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THE ANALYSIS OF SOME ASPECTS OF WEATHER AND MOISTURE STATUS OF SOIL IN THE LOW COUNTRY TO DETERMINE THE MOST SUITABLE TIME FOR PLANTING TEA

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Twenty years weather data recorded at St. Joachim Estate Agromet Station (30 m amsl) were analysed to determine the most suitable time for planting tea. The moisture status of the soil was determined by calculating available water using daily rainfall, potential evaporation, field capacity and permanent wilting point. The probability levels for commencement of rain, length of rainy season, length of dry period and most suitable day for planting tea were then calculated for both south-west and north-east monsoon periods.

The 90% probability for the most suitable day for planting tea was 19th May and 4th October in south-west and north-east monsoon period respectively. Although, the length of favourable season for establishment of tea was marginally better in north-east monsoon period, the south-west monsoon period is preferred due to a shorter dry period being followed by the monsoon rains.

INTRODUCTION

When the genetic make-up, management and soil fertility are at optimum level, the ultimate growth and development of any crop plant is mainly governed by the weather regime viz. radiation, temperature and water relations. Since the grower has little or no control over radiation and temperature, water relations become a factor of importance from his point of view. In addition, water relations is vital in determining the success of establishment of crop plants in the field.

There were several attempts in the past to analyse weather data, but all these studies aimed at correlating weather factors mainly rainfall in order to correlate it with growth and yield of tea (Portsmouth, 1957; Devanathan, 1975; Kandiah, 1980; Kandiah and Thevadasan, 1980). Further in all these studies, only the summarised values, either total or average were used as the data for analysis. As Abeyasekera *et al.* (1983) pointed out, this approach has many inherent limitations such as losing useful information on dry spells etc. By analysing daily rainfall records for 56 years, they demonstrated that, one should use daily measurements to obtain useful agronomic results.

Timing of planting is extremely important to avoid casualties due to insufficient soil moisture during the period of establishment. Too early or too late planting may result in the plants having to go through a stress period before thorough establishment in the field causing death or set-back in growth. Since tea is a rainfed crop and has limited scope for irrigation, it is important to ensure that there should be sufficient soil moisture particularly during the period of establishment.

In this study, an attempt was made to analyse daily measurements of rainfall, potential evaporation and soil moisture for a 20 year period to determine the most suitable time for planting tea.

MATERIALS AND METHODS

Twenty years (1966 to 1985) weather data viz. rainfall and potential or pan evaporation, recorded at St. Joachim Estate Agromet Station, Ratnapura (30 m amsl) was used in this study.

The effective depth of planting tea is 45 cm (this is the depth of planting hole recommended for tea). The available water in this soil layer was estimated as follows :

Soil moisture percentage at Field Capacity (FC) (deterimined gravimetrically) = 24.4%

Soil volume of 1 m^2 to a depth of 45 cm = $1 \times 0.45 = 0.45\ m^3$

Bulk density of soil = 1,283 kg/m^3 (measured by taking soil core samples)

Weight of this soil volume = $1{,}283 \times 0.45$ = 577.35 kg

Amount of water in this soil volume at FC = $577.35 \times \frac{24}{100}$ = 138.56 kg

= $\frac{138.56 \times 10^3}{10^4}$ = 13.856 cm = 138.56 mm

This is the maximum water holding capacity.

Permanent Wilting Point (PWP) = 9%
(Measured using Pressure Membrane Apparatus)

Amount of water at PWP = $577.35 \times \frac{9}{100}$ = 51.96 kg

= $\frac{51.96 \times 10^3}{10^4}$ = 5.196 cm

= 51.96 mm

∴ Available water at FC = FC – PWP
= 138.56 – 51.96
= 86.6 mm

Daily Potential Evaporation (Pan Evaporation) = E

The actual evaporation is assumed to be 85% of the potential evaporation (Laycock, 1964). When rainfall is in excess of 138.56 mm/day, the soil can be assumed to be at FC. Therefore, the available water of the soil at a given time is $= 138.56 - (E \times 0.85)$

In this analysis, the two monsoonal periods were considered separately.

The following definitions were identified for the different events in relation to planting season for tea.

Commencement of Rain—When the amount of rainfall received within a period of 5 days is sufficient to bring the soil moisture to 50% of the FC.

