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FERTIGATION OF ARECANUT (*Areca catechu* L.) DURING PRE-BEARING STAGE

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ABSTRACT

A long term experiment on ferti- drip irrigation was initiated in December, 1996 in a two year old arecanut (*Areca catechu* L.) garden at Central Plantation Crops Research Institute, Regional Station, Vittal with an objective to evaluate the feasibility of supplying fertilizers through drip irrigation and economising the input cost on labour, fertilizers and energy. The treatments comprised of four fertilizer levels (25 %, 50 %, 75 % and 100 % of recommended dose), three frequencies of fertigation(10, 20 and 30 days) and two controls (absolute control and 100 % NPK soil application). Drip irrigation was given daily from December to May equivalent to 100 % ET. After four years of experimentation, different fertilizer levels significantly influenced girth and trunk elongation. Percentage of flowering was maximum with 75 % fertilizer level followed by 50 % fertilizer level. Four year average of physiological parameters indicated that different fertilizer levels have maintained more or less same amount of net photosynthesis, transpiration, stomatal conductance etc. Fertilizer levels significantly influenced crop growth rate (CGR). Based on growth observaions and photosynthetic parameters, it was observed that all fertilizer levels were good and 50 % of the standardised fertilizer dose was found sufficient for pre-bearing arecanut palms through ferti-drip irrigation thus saving considerable fertilizer dose. Annual maintenance cost could be reduced considerably through saving in labour and fertilizer input to the tune of Rs. 14, 450/ ha over normal practice of basin application of fertilizers and irrigation.

Key words : Fert-drip irrigation, CGR, RGR

INTRODUCTION

Arecanut (*Areca catechu* L.) is a high valued commercial plantation crop concentrated in the coastal belt of Karnataka and Kerala. It has to be irrigated invariably during post-monsoon period i. e., Nov. – May. Drip irrigation has proved to be a success in arecanut with 44 % water saving and 45 per cent increase in yield (Abdul Khader, 1988). Arecanut, being the most profitable cash crop, irrigation and fertilizers have positive and significant effect on economics (Dinesh Kumar and Mukundan, 1996). However, some agronomical practices like fertilizer application need to be improved to guarantee optimisation, fertilizer dose as well as reliable productivity. The micro- irrigation system is highly efficient method of water application and ideally suited for controlling the placement and supply rate of fertilizers. Ferti-drip irrigation has the advantage of saving in labour and flexibility in timing of fertilizer application in relation to crop demand besides increasing the fertilizer use efficiency (Goldberg *et al.*, 1976). With the adoption of ferti-drip irrigation, the fertilizer use efficiency could be increased to the extent of 60 per cent mainly because of minimal losses due to leaching, optimising the nutrient balance by supplying the nutrients directly to the root zone and control of nutrient concentration in the soil solution. The efficiency of fertilizer recovery is relatively high with fertigation through drip (Miller *et al.*, 1981). No work has been done on this aspect in arecanut. In view of several advantages with ferti-drip irrigation, an experiment was initiated with an objective to study the feasibility of supplying and economising the fertilizers through fertigation in arecanut.

MATERIALS AND METHODS

The long term experiment on ferti-drip irrigation was initiated in December, 1996 in a two year old arecanut garden planted with Mohitnagar variety at a spacing of 2.7 m x 2.7 m at Central Plantation Crops Research Institute, Regional Station, Vittal. The trial was devised as a Randomised Block Design with three replications incorporating factorial component. The treatment comprised of four fertilizer levels. (25 %, 50 %, 75 % and 100 % of standardized dose), three frequencies of fertigation (10, 20 and 30 days) and two controls (absolute control and 100 % NPK soil application). The experimental soil is sandy clay loam with acidic pH.

Drip irrigation was given daily from November to May every year through three microtubes of 8 litre / hour discharge rate. The microtubes were placed at 50 cm away from the base of the palm. The quantity of water given was equivalent to 100 % ET. Fertilizers (Urea, Diammonium Phosphate and Potassium chloride) were injected in to the drip system through Ventuty. The standardized fertilizer dose at present is 100 g N : 40 g P_2O_5 : 140 g K_2O per palm per year. The fertigation schedule was followed throughout the post- monsoon period i.e., Nov.- May at 10 days, 20 days and 30 days intervals. In case of 100 % NPK soil application, fertilizer dose of 100 g N : 40 g P_2O_5 : 140 g K_2O per palm per year was applied in two splits (1/3rd in June and 2/3rd in October).

