



## Root distribution of arecanut (*Areca catechu* L.) under rainfed condition in hill zone of Karnataka

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**Keywords:** Arecanut, hill zone, root length, root weight

Arecanut (*Areca catechu* L.) has fibrous root system without a taproot. Arecanut based multiple cropping is a common and accepted practice in the hill zone of Karnataka. Roots in perennial tree crops radiate from the trunk and it consists of vertical roots descending to deeper soil horizons and highly branched spreading roots which forage nutrition from superficial horizons. Root distribution studies are of paramount importance to formulate agronomic practices for obtaining highest efficiency in the uptake of nutrients. The effect of root distribution on nutrient uptake, however, will depend upon the concentration of nutrients and the length of roots at different depths and the extent to which roots in any given part of the profile are absorbing. Bhat and Leela (1969) reported maximum concentration of roots (> 66%) within first 50 cm layer of soil surface under well-drained deep lateritic soil condition. In low lying arecanut plantation with high water table, Bhat (1978) reported more lateral root spread within a shallow depth. Sujatha and Haris (2000) reported root distribution is shallow in two year old areca plantation. Since trees planted at different densities develop different root systems, in higher-densities a higher proportion of root volume occur at all depths which influences the rate of nutrient uptake and hence, of practical significance in scheduling fertilizer application.

Study on root distribution of 30 years old arecanut cultivar, Sirsi Local grown as rainfed crop, was undertaken at Agricultural Research Station, (Pepper), Sirsi (14.60°N latitude, 74.83° E longitude, 619 m. altitude) Karnataka. Sirsi comes under hill zone of Western Ghat receiving an annual rainfall of 2500 mm distributed from June to September. Soil of the study area was acidic to neutral having a mean pH of 6.06 and EC of 0.24 m mhos/cm. Available nitrogen, phosphorus and potassium content of soil was 131.7, 43.7 and 174.9

kg/ha, respectively. Organic carbon content of the plantation was 0.88 %. Plantation was maintained as per the recommended package of practices. Mean number of bunches per palm in the plantation was 2.17 with a mean *chali* yield of 2.81 kg and mean number of nuts per palm was 473. Three representative arecanut palms were selected for the observations on the distribution of roots by excavation method described by Leon and Umana (1961). Roots were excavated from the sector covering 1/8<sup>th</sup> of the circumference and observed for root dry weight and root length after separating into thick roots (>2 mm in diameter) and fine roots (< 2 mm in diameter). Observations were made on the root by excavating the soil in one sector covering half the quarter of the circumference (1/8<sup>th</sup> of the circumference). Soil along with roots were excavated from the surface for every 30 cm depth and 30 distance from the bole, layer by layer till no traces of roots were seen. Roots were separated and washed to clean adhered soil particles. Among the various parameters described by Bohm (1979), only root length and root dry weight were recorded after separating into thick and fine roots.

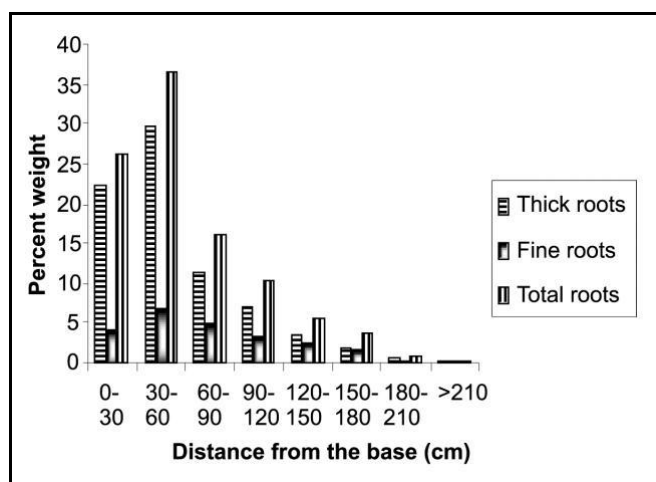
Total dry weight of 3,628.8 g (Table 1) and a total cumulative root length of 4,095.4 m (Table 2) was recorded in rainfed arecanut palm of 30 years age. Thick roots (> 2 mm in diameter) accounted for 76.7 % of total dry weight of roots, while fine roots (< 2 mm in diameter) accounted for 61% of total cumulative root length. Roots were concentrated near the bole of the palm. Spread of roots within 60 cm distance from the center of the palm was 63 % of total root dry weight and 55 % of cumulative root length (Fig.1 and 2). Similarly 76.1 % of total root dry weight and 76.7 % of total cumulative root length was observed within 60 cm depth from the surface (Fig. 3 and 4). This indicates that, interspaces beyond 60 cm from the palm are not exploited fully leaving scope for