Dry Spell—15 consecutive days without any wet day* or a period of 20 days in which the available water falls below 50% of the FC.

*Wet day is when rainfall is more than 0.85 mm/day.

End of Rainy Season—When available water falls below 50% of the FC.

Length of Rainy Season—Number of days between commencement and end of rainy season.

Most suitable day for Planting—When there will be no dry spell during the favourable period for establishment.

Favourable period for Establishment—Number of days between the date of planting and end of rainy season.

Analysis of Rainfall, Potential Evaporation and available Water—The monthly average rainfall data for 20 year period (1966 to 1985) is given in Fig. 1. It can be identified into two distinct rainy seasons (April/June and September/November) and corresponding dry season (July/August and December/March).

The most important factor for successful establishment of plants in the field is the moisture status in the soil at the time of planting and the period that will retain soil moisture at a favourable level. Fig. 2 shows the probability of rainfall that will maintain the soil moisture at various levels. This was estimated by analysing the daily change in available water in the soil, based on daily rainfall and potential evaporation for the 20 year period (1966—1985).

From this analysis, it was possible to determine the probability of commencement and end of rain during two rainy seasons (Table 1).

TABLE 1—*Probability of commencement and end of rain*

(a) *South-west Monsoon*

Commencement of Rain		*End of Rain*	
Date	*Probability* (%)	*Date*	*Probability* (%)
Before 10th April	55	Before 31st July	5
Before 20th April	85	Before 10th August	10
Before 24th April	90	Before 20th August	20
Before 10th May	100	Before 30th August	30

(b) *North-east Monsoon*

Commencement of Rain		*End of Rain*	
Date	*Probability Level* (%)	*Date*	*Probability Level* (%)
Before 10th Sept.	45	Before 31st Dec.	10
Before 20th Sept.	65	Before 10th Jan.	30
Before 30th Sept.	90	Before 20th Jan.	55
Before 10th Oct.	100	Before 30th Jan.	80

