SOIL AND CLIMATE BASED IRRIGATION SCHEDULING FOR ADULT COCONUT

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ABSTRACT

An attempt has been made to develop a soil and climate based irrigation schedule for adult coconut. The study revealed that coconut is to be irrigated during January to April in South Kerala. In Entisols (coastal alluvium) coconut is to be irrigated in the basins in an area 12m² around the palm, with 360 litres of water per tree at an interval of 2-3 days during January, 2 days during February and March and 6 days during April. In the Alfisols (red loam) 540 litres of water may be supplied per tree at an interval of 4 days during January, 3 days during February, 3-4 days during March and 9-10 days during April. In Oxisols (laterites) 720 litres of water may be supplied per tree at an interval of 5-6 days during January, 4-5 days during February and March and 12-13 days during April.

1. INTRODUCTION

Irrigation is an essential requirement for achieving higher productivity of crops. Copeland (1931) reported that a coconut palm can absorb 24 litres of water in a day. Water requirement of coconut depends on soil, variety, season and soil moisture level. The influence of soil and climatic parameters on Consumptive Use of crops (CU) has been studied by many researchers. Crop water requirement is the depth of water needed to meet the water loss through evapotranspiration of a disease free crop, growing in large fields under non-restricting soil conditions including soil water and fertility achieving full production potential under the given growing environments (Doorenbos and Pruitt, 1977).

Crop evapotranspiration (ET crop) also known as consumptive use is determined by the climatic environment and specific crop characteristics. In order to ca culate the ET crop, the referenc (Potential) crop evapotranspira tion (ETo) is to be determine (Doorenbos and Pruitt, 1977) Crop coefficients (Kc) relate ET to ET crop : ET crop = Kc (ETo) The value of Kc depends on th crop species and the phemologica stage of the crop. Coconut has deep and well spread root syster About 80% of the coconut root are found in the soil, 2.0m laterall and 1.2 m vertically from the bas of the plant (CPCRI-1973). Re sults of studies conducted at th Kerala Agricultural Universit revealed that 90% of the activ roots of adult coconut are seen i the soil 2.5 m laterally and 0.9 m vertically from the base of th plant (Anon-1988).

Oxisols, Entisols and Alfisol are the important soil types o Kerala and they differ in their soi moisture characteristics and physi- cochemical properties (Anton 1982). In the present study a attempt has been made to develop a soil and climate based irrigatio schedule for adult coconut

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grown in the three major soil types of South Kerala.

2. MATERIALS AND METHODS

Observations on normal weather collected from the Meteorological Observatory, Trivandrum, were made use of in the present study. The effective rainfall was calculated following the method suggested by Dastane (1975). The root zone capacity for each soil was estimated assuming the basin area to be irrigated as 12 m^2 around the palm (2 m radial distance) to a depth of 1 m. ETo was calculated following the method of Penman (1948) modified by Rao *et al.* (1971) ET crop (CU) for adult coconut (spacing of 7.5 x 7.5 m) was estimated as a product of ETo and Kc. A crop coefficient of 0.65 (Saseendran and Jayakumar 1988) has been made use of. The physicochemical properties of the soils of the study area reported by Antony (1982) were utilised for the study.

3. RESULTS AND DISCUSSIONS

a) *Weather Conditions*

The data on weather (Table 1) reveal that the region (South Kerala) receives a mean annual rainfall of 1820 mm. The monthly rainfall varies from 22.6 to 350.6 mm, the lowest being in January and the highest in June. About 68% of rainfall is received during June-September (South West Monsoon Season) and 31% received during October - January (North East Monsoon). The remaining 21% of the rainfall is received during February - May (Summer Season). The rainfall is more or less evenly distributed from May to December enabling the crop to meet the CU from the rainfall itself during the monsoon period.

The effective rainfall calculated as suggested by Dastane (1975) reveals that, of the total annual rainfall of 1820 mm, 1307 mm (72%) is effective. Of this, 1148 mm (88%) is spread over the wet seasons and during the dry season (January — April) 159 mm is effective. A study of the rainfall climatology of Trivandrum further reveals that upland crops generally require irrigation during January to April (4 months) during which the CU exceeds the precipitation.

The maximum temperature of the region ranges from 26.2 to 28.8°C, the hottest months being March to May and the coolest December to January. The mean relative humidity ranged from 70 to 85%, January to March being the dry months and May to November the humid. The mean wind speed ranged from 8.1 to 12.6km h^{-1}. Strong winds occur during January—May (the dry period) and the pan evaporation ranges from 3.2 to 5.8 mm d^{-1}. The PE is high during January to May. From the results of weather data analysis presented above, it can be seen that the southern parts of Kerala enjoy a warm humid climate with evenly distributed rainfall during May-December. The period from January-April is dry during which the CU exceeds precipitation and the crop requires irrigation.

b) *Irrigation Scheduling*

The data on soil moisture characteristics (Table 2) reveal that the three major soils of the region viz. Entisols (coastal alluvium), Alfisols (redloam) and Oxisols (laterites), differ in their bulk density (BD) as well as available water holding capacity. The BD was highest in coastal alluvium and lowest in laterites. The available water holding capacity showed a reverse trend. Thus, the root zone capacity was also different in these soils, highest being in laterites (720 litres) and lowest in coastal alluvium (360 litres).