**Table 1. Dry weight of arecanut roots distributed at different depths and distances from the base of the palm**

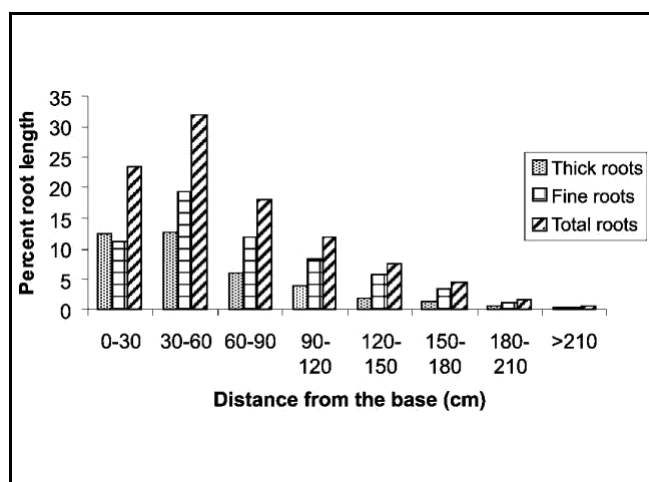
Depth (cm) ⇒ Distance (cm) ↓	Type of roots	0-30		30-60		60-90		90 - 120		>120		Total weight	
		Wt. (g)	(%)	Wt. (g)	(%)	Wt. (g)	(%)	Wt. (g)	(%)	Wt. (g)	(%)	(g)	(%)
0 to 30	Thick	238.10	06.6	346.7	09.6	161.6	04.5	55.6	1.5	09.8	0.3	811.8	22.4
	Fine	42.7	01.2	63.1	01.7	30.4	00.8	05.1	0.1	01.9	0.1	143.2	03.9
	Total	280.8	07.8	409.8	11.3	192.0	05.3	60.7	1.6	11.7	0.4	955.0	26.3
30 to 60	Thick	158.7	04.4	627.0	17.3	242.3	06.7	47.1	1.3	07.6	0.2	1082.7	29.8
	Fine	61.7	01.7	146.7	04.0	33.0	00.9	04.2	0.1	02.2	0.1	247.8	06.8
	Total	220.4	06.1	773.7	21.3	275.3	07.6	51.3	1.4	09.8	0.3	1330.5	36.7
60 to 90	Thick	98.4	02.7	210.6	05.8	55.2	01.5	47.0	1.3	-	-	411.2	11.3
	Fine	102.0	02.8	29.8	00.8	33.3	00.9	10.6	0.3	01.2	0.03	176.9	04.9
	Total	200.4	05.5	240.4	06.6	88.5	02.4	57.6	1.6	01.2	0.03	588.1	16.2
90 to 120	Thick	86.8	02.4	123.7	03.4	36.8	01.0	08.3	0.2	-	-	255.6	07.1
	Fine	68.0	01.9	019.8	00.5	18.0	00.5	07.1	0.2	-	-	112.9	03.1
	Total	154.8	04.3	143.5	03.9	54.8	01.5	15.4	0.4	-	-	368.5	10.2
120 to 150	Thick	80.3	02.2	25.6	00.7	18.7	00.5	-	-	-	-	124.6	03.4
	Fine	65.3	01.8	07.8	00.2	07.7	00.2	02.9	0.1	-	-	83.7	02.3
	Total	145.6	04.0	33.4	00.9	26.4	00.7	02.9	0.1	-	-	208.3	05.7
150 to 180	Thick	43.3	01.2	17.1	00.5	11.5	00.3	-	-	-	-	71.9	02.0
	Fine	43.7	01.2	06.4	00.2	06.3	00.2	-	-	-	-	56.4	01.6
	Total	87.0	02.4	23.5	00.7	17.8	00.5	-	-	-	-	128.3	03.7
180 to 210	Thick	06.8	00.2	11.9	00.3	-	-	-	-	-	-	18.7	00.5
	Fine	12.4	00.3	03.5	00.1	-	-	-	-	-	-	15.9	00.4
	Total	19.2	00.5	15.4	00.4	-	-	-	-	-	-	34.6	00.9
>210	Thick	04.5	00.1	03.4	00.1	-	-	-	-	-	-	07.9	00.2
	Fine	05.7	00.2	01.9	00.1	-	-	-	-	-	-	07.6	00.2
	Total	10.2	00.3	05.3	00.2	-	-	-	-	-	-	15.5	00.4
Total weight (g)	Thick	716.9	19.8	1366.0	37.6	526.1	14.5	158.0	4.4	17.4	0.5	2784.4	76.7
	Fine	401.5	11.0	279.0	07.7	128.7	03.5	29.9	0.8	05.3	0.1	844.4	23.3
	Total	1118.4	30.8	1645.0	45.3	654.8	18.0	187.9	5.2	22.7	0.6	3628.8	100.0

