Distribution of Cashew Roots in the Laterite Soils of West Coast of India

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Summary

The root distribution pattern of cashew trees grown in the West Coast tracts of Karnataka was studied at the Central Plantation Crops Research Institute, Regional Station, Vittal. The lateral as well as vertical spread of the roots were determined on dry weight basis. The results revealed that 97·87 per cent of thicker roots and 81.27 per cent of fine roots were spread over within a radius of 2m of the tree and 90.84 per cent of thicker and 53.74 per cent of fine roots were observed from 0-1 m depth. The maximum depth upto which the cashew roots penetrated was 9.5m. The results also showed that 512.73g of thicker and 43.73g of fine roots are present per m^3 of soil volume. The calculated gross weight of thicker and fine roots per tree were 26.02 and 2.22 kgs respectively. The calculated fine roots as a percentage of thicker roots was 8.53.

Introduction

The cashew tree *(Anacardium occidentale* L.) belongs to the genus *Anacardium*, a member of the family of *Anacardiaceae* and has extensive root systems.Taskiris and Northwood (1967) in Tanzania studied the root system of young cashew trees growing in a non-laterised red soil of loamy to sandy loam texture and reported that the tap root of a three and a half year old tree had extended to a depth of over 2.3m and had a diameter of 8.8 cm at a depth of 46 cm, tapering gradually to 1.9 cm at a depth of 1.40 m. They have observed that the spread of the lateral roots was up to 1.2 m in eighteen month old tree and upto 4.6 m in a two-and-half years old tree, 5.6 m for a tree that was six years old. According to Adams (1975) after the emergence the radicle rapidly develops into a tap root which produces laterals after four days and as the lateral roots elongate fibrous roots grow on the tap root. Harishukumar and Khader (1985) while studying the root development in cashew seedlings observed the maximum tap root proliferation in medium textured soils. Agnoloni and Giuliani (1977) have noticed simple fragile tap root in the first phase of growth of the young plant and a more complex strong and extensive roots both sideways and downwards at a later stage. They also noticed that by the time the plant is one and half years old the side roots developed progressively and extensively attaining an area of double the size of the canopy. Barring these observations, there appears to be no report of any detailed study of the underground portions of the adult tree in laterite soils under the climatic conditions prevailing in West Coast of India. Studies on the spread and distribution of adult cashew trees grown in laterite soils was undertaken at the Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka and the results are presented in this paper.

Materials and Methods

The study was undertaken in the experimental field of CPCRI, Regional Station, Vittal at the termination of heavy rains of the South-West monsoon in August and September 1982. The soils of the experimental field was lateritic in origin which is classified as clay loam, moderately deep, well drained and slightly acidic with a pH range of 5.20 to 5.4. The bulk density of the soil ranged from 1.56 to 1.6 g/cc with a mechanical fraction of 46 per cent sand, 16 per cent silt and 34 per cent clay. The field capacity of the soil was found to be 21 per cent with a permanent wilting point of 9.3 per cent. Cashew plants planted in 1972 at a spacing of 8m x 8m were selected for the study. The seedlings were planted in 60 cm cube pits after filling half of which with top soil. Five plants were selected in an area of one hectare.

The procedure adopted was the soil blocks or the quantitative method used by France and Inforzato (1951), Leon and Umana (1961) and Bhat and Leela (1969). The method adopted was digging of trenches of size 50 cm width between the two adjacent trees commencing at a distance of 25 cm from the base of the tree. The soil from the trench was removed in rectangular blocks of 50 cm wide, 25 cm long and 10 cm deep. Excavation was continued till no traces of roots were seen. The roots from