All the growth parameters were recorded in November every year. Biomass estimation for calculating CGR and RGR values was done by using regression equation (Muralidharan, 1980). The trunk dry matter was estimated by the following regression equation. $Y = 0.01435\ l + 0.3442\ g - 1.0017$ (where y = trunk dry matter, l = length of trunk and g = girth of the trunk)

Total leaf weight was added to trunk dry weight to estimate total biomass. Measurement of photosynthetic parameters were made in the leaves of arecanut using LI-620 Portable Photosynthesis system(Li-Cor Inc., Nebraska, USA) in March between 10.00-12.00 hrs

RESULTS AND DISCUSSION

After three years of treatment imposition, it was observed that all fertilizer levels significantly

Table 1. Effect of fertigation on growth parameters and flowering of arecanut (1999).

Treatment	Height (cm)	Trunk height (cm)	Girth (cm)	No.of leaves	% of flowering
Fertilizer dose					
25 %.	417.3	277.9	52.83	8.2	9.3
50 % .	442.3	289.6	52.58	8.3	29.8
75 %.	447.7	303.9	54.84	8.5	40.7
100 %	454.7	319.2	55.11	8.2	25.9
Frequency of fertigation					
10 days	448.8	300.5	53.52	8.4	20.8
20 days	445.8	305.4	54.40	8.3	27.8
30 days	427.0	287.0	53.75	8.2	29.2
Control 1(absolute)	406.3	261.0	50.00	7.6	5.6
Control 2 (100 % NPK soil application)	472.8	317.1	52.80	8.1	16.7
CD (5%) for ferti. Dose	NS	28.67	2.30	NS	-
CD (5%) for frequency	NS	NS	NS	NS	-
CD(5%) for interaction	65.25	NS	NS	NS	-
CD (5%) for Control 1 vs Factorial set	NS	Sig	Sig	Sig	-
CD (5%) for Control 2 vs Factorial set	NS	NS	NS	NS	-

influenced growth parameters such as trunk height and girth (Table 1). There was increase in trunk height and girth with increase in fertilizer dose up to 100 %. However, there were no significant differences among 50%, 75% and 100% levels with respect to all growth parameters. Highest percentage of flowering was observed with 75 % fertilizer dose (40.74) followed by 50 % fertilizer dose (27.78). Number of leaves were highest with 100 % fertilizer level (6.78) followed by 75 % fertilizer level. This indicates that 50 % of standardized fertilizer level is sufficient for pre-bearing arecanut palms through ferti-drip irrigation thus saving 50 % fertilizer dose. Significant difference was observed between factorial set of treatments and absolute control in case of growth parameters. While, same was not observed between factorial set and 100% NPK soil application. Hansen(1990) found more growth in black currants using ferti-drip irrigation rather than with surface broadcast application on nutrients. With regard to frequency of fertigation, growth characteristics did not vary significantly. However, all the growth parameters were maximum at 20 days interval followed by 10 days interval. Thus, both 10 days and 20 days interval of fertigation are superior to 30 days interval.

Photosynthetic parameters (such as net photosynthesis(Pn), transpiration(E) and WUE) were not significantly influenced by different fertilizer levels and frequencies of fertigation (Table 2). Photosynthetic characteristics did not vary significantly both among different fertilizer levels and frequencies. Higher WUE (0.955) was recorded with 50 % fertilizer level. However, WUE and stomatal conductance were significant when factorial set was compared with control 1. Higher transpiration, Pn and stomatal conductance with control 1 would have resulted in less WUE (0.83) when compared to other treatments. The data also indicates that all the fertigated treatments were equally effective in maintaining the same levels of net photosynthesis, transpiration and WUE. Photosynthetic characteristics also indicate that 50 % of fertilizer level was sufficient for arecanut during pre-bearing stage.

Fertilizer levels significantly influenced crop growth rate (CGR)(Table 3). CGR was highest

Table 2. Effect of ferti-drip irrigation on photosynthetic characteristics of arecanut (Mean of four years-1997-2000).

