

FINAL REPORT

1. Institute Code No: *Age IV (131)*
2. I. C. A. R. Code No:
3. Name and Address of Research Institute/Centre: *Central plantation Crops Research Institute
Regional Station, Vittal - 574243.*
4. Project Title: *Effect of different intervals of irrigation
at different depths of planting Arcanaut.*
5. Name and Designation of Project Leader
- | | |
|---------------------------|------------------|
| <i>Kum M. Leela</i> | <i>- 1966-68</i> |
| <i>Sri AK Sadanandan</i> | <i>1968-71</i> |
| <i>Sri CK George</i> | <i>1972</i> |
| <i>Sri KB Abdul Kader</i> | <i>1972-75</i> |
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6. Name (s) and Designation(s) of Project Associates including Project Leader and work to be done:
- | Sl. No. | Name and Designation | Time spent | work done |
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| | <i>M Sannamarappa Scientist-S₂</i> | | |
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7. Location of Research Project with complete address (Division/Section/Sub-Centre)
- CPRI, Regional Station Vittal
Rural extension H'challi, puchi and Kahu Kuehi*

8. Date of start 1966

9. Date of termination 1978

10. (a) Objectives (Not more than 150 words)

To fix up the frequency of irrigation to arecanut planted at different depths.

(b) Practical Utility including background information (Not more than 150 words)

The variation in the yield of arecanut under irrigated and non-irrigated conditions has to be ascertained by conducting regular experiments. Normally, the depth at which areca seedlings are planted varies considerably depending upon the nature of the soil, age of seedlings, ground water table etc. In places where the ground water table is comparatively high, shallow planting is followed. In areas where water table is low, the depth at which seedlings are planted varies considerably. So the merits on account of the depths adopted at planting are to be ascertained by regular experiments. Since the depth of planting is likely to influence the availability of soil moisture, interaction is possible between irrigation and depths of planting. This investigation will be of immense help to the farmers in that, the economic use of water and the optimum depth of planting will save much labour and resources at the same time will enable the farmer to get the maximum profit.

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KASARAGOD-670 124, KERALA

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Project No.

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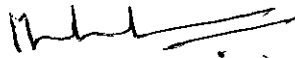
2. Final Report 1966 -1978

Date of Start: 1966

The trial was laid out at CPCRI, Regional Station, Vittal Karnataka in 1966 using a 4 x 3 x 5 strip plot design with 4 intervals of irrigation viz; 5, (I1) 10 (I2) 15, (I3) and 20 (I4) days and 3 depths of planting viz; 30, (D1) 60 (D2) and 90 (D3) cm. The soil was sandy loam mixed with gravel having 62% sand, 9% silt and 26% clay (Mohapatra, 1977). Moisture content at 0.15 atmospheric pressure at 0.50 cm depth was 23.54% (Pressure plate apparatus) and at 50-100 cm depth it was 23.64%. At 15 atmospheric pressure and at 0.50 cm depth the moisture content was 13.01% ~~xxxxxx~~ and at 50-100 cm depth, it was 14.42%. The hydraulic conductivity was 95 cm/hr at 0-50 cm depth and at 50-100 cm depth it was 99 cm/hr.

Irrigation channels were provided in each alternate rows of arecanut trees and water was supplied by splashing to the basins as well as interspaces. The area of the irrigation treatment plot was 385.32 sq.mt. accommodating 27 treatment palms and 38 border palms planted with a spacing of 2.6 m on either side. Between irrigation treatments double rows of border palms were provided. In the treatment under depths of planting, there were 9 trees with a single guard row.

Water was applied to each plot at the rate of 200 litres per plant per irrigation. Water was diverted to plots from cement plastered channels. Measured quantity of water was applied by allowing uniform discharge of water through 'V' shaped syphons of known diameter. Four syphons were used at a time for 15 minutes to deliver 13,000 litres of water per plot



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Date of Start:

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which was distributed uniformly among 65 palms, each palm getting 200 liters of water per irrigation. Palms were irrigated from second fortnight of November to first fortnight of May during the experimental period. The number of irrigations given were 30, 15, 10 and 8 according to the treatment schedule.

The study was conducted for seven years (1966 to 1973) The data on growth characters and yield were collected and subjected to statistical analysis.

Only height of the plants differed significantly with irrigation levels. Plants irrigated once in 5 and 10 days were significantly taller than those irrigated once in 20 days. The number of leaves per plant and girth at collar were significantly higher in plots irrigated once in 5 and 10 days interval as compared to those irrigated once in 20 days. The data for the year 1970 revealed that girth of the palm and number of nodes were significantly higher in plants irrigated once in 5 days over all other treatments.

The plants commenced for yielding in 1970. Yield of arecanut both number and wet weight of nuts were recorded tree-wise from 1970-71 to 1973-74. The data were pooled and statistically analysed. The mean number of nuts and wet weight of nuts per plot are presented in table-IV. Irrigation once in 5 and 10 days gave significantly more number of nuts than those irrigated once in 15 and 20 days. There was no significant difference in number of nuts between the treatments which received water once in 5 and 10 days time interval. The present increase in number of nuts in I, 12 and 13 treatments over I4 were in the order of 262, 145 and 13 respectively.



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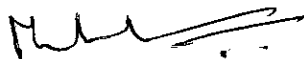
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In respect of depth of planting, 90 cm depth gave significantly more number of nuts than those planted at 30 and 60 cm depths. There was no significant difference between the yield of nuts in plots planted at 60 and 30 cm depths. The interaction between irrigation intervals and depth of planting were also ^{not} significant. Planting at 90 cm depth and irrigation once in 5 days gave 40% more number of nuts as compared to irrigation once in 20 days and planting at 30 cm depth.

In respect of wet weight of nuts it was observed that irrigation once in 5 days was significantly superior to irrigation once in 15 and 20 days intervals. Though there was no significant difference between treatments irrigated once in 5 and 10 days, there was increase in the yield in respect of wet weight of nuts in I1 over I3 was 136% and the corresponding increase over I4 was 303%.

Planting at 90 cm depth had given significantly more weight of nuts than planting at 30 and 60 cm depths. Though the significant difference was not observed an increasing trend could be noticed in regard to weight of nuts in D2 over D1. The increase in the yield of the plants, planted at 90 cm depth over the plants, planted at 30 cm depth was 49%.

