

EFFICIENCY OF DRIP IRRIGATION IN ARECANUT AND COCOA MIXED CROPPING SYSTEM

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INTRODUCTION :

Irrigation plays a very important role in agricultural crop production and water has to be used judiciously and economically. For developing countries like India, plantation crops are a major source of foreign exchange. A variety of crops like coconut, arecanut, pepper, cardamom, tea and coffee etc., are cultivated in the midland region of the west coast. The precipitation in coastal Karnataka is confined from June to November and during this period there is heavy rainfall ranging from 3700 mm to 3800 mm. The monsoon is followed by prolonged summer with 3-6 months of dry period, and the crops are invariably subjected to water stress since water becomes limiting, it is imperative to optimize the irrigation needs of the crop.

The arecanut palms requires about 190 litres of water once in 3 days (Sadanandan 1973). Each method of irrigation is suited to a certain set of limiting conditions. A thorough understanding of the soil, topography, water supply will be helpful in selecting proper method of irrigation (Marr. 1958; Smith. 1957). Significant yield increase in drip irrigated arecanut palms was observed compared to local methods of irrigation (Khader. 1983).

The paper deals with the efficiency of drip irrigation in an arecanut-Cocoa mixed garden.

MATERIALS AND METHODS :

A Cocoa - Arecanut mixed garden with a spacing of 2.7m X 2.7m for arecanut and 2.7m X 5.4m for Cocoa was used for the study. The trial had 5 replicates, each block contained 3 irrigation levels viz., I_1 , I_2 and I_3 as detailed below.

- i) half of the open pan evaporation rate (10 lit. of water)
- ii) equal to the open pan evaporation rate (20 lit. of water)
- iii) $1\frac{1}{2}$ times the open pan evaporation rate (30 lit. water)

The system was installed during 1989, the water was supplied from a overhead tank. The drip system consists of main line, submain, laterals, emitters and microtubes. 63mm diameter of PVC main line of length 290m, 40mm diameter PVC submain of 140m length, 12.5mm diameter laterals line of 4000m length were used. Two emitters of discharge rate viz., 2 lph and 4 lph, and 4mm diameter microtubes were used. Discharge rates at various points along with laterals were measured using plastic containers for 2 lph and 4 lph and the results obtained were statistically analysed.

The wetting front was monitored by keeping the emitters (2 lph and 4 lph) at different vertical depths viz., 0cm, 5cm, 10cm. The wetted boundary was marked on a glass plate and was later transferred on to a tracing sheet. The soil moisture was determined by gravimetric methods and the percentage of moisture calculated. The root distribution under drip source was studied by taking soil cores using soil auger at lateral (45cm) and vertical (90cm) distance both for arecanut and cocoa. The roots were separated from the sample and washed with fresh water and kept for drying in an oven for two days at 80°C. The dry weight of roots were noted for different depths both for arecanut and cocoa palms.

RESULTS AND DISCUSSIONS :

The results were statistically analysed (table 1 & 2). There was no significant variation in discharge along the laterals both for I_1 and I_2 level of irrigation. But for the irrigation level I_3 , significant variation in discharge was observed as the emitters are of different discharge rate viz., 2 lph and 4 lph. The soil wetting pattern was observed under discharge rate of 2 lph for $2\frac{1}{2}$ hours of irrigation, at different depths of emitters (fig. 1). When the drippers are kept on the surface the soil was wetted to a maximum of 50cm radial distance and to a vertical depth of 34cm. When the drippers are kept at 5cm below ground, the soil was wetted to a maximum of 27.5cm radial distance and to a vertical depth

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of 31cm. When the drippers are kept at 10cm below ground, the soil was wetted to a maximum of 42.5cm radial distance and to a vertical depths of 36.5cm. When the drippers are kept on the surface, with the discharge rate of 41ph the soil was wetted to a maximum of 40cm radial distance and to a vertical depth of 33.5cm. When the drippers are kept at 5cm below ground, the soil was wetted to a maximum of 47.5cm radial distance and to a vertical depth of 35cm. When the drippers are kept at 10cm below ground the soil was wetted to a maximum of 42.5cm lateral distance and to a vertical depth of 35cm. There was not much difference in moisture content at the point source and upto a lateral distance of 30cm, in all depths irrespective of different rate of discharge and hours of operation. But beyond 30cm lateral distance and for different depth of sampling, varying percentage of moisture was noticed. The experiment showed a higher percentage of moisture under the point source with a discharge rate of 4 lph in all depths of soil both for arecanut and cocoa (table 3-6). The experiment on root distribution under drip source showed that the root concentration (dry weight in gms) was more around drip source, which is due to uniformity of moisture at all time. Similar results were obtained in other crops (Kudanimani, 1977, Ananthkumar, 1984). It was noticed from the results that the root growth was maximum in the upper layer and spread of roots was maximum laterally within the wetted zone both for arecanut and cocoa trees.