The data on CU of coconut (Table 3) reveal that the CU vary with the month, the highest in March (117 mm) and the lowest in January (93 mm). The difference in PE, between these months explain this (Table 1). The temperature and wind velocity were also high during March. PE is a function of temperature and wind velocity. As

such, the rate of PE was found to be the highest during March due to the influence of these weather parameters. The total effective rainfall received during the 4 dry months (January to May) was 159 mm, April receiving the highest amount (81 mm) and January and February the lowest. Thus the IR was comparatively low in April.

The irrigation intervals (Table 4) vary with the month as well as with the type of soil. This irrigation interval was wide in Oxisols and narrow in Entisols. This is due to the difference in water holding capacity of these soils. The frequency of irrigation was more during January—March and less during April. The difference in the receipt of rainfall between these months explain this.

From the study it was found that in Entisols, adult coconut is to be irrigated in the basins with 360 litres of water per tree at an interval of 2-3 days in January, 2 days in February and March and 6 days in April. In the Alfisols 540 litres of water per tree may be applied in the basins at an interval of 4 days in January, 3 days in February, 3-4 days in March and 9-10 days in April. In Oxisols, coconut is to be irrigated with 720 litres of water per tree at an interval of 5-6 days in January, 4-5 days in February and March and 12-13 days in April. This specific monthwise irrigation schedule developed by considering both soil as well as climate, seems to be more reasonable and appropriate and can be considered for adoption in the southern parts of Kerala.

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TABLE 1

NORMAL WEATHER AT TRIVANDRUM

Latitude : 08° 29' N
Longitude : 76° 57' E
Altitude : 64 m above MSL

	Monthly Rain-* fall (mm) 1901 - '71	Eff. rain fall (mm) **	Mean tem. °C	RH mean %	Bright sun shine hrs per day	Mean wind speed (km. h^{-1}	Evaporation mm. d^{-1}
...uary	22.6	21	26.8	70	8.5	9.4	4.6
...uary	24.0	21	27.3	71	8.9	11.4	5.5
...rch	39.9	36	28.4	73	8.4	12.3	5.8
...pril	108.2	81	28.8	77	7.0	12.6	5.7
...ay	211.4	158	28.3	80.5	6 3	12.5	5.6
...ne	350.6	200	26 5	86	4 0	9.8	3.3
...ly	234 7	176	26.2	85	4.3	9.2	4.0
...gust	134.9	101	26.4	83	5.7	8.9	3.8
...ptember	148.7	111	26.6	81.5	6.3	8.7	4.0
...tober	276.1	179	26.7	83.5	5.5	8 8	3.2
...vember	195.1	157	26.6	82.5	5.7	8.1	3.2
...cember	73.2	66	26.7	74.5	7.6	8.3	3.3
...tal	1820.0	1307	27.1				

*70 years mean
All other parameters - 30 years mean
**Dastane (1975)

TABLE 2

SOIL MOISTURE CHARACTERISTICS OF MAJOR SOILS OF SOUTH KERALA

Soil type	Apparent sp. gravity * g. cm^{-3}	Available Water holding capacity* %	Rooting depth of coconut (m)	50% of available water (%)	Root zone capacity of adult coconut** (l)
Entisol (Coastal Alluvium)	1.65	3.6	1.0	1.8	360
Alfisol (Red loam)	1.45	6.2	1.0	3.1	540
Oxisol (laterites)	1.20	10.0	1.0	5.0	720

* Antony (1982)

** Around the palm over $12m^2$ area to a depth of 1 m.

TABLE 3

CONSUMPTIVE USE AND IRRIGATION REQUIREMENT OF ADULT COCONUT IN SUMMER

	January	February	March	April	Total
No. of days	31	28	31	30	120
ETo (mm)	143	154	180	171	648
Kc*	0.65	0.65	0.65	0.65	–
ET crop (cu) mm.	93	100	117	111	421
Effective rainfall (mm)	21	21	36	81	159
Irrigation requirement (mm)	72	79	81	30	262
Irrigation reguirement** ($l.d^{-1}$ $tree^{-1}$)	131	158	147	56	492

* Saseendran and Jayakumar (1988)

** Estimated for a tree planted with a spacing 7.5 x 7.5 m.

TABLE 4

IRRIGATION SCHEDULE FOR ADULT COCONUT IN SOUTH KERALA

Type of soil	Quantity of water to be applied per tree (l)	Irrigation interval (days)			
		Jan.	Feb.	March	Apr
Coastal alluvium (Entisol)	360	2—3	2	2	
Red loam (Alfisol)	540	4	3	3—4	9-
Laterite (Oxisol)	720	5—6	4—5	4—5	12-