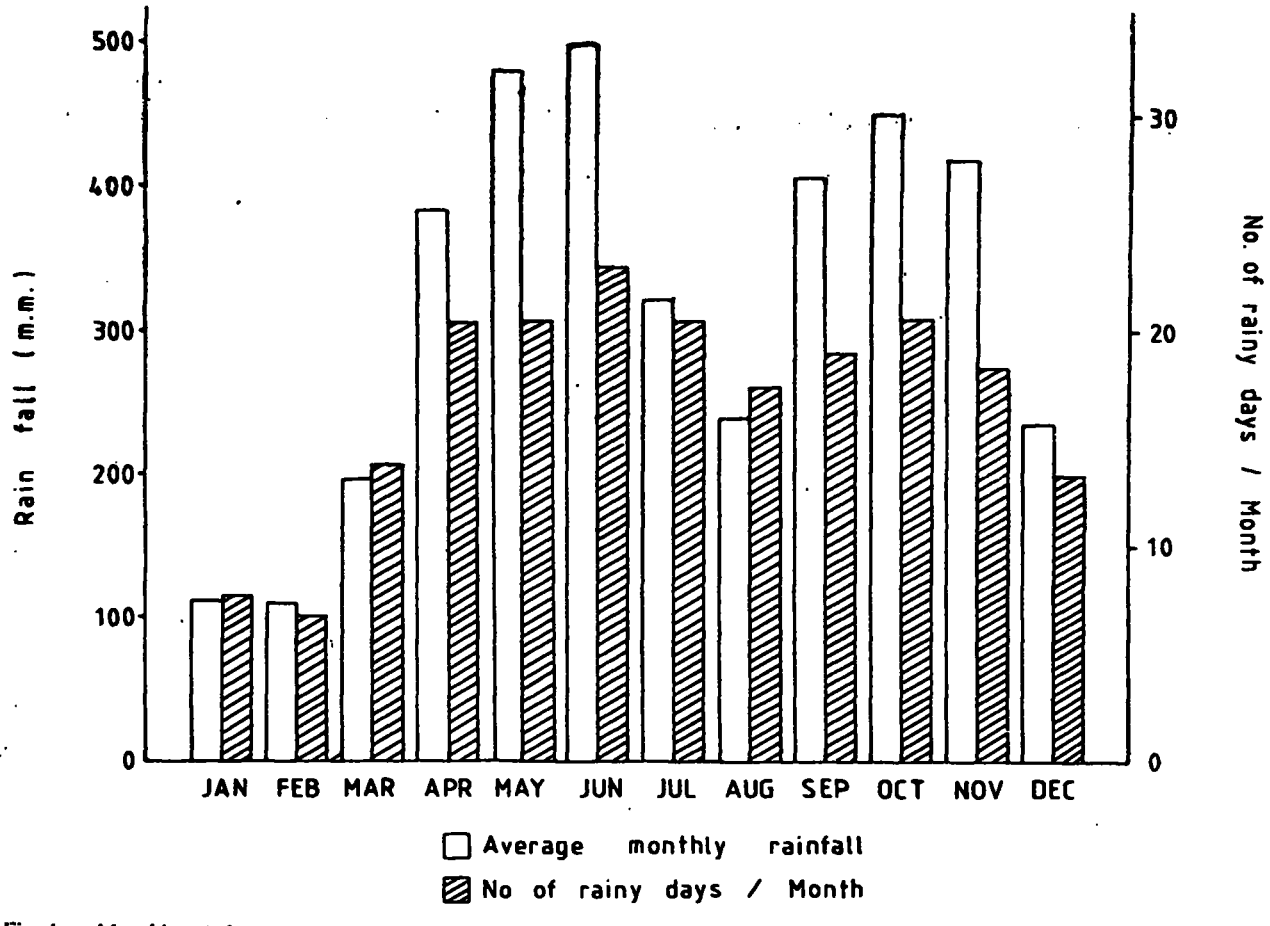

Fig. 1 — *Monthly rainfall and number of rainy days per month averaged over a* 20 *year period* (1966 – 1985)