The treatment combination of planting at 90 cm depth and irrigation frequency of 5 days proved to be significantly superior to all other combinations in respect of wet weight of nuts. The increase in the yield in the above case was 406% over planting at 30 cm depth and irrigating once in 20 days.



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Irrigation once in 5 days had resulted in 303% increase in respect of wet weight of nuts as against an increase of 262% in the case of number of nuts, which means that irrigation frequency has more positive effect on weight of nuts than number of nuts.

DISCUSSION:

At the rate of 200 litres of water to a palm under each irrigation, the duty was 1459.46 ha. cumec for 150 days at a frequency of once in 5 days (1480 palms/ha.). This is equivalent to a standing irrigation water depth of 88.8 cm. The average rainfall during the period was 18.87 cm. The pan evaporation for the experimental period was 101.6 cm which is 12.6% more than the irrigation during the same period.

Irrigation once in 5 days had given an extra income of Rs.11,156-80/ha over the treatment which received water once in 20 days, and the corresponding increase over the plants which received irrigation once in 15 days was Rs.7,420-48. Though there was no significant difference between the treatments irrigated once in 5 and 10 days, irrigation once in 5 days had resulted an extra remuneration of Rs.3737.32 per ha. with an additional expenditure of Rs.540/- over the treatment which received water once in 10 days. Thus the overall result revealed that irrigating arecanut palms once in 5 days with 200 litres of water and planting seedlings at 90 cm depth is economical.

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Table:1 Mean growth characters of areca palm as affected by irrigation and depth of planting (1968)

	1. Number of leaves/palm				2. Girth at permanent mark(cm)				3. Height of the palm(cm)				4. No. of nodes/palm			
	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean
I ₁	6.77	6.91	6.91	6.86	28.95	29.73	29.31	29.33	310.44	341.65	318.36	323.48	6.93	7.00	5.84	6.59
I ₂	6.80	7.15	7.09	7.01	29.49	29.76	31.04	30.09	308.24	330.71	334.93	324.62	6.42	6.35	5.82	6.20
I ₃	6.62	6.99	6.71	6.77	27.09	28.78	29.80	28.55	275.13	321.15	308.40	301.56	6.47	5.92	5.31	5.90
I ₄	6.82	7.11	7.05	6.99	27.82	29.87	29.44	29.04	284.35	303.22	287.31	291.62	6.69	5.87	5.33	5.96
Mean	6.75	7.04	6.94	6.91	28.34	29.53	29.90	29.25	294.54	324.18	312.25	310.32	6.63	6.28	5.57	6.16
CD for irrigation (P= 0.05) - 25.82																

I₁ = Irrigation once in 5 days; I₂ = Irrigation once in 10 days; I₃ = Irrigation once in 15 days
 I₄ = Irrigation once in 20 days.
 D₁ = Planted at 30 cm depth; D₂ = Planted at 60 cm depth; D₃ = Planted at 90 cm depth.

M. N. G. Subramanian

Table-III: Mean growth characters of areca palm as affected by irrigation and depth of planting (1970).

	Trunk Height of the palm(cm)	Girth/palm(cm)	Number of nedes/palm	Number of leaves/palm												
I1	169.64	206.75	178.82	185.08	49.40	51.61	49.40	50.17	13.16	14.98	13.14	13.93	9.85	10.29	10.47	10.20
I2	150.76	177.13	165.48	164.46	45.51	47.91	48.87	47.43	12.60	13.80	13.41	13.27	9.51	9.93	9.98	9.81
I3	107.20	134.29	138.75	126.75	43.51	43.88	47.26	44.89	10.29	11.57	11.63	11.16	9.55	9.43	9.88	9.62
I4	107.58	121.77	114.96	114.78	45.42	45.19	47.80	46.24	10.78	11.52	11.46	11.25	9.01	9.35	9.45	9.27
CD for Irrigation (P = 0.05)									3.07				1.90			0.46

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Table-IV: Yield of arecanut as affected by irrigation and depth of planting (Mean for 1970-71 to 73-74).

	Number of nuts(per plot)				Wet weight of nuts(kg/plot)			
	D1	D2	D3	Mean	D1	D2	D3	Mean
I1	1070.30	1348.65	1784.60	1401.18	36.69 36.69	47.91	58.78	47.79
I2	1056.20	1019.45	1644.95	1240.20	35.22	32.95	52.62	40.26
I3	376.65	680.65	654.50	570.60	13.79	23.88	22.91	20.19
I4	416.90	386.05	355.85	386.26	12.19	11.73	11.62	11.85
Mean	730.01	858.70	1109.97		24.47	29.12	36.48	
CD for Irrigation(P = 0.05)								10.61
CD for depth								6.60
CD for D x I								8.26

M. J. S. Srinivasan

Table V: Economics of Irrigation in arecanut

Frequency of Irrigation	Depth of water (cm)	Yield of chalt nut (kg/ha)	Value @ Rs.8/kg (Rs/ha.)	Total man days/ha	Cost of labour @ Rs.6/head (Rs/ha.)	Extra yield over I ₄ (kg/ha.)	Extra Income in Rs/ha. over I ₄
I ₁ (Irrigation once in 5 days).	88.80	1854.49	14835.92	180	1,080/-	1394.60	11,156.80
I ₂ (Irrigation once in 10 days).	44.40	1562.45	10099.60	90	540/-	1102.56	6,420.48
I ₃ (Irrigation once in 15 days).	29.60	783.55	6268.40	60	360/-	323.60	2,589.28
I ₄ (Irrigation once in 20 days).	23.68	459.89	3679.12	48	288/-	-	-

M. S. Subramanian
CN. Mysore

Later in 1973-74 the treatments were modified in the experiment as follows:

- I₁ - Irrigating 30 mm when cumulative pan evaporation approaches 30 mm (1:1).
- I₂ - Irrigating 30 mm when cumulative pan evaporation approaches 60 mm (0.5:1).
- I₃ - Irrigating 60 mm when cumulative pan evaporation approaches 60 mm (1:).
- I₄ - Irrigating 60 mm when cumulative pan evaporation approaches ~~60 mm~~ 120 mm (0.5:1).

The irrigation was provided through surface conveyance and water was conveyed to the plots by using syphons from a main cement lined channel. 'U' shaped syphons of one metre length and 5 cm diameter were used and 5 such syphons could discharge 30 mm water in 15 minutes.