From standard graphs for design criteria the laterals diameter of 12mm, sub-main diameter of 3.5cm, main line diameter of 12cm were determined both for arecanut and cocoa palms. Emitters of 2 lph were found to be ideal.

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TABLE 1
DISCHARGE VARIATION ALONG WITH
LENGTH OF LATERALS

Treatment	Mean I ₂	Mean I ₁
1st lateral	3312.80	1842.00
11nd lateral	3244.80	1921.20
S.E.M. ±	74.26	51.73
L.S.D. (5%)	N.S.	N.S.
1st point	3360.00	1936.00
2nd point	3414.00	1890.00
3rd point	2962.00	1830.00
4th point	3252.00	1867.00
5th point	3406.00	1855.00
S.E.M. ±	117.40	81.80
L.S.D. (5%)	N.S.	N.S.

TABLE 2
DISCHARGE VARIATION ALONG WITH THE
LENGTH OF LATERALS

Treatment	Mean I ₂
1st lateral	2749.50
2nd lateral	2825.80
S.E.M. ±	69.70
L.S.D. (5%)	N.S.
1st emitter (21ph)	1914.70
2nd emitter (41ph)	3660.00
S.E.M. ±	69.70
L.S.D. (5%)	197.14
1st point	2887.00
2nd point	2822.00
3rd point	2817.00
4th point	2692.20
5th point	2719.00
S.E.M. ±	110.20
L.S.D. (5%)	N.S.

TABLE 3
MOISTURE DISTRIBUTION AND ROOT DISTRIBUTION UNDER DRIP SOURCE WITH A
DISCHARGE RATE OF 2 LPH FOR 2½ HOURS (ARECANUT TREE).

Lateral distance (cm)	Vertical depth (cm)	Moisture content %	Dry weight of Roots (gm)*
Point source	00-30	17.18	5.25
	30-60	15.32	3.91
	60-90	14.63	1.18
At 30cm distance	0-30	12.70	0.57
	30-60	12.48	0.78
	60-90	12.31	0.47
At 45cm distance	0-30	11.44	0.33
	30-60	10.94	0.17
	60-90	10.56	0.13

TABLE 4
MOISTURE DISTRIBUTION AND ROOT DISTRIBUTION UNDER DRIP SOURCE WITH A
DISCHARGE RATE OF 2 LPH FOR 2½ HOURS (COCOA TREE).

Lateral distance (cm)	Vertical depth (cm)	Moisture content %	Dry weight of Roots (gm)*
Point Source	0-30	13.23	0.62
	30-60	12.58	3.35
	60-90	11.48	0.31
At 30cm distance	0-30	12.58	0.16
	30-60	12.08	0.14
	60-90	11.16	0.05
At 45cm distance	0-30	11.86	0.02
	30-60	11.55	0.02
	60-90	10.59	0.01

* per 935cm³ column.

TABLE 5
MOISTURE DISTRIBUTION AND ROOT DISTRIBUTION UNDER DRIP SOURCE WITH A
DISCHARGE RATE OF 4 LPH FOR 2½ HOURS (ARECANUT TREE).

Lateral distance (cm)	Vertical depth (cm)	Moisture content %	Dry weight of Roots (gm)*
Point source	0-30	21.38	2.78
	30-60	19.83	1.18
	60-90	18.22	0.40
At 30cm distance	0-30	16.93	0.67
	30-60	14.51	0.18
	60-90	13.16	0.01
At 45cm distance	0-30	13.06	0.43
	30-60	11.38	0.17
	60-90	10.90	0.01

TABLE 6
MOISTURE DISTRIBUTION AND ROOT DISTRIBUTION UNDER DRIP SOURCE WITH A
DISCHARGE RATE OF 4 LPH FOR 2½ HOURS (COCOA TREE).