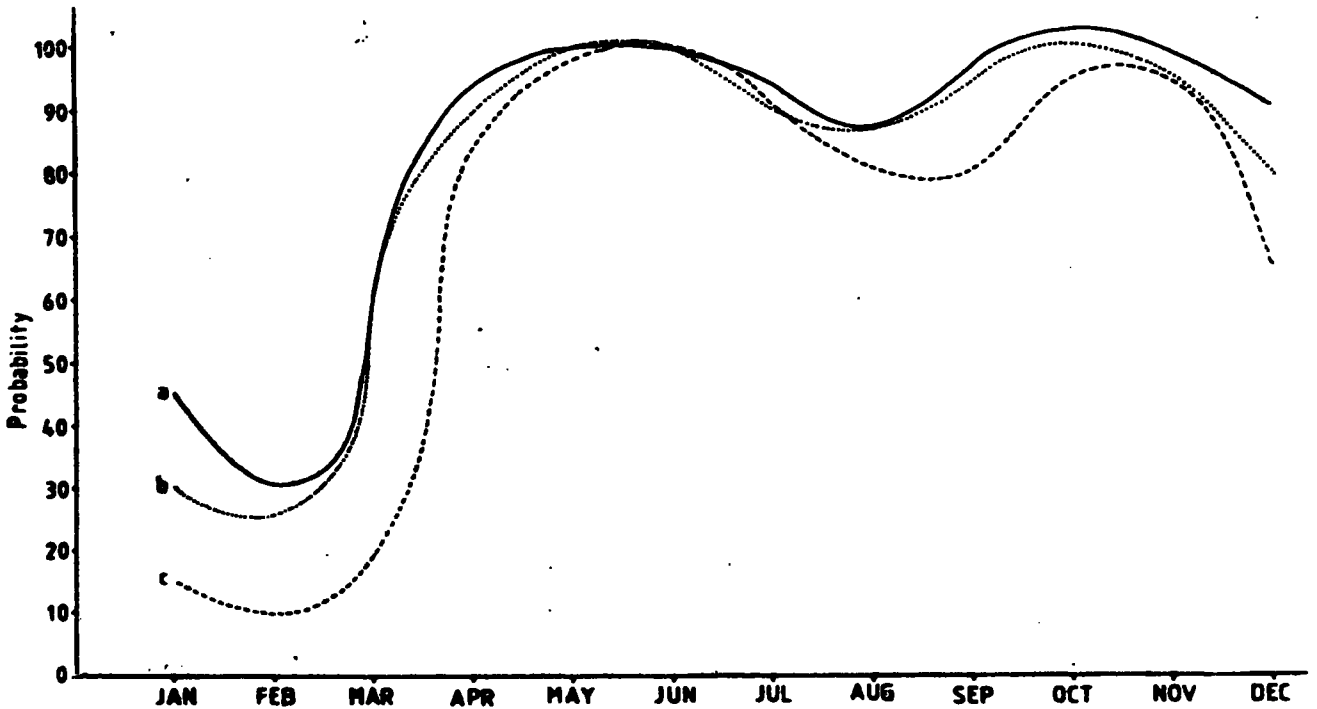

Fig. 2 — Probability of rainfall which will not allow water balance to fall (a) below zero, (b) below 50% Field Capacity, (c) below Field Capacity.

Taking 10% probability as the earliest that rainfall will end during a particular season, the length of rainy season at different levels of probabilities were also calculated (Table 2).

TABLE 2—*Probability of length of rainy season*

(a) *South-west Monsoon* *Length of rainy season*	*Probability* (%)	(b) *North-east Monsoon* *Length of rainy season*	*Probability* (%)
More than 122 days	55	More than 112 days	45
More than 112 days	88	More than 102 days	65
More than 107 days	90	More than 95 days	90
More than 92 days	100	More than 82 days	100

The length of two dry periods i.e. end of rain in one season to the commencement of rain in the next season was also calculated (Table 3). As in the case of length of rainy season, the calculation of the length of dry season was also based on the 10% probability of the end of rainy season.

TABLE 3—*Probability of length of dry period*

(a) *South-west Monsoon* *Length of dry period*	*Probability* (%)	(b) *North-east Monsoon* *Length of dry period*	*Probability* (%)
Less than 31 days	45	Less than 100 days	55
Less than 41 days	65	Less than 110 days	85
Less than 53 days	90	Less than 115 days	90
Less than 61 days	100	Less than 130 days	100

The different probabilities of most suitable day for planting tea is given in Table 4

TABLE 4—*Probability of most suitable day for planting*

(a) *South-west Monsoon* *Date*	*Probability* (%)	(b) *North-east Monsoon* *Date*	*Probability* (%)
30th April	80	10th September	45
10th May	85	20th September	65
19th May	90	1st October	90
30th May	95	10th October	95

The probability levels for commencement of rain, end of rain and most suitable dates for planting are also presented in Fig. 3.

It can be seen that the 90% probability of length of favourable period for establishment of tea is 82 days in south-west monsoon season and 90 days in north-east monsoon season.

