1.1	4.2

c) Relative humidity

The seasonal variation in relative humidity closely follows the rainfall pattern (Fig. 8); but, with a diurnal variation caused by the warming effect by solar radiation during day time and cooling during the night (Fig. 9). High relative humidity favours crop growth by allowing the crops to absorb moisture and reduces evapo-transpiration losses. Nevertheless, high incidence of diseases can be a problem in rubber plantations under high humid conditions, during the rainy seasons.

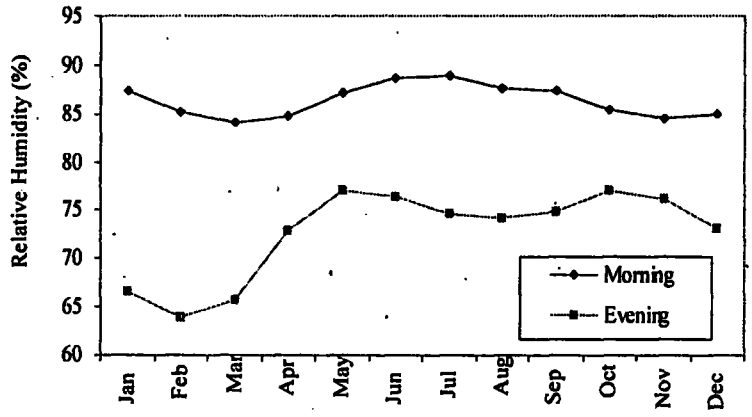

Fig. 8. Seasonal variation in relative humidity at Dartonfield

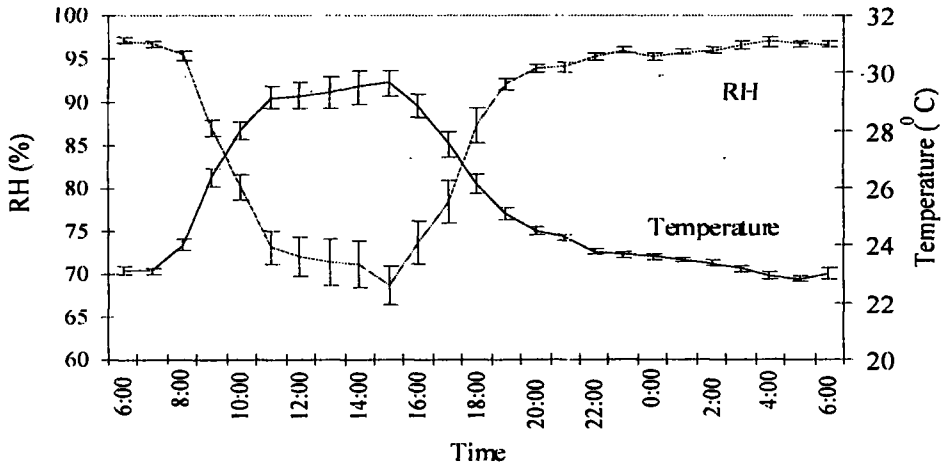

Fig. 9. Diurnal variation in relative humidity and temperature at Dartonfield during Oct/Nov period, 1999

d) Temperature

The ideal mean annual temperature for rubber cultivation fall within the range of 23 to 28 °C. Temperature below 20 °C is harmful in both ways, reducing the growth rate and aggravating incidence of leaf diseases. Higher temperatures, on the other hand adversely affect on tree performance due to increase in consumptive use of water. The mean monthly temperature at Dartonfield, together with minimum and maximum values are presented in Fig. 10. The mean temperature fall in the range of 26 to 28 °C. Maximum temperatures above 32 °C are observed during February to May. The minimum temperatures are lowest during December and January (Fig. 10). The diurnal variation in temperature during the North East rainy season is depicted in Fig. 9.