Lateral distance (cm)	Vertical depth (cm)	Moisture content %	Dry weight of Roots (gm)*
Point source	0-30	14.75	0.53
	30-60	13.83	0.24
	60-90	12.75	0.20
At 30cm distance	0-30	13.29	0.27
	30-60	11.94	0.12
	60-90	11.25	0.01
At 45cm distance	0-30	12.31	0.01
	30-60	10.96	0.01
	60-90	10.40	0.01

* per 935cm³ column.

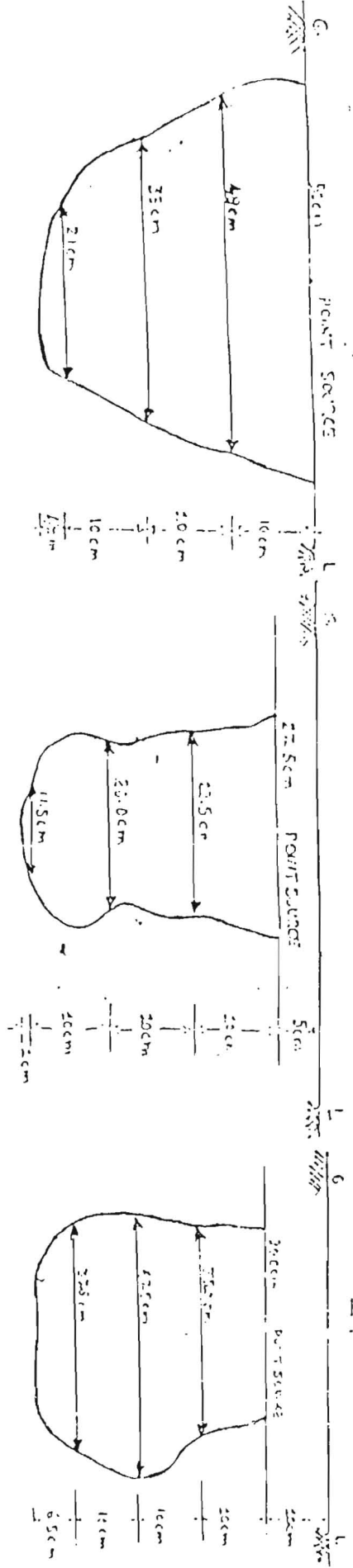


Fig. 1 :- Soil wetting pattern under discharge rate (2 lph) for 2½ hours at different depths of emitters.

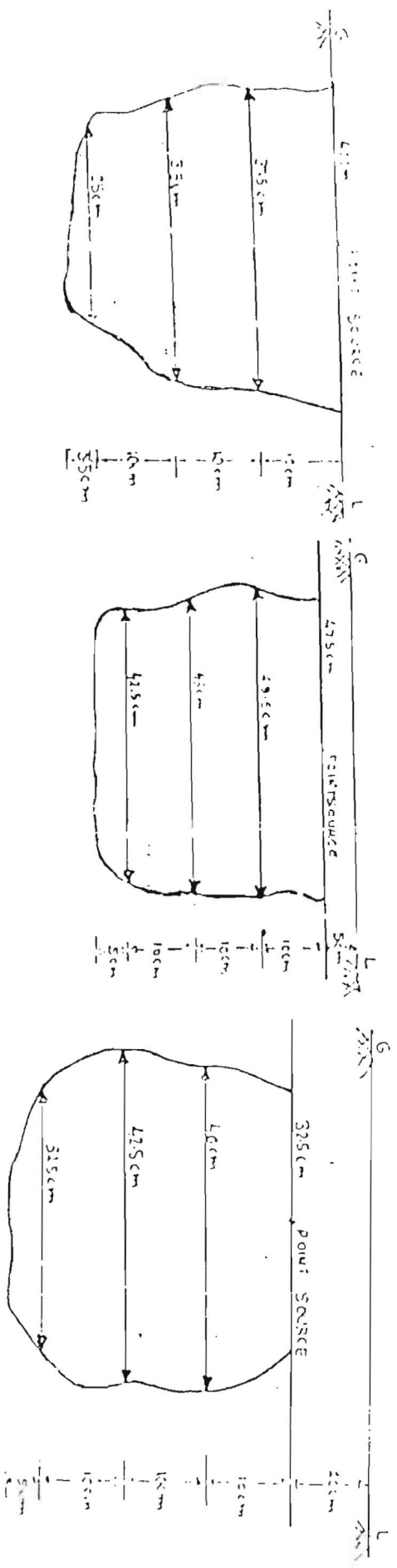


Fig. 2 :- Soil wetting pattern under discharge rate (4 lph) for 2½ hours at different depths of emitters.