The water evaporation was monitored through a open pan evaporimeter conforming to USWB class 'A' specifications. The irrigation scheduling was done as detailed above. The data on maximum temperature, RH, evaporation rate and rainfall were collected, and are depicted in figure I. Irrigation was provided only during the non-monsoon months extending from second half of November to the end of May each year. There was only occasional precipitation during the irrigation period which was accounted for while scheduling the irrigation.

The data on nut yield in terms of number and fresh weight were collected during each harvest and pooled to obtain year-wise yield. Statistical analysis carried out on pooled yield data obtained over the four year experimental period.

The soil moisture content was determined by the gravimetric method of piper (1950) under the different irrigation treatments from 0-90 cm depth just prior to each irrigation and on the day following irrigation.

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RESULT AND DISCUSSION:

The data on number and wet weight of nuts as affected by irrigation and depth of planting are presented in Table-I. Irrigation with 30 mm water when the CPE approached 30 mm was significantly superior to other two irrigation treatments namely I₃ and I₄. Where as there was no significant difference between I₁ and I₂.

It is therefore clear that arecanut is fairly sensitive to moisture stress and requires irrigation to be provided at more frequent intervals. This is very well reflected when a comparison is made between treatment I₁ on one hand and the other irrigation schedules on the other.

Soil moisture content ranged between 19.50 to 21.40% subsequent to irrigation and reduced considerably to about 12.1% within a period of 5 to 10 days just before the next irrigation in treatments I₁, I₂ and I₃ irrespective of the quantity of water used. While in I₄ the reduction (8.81) in moisture content was even more prominent just before the next irrigation (Fig.2). Though the total quantity of water irrigated was the same for I₃ and I₁ treatments the frequency of irrigation in I₃ was only the half of that in I₁ resulting in wide fluctuations in soil water and a larger period of moisture stress. There by resulting in decreased nut yield. Such an effect of moisture stress on yield of crops has been observed by Bresler, (1977).

Though in the treatments I₂ and I₃ the frequency of irrigation was the same, I₂ had received only half the quantity of water than that of I₃. Here, again the differences in the nut yield were not significant showing that reducing the frequency of irrigation by increasing the quantum of water applied is not beneficial as the excess water supplied is not advantageous for plant use. As the soil was of a light texture with a low water holding capacity, the excess water used was not retained in the root zone efficiently leading to decreased usage by the plant. This is also clear from the data obtained on the soil moisture contents before and

after irrigation. The excess water applied may also be lost by surface run off and seepage which in addition may cause nutrient loss due to leaching beyond the root zone (Zaslovasky, 1972 Haller and Bresler, 1973).

Economies of irrigation scheduling was worked out based on the yield, volume of water required, frequency of irrigation and the cost of irrigation. The relative economics of arecanut cultivation with the different schedules of irrigation is given in table II. The monetary returns with I₁ was Rs.13,000/- with 34 irrigations and an application of 1020 mm of water during the period November to May. Eventhough only 17 irrigations were required with 510 mm of water applied the monetary return was Rs.10,072. These results have clearly demonstrated that the best irrigation schedule is 30 mm water when CPE approaches 30 mm. But, under situations where there may be limitations of water and energy ~~supply~~ supply the scheduling can be extended to 30 mm water when CPE reaches 60 mm (Treatment I₂ in the study) minimising water and energy use. From the practical point of view it may be desirable to sketch the irrigation intervals to 8 to 10 days during the later part of summer when both water and power supply become critical under the existing conditions over a vast tract of arecanut cultivation in the South Kanara District of Karnataka. The frequency of irrigation and the total depth of water required for schedules I₁ and I₂ are provided in table-III. The data on frequency, number of irrigations and depth of water required indicate that in terms of water and power use efficiency, if these inputs are critical schedule I₂ where 30mm water is irrigated as the CPE approaches 60 mm may be more beneficial eventhough resulting in a lesser monetary return. However if the inputs for irrigation are non-critical 30 mm irrigation for 30 mm pan evaporation is most ideally suited irrigation practice for arecanut. The other two irrigation schedules namely I₃ and I₄ were not found to be ideal because of imposition of widely fluctuating moisture regimes leading to moisture stress on the plants.

Among these two treatments moisture stress on the plants will be much more with treatment I₄ leading to prolonged soil moisture depletion and the resultant deleterious effect on the plant while in treatment I₃ the irrigation provided may be much more than the needs leading to losses due to seepage, surface run off and leaching. Excess water applied in this treatment may also lead to leaching of nutrients beyond the root zone of the crop and the generation of partially an aerobic condition affecting root respiration and other biological activities due to the effect of excess water on soil aeration.

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(N. Yadukumar)

Table-II: Economics of Irrigation treatment in Arecanut

Treatments	Number of Irrigations water applied during the season (mm)	Total depth of Irrigations water applied during the season (mm)	Yield Kg/ha.	Value of produce @ Rs. 8/- kg (Rs/ha)	Labour engaged (Man days)	Cost of Labour @ Rs/8/day (Rs/ha)	Total cost of cultivation (Rs/ha)	Profit per ha. (Rs/ha)
1. Irrigation with 30 mm when CPE reaches 30 mm (I ₁).	34	1020	2545	20360	170	1360	7360	13,000
2. Irrigation with 30 mm when CPE reaches 60 mm (I ₂).	17	510	2094	16752	85	680	6680	10,072
3. Irrigation with 60 mm when CPE reaches 60 mm (I ₃).	17	1020	1922	15376	90	720	6720	8,656
4. Irrigation with 60 mm when CPE reaches 120 mm (I ₄).	8	480	122	9768	48	384	6384	3,365

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M. S. S.
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IRRIGATION REQUIREMENTS OF ARECANUT

DEPTH OF PLANTING AND INTERVALS OF IRRIGATION IN ARECANUT

N. YADUKUMAR** K.B. ABDUL KHADER* AND K. SHAMA BHAT

ABSTRACT

The water requirement of arecanut (Areca catechu L.) was determined at the Central Plantation Crops Research Institute, Regional Station, Vittal. Irrigation once in 5 days at 200 litres of water per tree giving a duty of 1459.46 ha. Cumec. gave the maximum profit. Planting arecanut seedlings at a depth of 90 cm gave significantly more yield than planting at 30 and 60 cm.

