EFFECT OF IRRIGATION ON THE MOISTURE REGIME OF COCONUT SEEDLINGS IN THE DRY ZONE

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SUMMARY

Effect of most desirable quantity and frequency of irrigation on establishment and growth of coconut seedlings cv. Tall x Tall, was studied by determining the moisture regime of a sandy soil in the Dry Zone.

Results showed that application of 20 l and 40 l of water/seedling twice a week maintained sufficient available water throughout the soil profile in the effective root zone. However, in terms of cost effectiveness, seedlings irrigated with either 40 l once a week or 60 l once in two weeks or those provided with two clay pots filled with water/seedling and combined with straw mulch maintained a favourable moisture regime in the soil profile for establishment and growth of coconut seedlings. In contrast, seedlings irrigated with either 20 l once a week or 40 l once in two weeks or non irrigated seedlings experienced moisture strees throughout the irrigation cycle.

INTRODUCTION

In Sri Lanka, coconut plantations are widespread on deep sandy soils (Regosols) in the Dry Zone. One of the main constraints of sandy soil is its poor water holding capacity, which drops down to a low level during the dry season. The importance of an assured supply of water in the dry season particularly during the first 2–3 years of establishment of coconut seedlings in the Dry Zone has been stressed by Menon and Pandalai (1958). In the absence of irrigation, coconut seedlings grown in sandy soil are often subject to severe moisture stress during the dry season causing a set-back on the establishment and growth. Therefore, it appears that a major obstacle for the establishment of coconut seedlings in the Dry Zone is the poor moisture regime in the root zone. To overcome this situation, seedlings have to be watered periodically during the dry season to ensure good establishment in the field.

This trial was conducted to determine the most effective dosage and frequency of irrigation that will ensure optimum moisture regime in the root zone of coconut seedlings for their establishment and growth in the Dry Zone.

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MATERIALS AND METHODS

The trial was conducted at Passekudah Research Station in sandy soils (Regosol) with a mineral composition of 93.6% sand, 2.1% silt, 4.3% clay and characterised by very low water holding capacity and slightly acid to neutral pH. The mean annual rainfall at the site was approximately 1200 mm. Coconut seedlings cv. Tall x Tall (CRIC 60) were planted during the 'Maha' (Oct/Nov.) season 1982, at the spacing of 7.2 m x .7.2 m square giving a density of 192 seedlings/ha.

The nine treatments were (T1) control - no watering; (T2) supplying water into two unglazed clay pots (pitchers) of 6.75 l capacity each, which were re-filled when necessary; (T3) supplying 30 l water/seedling once a week; (T4) supplying 20 l water/ seedling twice a week; (T5) supplying 20 l water/seedling once in two weeks; (T6) supplying 40 l of water /seedling once a week; (T7) supplying 40 l of water/seedling twice a week; (T8) supplying 40 l of water/seedling once in two weeks; (T9) supplying 60 l of water once in two weeks. These were arranged in a randomized block design with three replications. The seedlings were subjected to the above irrigation treatments during the dry season beginning January 1983. After irrigation, 10 cm thick straw mulch was maintained around each seedling throughout the experimental period.

The soil moisture regime in the root zone of coconut seedlings was measured around a 0.6 m radius from the base of seedlings during the irrigation cycle between 23 May - 12 June 1983. Soil samples were drawn from 0-15 cm, 15-30 cm, 30-45 cm and 45-60 cm depths of soil profile. In order to minimise verticle and horizontal variability in soil moisture distribution, two samples at each depth were taken from either side of the seedling. Three coconut seedlings per treatment were chosen at random for continuous monitoring of moisture regimes throughout the irrigation cycle.

Sampling commenced one hour after irrigation and continued daily over the entire irrigation cycle. Soil samples were collected in aluminium moisture cans and the moisture content was determined by the Gravimetric method. Soil moisture characteristic curves were established by the Pressure Plate Appatatus at 1/3 bar pressure (Tanner and Elrick, 1985). Texture of the soil was determined by the Hygrometer method (Day, 1965).

RESULTS AND DISCUSSION

Soil moisture regime :

Moisture content of the soil profile is shown in Table 1. As expected moisture regime in the root zone of irrigated coconut seedlings were higher than those in the non-irrigated control plots. Further, in all irrigation treatments, the available moisture in the soil profile increased with depth (Table 2). This may be due largely to the increased clay content with increasing soil depth (Table 3), as clay has a high water holding capacity (Massond, 1975). Among treatments, root zone of seedlings irrigated with either 20 l or 40 l of water /seedling twice a week maintained a high moisture regime in the soil profile than other treatments.

