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Water Management in Coconut and Arecanut

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1. INTRODUCTION

Coconut (*Cocos nucifera* L.) and arecanut (*Areca catechu* L.), two important palm species grown in India, occupy a prominent place in the social, cultural, religious and economic activities of the society. While coconut is grown mostly as a rainfed crop in the humid tropical regions, arecanut is raised mostly as an irrigated crop except in southern Kerala, where the rainfall is well distributed.

Among the coconut growing states in the country, Kerala ranks first in area and production, accounting for 57 per cent of the total area of 1.51 million ha and 47 per cent of the annual production of 9700 million nuts. The annual rainfall in the major coconut growing areas along the West Coast ranges from 1500 to 4000 mm, but most of it occurs within a short span of about three to four months during the south-west monsoon season. Water deficit exists for about six months in a year and palms suffer from severe moisture stress during November to May (Yusuf and Dhanapal, 1988). Thus, the crop experiences a wide spectrum of soil moisture regimes, ranging from excess moisture during monsoon to extreme stress conditions during April-May, which affect the productivity of the crop. yields as high as 150 nuts/palm/year or even more have been realised from the commonly grown Tall cultivars in research station and by many progressive farmers under optimum management conditions with irrigation as against the national average of about 37 nuts/palm/year. Moisture stress, in general, is the most important factor responsible for the low productivity.

Unlike coconut, arecanut palm is highly sensitive to moisture stress and exposure to drought resulting in severe reduction of growth and yield. Scarcity of water for irrigation is also a common feature in most of the years and once the crop is affected by water stress, it takes two to three years for regaining the normal vigour and yield. Death of palms due to drought is also not uncommon. Therefore, economising irrigation water and optimising the irrigation schedule is of great importance in arecanut cultivation.

2. EFFECT OF SOIL MOISTURE STRESS

Water is a major constituent of plant tissues. It is involved in vital processes like nutrient uptake, carbohydrate and protein metabolism, and translocation of ions and metabolites. Both initiation and differentiation of vegetative and reproductive primordia and enlargement of cells are very sensitive to moisture stress.

2.1 Coconut

Severe drought results in drooping of leaves, breaking of leaf petioles and even death of palms. According to Coomans (1975), water stress results in lower leaf production and consequently less number of inflorescences produced. Water deficit also affects female flower production. Menon and Pandalai (1960) opined that moisture stress during initiatiion of flower primordia (which takes place about one year before the opening of spathe) affected the nut yield two years later. Coomans (1975) observed a negative correlation between fruit set and accumulated water deficit over a period of five months prior to one year. Shedding of buttons and young nuts is a direct result of the preceding dry months (Abeyawardena and Mathes, 1971). The nut fall may even take place after the receipt of rains. Nambiar *et al.* (1969) identified three phases in development of nut, namely, slow progressive growth for about three months after fertilization, rapid growth for about four months and finally decline in growth rate for about two months. They found that the rate of growth during the second phase was highly correlated with the final volume and weight of nuts and copra content, and moisture stress at this phase adversely affected the size of the nut and copra content. Investigations at the Central Plantation Crops Research Institute (CPCRI), Kasaragod revealed that the coconut palms irrigated during dry season recorded 195 g copra/nut as against 153 g under rainfed conditions in the case of nuts harvested during November, which had undergone the second phase during summer season.

3. EFFECT OF WATER LOGGING

Coconut as well as arecanut palms are susceptible to prolonged water logging. Under water logged conditions, palms suffer from stunted growth due to oxygen deficiency which results in : (i) reduced respiration and root volume; (ii) increased resistance to water and nutrient movement through roots (Kramer, 1965); (iii) reduced supply of nitrogen due to decreased microbiological activity resulting in chlorosis of leaves; (iv) decrease in the nutrient content of N, P, K, Ca and Mg; (v) malfunctioning of roots due to reduced cell permeability and death of root cells; (vi) formation of toxic compounds like sulphides and butyric acid which are extremely toxic; and (vii) greater solubility of reduced forms of metals, especially manganese which are toxic. Prolonged anaerobic conditions result in death of roots and palms.

4. WATER REQUIREMENTS

4.1 Coconut

In its natural habitat, coconut is generally grown without irrigation in areas with an annual rainfall of above 2500 mm evenly distributed throughout the year. After the juvenile period, growth and reproductive stages proceed simultaneously in coconut. Therefore, it requires readily available soil moisture throughout its life.

