

SUMMER IRRIGATION REQUIREMENT OF THE COCONUT PALM

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Coconut is mainly grown as a irrigated crop. Much of the seasonal variations in coconut yield are attributable to the vagaries in rainfall.

How does rainfall affect coconut yield? It takes about 44 months for the spadix primordia to develop into a bunch of ripe coconuts. Poor yield, smaller size of nuts and low copra content of nuts harvested during September-November are due to the dry spell the palm faces at the time of spadix primordia initiation and early stages of kernel formation. These stages synchronise with the dry spell during January-April. Similarly, good yield, bigger size of nuts and high copra content of nuts harvested during January-May have their development stages falling in the months of June-September, when the crop receives plentiful rainfall. In areas having well distributed rainfall (as in Kuttiadi, Calicut district, Kerala) the production of nuts is generally high. This shows that coconut will respond to irrigation and moisture conservation practices.

EFFECT OF MOISTURE STRESS ON YIELD

The period of development of an inflorescence from initiation to flowering has been estimated to be 32 months for tall cultivars of coconut (Patel, 1938). With such a great time lapse between the initiation of leaf and inflorescence primordia and flowering, and with many other inflorescences in various stages of development present at the same, it is difficult to relate growth, flowering or yield responses to any particular climatic condition.

Abortion of young, developing inflorescences can seriously reduce the yield of coconut. Patel (1938) traced the reason for the abortion of developing inflorescences of coconut palms to a drought effect from 15 to 16 months before the spathe opened. He also associated the adverse effects of drought during the time of ovary and perianth differentiation with the low production of flowers on the inflorescence.

Studies conducted at the Central Plantation Crops Research

Institute (CPCRI), Kasaragod, Kerala indicated that yield of coconut in any particular year was related to the rainfall during the dry months for the entire period from initiation to fruiting (i. e. January to April rainfall for 2 years previous to the harvest and for the year of harvest). In Ceylon, it was found that drought for a period of 8 months affected the yield of coconut for a period of about 24 months with a maximum effect for about 13 months after the termination of the drought. Copra production per nut was reduced for a period of one year. A recent study on the effect of drought on coconut yield conducted by Prasada Rao and Nair (1986) indicated that decrease in nut yield started from the eighth month with the maximum reduction in the thirteenth month after the drought was over. The decline in nut yield due to drought in 1983 continued for 12 months from February, 1984 to January, 1985. Prasada Rao (1982), based on weekly soil moisture deficit and the expression of stress symptoms (drooping), opined that the effect of drought on coconut palms was

seen (drooping of leaves) when the aridity index exceeded 65 per cent. The central and southern parts of Kerala never attain aridity indices above 65 per cent while the northern parts experience aridity indices above 65 per cent for 3 or 4 months in the summer. This is one of the reasons why the productivity of coconut is higher in the southern districts in spite of the disease root (wilt).

WATER REQUIREMENT OF COCONUT

It has been widely recognised that when coconut palms are grown under condition of high temperatures and intense sunshine, their water requirement for satisfactory growth will be very high. In the Philippines, Espino and Juliono (1924, cited by Thampan, 1982) estimated the water requirement of coconut at 16 liters per day. In another study, the daily loss of water from a mature palm was estimated at 28 litre to 74 litre (Copeland, 1931).

The rate of ET depends to a large extent on the amount of water available in the growth medium. The studies conducted at the CPCRI, Kasaragod (Joshy *et al.*, 1986) showed an initial ET

of 4 mm/day after a rainfall. This changed to 2.4 mm/day (mean of 7 days) and 2.2 mm/day (mean of 15 days) after the cessation of rains indicating that coconut utilizes more water when the soil is comparatively wet and that equal amount of water is not available in the entire range of available water capacity of the soil.

The ET demand of coconut is largely met by the 0-70cm soil layer (Joshy *et al.*, 1986). The 90-130 cm layer has little contribution. The contribution from the lower layers may become significant when the profile is at low water content.

Joshy *et al.*, (1986) have concluded that water applied at the

rate of 5 mm/ day is adequate for the crop in the sandy loam soil at Kasaragod. This approximates to 35 litres of water per basin of 1.5m radius (per day.)

RESPONSE TO IRRIGATION

Response of coconut palm to summer irrigation has been observed in almost all places, the magnitude of response depending on soil type, depth of water table and moisture conservation practices. At Nileshwar (Kerala) where the soil type is littoral sand, irrigation once in 5 days in basins resulted in a 514 per cent increase in nut yield (Table 1).