Table 1. Effect of Irrigation on Moisture Regime (% dry weight of the soil profile*)

Irrigation treatment	Depth of soil profile			
	0–15 cm	15–30 cm	30–45 cm	45–60 cm
T1 (control)	1.25	2.05	2.30	2.36
T2 (pitcher)	1.61	4.40	4.92	4.77
T3 (20 1/week)	2.51	2.69	2.70	3.18
T4 (20 1/twice weekly)	3.42	3.66	4.38	5.14
T5 (20 1/once in two weeks)	2.45	2.99	3.26	3.45
T6 (40 1/week)	2.81	3.83	5.39	5.62
T7 (40 1/twice weekly)	3.71	4.14HH/	5.13	5.78
T8 (40 1 once in two weeks)	2.70	3.35	3.97	4.92
T9 (60 1 once in two weeks)	2.81	3.65	5.16	6.32
CV (%)	6.47	2.81	1.63	1.52
Significance	xxx	xxx	xxx	xxx
SE (x)	0.10	0.06	0.04	0.04

* measured two days following irrigation treatments

Table 2. Moisture Characteristics of Soil Profile

Depth of soil profile (cm)	Field capacity % (1/3 bar)	Permanent wilting point % (15 bar)	Available moisture %
0–15	2.65	1.45	1.20
15–30	3.65	0.63	3.02
30–45	5.19	1.01	4.18
45–60	5.96	1.23	4.73

It was observed that the degree of reduction in moisture with depth in the soil profile was not uniform throughout the irrigation cycle (Table 4). For example, in treatments 3 and 5 (T3 and T5) where initial wetting depth was low, moisture regime of the soil profile dropped faster, whereas in treatments 4 and 7 (T4 and T7) in which seedlings were irrigated with 20 l or 40 l of water twice a week, the degree of reduction in moisture regime was relatively low, probably due to the high initial depth of wetting.

Moisture characteristics:

Moisture characteristic curves of the soil profile at four depths (Fig. 1) indicated a sharp decline in moisture content at low pressure, irrespective of the depth of soil profile. This could be due to the high porosity of sandy soil which requires a low tension. Also, available moisture content of soil profile increased with depth (Table 2 Fig. 1) due to the increasing clay content as revealed by particle size analysis (Table 3).