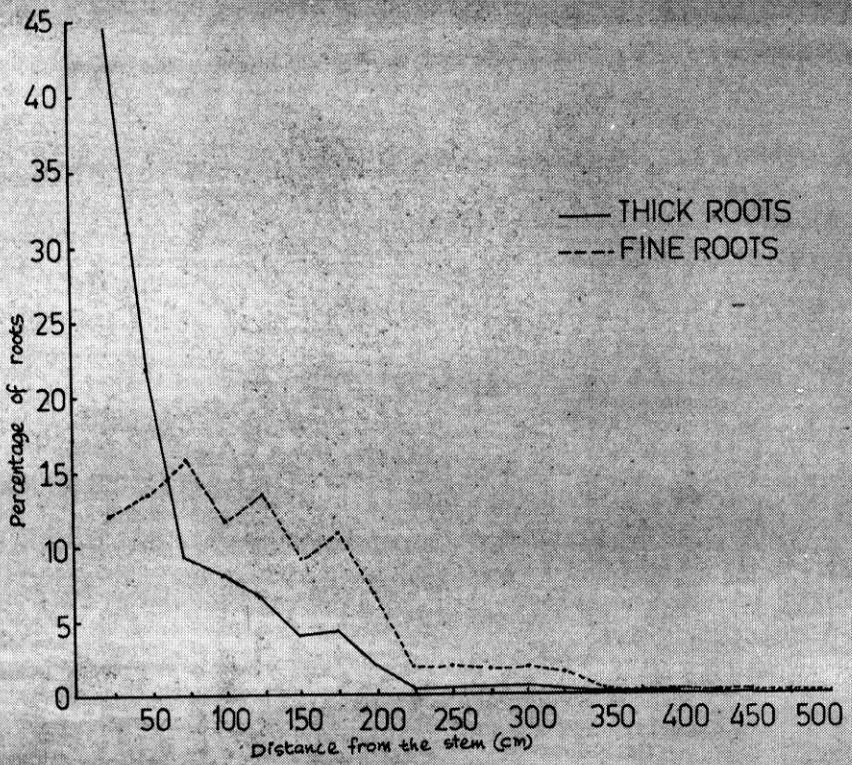

FIG.1 DISTRIBUTION OF ROOTS AT DIFFERENT DISTANCES

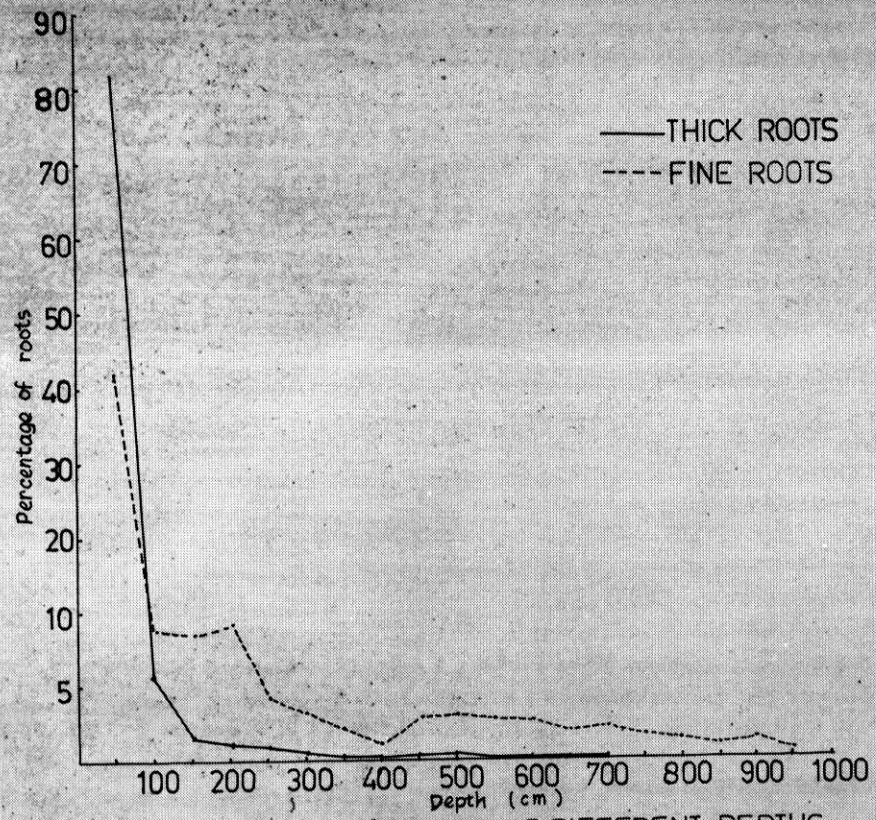

FIG. 2. DISTRIBUTION OF ROOTS AT DIFFERENT DEPTHS

each block of soil were washed and dried in an oven and the dry weight was recorded. The data were pooled and the mean values were worked out. The lateral as well as vertical spread of the roots were determined and the details are presented in this paper.