TABLE 1
Growth and yield response of coconut to summer irrigation in littoral sand, Nileshwar

	Unirrigated	Irrigated	Increase(%)
No. of functioning leaves per palm	15.5	23.5	51.6
No. of palms which flowered in a group of 100 palms	2	92	90
Nut yield (per palm)	4.3	26.4	514

In the red sandy soil of Nileshwar II (Kerala) the increase in the yield of nuts due to basin irrigation once in 7 days was 74% (Bhaskaran and Leela, 1977). The beneficial effect of irrigation was manifested

through larger production of female flowers and higher setting percentage (Table 2). The study was conducted over a period of 11 years.

TABLE 2
EFFECT OF IRRIGATION ON FEMALE FLOWER PRODUCTION, SETTING PER CENT AND NUT YIELD

No. of female flowers produced/palm			Setting %			Nut yield/palm		
Pre-irrigation	Post-irrigation	% increase	Pre-irrigation	Post-irrigation	% increase	Pre-irrigation	Post-irrigation	% increase
130.4	167.9	28.8	87.7	122.6	39.8	42.2	73.5	74

study, it was also found influence of irrigation on characters and yield was pronounced in low (20-40

nuts/palm/year) and medium (40-60 nuts/palm/year) yielding groups of palms as compared to high yielding (60-80 nuts/palm/

year) ones.

The data are summarised in Table 3.

TABLE 3

NUT YIELD OF WEST COAST TALL PALMS OF VARYING YIELD GROUPS AS AFFECTED BY IRRIGATION

Parameters	Yield group (nuts/palm/year)				Mean
	Poor (below 20 nuts)	Low (20-40 nuts)	Medium (41-60 nuts)	High (61-80 nuts)	
Pre-irrigation yield	13.4	30.2	54.3	70.8	42.2
Transit period	33.6	56.1	77.7	82.9	62.6
Per cent increase over pre-irrigation yield	(150.4)	(85.7)	(43.3)	(16.9)	(48.3)
Post-irrigation yield for 8 years	42.2	69.5	85.3	94.8	73.5
Per cent increase over pre-irrigation yield	(214.9)	(130.1)	(57.4)	(33.8)	(74.2)
Cost : Benefit ratio	1:2.9	1:3.5	1:3.1	1:2.4	1:3.1

A study on the effect of summer irrigation on the growth and yield of coconut CV. WCT. has been in progress at Chalakudy (soil type: Alluvial soil sandy clay loam in texture) since 1983.

The treatments are:

- Irrigation with 500 litres of water per palm at 75mm CPE
- Irrigation with 500 litres of water per palm at 50mm CPE
- Irrigation with 500 litres of water per palm at 25mm CPE
- Irrigation with 200 litres of water per palm once in 3 days
- No irrigation

Irrigation was given in basins of 1.8m radius.

The effect due to irrigation treatments on nut yield in the third and fourth year was significant and almost similar. The only difference was that in 1985, T3 recorded the highest nut yield as against T4 in 1986 (Table 4). However, the treatments T2, T3 and T4 were on par and significantly superior to the control (T5). The increase in nut yield per palm due to irrigation at 50mm CPE, 25mm CPE and once in 3 days over no irrigation was 16.8, 34.0 and 28.8 in 1985 and 36.8,

41.6 and 54.8 in 1986, respectively. The treatments T2, T3 and T4 received 5500, 9500 and 7200 litres of water in 11, 19 and 36 irrigations in the year 1985 and 5500, 10500 and 8600 litres of water in 11, 21 and 43 irrigations in the year 1986, respectively.

The results gathered so far at Chalakudy clearly indicate that coconut responds well to irrigation during the dry months from the third year onwards, the ideal schedule being irrigation of the crop with 500 litres of water in basins of 1.8m radius at a CPE value of 50mm.

TABLE 4

NUT YIELD PER PALM PER YEAR AS INFLUENCED BY IRRIGATION (NAIR *et al.*, 1989)

Treatment	Pre-treatment period (1982)	Experiment period				
		1983	1984	1985	1986	1987
T1 75 mm CPE	63.1	73.9	40.8	104.1	96.1	99.8
T2 50 "	67.1	74.5	39.8	112.8	113.9	110.3
T3 25 "	61.1	60.8	39.9	129.9	119.3	116.8
T4 once in 3 days	65.1	69.7	41.4	124.7	131.8	122.8
T5 No irrigation	59.2	80.8	31.7	95.9	77.1	97.8
CD (0.05)	—	—	—	15.6	24.1	—

IRRIGATION FERTILIZER INTERACTION

Does irrigation improve response to applied fertilizer? Response to applied fertilizer generally increased when fertilizer application was combined with irrigation. This is clearly evident from the data gathered (Table 5) from a field experiment conducted at the CPCRI, Kasaragod.

