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RESPONSE OF COCONUT ROOTS TO THE METHODS OF IRRIGATION IN LITTORAL SANDY SOIL

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ABSTRACT

A study on the rooting behaviour of WCT coconut palm to irrigation was taken in the year 1997-1998. Number of main roots from one fourth of the basin area were higher under irrigated palms (1149-1212) compared to rainfed palms (429). The response for irrigation of the fine roots was more compared to the main roots. Irrespective of the methods of irrigation the dry weight of roots were more in the irrigated palms compared to the rainfed palms. Since the main as well as fine roots were more in the limited area of the wetted zone under drip irrigation, the performance of drip irrigation palms (66% Eo) was on par with basin irrigated palms

Key words: Coconut, Irrigation, Roots

INTRODUCTION

Adequate root mass is essential for any crop to achieve proper anchorage, uptake of nutrient and water. It is all the more important for perennial crops like coconut where the life cycle is prolonged up to 80 years (approximately) during which time the palm may undergo one or other kind of natural calamity. The adventitious nature of coconut root is sufficient to serve the basic functions provided the palms are planted at a fairly good depth (60 cm) and in a place where the soil depth is 1.2 m and more. It is a proven fact that roots density/pattern varies with the surrounding environment i.e., when the water is available sufficiently on the surface, more root will concentrate on the surface, and under stressed conditions the roots tend to go deeper in search of water. Further the frequency, the method of irrigation and soil type also has impact on the rooting density. However such studies on rooting behaviour is limited in coconut. Keeping this in view a study was taken at CPCRI Kasaragod to find out the rooting behaviour of WCT coconut palms for Drip/Basin irrigation in littoral sandy soil.

MATERIALS AND METHODS

The experiment was started in the year 1993 with different treatments i.e., basin irrigation at 100% of open pan evaporation, drip irrigation with 66, 100 and 133% open pan evaporation and rainfed control. The root study was taken up in the year 1997-1998 in the rainfed, basin and drip irrigated palms in the littoral sandy soils. However in the drip irrigated palms, only palms irrigated at 66% of Eo was taken for the study (since the response for irrigation in terms of nut yield was on a par with 66, 100 and 133% of drip irrigation). All the palms were given recommended dose of fertilizer i.e., 500 g of N, 320 g of P_2O_5 and 1200 g of K_2O/palm/year in two splits. A trench was opened at 2.5 m away from the

bole and the roots were washed from a sector of one fourth portion of the basin with the help of a hose pipe. The washed sand which collected in the trench was removed as and when it got filled. Likewise the soil was washed away up to 1.2 m depth. The main and fine roots were collected from 0-30, 31-60, 61-90 and 91-20 cm twice *i.e.,* during November 1997, immediately after the cessation of monsoon and once before the onset of monsoon i.e. in May 1998 from the same palm. The number of main roots, its fresh and dry weight were recorded along with the weight of the roots.

RESULTS AND DISCUSSION

Main roots

The number of main roots was more in the basin and drip irrigated palms under both the periods of observation compared to the rainfed control (Table 1), which was mainly due to long term effect of irrigation. The distribution of roots was less in the 0-30 cm depth irrespective of, no irrigation, irrigation and methods of irrigation. Kushwah *et al.* (1973) reported that over 82% of the roots of the palms in the regularly cultivated and manured plot was found in the 31-120 cm depth and only 8.7% of the roots went below 120 cm. Maximum number of main roots were found in the second layer i.e 31-60 cm and later there was a decreasing trend noticed in the deeper layers that followed (61-90 and 91-120 cm). Vidhana Arachchi (1998) found that 75-80% of roots of adult coconut were concentrated at a depth between 20-80 cm. On critical observation, the variation in the root number at different depths was found to be less for the drip irrigation compared to the basin irrigation method. This may be attributed to the better availability of moisture throughout the depth as the water was applied daily at a rate in which the palm can take up and all the applied water was available to the palms. Louis and Balasubramanian (1983) reported that irrigation promoted root growth in coconut.