Results

Lateral spread :

The data on distribution of roots (expressed on dry weight basis in grammes) at different distances from the base of the tree are given in Table-1. It was observed that 66.29 per cent of thicker roots and 26.08 per cent of fine roots concentrated within a radius of 50 cm from the stem. In the next zone, i.e. 51-100 cm there were 16.88 per cent of thicker roots and 20.48 per cent of fine roots. The percentage of roots observed from 101-200 cm radius were 34.71 and 14.70 respectively. From 201-400 cm of radius there was only 18.37 per cent of thicker roots and 2.10 per cent of fine roots. The data also revealed that 99.97 per cent of thicker roots and 99.64 per cent of fine roots lie within a radius of 2m. The maximum spread of roots were observed up to a distance of 5m radius.

Vertical spread :

The data on vertical spread of the roots are given in Table-2. The maximum downward penitration of roots was observed up to 9.5 m and 85.1 per cent of thicker roots and 45.18 per cent of fine roots were noticed from 0-50 cm of depth. The soil layer, 51-100 cm contained 5.33 and 8.56 per cent of thicker and fine roots respectively. Between 101-200 cm there were 4.57 per cent of thicker roots and 15.30 per cent of fine roots respectively. In a soil horizon of 201-300 cm there were 2.31 per cent of thicker roots and 7.13 per cent of fine roots. From 301-950 cm the percentage of thicker roots and fine roots observed were 2.18 and 23.70 respectively.

The concentration and pattern of spread of cashew roots at lateral distances and depths are illustrated in figures 1 and 2. From figure-1 it can be seen that in lateral spread the maximum percentage of roots are within 2 m radius of the tree. From figure-2 it is evident that in the case of thicker roots, the maximum percentage is in the upper soil layer i.e. from 0-50 cm while the maximum percentage of fine roots are in the deeper strata extending up to a depth of 9.5 m.

Weight of roots per unit volume of soil and calculated gross weight of roots :

The data presented in the Table-3 show the relationship between the weight of roots and the volume of soil they occupy. It was observed that 512.73g of thicker roots and 43.73g of fine roots are present per m^3 of soil volume. The calculated gross weight of thicker and fine roots per tree were found to be 26.03 and 2.22 kgs respectively. The calculated fine roots as a percentage of thicker roots was 8.53.

Table 1. Lateral spread of cashew roots

S. No.	Distance (cm)	Thicker roots				Fine roots			
		Weight (g)	(%)	Progressive total (g)	Progressive (%)	Weight (g)	(%)	Progressive total (g)	Progressive (%)
1	0-25	1624.21	44.45	1624.21	44.45	30.49	9.78	30.49	9.78
2	26-50	797.99	21.84	2422.20	66.29	50.80	16.30	81.29	26.08
3	51-100	616.90	16.88	3039.10	83.17	63.77	20.48	145.06	46.56
4	101-150	342.80	9.38	3381.90	92.55	65.26	20.94	210.32	67.50
5	151-200	194.40	5.32	3576.30	97.87	42.92	13.77	253.24	81.27
6	201-250	49.50	1.35	3625.80	99.22	25.80	8.27	279.04	89.54
7	251-300	17.91	0.49	3643.71	99.71	15.50	4.97	294.54	94.51
8	301-350	6.60	0.18	3650.31	99.89	10.27	3.29	304.81	97.80
9	351-400	2.93	0.08	3653.24	100.00	5.74	1.84	310.55	99.64
10	401-450					0.94	0.30	311.49	99.94
11	451-500					0.11	0.03	311.60	100.00