Started in 1968, the experiment aimed to determine the optimum

depth and frequency of summer irrigation and fertilizer level for coconut CV. WCT. The interaction of frequency of irrigation and fertilizer level had a significant influence on the yield of nuts. The palms receiving 20mm irrigation at IW/CPE = 1.00 combined with a fertilizer level of 0.750, 0.670, 1.500 (NPK) kg per palm/annum recorded the highest yield of 91 nuts/palm/annum. The next best performance was recorded by palms receiving irri-

gation at IW/CPE 0.75 and NPK @ 1.00, 1.00, 2.25 kg/palm. The production of female flowers was markedly influenced by irrigation and fertilizer. The palms receiving only irrigation (without fertilizer) gave a mean yield of 51 nuts/palm/year and the palms receiving only fertilizer (no irrigation) recorded 41 nuts/palm/year compared to the mean yield of 75 nuts per palm registered by the palms receiving both irrigation and fertilizer.

TABLE 5

NUT YIELD OF WCT PALMS AS INFLUENCED BY IRRIGATION AND FERTILIZER APPLICATION

NPK g/palm/year	IW/ CPE Ratio		
	1.00	0.75	0.50
0.50, 0.33, 0.75	69	74	77
0.75, 0.67, 1.50	91	67	67
1.00, 1.00, 2.25	77	83	67

RESPONSE OF YOUNG COCONUT SEEDLINGS TO IRRIGATION

Young coconut palms (seedlings) require frequent irrigation. The size and vigour of seedlings generally depend on the soil moisture availability (Child, 1964). During their first 3 years in the field coconut palms should continue

watered during dry periods. was conducted at Kasaragod ed that irrigation with 45 of water once in 4 days med with application of of red earth in planting prior to planting resulted in and vigorous growth of coconut palms (Nelliat, At the end of the 3 year (after planting) the young clearly showed the differ- in growth and vigour. Red helped the retention of soil ure and thereby facilitated a longer interval bet- irrigations without adversely the growth of young s.

was lethal to crops like jack, mango and cashew. Trials conducted at Kasaragod showed that irrigation with sea water in sandy soils was as effective as fresh water irrigation. In fact, sea water irrigation gave a 12 per cent increase in yield than fresh water irrigation. When sea water and fresh water were mixed in the ratio 1:2, the response was still high, recording an yield improvement of 50 per cent (Marar, 1963).

WATER MANAGEMENT IN AREAS HAVING HIGH WATER TABLE

Adequate drainage is necessary to alleviate the ill effects of high water table. In such situations drains will have to be provided in between rows of coconut. In a study conducted at Nileshwar, it was found that surface drains of 1.5m depth provided in between rows of coconut increased the yield by 84.8% (Pre-treatment yield 35.7 nuts/palm; post-treatment yield 66.1 nuts/palm). The crop was irrigated during summer months.

MOISTURE CONSERVATION PRACTICES

Soil moisture conservation through agronomic practices have been found to improve the yield of coconut. Burying coconut husk in linear trenches taken 3m away from the trunk between rows of coconut or in circular trenches taken around the palm at a distance of 2m from the trunk has effected a 35 per cent yield increase at Nileshwar. The yield improvement started from the 3rd year and the beneficial effect lasted for about 8 years.

PROBLEMS ASSOCIATED WITH IRRIGATION

When a coconut garden is brought under irrigation more functioning roots will be distributed in the surface layers of the soil. If irrigation is discontinued after some time, the palms will be easily affected by soil drought resulting in severe set-back in growth and production. Therefore, irrigation once provided should be continued without interruption.

Mulching with dry leaves is another practice useful for moisture conservation.

With the available observations and experimental evidences, it can be concluded that summer irrigation is the most productive input in coconut cultivation.

IRRIGATION WITH SALINE WATER

Coconut is fairly tolerant to salinity. According to Krishnamurthy and Premanathan (1968) coconut palm can withstand salt concentrations of 10,000 ppm. Ankanarayanan *et al.* (1957) reported that coconut palms showed no permanent physiological injury even in situations where their roots had come into contact with salt concentrations upto 6380 ppm in the soil which

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