Thick roots = > 2 mm in diameter

Fine roots = < 2 mm in diameter



**Fig. 1. Distribution of roots (%) at different distances from the base of the palm**



**Fig. 2. Distribution of roots (%) at different distances from the base of the palm**

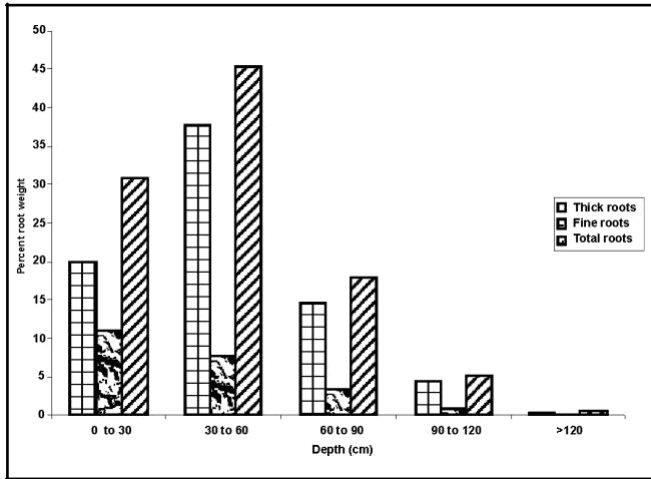


Fig. 3. Distribution of roots (%) at different depth in arecanut

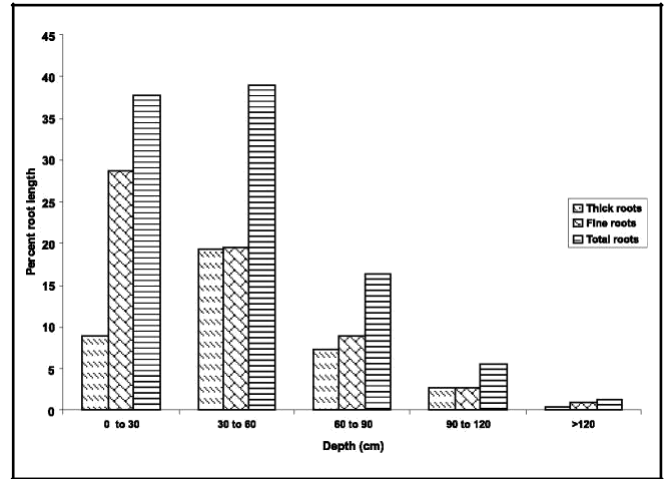


Fig. 4. Distribution of roots (%) at different depth in arecanut

Table 2. Cumulative root length of arecanut palm distributed at different depths and distances from the base of the palm

Depth (cm) ⇒ Distance(cm) ↓	Type of roots	0-30		30-60		60-90		90 - 120		>120		Total	
		Length (m)	(%)	Length (m)	(%)	Length (m)	(%)	Length (m)	(%)	Length (m)	(%)	length (m)	(%)
0 to 30	Thick	132.3	3.2	249.9	6.1	85.1	2.1	31.0	0.8	10.6	0.3	508.9	12.4
	Fine	154.2	3.8	182.8	4.5	90.0	2.2	19.2	0.5	12.0	0.3	458.2	11.2
	Total	286.5	7.0	432.7	10.0	175.1	4.3	50.2	1.3	22.6	0.6	967.1	23.6
30 to 60	Thick	71.2	1.7	282.6	6.9	121.8	3.0	38.6	0.9	6.1	0.2	520.3	12.7
	Fine	242.7	5.9	423.4	10.3	90.1	2.2	15.7	0.4	14.7	0.4	786.6	19.2
	Total	313.9	7.6	706.0	17.2	211.9	5.2	54.3	1.3	20.8	0.6	1306.9	31.9
60 to 90	Thick	51.3	1.2	122.4	3.0	41.1	1.0	36.6	0.9	-	-	251.4	06.1
	Fine	261.7	6.4	86.8	2.1	92.5	2.3	40.0	1.0	7.5	0.2	488.5	11.9
	Total	313.0	7.6	209.2	5.1	133.6	3.3	76.6	1.9	7.5	0.2	739.9	18.0
90 to 120	Thick	39.2	1.0	81.0	2.0	27.4	0.7	10.1	0.3	-	-	157.7	3.9
	Fine	197.9	4.8	59.8	1.5	55.0	1.3	24.7	0.6	-	-	337.4	8.2
	Total	237.1	5.8	140.8	3.5	82.4	2.0	34.8	0.9	-	-	495.1	12.1
120 to 150	Thick	34.1	0.8	25.8	0.6	14.4	0.4	-	-	-	-	74.3	01.8
	Fine	175.5	4.3	18.2	0.4	22.9	0.6	15.2	0.4	-	-	231.8	05.7
	Total	209.6	5.1	44.0	1.0	37.3	1.0	15.2	0.4	-	-	306.1	07.5
150 to 180	Thick	27.9	0.7	14.9	0.4	11.6	0.3	-	-	-	-	54.4	01.3
	Fine	98.1	2.4	18.8	0.5	18.2	0.4	-	-	-	-	135.1	03.3
	Total	126.0	3.1	33.7	0.9	29.8	0.7	-	-	-	-	189.5	04.6
180 to 210	Thick	08.6	0.2	15.2	0.4	-	-	-	-	-	-	23.8	0.6
	Fine	30.5	0.7	09.6	0.2	-	-	-	-	-	-	40.1	1.0
	Total	39.1	0.9	24.8	0.6	-	-	-	-	-	-	63.9	1.6
>210 cm	Thick	03.7	0.1	03.5	0.1	-	-	-	-	-	-	07.2	0.2
	Fine	15.8	0.4	03.9	0.1	-	-	-	-	-	-	19.2	0.5
	Total	19.5	0.5	7.4	0.2	-	-	-	-	-	-	26.9	0.7
Total length(m)	Thick	368.3	9.0	795.3	19.4	301.4	7.4	116.3	2.8	16.7	0.4	1598.0	39.0
	Fine	1176.4	28.7	803.3	19.6	368.7	9.0	114.8	2.8	34.2	0.8	2497.4	61.0
	Total	1544.7	37.7	1598.6	39.0	670.1	16.4	231.1	5.6	50.9	1.2	4095.4	100.0