Table 2. Vertical spread of cashew roots

Sl. No.	Depth (cm)	Thicker roots				Fine roots			
		Weight (g)	(%)	Progressive total (g)	Progressive (%)	Weight (g)	(%)	Progressive total (g)	Progressive (%)
1	0-10	1580.0	43.24	1580.0	43.24	82.10	26.34	82.10	26.34
2	11-20	1307.30	35.78	2887.3	79.02	25.20	8.08	107.30	34.42
3	21-30	77.10	2.11	2964.40	81.13	9.30	2.98	116.60	37.40
4	31-40	102.30	2.80	3066.70	83.93	11.40	3.65	128.00	41.05
5	41-50	57.80	1.58	3124.80	85.51	12.90	4.13	140.90	45.18
6	51-100	194.90	5.33	3319.70	90.84	26.70	8.56	167.60	53.74
7	101-150	96.74	2.64	3416.44	93.48	25.57	8.20	193.17	61.94
8	151-200	70.87	1.93	3487.31	95.41	22.14	7.10	215.31	69.04
9	201-250	61.20	1.67	3548.51	97.08	12.88	4.13	288.19	73.17
10	251-300	23.67	0.64	3572.18	97.72	9.35	3.00	237.54	76.17
11	301-350	12.47	0.34	3584.65	98.06	7.18	2.30	244.72	78.47
12	351-400	13.73	0.37	3598.38	98.43	6.36	2.04	251.08	80.51
13	401-450	18.35	0.50	3616.73	98.93	8.31	2.66	259.39	83.17
14	451-500	14.45	0.39	3631.18	99.32	8.32	2.66	267.71	85.83
15	501-550	9.80	0.26	3640.98	99.58	7.10	2.27	274.81	88.10
16	551-600	5.69	0.15	3646.67	99.73	6.71	2.15	281.52	90.25
17	601-650	4.89	0.13	3651.56	99.86	5.32	1.70	286.84	91.95
18	651-700	1.68	0.04	3653.24	100.00	7.20	2.31	294.04	94.26
19	701-750					5.04	1.61	299.08	95.87
20	751-800					4.09	1.31	303.17	97.18
21	801-850					2.79	0.89	305.96	98.07
22	851-900					4.13	1.32	310.09	99.39
23	901-950					1.51	0.48	311.60	100.00

Table 3. Weight of roots per unit volume of soil and calculated gross weight of roots

Volume of the soil excavated (m^3)	Weight of roots in sample		Weight of roots per unit volume of soil		Calculated gross weight of roots in feeding zone/tree		
	Thicker (g)	Fine (g)	Thicker (g)	Fine (g)	Thicker (kg)	Fine (kg)	Fine roots as % of thicker roots
7.12	3653.24	311.60	512.73	43.73	26.03	2.22	8.53

Discussion

The results showed the general pattern of root system of adult cashew trees grown in laterite soils of West Coast of India. When the lateral spread of roots are considered 97.87 per cent of thicker roots and 81.27 per cent of fine roots were found within a cylindrical soil mass of 2m radius from the stem. The maximum concentration of thicker roots were found up to 1 m depth (90.84%). In the case of fine roots the maximum depth up to which the roots

extended was 9.5 m and 90.25 per cent of which was observed from 0 to 6 m depth. In the deeper soil strata fine roots observed were of very thin with extensive branches. Though the weight of fine roots decreased below the horizon of 6 m due to profuse branching and fineness, they exposed large surface area for the uptake of water and nutrients.The profuse branching and ramification of roots in the deeper soil horizons is probably the answer for the drought tolerance and hardy nature of the crop. In the laterite soils of West Coast region at a depth of beyond 8-9 cm sufficient moisture is expected during summer. The tap and thicker roots may be called as anchering roots and were found not penetrating too deep as in the case of fine roots.

A full knowledge of the root system can only be obtained by the study of soil and plant under varied environmental conditions. Leon and Umana (1959) and Bhat and Leela (1969) made similar studies on root system of coffee and arecanut respectively and reported that the root density varied according to spacing. The result of the present study indicates the root distribution pattern of 10 year old cashew trees grown with a recommended spacing of 8m x 8m. in the laterite soils of West Coast. This knowledge of root system may serve as a guide for recommending the planting distances and cultural and manurial practices. Because the concentration of maximum feeding roots are within 2m radius in lower horizones, deeper placement of fertilizers within a radius of 2m may result in better utilisation. Due to the inbuilt mechanism of absorbing soil moisture from underground, cashew trees probably may not respond to supplementary irrigation under West Coast conditions.

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