INTRODUCTION

Arecanut is grown both under irrigated and rainfed conditions. In places with high sub soil moisture and in areas where the rainfall is fairly uniform, no irrigation is practised. Irrigation is given in places with a long dry spell from December to May. Nambiar (1949) pointed out the need for investigating the effect of irrigation on yield. The depth at which the arecan seedlings are planted depends on the nature of the soil, the depth of water table and topography of land. Radhakrishnan (1973) reported that irrigation once in 3 days at the rate of 198.23 litres of water per palm, giving a duty of 1,305 ha. Cumec. resulted in the maximum benefit in middle Kerala and planting arecanut seedlings

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at a depth of 90 cm gave significantly more yield than planting at 30 and 60 cm depths.

The objects of the present investigation was to study the effect of depth of planting arecanut seedlings and frequency of irrigation on its performance of growth and yield in the soil and climatic conditions prevailing in the coastal Karnataka and Northern Kerala.

MATERIALS AND METHODS

The trial was laid out at Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka, India in 1966 using a 4 x 3 x 5 strip plot design with 4 intervals of irrigation, viz; 5, 10, 15 and 20 days and 3 depths of planting viz; 30, 60 and 90 cm. The soil was sandy loam mixed with gravel having 62% sand, 9% silt and 29% clay (Mehapatra, 1977). Moisture content at 0.15 atmospheric pressure at 0-50 cm depth was 23.54% (pressure plate apparatus) and at 50-100 cm depth it was 23.64%. At 15 atmospheric pressure and at 0-50 cm depth the moisture content was 13.61% and at 50-100 cm depth, it was 14.42%. The hydraulic conductivity was 95 cm/hr. at 0-50 cm depth and at 50-100 cm depth it was 99 cm/hr.

Irrigation channels were provided in each alternate rows of arecanut trees and water was supplied by flashing to the basins as well as interspaces. The area of the irrigation treatment plot was 365.32 sq.m. accommodating 27 treatment palms and 38 border palms planted with a spacing of 2.6 m on either side. Between irrigations

treatments double row of border palms were provided. In the treatment under depths of planting, there were 9 trees with a single guard row.

Water was applied to each plot at the rate of 200 litres per plant per irrigation. Water was diverted to plots from cement plastered channels. Measured quantity of water was applied by allowing uniform discharge of water through "U" shaped syphons of known diameter. Four syphons were used at a time for 15 minutes to deliver 15,000 litres of water per plot which was distributed uniformly among 65 palms, each palm getting 200 litres of water per irrigation. Palms were irrigated from second fortnight of November to first fortnight of May during the experimental period. The number of irrigations given were 30, 15, 10 and 8 according to the treatment schedule.

The plants were manured every year with ammonium sulphate, super phosphate and muriate of potash to supply N, P₂O₅ and K₂O at the rate of 100, 40 and 140 gms per plant in two split doses one in September and another in February. In addition to this 12 kg. of green leaf and 12 kg. of cattle manure were also applied in September and October every year. General cultural operations like forking the garden once in a year, spraying Bordeaux mixture against achali disease (Phytophthora grisea) were attended to. The mean monthly maximum and minimum temperature, relative humidity, rate of evaporation and the rain fall of experimental period are given in figure 1.

The study was conducted for seven years (1966 to 1973). The data on growth characters and yield were collected and subjected to statistical analysis.

RESULTS

In table I the growth characters recorded during October, 1968 are presented. Only height of the plants differed significantly with irrigation levels. Plants irrigated once in 5 and 10 days were significantly taller than those irrigated once in 20 days. Table II represents the morphological characters recorded during the year 1969. Number of leaves per plant and girth at collar were significantly higher in plants irrigated once in 5 and 10 days interval as compared to those irrigated once in 20 days. The data for the year 1970 (Table III) revealed that girth of the palm and number of nodes were significantly higher in plants irrigated once in 5 days over all other treatments.

The plants commenced for yielding in 1970. Yield of arecanut, both number and wet weight of nuts were recorded tree-wise from 1970-71 to 1973-74. The data were pooled and statistically analysed. The mean number of nuts and wet weight of nuts per plot are presented in table IV. Irrigation once in 5 and 10 days gave significantly more number of nuts than those irrigated once in 15 and 20 days. There was no significant difference in number of nuts between the treatments which received water once in 5 and 10 days time interval. Though an increasing trend could be noticed

in yield in the former. The percentage increase in number of nuts in I_1 , I_2 and I_3 treatments over I_4 were in the order of 262, 145 and 13 respectively.

In respect of depth of planting, 90 cm depth gave significantly more number of nuts than those planted at 30 and 60 cm depths. There was no significant difference between the yield of nuts in plants planted at 60 and 30 cm depths. The interaction between irrigation intervals and depth of planting were also significant. Planting at 90 cm depth and irrigation once in 5 days gave 401% more number of nuts compared to irrigation once in 20 days and planting at 30 cm depth.

With respect to wet weight of nuts it was observed that irrigation once in 5 days was significantly superior to irrigation once in 15 and 20 days intervals. Though there was no significant difference between treatments irrigated once in 5 and 10 days, there was an increase of 12.7% in I_1 over to I_2 . The percentage of increase in the yield in respect of wet weight of nuts in I_1 over I_3 was 156 and the corresponding increase over I_4 was 303%.

Planting at 90 cm depth had given significantly more weight of nuts than planting at 30 and 60 cm depths. Though there was no significant difference an increasing trend could be noticed with regard to weight of nuts in D_2 over D_1 . The increase in yield in the plants planted at 90 cm depth over the plants planted at 30 cm depth was 49%.

The treatment combination of planting at 90 cm depth and irrigation frequency of 5 days proved to be significantly

superior to all other combinations in respect of wet weight of nuts. The increase in yield in the above case was 406% over planting at 30 cm depth and irrigating once in 20 days.

Irrigation once in 5 days had resulted in 303 per cent increase in respect of weight of nuts against an increase of 262 per cent in the case of number of nuts, which means that irrigation frequency has more positive effect on weight of nuts than number of nuts.

DISCUSSION

At the rate of 200 litres of water to a palm under each irrigation, the duty was 1459.46 ha. Cumec. for 150 days at a frequency of once in 5 days, each ha. containing 1400 palms. This is equivalent to a standing depth of 89.8 cm. The average rainfall during the period was 18.87 cm. The pan evaporation for the experimental period was 101.6 cm which is 12.6% more than the irrigation during the same period.