Treatment	Pn (mmol/ CO_2/ m^2/S)	E (m.mol/ m^2/S)	WUE (Pn/E)	gs (mol/m^2)	CO_2int (ppm)	VPD (Kpa)
Fertilizer dose						
25 % of recom.	5.125	5.930	0.864	0.170	261.8	4.52
50 % of recom.	5.039	5.276	0.955	0.131	244.4	4.65
75 % of recom.	5.219	5.804	0.906	0.146	258.4	4.40
100 % of recom	4.814	5.237	0.919	0.129	245.9	4.64
Frequency of fertigation						
10 days	5.127	5.388	0.960	0.132	246.5	4.65
20 days	4.823	5.440	0.886	0.139	250.6	4.54
30 days	5.198	5.856	0.888	0.161	260.8	4.48
Control 1(absolute)	5.500	6.598	0.830	0.173	253.8	4.37
Control 2 (100 % NPK soil application)	4.868	5.731	0.849	0.181	257.7	4.25
CD (5%) for ferti. Dose	NS	NS	NS	NS	NS	NS
CD (5%) for frequency	NS	NS	NS	NS	NS	NS
CD (5%) for Control 1 vs soil application)	NS	NS	Sig	Sig	NS	NS
CD (5%) for Control 2 vs Factorial set	NS	NS	NS	NS	NS	NS

Table 3. Effect of fertigation on crop growth rate(CGR), relative growth rate(RGR) and leaf production rate(Between 1996 and 1999).

Treatment	CGR (kg/palm/yr)	RGR (kg/kg/yr)	Leaf production rate/year
Fertilizer dose			
25 % of recom.	0.610	0.265	1.51
50 % of recom.	0.714	0.279	1.49
75 % of **recom.**	**0.741**	**0.282**	**1.51**
100 % of recom	0.660	0.273	1.47
Frequency of fertigation			
10 days	0.691	0.282	1.57
20 days	0.691	0.278	1.46
30 days	0.662	0.270	1.46
Control 1(absolute)	0.531	0.239	1.28
Control 2 (100 % NPK soil application)	0.645	0.258	1.40
CD (5%) for ferti. Dose	0.052	NS	NS
CD (5%) for frequency	NS	NS	NS
CD(5%) for interaction	65.25	NS	NS
CD (5%) for Control 1 vs Factorial set	NS	Sig	NS
CD (5%) for Control 2 vs Factorial set	NS	NS	NS

with 75% fertilizer level (0.741 kg/palm/year) followed by 50 % fertilizer level (0.714 kg/palm/year). However, significant variation was not observed among different frequencies of fertigation indicating that all frequencies of fertigation were equally efficient. Relative growth rate(RGR), estimated between 1996-1999, did not vary significantly both among fertilizer levels and frequencies. However, both CGR and RGR were singnificant over control 1 when compared with factorial set of treatments. Lowest CGR (0. 531 kg/palm/year) and RGR (0.239 kg/kg/year) values were recorded with control 1. Though, leaf production rate/year did not vary significantly, it was higher with factorial set of treatments (1.48-1.57) as compared to control 1(1.28).

Economic analysis: Fertigation has vast potential in saving labour and reducing the cost of production. It was reported that fertigation significantly reduced the cost of production compared to surface banding fertilizer application (Ibrahim, 1992). Weed control is the additional benefit with fertigation (Parikh *et al.*, 1996). From the Table 4, it can be noticed that there was a saving in the annual maintenance cost on labour and fertilizer input to the tune of Rs. 14,450/ha

Table 4. Saving in annual maintenance cost(Rs./ha) during pre-bearing stage

Item	
1. Labour requirement per hectare under conventional management	
a. Basin irrigation	170 man days
b. Fertilizer application	83 man days
c. Weeding	40man days
2. Labour requirement per hectare under ferti-drip irrigation @ 1 man hr/day during post– monsoon season	30 man days
3. Total saving in labour	263 man days
4. Saving in labour cost @ Rs.50/ man day	Rs. 13,150
5. Saving in fertilizer dose(50 %)	Rs. 1,300
6. Total saving on input cost	Rs. 14,450

over normal practice of basin application of fertilizers and irrigation.

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