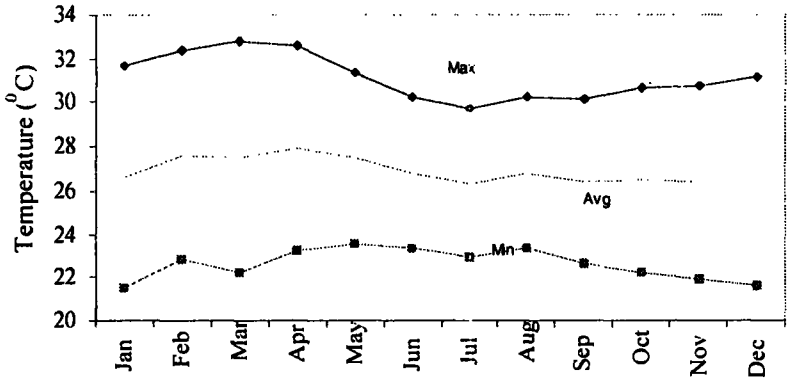

Fig. 10. Seasonal variation in temperature at Dartonfield

e) Sunshine hours

The hours of bright sun shine is not critical for rubber cultivation, but should ideally fall in the range of 5 to 7 hours per day. The average monthly sunshine hours recorded at Dartonfield are presented in Fig. 11. It was noted that the hours of bright sunshine fall below 5 hours during the latter part of the year probably associated with overcast weather conditions.

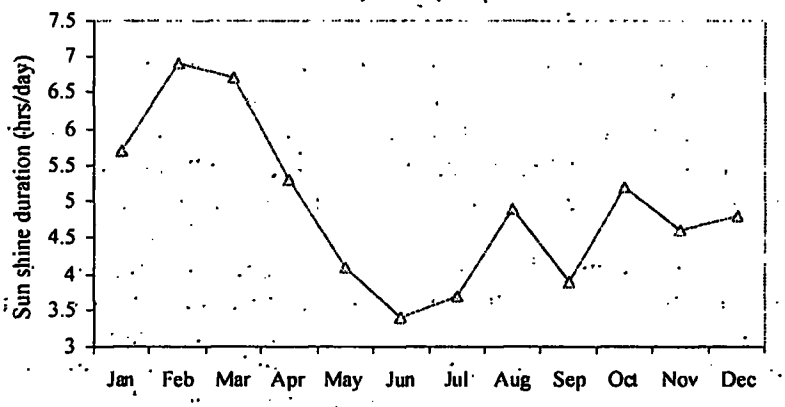

Fig. 11. Seasonal variation in hours of bright sunshine at Dartonfield

f) Wind velocity

Wind velocity also follows a seasonal pattern with highest values in July August period reaching about 2.5 km/hr (Fig. 12). Rubber plantations are affcted severely due to strong winds. Some clones have inherent resistance to wind, but damages are observed when the strength of the wind exceeds 40 knots (75 km/hr).

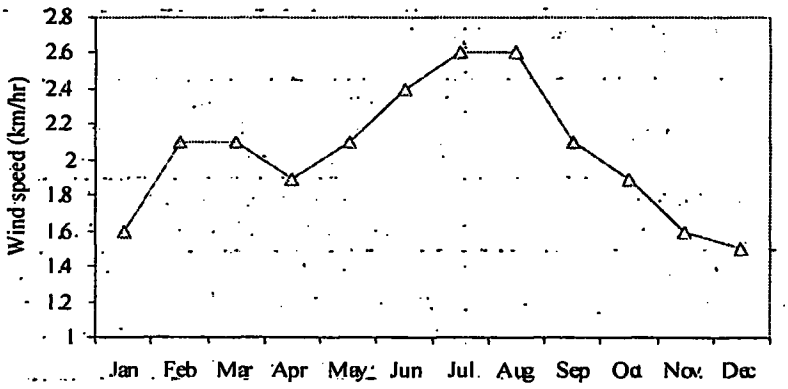

Fig. 12. Seasonal variation in wind velocity at Dartonfield