Irrigation once in 5 days had given an extra income of Rs 11,156-80 per ha. over the treatment which received water once in 20 days (table V), and the corresponding increase over the plants which received irrigation once in 15 days was Rs 7,420-48. Though there was no significant difference between the treatments irrigated once in 5 and 10 days, irrigation once in 5 days had resulted in an extra remuneration of Rs 3,757-32 per ha. with an additional expenditure of Rs 540/- over the treatment which received water once in 10 days. Thus the overall result revealed that irrigating

arecanut once in 5 days with 200 litres of water and planting seedlings at 90 cm depth is economical.

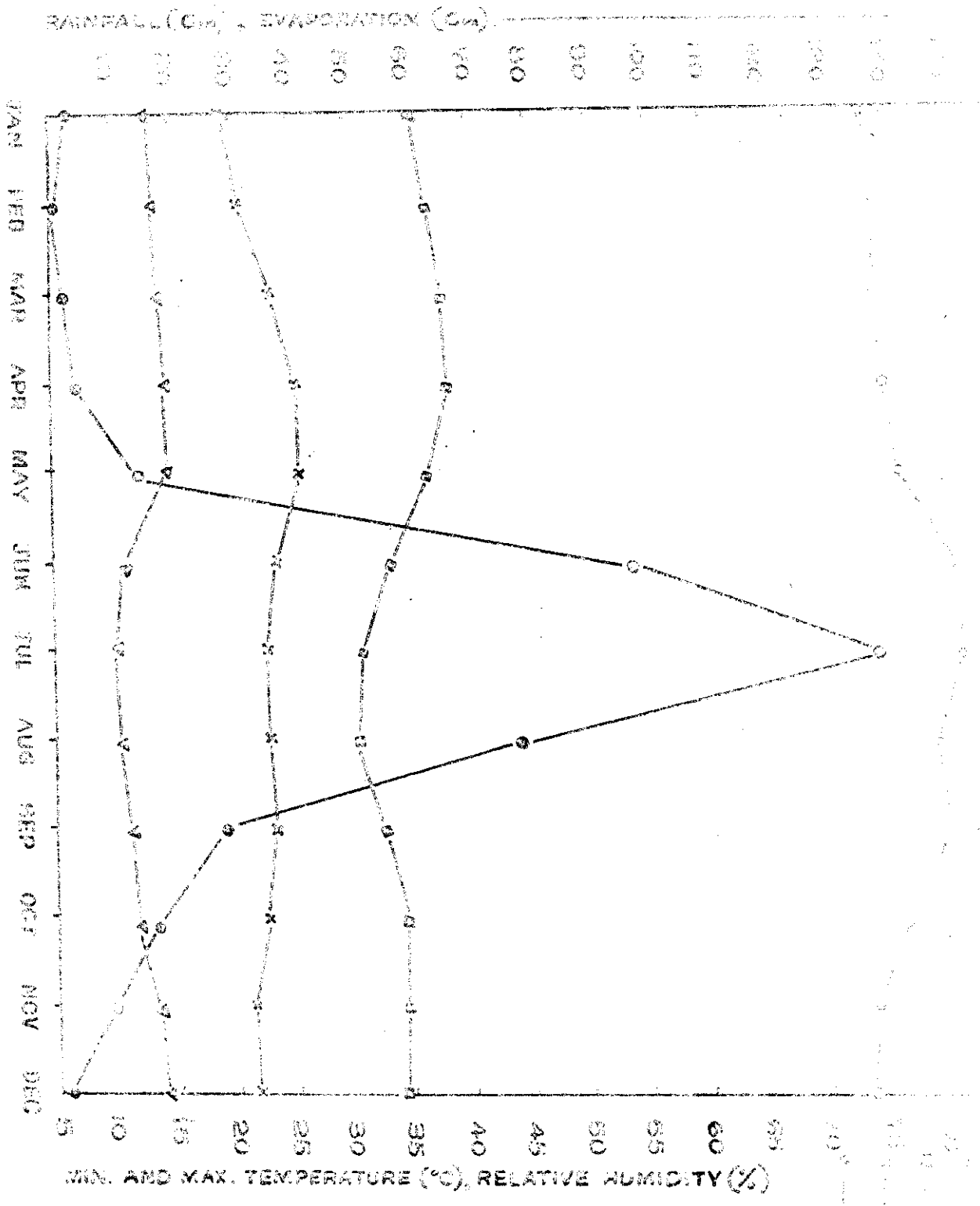
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 YEAR: ...

RELATIVE HUMIDITY (%)
 20° - 95%

The paper presented in the Symposium on Silver jubilee
Areca Nut Research Dec-12-14, 1982

SCHEDULING OF IRRIGATION FOR ARECANUT WITH PAN-EVAPORIMETER

N. YADUKUMAR, K.B.A. KHADER, K.SHAMA BHAT & [REDACTED]

ABSTRACT

Studies were conducted over a period of four years for scheduling irrigation in arecanut based on CPE. The ratios of irrigation to CPE used were (1) 30 mm irrigation for 30 mm evaporation (1:1), (2) 60 mm irrigation for 30 mm evaporation (1:0.5), (3) 60 mm irrigation for 60 mm evaporation (1:1) and (4) 120 mm irrigation for 60 mm evaporation (1:0.5). The field trial was laid out at CPCRI Regional Station conforming to strip plot design with above four irrigation treatments, three depths of planting of arecanut at 30, 60 and 90 cm and five replications. Significant effect on the yield of arecanut was recorded with 30 mm irrigation for 30 mm evaporation and this irrigation scheduling was found to be better in terms of economic returns than the other schedules. Under circumstances when water supply and energy become critical scheduling of irrigation with 30 mm water for 60 mm CPE was also found to be beneficial even though the monetary returns as compared to 30 mm irrigation for 30 mm CPE were lower.

Irrigation is an important component in the management of arecanut in areas where monsoon are only seasonal. In the South Kanara District of Karnataka where arecanut is cultivated extensively there is a need to irrigate the crop during a part of winter and the whole part of summer months extending from mid-November to May. Earlier studies conducted at the Regional Station of Central Plantation Crops Research Institute at Vittal (Annual report, CPCRI, 1972) have indicated that irrigation once in five days is optimal for sustained higher yield of arecanut. Additionally, planting seedlings at a depth of 90 cm was found to be better than planting at shallower depths. More recent data on the irrigation scheduling for crop plants have shown that it is indeed realistic to schedule irrigation based on evapotranspiration losses than an arbitrary approach depending on frequency and quantity of water applied. With this in view, an experiment was initiated during the year 1974-75 for scheduling irrigation in arecanut based on CPE data. An attempt was also made to study the depth of planting arecanut by integrating three different depths of planting along with the irrigation schedules.