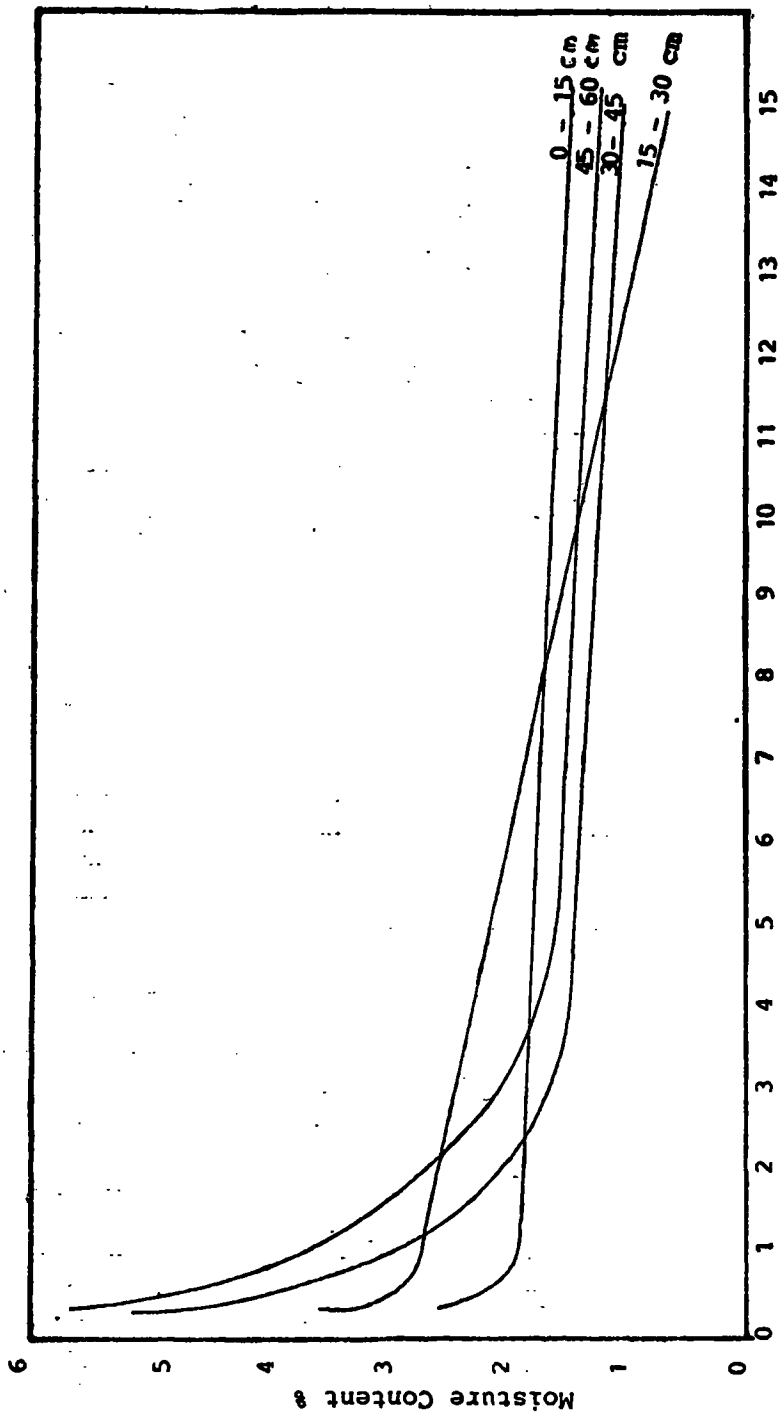

Fig. 1 Soil Moisture Characteristic Curves

Frequency of irrigation:

The number of days coconut seedlings are subjected to water stress after 50% depletion of available water is given in Table 4. It is reported that in general, irrigation should be repeated when 50% of available water in the root zone has been depleted (Michael, 1978). In this experiment, seedlings in control plots (T1) were under water stress throughout the soil profile which would have affected seedling establishment and growth. In T3, T5 and T8, coconut seedlings were subjected to a considerable amount of stress at all depths.

In treatments 2 (T2) and 9 (T9) seedlings experienced water stress mainly at the surface layer. In contrast, seedlings in treatments 4 and 7 plots did not experience any water stress conditions at all depths, indicating that application of either 20 l or 40 l of water twice a week is the most suitable frequency of irrigation for the establishment and early growth of coconut seedlings. These findings are supported by those reported by Liyanage and Mathes (1989). Among other treatments, seedlings in T6 plots experienced water stress at the surface layer only for a short period lasting 2½ days.

Table 3. Texture of Soil Profile

Depth of soil profile(cm)	Sand (%)	Silt (%)	Clay (%)
0.15	93.6	2.1	4.3
15–30	93.5	2.0	4.5
30–45	94.3	0.8	4.9
45–60	94.7	0.1	5.2

Table 4. Period of Moisture Stress Experienced by Coconut Seedlings During the Irrigation Cycle (Days)

Irrigation treatments	Depth of soil profile 0–15 cm	15–30 cm	30–45 cm	45–60 cm
T1	Throughout	Throughout	Throughout	Throughout
T2	Throughout	Nil	Nil	Nil
T3	3.0	1.5	Throughout	Throughout
T4	Nil	Nil	Nil	Nil
T5	9.0	6.0	12.0	11.0
T6	2.5	Nil	Nil	Nil
T7	Nil	Nil	Nil	Nil
T8	8.0	5.5	6.0	6.5
T9	7.5	2.5	0.5	Nil

CONCLUSION

These results revealed that application of either 20 l (T4) and 40 l (T7) twice a week maintained the most desirable moisture regime in the root zone which enhanced seedling establishment and growth in sandy soil, without being subjected to moisture stress. Further, seedlings supplied with 40 l once a week (T6) experienced stress at the surface only for about 2½ days during the irrigation cycle.

In terms of cost per irrigation cycle, application of 20 l water twice a week (Rs. 3.24/seedling) or 40 l once a week (Rs. 3.35/seedling) appeared to be more economical and, therefore suitable for smallholdings. Although application of 60 l water once in two weeks (T9) indicated water stress at the surface for a considerable period in terms of costs, it is less expensive (Rs. 2.19/seedling) than other treatments This may be suitable for large scale coconut plantations provided with a mulch around the palm.

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