Thick roots = > 2 mm in diameter

Fine roots = < 2 mm in diameter

multiple cropping in the plantation. Feeder roots (< 2 mm in dia.) were also lesser in the surface zone compared to the middle zone.

Dry weight of thick roots was more within 30 cm from the center of the palm than that of fine roots in the first two horizontal zones (0 to 30 cm and 30 to 60 cm distance). But in the third zone dry weight of fine roots (102 g) increased than that of thick roots (98.4 g). The existence of higher proportion of fine roots indicates efficient foraging of soil nutrients. Much of the thick roots facilitate better anchorage. The distribution of arecanut roots obtained in the present study is also comparable with the report of Bhat and Leela (1969). In oil palm (3 years old) also it is observed that root system is mainly confined to top 50 cm from the surface (Reddy *et al.*, 2002). However, Sujata and Haris (2000) reported more or less equal vertical root spread (43 to 58 cm) in pre bearing areca palms under three different methods of irrigation. In the present study the distribution of roots upto 90 cm radius was 79.2 % of total dry weight, while it was 94.1 % upto depth of 90 cm from ground level. However, unlike the results of present study, Bhat (1983) observed vertical traverse of arecanut roots as deep as 2.6 m.

Cumulative length of thick roots was more near the base than that of fine roots (within 30 cm radius it was 12.4 % thick root and 11.2 % fine roots). Higher

proportion of roots between 30 cm and 60 cm radius from the base of the palm (36.60 % of dry weight compared to 26.30 % upto 30 cm) and between 30 and 60 cm depth from the surface (45.30 % of dry weight compared to 30.80 % upto 30 cm) not only indicate scope for exploitation of soil mass by multiple cropping, but also emphasize the need for deeper drains in heavy rainfall areas.

### References

- Bhat, K.S. 1978. Agronomic research in arecanut. A review. *J. Plantn. Crops*. **6**: 57-78.
- Bhat, K.S. 1983. Plant interactions in a mixed cropping community of arecanut (*Areca catechu* L.) and cocoa. *Ph.D. Thesis*, University of Mysore, Karnataka. 159 p.
- Bhat, K.S. and Leela, M. 1969. The effect of density of planting on distribution of arecanut roots. *Tropic. Agric.* **46**: 61.
- Bohm, W. 1979. *Methods of studying root systems*, Springer-Verlag, Berlin, Heidelberg, New York. 188 p.
- Leon, J. and Umana, R. 1961. Varietal differences in the root system of coffee. *Coffee* **3**(11): 104-107.
- Reddy, V.M., K. Suresh, K.N. Sarma, K.M. Sivasankara Kumar, A. Bhanusri and P. Ramakrishna, 2002. Root biomass distribution in relation to its moisture pattern under different irrigation methods in oil palm *Proceedings of PLACROSYM*. **XV**, pp: 344-347.
- Sujatha, S. and Haris, A.A. 2000. Root distribution as influenced by different methods of irrigation in young arecanut (*Areca catechu* L.) palms. *J. Plantn. Crops*. **28**(2): 117-122.

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