The studies were conducted over a period of four years and the results obtained are presented and discussed in this communication.

MATERIALS AND METHODS

The experiment was laid out at the Regional Station of the Central Plantation Crops Research Institute, Vittal during the year 1974 on a previously established eight year old arecanut plantation. The palms were previously planted with 3 depths of planting and were uniformly irrigated with 200 litres of water every five days during the period from December to May. The irrigation treatments were superimposed on this by integrating the different depths of planting so as to obtain five replication for each treatment. There were five main irrigation treatments viz:

- I₁ Irrigation 30 mm when cumulative pan evaporation approaches 30 mm (1:1).
- I₂ Irrigation 30 mm when cumulative pan evaporation approaches 60 mm (0.5:1).
- I₃ Irrigation 60 mm when cumulative pan evaporation approaches 60 mm (1:1).
- I₄ Irrigation 60 mm when cumulative pan evaporation approaches 120 mm (0.5:1).

The three depths of planting were 30, 60 and 90 cm. For each treatment combination 9 palms were available. The total plant population in the plot was 1200. Out of which 540 palms were within the layout. The remaining palms represent the border rows on all the four sides of the plot. The palms were spaced 2.6 m apart. The layout conformed to a 4 x 3 x 5 strip plot design.

The irrigation was provided through surface conveyance and water was conveyed to the plots by using siphons from a main cement lined channel. 'U' shaped siphons of one meter length and 5 cm diameter were used and 5 such siphons could discharge 30 mm water in 15 minutes.

The water evaporation was monitored through a open pan evaporimeter conforming to USWB class 'A' specifications. The irrigation scheduling was done as detailed above. The data on maximum and minimum temperature, RH, evaporation rate and rainfall were collected,

and are depicted in figure 1. Irrigation was provided only during the non-monsoon months extending from second half of November to the end of May each year. There was only occasional precipitation during the irrigation period which was accounted for while scheduling the irrigation.

The data on nut yield in terms of number and fresh weight were collected during each harvest and pooled to obtain year-wise yield. Statistical analysis carried out on pooled yield data obtained over the four year experimental period.

The soil moisture content was determined by the gravimeter method of piper (1950) under the different irrigation treatments from 0-90 cm depth just prior to each irrigation and on the day following irrigation.

RESULT AND DISCUSSION

The data on number and wet weight of nuts as affected by irrigation and depth of planting are presented in Table -I. Irrigation with 30 mm water when the CPE approached 30 mm was significantly superior to other two irrigation treatments namely I₃ and I₄. Where as there was no significant difference between I₁ and I₂.

It is therefore clear that arecanut is fairly sensitive to moisture stress and requires irrigation to be provided at more frequent intervals. This is very well reflected when a comparison is made between treatment I₁ on one hand and the other irrigation schedules on the other.

Soil moisture content ranged between 19.50 to 21.40 % subsequent to irrigation and reduced considerably to about 12.1% within a period of 5 to 10 days just before the next irrigation in treatments I₁, I₂ and I₃ irrespective of the quantity of water used. While in I₄ the reduction (8.8%) in moisture content was even more prominent just before the next irrigation (Fig. -2). Though the total quantity of water irrigated was the same for I₃ and I₁ treatments the frequency of irrigation in I₃ was only the half of that in I₁ resulting in wide fluctuations in soil water and a larger period of moisture. Thereby resulting in decreased nut yield. Such an effect of moisture stress on yield of crops has been observed by Brisler, (1977).

Though in the treatments I₂ and I₃ the frequency of irrigation was the same, I₂ had received only half the quantity of water than

that of I₃. Here, again the differences in the nut yield were not significant showing that reducing the frequency of irrigation by increasing the quantum of water applied is not beneficial as the excess water supplied is not advantageous for plant use. As the soil was of a light texture with a low water holding capacity, the excess water used was not retained in the root zone efficiently leading to decreased usage by the plant. This is also clear from the data obtained on the soil moisture contents before and after irrigation. The excess water applied may also be lost by surface run off and seepage which in addition may cause nutrient loss due to leaching beyond the root zone (Zaslowsky, 1972, Haller and Bresler, 1973).

Economies of irrigation scheduling was worked out based on the yield, volume of water required, frequency of irrigation and the cost of irrigation. The relative economies of arecanut cultivation with the different schedules of irrigation is given in table II. The monetary returns with I₁ was Rs 13,000/- with 34 irrigations and an application of 1020 mm of water during the period November to May. Eventhough only 17 irrigations were required with 510 mm of water applied the monetary return was Rs 10,072. These results have clearly demonstrated that the best irrigation schedule is 30 mm water when CPE approaches 30 mm. But, under situations where there may be limitations of water and energy supply the scheduling can be extended to 30 mm water when CPE reaches 60 mm (Treatment I₂ in the study) minimising water and energy use. From the practical point of view it may be desirable to sketch the irrigation intervals to 8 to 10 days during the later part of summer when both water and power supply become critical under the existing conditions over a vast tract of arecanut cultivation in the South Kanara District of Karnataka. The frequency of irrigation and the total depth of water required for schedules I₁ and I₂ are provided in table III. The data on frequency, number of irrigations and depth of water required indicate that in terms of water and power use efficiency, if these inputs are critical schedule I₂ where 30 mm water is irrigated as the CPE approaches 60 mm may be more beneficial eventhough resulting in a lesser monetary return. However if the inputs for irrigation are non-critical 30 mm irrigation for 30 mm pan-evaporation is most ideally suited irrigation practice for arecanut. The other two irrigation schedules namely I₃ and I₄ were not found to be ideal because of imposition of widely fluctuating moisture regimes leading to moisture stress on the plants.

Among these two treatments moisture stress on the plants will be much more with treatment I₄ leading to prolonged soil moisture depletion and the resultant detrimental effect on the plant.