Root weight

a) Main roots

This is in line with the number of roots. Wherever the number of roots were more, more root weight was recorded, irrespective of the fresh and dry weight (Table 2). Unlike the moisture content of leaves, the root moisture content was less and it varied from 43.4 to 47.4 per cent in different

Table 1. ***Main root number (1/4th area) of coconut as influenced by method of irrigation in littoral sandy soil***

Depth (cm)	Rainfed		Basin		Drip	
	Nov.	May	Nov.	May	Nov.	May
0-30	108	98	278	308	261	280
31-60	178	160	323	358	298	376
61-90	68	63	198	241	203	263
91-120	60	63	109	153	160	186
121-150	40	45	55	89	83	107
Total	454	429	963	1149	1005	1212

Table 2. Weight of main roots (1/4th area) (kg) of coconut as influenced by method of irrigation in littoral sandy soil

Depth (cm)	Rainfed				Basin				Drip			
	Nov		May		Nov		May		Nov		May	
	FW	DW	FW	DW	FW	DW	FW	DW	FW	DW	FW	DW
0-30	5.9	3.4	5.4	3.0	8.9	4.7	8.3	4.6	7.5	3.8	6.9	3.8
31-60	5.8	3.3	5.3	3.0	8.2	4.3	6.9	3.8	8.7	4.9	9.3	5.2
61-90	1.2	0.7	1.1	0.7	7.6	3.7	8.3	4.8	6.8	3.6	8.5	5.0
91-120	0.7	0.4	0.8	0.6	3.9	1.8	4.3	2.2	4.3	2.2	5.6	3.3
121-150	0.6	0.4	0.8	0.6	1.8	0.6	2.3	1.2	1.9	0.7	2.8	1.6

FW: Fresh weight, DW: Dry weight

treatments under both the periods of observation. There was no marked variation in the moisture content of roots among the palms of rainfed, irrigated and the methods of application treatments.

b) Fine roots

Unlike the main roots, more fine root weight was found in the first layer of 0.30 cm of the rainfed and basin irrigated palms (Table 3). Then there was a reduction in root weight at other depths. Whereas in drip irrigated palms since the water is allowed to drip at 30 cm depth more root weight was noticed in 31-60 and 61-90 cm depths during May. Since the drip irrigation is daily irrigation and where the soil moisture is always maintained at field capacity more roots were found in the wetted area of the drip irrigation. The effect of drip irrigation was conspicious and thus the increase in the weight of fine roots was 135% where as it was 74 % increase for basin irrigation compared to rainfed control. Between the seasons, the rainfed palms and the drip irrigated palms behaved in a similar way i.e., the difference in fine roots weight between the season is more or less same. However more root weight was noticed in drip irrigated palms. In the rainfed palm, due to stress the palms would have lost the regeneration capacity. In drip irrigated palms the effect of rain as well as irrigation were similar in providing adequate soil

Table 3: *Weight of fine roots (1/4th area) (kg) of coconut as influenced by method of irrigation in litoral sandy soil*

Depth (cm)	Rainfed				Basin				Drip			
	Nov		May		Nov		May		Nov		May	
	FW	DW	FW	DW	FW	DW	FW	DW	FW	DW	FW	DW
0-30	6.4	3.7	5.6	2.9	10.3	5.8	9.8	5.3	8.5	1.9	6.0	3.1
31-60	5.2	3.0	5.4	2.8	8.4	4.3	4.7	2.5	7.5	4.1	8.3	4.3
61-90	1.2	0.8	1.3	0.8	8.3	4.0	5.3	2.9	6.6	3.5	9.8	5.5
91-120	1.1	0.7	1.1	0.6	2.8	1.8	2.3	1.3	3.7	2.0	5.3	3.5
121-150	0.6	0.2	0.6	0.2	1.4	0.8	1.4	0.7	1.6	0.8	1.8	0.8
Total	14.5	8.4	14.0	7.3	31.2	16.7	23.5	12.7	27.9	12.3	31.2	17.2

FW: Fresh weight, DW: Dry weight

moisture to the palms. Whereas in the basin irrigated palms the rainy season was favourable for fine root production. In summer, though irrigation was provided once in four days, the soil moisture was not adequate enough to trigger fine roots. Further the soil being sandy the low water holding capacity and high soil temperature would have aggravated the situation in basin irrigation. Thus drip irrigation resulted not only in water saving but also in an equivalent yield compared to basin irrigation (Dhanapal *et al.*, 1998). Hence, it is clear that the fine roots are found distributed in the area where adequate moisture is available resulting in more number of roots in the irrigated palms. If we consider the total root mass of the basin volume (1.8 m radius and 1.2 m depth), then there is chance for basin irrigated palms to have more number of roots. However when the nut yield was compared, it was noticed that there was no significant difference between the basin and drip irrigation (Dhanapal *et al.* 1998)

Though only limited area of the root zone was wetted by the drip method, but because of daily irrigation, the soil moisture is always maintained at field capacity which resulted in more number of roots in the wetted area of drip irrigated palms (at 66% of Eo) which facilitated an equivalent nut and 34% water saving compared to the palms irrigated through drip at higher levels and basin (where the irrigation was provided once in four days). In general the fine root initiation responded more to irrigation compared to the main roots. Introduction of drip irrigation at adult stage clearly shows that there is not much variation in the main roots between the methods of irrigation.

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