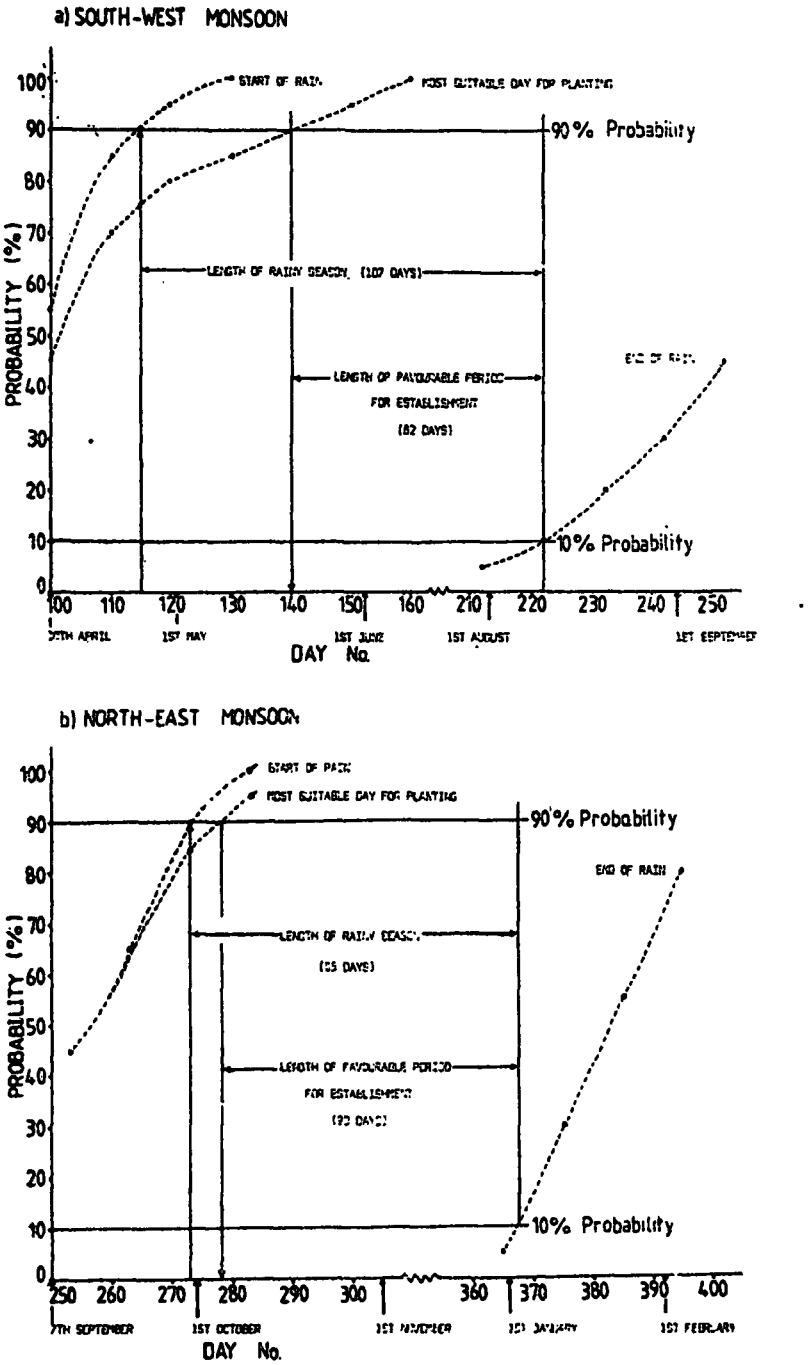

Fig. 3 — Probability levels for commencement of rain, end of rain and most suitable day for planting in (a) South-West Monsoon (b) North-East Monsoon.

DISCUSSION

The monthly average values for rainfall and number of rainy days (Fig. 1) indicate the pattern of two monsoon periods with corresponding dry periods. Although, this is an useful information for many agricultural purposes, it has the inherent disadvantage of masking some useful information such as dry spells, etc within these periods (Abeysekera, *et al.*, 1983). This can be overcome by analysing daily measurements.

For different events in relation to planting season, probability of 90% has been taken as the basis to decide the particular date for such event to take place except in end of rainy season. In this event, probability of 10% was considered as a reliable level to decide on the date that rain ends.

The rainfall commences on the 24th April and 30th September in the south-west and north-east monsoon respectively, and end on 10th August and 31st December (Table 1). Accordingly, the south-west monsoon season consists of 107 days and the north-east monsoon period of only 95 days (Table 2 and Fig. 3). This is followed by a dry period of 53 days after south-west monsoon season and 115 days after north-east monsoon season (Table 3 and Fig. 3).

For successful establishment of plants, the most important factor is soil moisture during the period of establishment, which is the balance between the rainfall and moisture loss due to evapo-transpiration. Soil factors such as field capacity and permanent wilting point are also important in retaining the soil moisture. Therefore, it is necessary to consider all these factors to decide on the most suitable day for planting.

The analysis revealed that the most suitable day for planting tea is 19th May and 4th October in south-west and north-east monsoon period respectively. This means that if planting is done on this date, there is 90% probability that soil will contain sufficient moisture during the period of establishment. Although the length of favourable period for establishment (Fig. 3) is marginally better in north-east monsoon period (90 days compared to 82 days in south-west monsoon period), the south-west monsoon is better for planting in view of the comparatively shorter dry period which is followed by the monsoon period. However, this is the general practice adopted in the low country.

Since this analysis was carried out using data from St. Joachim Estate, this may apply only to those estates in close proximity. The analysis is particularly useful for planning, especially preparation of land in time for planting. Delay in planting may result in heavy casualties. However, the exact date that planting should commence will finally depend on weather conditions prevailing in that particular season.

It is essential to use data for a long period (at least 15 to 20 years) to obtain any meaningful information from this analysis. Therefore, it may be important that every estate should maintain daily weather records accurately, at least for future use.

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