4.1.1 *Seedlings in Nursery*

Favourable soil moisture around the seed nut is essential for quick germination and vigorous growth of seedlings. Hence, light but frequent irrigation of nurseries is essential. In sandy soils on the west coast where seed nuts are sown during June-July, watering is required on alternate days during November to May. In sandy loam and laterite soils, the frequency of irrigation may be three or four days. In both cases, about 10 mm of water needs to be applied. While small nurseries can be irrigated either by pot watering or through hose pipes, sprinklers are more suited for larger nurseries. On the East Coast, seed nuts are sown during October-November in small border strips or check basins and nurseries are irrigated with 3 to 5 cm of water twice a week.

Shanthamalliah *et al.* (1978), at Arsikere in the maidan tract of Karnataka, reported maximum number of leaves and increased girth of stem in the treatments involving irrigation at 80 to 100 or 60 to 100 per cent available moisture with 15 cm thick coir dust mulching. The total water requirement was 1591 and 1533 mm per year for maintaining 80 to 100 and 60 to 100 per cent available soil moisture respectively. Mulching with coir dust reduced water requirement by about 40 to 55 per cent.

4.1.2 *Young Palms*

The water requirement of young palms in the initial years (up to three years) is very low as the number and size of the leaves are small. But irrigations are very crucial during this period because the root system of young palms is not well developed to exploit water from lower layers. Therefore, regular watering during rainless period from November to May on the West coast is essential for establishment and optimal growth. In the other regions, irrigations are generally given throughout the year as and when required.

The usual practice on the West Coast is to irrigate newly planted seedlings for first two or three years with about 20-25 litres of water twice a week (Nelliat, 1967). But this irrigation schedule is not optimal for proper growth and early bearing of the palms. Nelliat (1968) reported that irrigation with 45 litres of water once in four days combined with application of 0.15 m^3 of red earth in planting pits prior to planting in littoral sandy soils resulted in quick and vigorous growth of the young palms. Application of red earth improved the retention of soil moisture which helped to increase the interval between two irrigations. Similar results were also reported from Coconut Research Station, Nileshwar, where 40 litres of water twice a week resulted in vigorous growth of seedlings.

In areas of water scarcity, burying two earthen pots of 20 litres capacity up to the neck at a distance of 75 cm from the shoot on either side of the seedling and filling the pots periodically with water, supplies sufficient moisture for establishment and vigorous growth of seedlings.

4.1.3 *Adult Palms*

The crop water requirement for optimum growth and high yield is location specific and varies due to variations in climate, soil, variety/hybrid and system of irrigation. Copeland (1931) reported that a coconut palm can absorb 28 to 46 litres of water in a day. A mature palm under favourable conditions in Indonesia has been reported to transpire as much as 200 litres per day (Reyne, 1948). Recently, Mohandas *et al.* (1989) at Coimbatore, Tamil Nadu measured the transpiration rate of coconut leaves to be 7.5 μ g/cm^2/second and estimated total transpiration as 90 litres per day.

Vijayalaskhmi and Marar (1959) reported that in deep sandy soils of Nileshwar, Kerala, irrigation increased the annual yield by 5 to 30 nuts/palm, though the palms did not respond to other management practices. Marar (1963) reported that summer irrigation in the west coast helped in improving coconut yield by 20 nuts/palm/year compared to rainfed palms. Venkitesan (1973) found that summer irrigation increased female flower production and arrested button shedding resulting in high yield. At CPCRI, Kasaragod, when irrigations were scheduled based on climatological approach, irrigation with 20 mm of water, when cumulative pan evaporation reached 20 mm, was found to be best (CPCRI, 1988).

Rao (1989) determined evapotranspiration of five-year old coconut palms using lysimeter. The ET rates increased from 2.9 mm/day in December to 5.5 mm/day in April and fell to 2.3 mm/day in June following the onset of monsoon (Table 1).

Table 1 : Evapo-transpiration (ET) rate of five-year old coconut palm at Calicut, Kerala

	ET (mm/day)		Open pan evaporation (E_{pan}) (mm/day)	Crop co-efficient (ET/E_{pan})	Rainfall (mm)
	Lysimeter	Coconut grove			
1985					
September	5.1	3.6	4.1	0.88	98
October	4.9	3.4	3.9	0.87	260
November	4.4	3.1	3.8	0.87	175
December	4.2	2.9	3.6	0.81	13
1986					
January	4.8	3.4	4.0	0.85	3
February	6.0	4.2	5.4	0.78	0
March	7.2	5.0	5.6	0.80	9
April	7.8	5.5	6.3	0.87	56
May	6.4	4.5	4.7	0.96	50
June	3.3	2.3	3.5	0.66	1007
July	3.6	2.6	4.3	0.60	348
August	3.9	2.7	4.0	0.68	420
Mean	5.1	3.6	4.4	0.82	2436

Rao, 1989.

Using the crop coefficient values given in Table 1, water requirement of coconut palms at a given place can be estimated by the following equation.

$$WR = A \times B \times C \times D$$

where WR = Water requirement (litres)
A = Evaporation from Class A pan (mm)
B = Crop coefficient (Kc)
C = Area occupied by the palm (in m^2) and
D = Fraction of area occupied by crown

Joshi *et al.* (1988) recorded maximum ET of 6.6 mm/day when irrigations were scheduled with 20 mm of water at IW/CPE ratio of 1.00 during the month of March. Decreasing the frequency of irrigation to IW/CPE ratio of 0.75 and 0.50 reduced the ET rate to 4.0 and 2.3 mm/day, respectively.

4.2 Arecanut

Field experiments to determine the effect of depth of planting of arecanut seedlings and frequency of irrigation on the performance of areca palms were laid out at Peechi (Central Kerala) and at Mohitnagar (West Bengal) in 1962, Hirehalli (maidan part of Karnataka) in 1963, Kahikuchi (Assam) in 1964 and Vittal (coastal Karnataka) in 1966 (Shama Bhat, 1978). At Peechi, irrigation with 189 litres of water/palm once in 3, 6 or 9 days resulted in substantial yield increase over rainfed condition and irrigation at three days interval recorded the highest yield (Sadanandan, 1973). The water requirement during the four dry months (February-May) was 825 mm. Abdul Khader *et al.* (1985) have reported that palms irrigated with 200 litres/palm once in 5 and 10 days had produced significantly more number of nuts and higher weight of nuts than palms irrigated once in 15 and 20 days interval (Table 2).

At Kahikuchi, irrigation at 7 and 14 days interval was found superior to no irrigation and irrigation at 21 days interval. However, at Hirehalli, there was no significant difference in the yield of areca palms irrigated at 5, 10, 15 and 20 days interval probably because of high water holding capacity of the heavy soil (Shama Bhat, 1978).

Table 2 : Yield of arecanut as influenced by irrigation interval (1970-71 to 1973-74)

Irrigation interval (days)	No. of nuts/plot	Wt. of nuts/plot (kg)
5	1401	47.8
10	1240	40.3
15	571	20.2
20	386	11.8
CD (P = 0.05)	315	10.6

Abdul Khader *et al.*, 1985.

The experiment at Vittal was modified during 1974-75 to schedule irrigation based on climatological approach. The revised irrigation treatments were : I_1 = irrigation with 30 mm of water when cumulative pan evaporation reaches 30 mm (IW/CPE ratio = 1); I_2 = irrigation with 30 mm water when cumulative pan evaporation reaches 60 mm (IW/CPE ratio = 0.5); I_3 = irrigation with 60 mm water when cumulative pan evaporation reaches 60 mm (IW/CPE ratio = 1) and I_4 = irrigation with 60 mm water when cumulative evaporation reaches 120 mm (IW/CPE ratio = 0.5). The results (Table 3) revealed that irrigation with 30 mm water when the CPE approached 30 mm (I_1) was significantly superior to treatments I_3 and I_4 whereas, it was at par with I_2 (Yadukumar *et al.*, 1985).

Table 3 : Effect of irrigation on arecanut yield

Irrigation schedule IW : CPE (mm)	No. of nuts/ palm	Wt. of ripe nuts (Kg/Palm)
30 : 30 (I_1)	248.3	8.9
30 : 60 (I_2)	209.1	7.3
60 : 60 (I_3)	188.3	6.7
60 : 120 (I_4)	122.1	4.3
CD (P = 0.05)	50.9	1.7

Yadu Kumar *et al.*, 1985.

Abdul Khader and Havanagi (1991) estimated that the crop coefficient values of 12 to 15 years old arecanut palms ranged from 0.95 to 0.99 for the dry period of January to May (Table 4).

Table 4 : Crop coefficient values for arecanut palm

Month	Mean ET crop (mm/day)	Mean ET_0 (mm/day)	Crop co-efficient
January	4.76	4.88	0.98
February	5.40	5.55	0.97
March	5.70	5.76	0.99
April	6.05	6.22	0.97
May	6.18	6.48	0.95
Mean			

Abdul Khader and Havanagi, 1991.

Mahesha (1987) estimated daily evapotranspiration of areca palms using modified Penman's method (Doorenbos and Pruitt, 1975). The values were 4.6, 4.7, 5.3, 5.9, 6.3 and 5.8 mm/day during December to May, respectively.

5. SYSTEMS OF IRRIGATION

5.1 Coconut

Common surface irrigation methods adopted in coconut gardens are flood irrigation, basin irrigation, sprinkler irrigation or perfospray and drip irrigation. In parts of Tamil Nadu and Andhra Pradesh where adequate supply of water is available, coconut gardens are flood irrigated. Though the yield of coconut under flood irrigation may be higher than basin irrigation, there is colossal loss of water. At Nileshwar, Bhaskaran and Leela (1978) reported that flood irrigation with 5 cm of water once in five days significantly increased the number of functional leaves and yield (96.6 nuts/palm/year) compared to basin irrigation with 800 litres of water once in a week (33.4 nuts/palm/year).

In basin irrigation, water is applied in basins of 1.8 to 2 m radius around the palms which is the active root zone of coconut. Irrigation channels are provided in between two rows and each basin is connected with the channel. In this method also, there is some loss of water due to deep percolation, seepage and evaporation. However, these losses are reduced when basins are irrigated through hose pipes. This method is common in Kerala and Karnataka. Bhaskaran and Leela (1978) at Coconut Research Station, Nileshwar studied the response of poor, low, medium and high yield groups of palms to basin irrigation in red sandy loam soil with 800 litres of water applied once in seven days in basins of 2 m radius. Maximum yield increase of 39.3 nuts per palm per year was recorded in low yield group followed by medium yield group (31.0 nuts). The response of palms in the high yield group was small, being only 23.4 nuts/palm/year.

Sprinkler irrigation or perfospray is most suited for inter or mixed cropping systems where entire surface is required to be wetted. As the water is conveyed through pipes, irrigation efficiency in sprinkler or perfospray is high compared to flood or basin irrigation systems. Systematic studies based on climatic approach on irrigation requirement of West Coast Tall coconut palms during early bearing stage conducted by Nelliat and Padmaja (1978) with three depths of irrigation water (IW), namely, 20, 40 and 60 mm applied through perfospray at three frequencies of irrigation based on irrigation water (IW) : cumulative pan evaporation (CPE) ratios of 1.00, 0.75 and 0.50. The experiment revealed that growth characters did not differ significantly under different depths of irrigation, but irrigation at IW/CPE ratios of 1.00 and 0.75 significantly increased leaf number, female flower production and total nut yield over IW/CPE ratio of 0.50. The seasonal water requirement with 20 mm IW at IW/CPE ratios of 1.00 and 0.75 was 930 and 680 mm, respectively.

The results of above experiment after 16 years of planting revealed that cumulative yield since bearing was significantly influenced by the quantity and frequency of irrigation. Palms irrigated with 20 mm of water at IW/CPE ratio of 1.00 produced the highest yield of 918 nuts/palm (Table 5) followed by the same quantity at IW/CPE ratio of 0.75 (872 nuts/palm). The palms under the above treatments gave a mean yield of 123 and 121 nuts/palm/year, respectively during the last four years (1981-85) of study (CPCRI, 1988).

In another experiment (Yusuf and Gopalasundaram, 1991), COD × WCT hybrid with 20 mm of water at IW/CPE ratio of 0.75 produced 147 nuts/palm/year compared to 122 nuts under rainfed condition during 1986-88. Similar trend was observed with

Table 5 : Cumulative yield of nuts (up to sixteen years age) as influenced by depth and frequency of irrigation

Depth of water (mm)	IW/CPE ratio			Mean
	1.00	0.75	0.50	
20	918	872	637	809
40	834	783	776	798
60	769	698	741	736
Mean	841	784	718	

CPCRI, unpublished data.

WCT × COD hybrid and WCT also.

In recent years, drip irrigation system is becoming more and more acceptable to economise water, labour and energy. The system maintains favourable soil moisture in the root zone and higher yields are realized. The irrigation efficiency of drip irrigation is 40 to 60 per cent higher than basin irrigation. In littoral sandy soil of Kasaragod, drip irrigation with 32 litres of water/palm/day recorded 32.9 nuts/palm/year which was 38 and 57 per cent higher than palms receiving basin irrigation with 200 l once in four days and under rainfed conditions, respectively (CPCRI, 1989). Conspicuous response of coconut palms to drip irrigation has been reported by Varadan and Chandran (1991). The mean yield of palms for three years (1985 to 1987) irrigated with 30 litres of water/palm/day through drip irrigation (87.4 nuts/palm/year) was at par with yield recorded under basin irrigation with 600 litres/palm/week (82.2 nuts/palm/year). Thus, there was about 67 per cent saving of water in drip irrigation without any reduction in yield (Fig. 1).

5.2 Arecanut

In the traditional system, irrigation is done by bunding and storing water in the drainage or irrigation channels and allowing water to percolate. Irrigation in majority of the gardens is done by splashing water guided into the channels. In recent years, sprinkler and perfospray methods of irrigation are also practised. Irrigation systems adopted at present by areca growers are of low efficiency. In the conventional methods of irrigation, plants utilise only 50 to 60 per cent of applied water. In regions where water is in short supply, drip irrigation has been recognised as a promising technology for managing water and increasing its efficiency.

Drip irrigation was compared to local method of irrigation (basin irrigation) at three fertlizer levels at CPCRI, Regional Station, Vittal. There were four drippers with a discharge rate of 2 litres/hour for each palm placed on the four sides of the basin, 60 cm away from the trunk. The system was operated for two hours daily to deliver 16 litres of water/palm/day as against the control in which water was applied once in a week at the rate of 200 litres/palm by check basin method. Significant yield increase was observed (Table 6) in drip irrigated palms as compared to local method of irrigation (Abdul Khader, 1988).

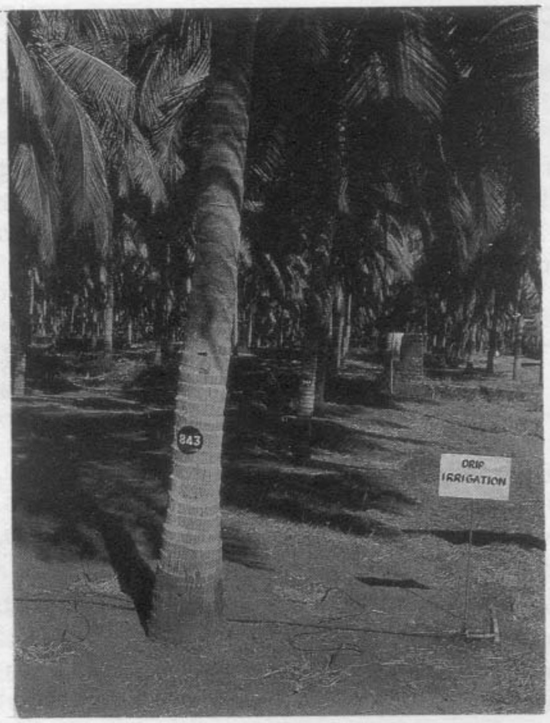

Fig. 1 : Drip irrigation in coconut.

Abdul Khader (1988) reported that drip irrigation had significantly increased the growth components like height, girth, number of nodes and leaf area. Number of spadices, percentage of spadices to leaf fall and percentage of nut set were found to be significantly more in drip irrigated palms compared to palms irrigated by conventional method. Besides increasing the yield, drip irrigation also economised irrigation water to the extent of 44 per cent.

Table 6 : Effect of irrigation methods and fertilizer levels on yield of arecanut (1979 and 1980) (kg/palm/year)

Treatments	Fertilizer levels			Mean
	F_1	F_2	F_3	
Local	8.69	9.02	9.01	9.01
Drip	11.65	12.98	14.40	13.01
Mean	10.17	11.00	11.86	11.01

Abdul Khader, 1988.
CD (P = 0.05) Irrigation methods : 0.46; Fertilizers : 0.56; and Interaction : 0.80.

6. RESPONSE OF COCONUT PALMS TO SEA WATER IRRIGATION

Several workers have reported that coconut palms can withstand salt concentration ranging from 0.60 to 1.00 per cent (Shanmugam, 1973). Studies on the use of sea water for irrigating coconut palms at Kasaragod (CCRS, 1968) revealed that irrigation with sea water at the rate of 90 litres/palm in basins of 1.5 m radius twice a week was as good as irrigation with fresh water and increased yield by 41 per cent over rainfed palms in sandy soil (Table 7). In sandy loam soil, irrigation with sea water and fresh water in the ratio of 1:2 recorded the highest yield.

Table 7 : Effect of sea water and fresh water irrigation on yield of coconut

Treatment	Mean yield (1967 and 1968) (nuts/palm/year)
Sandy soil	
Irrigation with sea water	42.2
Irrigation with fresh water	43.0
Unirrigated	30.0
Sandy loam soil	
Unirrigated	52.6
Sea water + fresh water (2:1)	60.8
Sea water + fresh water (1:2)	80.5
Sea water	67.1
Fresh water	53.6

Experiments were conducted at Kasaragod during 1977-79 to explore the possibility of utilizing sea water for irrigating young palms in littoral sand. The palms were irrigated with 50 litres of water/palm once in four days during the dry months of December-May. The results revealed that by May the electrical conductivity (EC) of soil was increased four-fold under sea water irrigation compared to control (rainfed). The mean EC was 1432 μ mhos/cm under 100 per cent sea water irrigation as against 338 μmhos/cm only in control. However, soil samples collected after monsoon in December did not show any appreciable difference between control and sea water irrigation. The electrical conductivity was 122 and 140 μmhos/cm, respectively in the above treatments. These results indicate that in high rainfall areas, sea water could also be used for irrigation in sandy soils without any serious adverse effect on coconut or soil characteristics.

7. SOIL MOISTURE CONSERVATION PRACTICES

7.1 Coconut

There are two possibilities of alleviating drought effects on coconut palms, viz., increasing water supply and decreasing demand for water by palms. The supply of water can be increased by *in situ* water harvesting. Harvesting of 10 mm rain water from a palm spaced 7.5 m × 7.5 m by concentrating it in the basin will provide 260 litres of water if the soil pores are sealed by bentonite clay or bitumen to generate cent per cent run-off from the non-basin area. This may not be practical or economically feasible. However, practices such as contour bunding and terracing (Vijayalaskhmi and Marar, 1959) and opening short linear trenches across the slope in a staggered manner (Rethinam, 1987) could be adopted for intercepting run-off water.

For reducing the demand for water, practices like : (i) mulching with coconut husks, coir dust, dried coconut leaves; (ii) addition of 50 kg/palm of bulky organic manures or green leaves and tank soil (100-200 kg) to improve water holding capacity; (iii) husk burial to retain water for longer time; (iv) cover cropping to reduce soil temperature; (v) intercultivation to suppress weed growth; and (vi) application of common salt at 2 kg/basin could be adopted (Vijayalakshmi and Marar, 1959; Chacko Mathew, 1979; Rethinam, 1987). However, most of these recommendations are baed on personal experience or some observations and only few experimental evidences are available.

A study on the response of coconut to husk burial was first initiated in 1937 at Kasaragod in red sandy loam soil with WCT palms of about 40 to 50 years age (Marar and Kunhiraman, 1957). Trenches of 1.8 m width and 30 to 45 cm depth were opened in between rows in both the directions. Dry coconut husks at 1000/palm were buried in the trenches and no fertilizer was applied to the palms. It was found that though during the initial years (1937-39), the mean yield per palm in husk burial plot was 7 nuts less than that of control, the productivity increased and during 1941 the palms in husk burial plot produced 22 nuts/palm more than the control plot. Thereafter, the yield declined and plams reverted to their original condition by 1946. This showed that the beneficial effect of husk burial lasted for about six years and the average increase in yield was 11 nuts/palm/year over control. Beneficial effect of husk burial has been reported from Agricultural Research Station, Pilicode also. The first visible effect of husk burial was a general improvement in the condition of palms followed by an increase in the number of functional leaves, female flowers, setting percentage and nut yield (Nambiar and Sasidharan, 1988).

Balasubramanian *et al.* (1985) from Veppankulam reported that burying 1000 coconut husks in trenches, 150 cm wide and 40 cm deep in between rows of coconut, recorded higher available soil moisture status throughout the four years of investigation. The next best treatment for moisture conservation was found to be mulching the basins of 2 m radius with coconut husks. The total yield per palm for four years was 235 and 265 nuts, respectively under the treatments of burying husk in trenches and mulching basins with husks as against 177 nuts under control.

Opening trenches of 30 cm depth and 60 cm width at the end of south-west monsoon season, filling them with dry coconut leaves, green leaves and compost and covering the trenches at the end of north-east monsoon has been suggested by Nambiar and Sasidharan (1988) to conserve soil moisture. Trenching helped to increased the female flower production and reduced the shedding of buttons.

Application of coir dust at 50 kg/palm also helps in better utilization of available water. Studies conducted by Joshi *et al.* (1982) in coastal sandy soil at Kasaragod have shown that application of coir dust helped to improve the available water capacity (water held between 0.3 and 15.0 bars) of littoral sand to 1.94 from 0.74 per cent in the control.

7.2 Arecanut

Mulching in arecanut gardens is an important operation practised by growers. At Vittal, four types of mulching materials namely, chopped arecanut leaves, Guatemala grass (*Tripsacum laxum*), arecanut husk and dry forest leaves were compared. Though, there was no appreciable difference among the different mulches, the soil moisture studies showed that the loss of moisture from the mulched plot was lower compared to the plots with 'no mulch'. The moisture level in 'no mulch' plot was 10 per cent ten days after irrigation, whereas under mulched condition, the same soil moisture level was reached 18 days after irrigation (Shama Bhat, 1978).

Abdul Khader and Havanagi (1991) have studied the effect of mulching on consumptive use of water under different irrigation schedules. Their results indicated that mulching during dry months increased the yield (Table 8). Both organic mulch and polythene cover were equally effective but the later was expensive for wider adoption.

Table 8 : Effect of mulching and irrigation levels on the yield of ripe arecanut (kg/ha)

Irrigation levels (IW:CPE (mm))	No mulch	Arecanut husk mulch	White polythene sheet mulch	Mean
I1 (30 : 30)	9604	11357	11070	10672
I2 (30 : 60)	7247	8946	9371	8521
I3 (60 : 60)	7453	9535	9700	8891
I4 (60 : 120)	4166	5370	5370	4073
Mean	7110	8795	8878	8261

Abdul Khader and Havanagi, 1991.
CD (P = 0.05) : irrigation = 881; mulch = 391.

Further studies have indicated that ET requirement was reduced by mulches. The mean ET values estimated during the period of January to May was only 4.40 and 3.79 mm/day under, mulching with arecanut husk and white polythene sheet mulch respectively as compared to 4.96 mm/day without mulch. Thus, mulching is of advantage under water scaracity situations.

8. DRAINAGE

Among the three major coconut growing states, Kerala and coastal Karnataka receive high rainfall. But as the coconut growing soils in these areas are well drained, there is no stagnation of water for longer period. However, in Kuttanad area which is below the mean sea level and some backwater area in Quilon, Alleppey, Ernakulam, Calicut andCannanore districts of Kerala State, coconuts remain submerged during rainy season. In these areas, planting of coconut is done on mounds or bunds. Some paddy fields converted into coconut gardens also experience waterlogging problem during rainy season. In such gardens, ground water table rises to the surface during rainy season causing water logging. Rocky substrate/hard pans below the surface sometimes prevent water to percolate down to the lower layers resulting in temporary water stagnation. Drainage system, suited to local conditions, may be provided to remove surplus water from the root zone. Relief drains (shallow channels) are opened at places where water accumulates and connected with main drain to remove water from the surface which otherwise will contribute to water table. For lowering water table, intercepting drains are provided. In this system, a network of mains, submains and secondary drains are provided at convenient depth keeping the slope of the land into consideration.

At Agricultural Research Station, Nileshwar, providing drainage by surface drains to a depth of 1.5 m in between rows of palms to remove excess water from root-zone during rainy season and irrigation during summer months increased the yield from 35.7 nuts to 66.1 nuts/palm/year (Nair *et al.*, 1988).

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