While in treatment if the irrigation provided may be such more than the needs leading to losses due to seepage, surface run off and leaching. Excess water applied in this treatment may also lead to leaching of nutrients beyond the root zone of the crop and the generation of partially an aerobic condition affecting root respiration and other biological activities due to the effect of excess water on soil aeration.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. N.M.Nayar former Director and Dr. K.V.A.Bavappa, Director, CPCRI, Kasaragod and Shri K.Narasimha Murthy, Senior Scientist-In-Charge, CPCRI, Regional Station, Vittal for providing necessary facilities to conduct above experiment and for their valuable suggestions.

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(N. Yadav)

Table 1: Effect of irrigation and depths of planting on the number of nuts/weight of ripe nuts/palm

Irrigation treatments	(1) Number of nuts per palm				(11) Weight of ripe nuts kg/palm				
	Depth of planting		Mean	Depth of planting		Mean	Depth of planting		Mean
	30 cm	60 cm		60 cm	90 cm		60 cm	90 cm	
I1	248.38	229.55	248.34	8.59	8.60	9.56	8.91		
I2	184.48	119.57	209.06	6.64	7.31	8.03	7.32		
I3	147.97	221.43	188.26	4.93	7.92	7.92	6.71		
I4	129.42	116.73	122.08	4.50	4.03	4.30	4.27		
Mean	177.56	191.82	206.43	6.16	6.96	7.29	6.80		
CD for Irrigation	-	-	50.92	-	-	-	1.74		
CD for depth	NS	NS	NS	NS	NS	NS	NS		

Pooled yield data from 1975-1978.

NS = Not significant

M. N. G. S. (N. G. S. S. S. S.)

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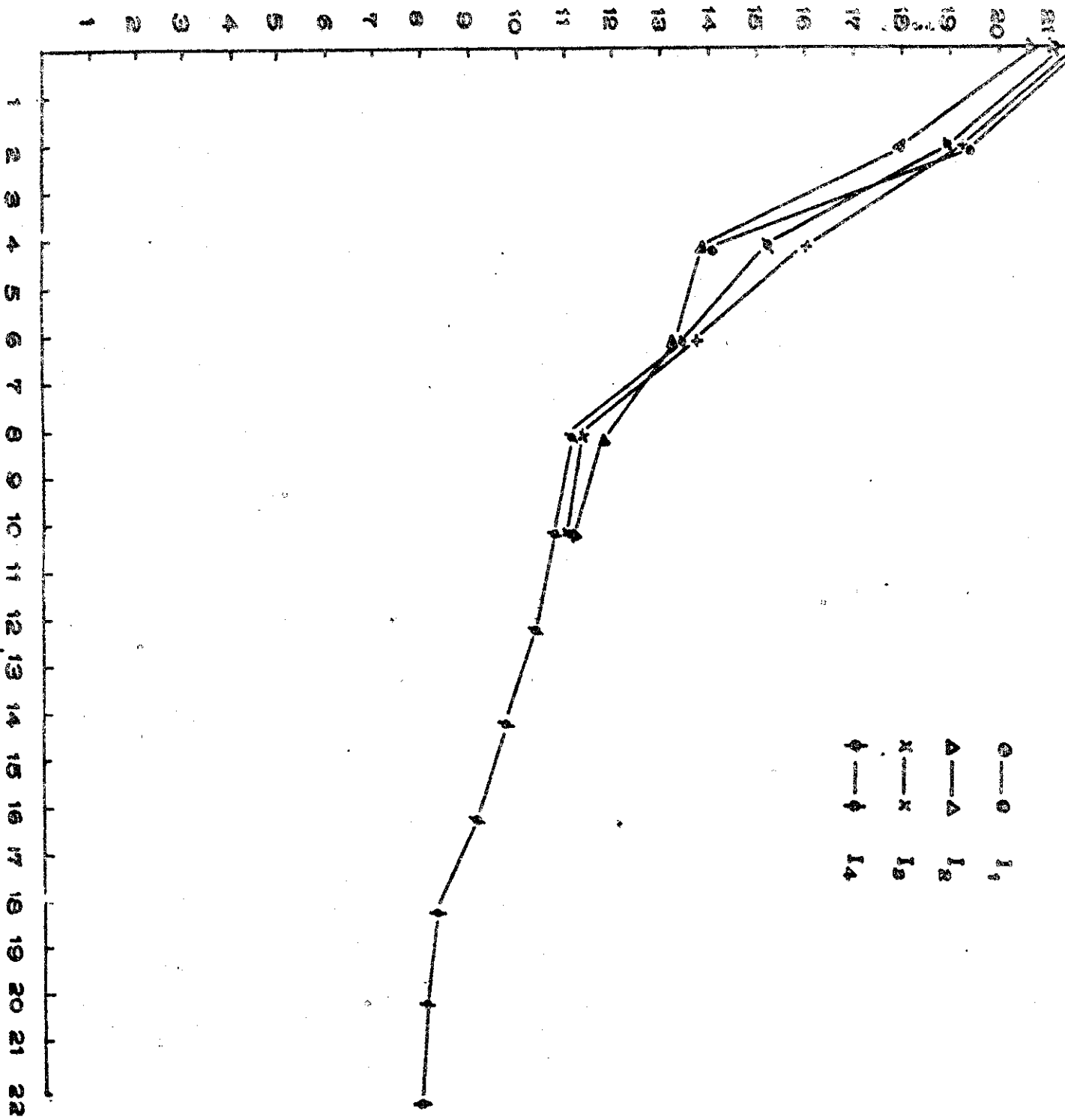
Table II. Economics of irrigation treatment in Arcanmut

Treatments	Number of irrigations	Total depth of water applied during the season (mm)	Yield kg/ha	Value of produce @ Rs 8/-kg (Rs/ha.)	Labour engaged (man days)	Cost of labour @ Rs 8/day (Rs/ha)	Total cost of cultivation (Rs/ha.)	Profit per ha. (Rs/ha.)
1. Irrigation with 30 mm when CPE reaches 30 mm (I ₁).	34	1020	2545	20360	170	1360	7360	13,000
2. Irrigation with 30 mm when CPE reaches 60 mm (I ₂).	17	510	2094	16752	85	680	6880	10,072
3. Irrigation with 60 mm when CPE reaches 60 mm (I ₃).	17	1020	1922	15376	90	720	6720	8,656
4. Irrigation with 60 mm when CPE reaches 120 mm (I ₄).	8	480	122	9768	48	384	6384	3,365

M. S. N. S. N.
(N. S. N. S. N.)

PERCENTAGE OF SOIL MOISTURE

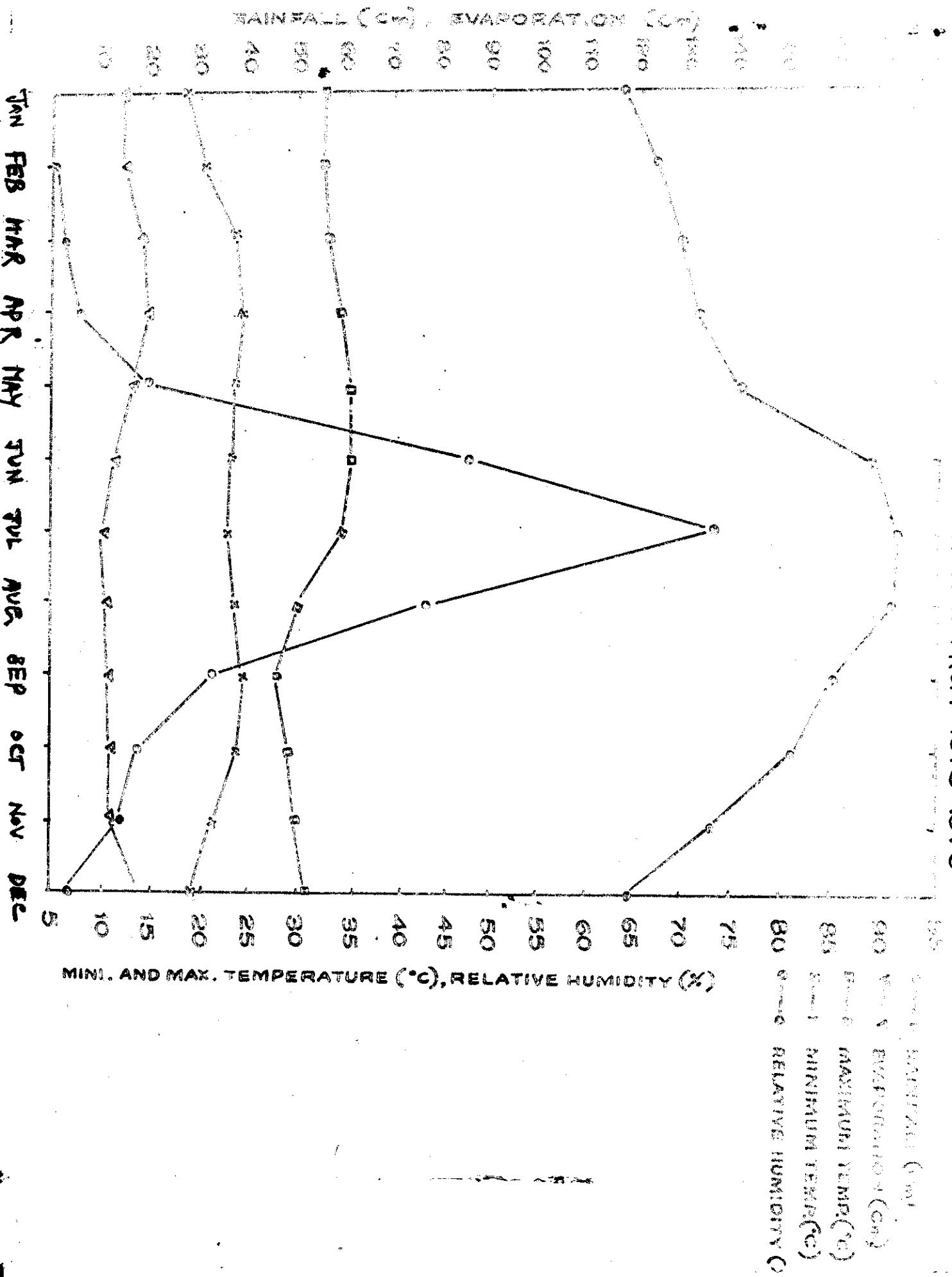
DEPTH OF IRRIGATION. (Co-90cm)



O—O I1
 A—A I2
 X—X I3
 †—† I4

DAYS AFTER IRRIGATION

FIG. 1 MEAN MONTHLY RAINFALL, MAXIMUM AND MINIMUM TEMPERATURES
RELATIVE HUMIDITY AND EVAPORATION FROM 1973-1978



13. Approximate expenditure incurred in the Project: (Give reasons for variation, if any, from original estimated cost)

Rs 452,500/-

14. Publications and material (one copy each to be supplied with this proforma)

a) Research papers

2 Nos.

b) Popular articles

c) Reports

d) Seminars and workshops (Relevant to the Project) in which the Scientists have participated:

Silver jubilee on Arsenic Research - Symposium.

e) Material developed such as new varieties of crops or breeds of farm animals, implements, products, etc.)

Expt. I

- Under Vittal conditions, irrigation once in five days is optimal for sustained higher yield of Arsenic. Additionally, flanking subdrains at a depth of 90 cm was found to be better than flanking at shallower depths.

Expt. II

- Significant effect on the yield of Arsenic was recorded with 30mm irrigation for 30mm evaporation and this irrigation scheduling was found to be better in terms of economic returns than the other schedules. Under circumstances when water supply and energy become critical, the of irrigation with 30mm water for 60m CPE was also found to be beneficial with the monetary returns as compared to 30mm irrigation for 30mm CPE was lower.

15. Details (Nos. etc.) of Field/Laboratory Note books and final material and their location,

Log book

Field note books

Metereological observation books

Registers - Nos. II, III & IV


Project file

All these records are available with in the Agronomy Section CPRI (RS), Vittal.

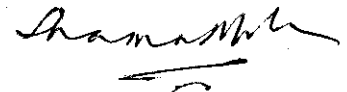
16. Comments/suggestions of Project leader regarding possible future line of work that may be taken up arising of this project:

1. different moisture conservation techniques can be combined with irrigation treatments
2. different irrigation systems like, flood, channel, sprinkler, furrow and drip irrigation systems can be tried
3. Response to different doses of fertilizers can be tried under various systems of irrigations

17. Signatures with name of Project Leader and Associates:


(M. Yadukumar)

18. Signature (with comments, if any) of Head of Division/Section/Station:



19. Signature (with comments, if any) of Director:

