



# Evidences versus Claims on Deep Rootedness in Planted Eucalyptus

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**Abstract:** Eucalyptus has been grown in India since its introduction in 1790. It is a prominent tree which has been planted both within and outside forests in the greater geographical area of the country. The tree started attracting hate from some quarters around 1980's and continues till date from some parts of the country. The major claim by its opponents is related to its root system which is repeatedly quoted penetrating very deep in the soil to exploit groundwater table leading to land degradation. Though there are many other claims made by its opponents and proponents, this paper reviews Eucalyptus root spread from the exiting reports. The paper also includes four case studies with pictorial evidences exhibiting actual root spread of some Eucalyptus species. The tree is currently grown under short production cycles 2 years onward. Based on the available information on its root spread, it is inferred that the tree does not grow a deep root system which could be held responsible for exploiting the deep ground water table especially on degraded and stressed sites.

**Keywords:** Eucalyptus, Tap root, Root length, Root spread, Water use controversies

Eucalyptus is the top planted, top wood producer, and the backbone of at least the paper and panel industry in India. The tree is gradually attaining the status of common-man tree as its wood is locally available at low cost, is durable, and is now being used in numerous utilities including construction in many parts of the country. Eucalyptus is now a torch bearer of the clonal forestry with highest number of clonal plants for a single tree species being planted in the country. According to an estimate around 50 Crore clonal Eucalyptus plants were planted during 2024-25 (Dhiman 2025a). Dozens of its fast growing and site matched clones have been developed by different organizations which are grown by farmers on their farmland.

The tree is significantly contributing towards the livelihood of millions of people who are directly and indirectly engaged in its nursery and plantation production; logistic support in plantation works including harvesting of trees; transportation and trading of its wood; and wood processing and making its products. There are a large number of economical activities happening around its value chain from growing and trading of its nursery plants; trade and handling of wood between production and consumption centres, trading and marketing wood products and finally their end-use in different utilities. According to an estimate Rs. 48,000 Crore worth of its wood was traded during 2023-24 in the country which is transforming the economical conditions of engaged stack-holders (Dhiman et al., 2023). The tree has indirectly helped in conservation of native forest and tree resources by diverting the pressure to non-forest land where it is being grown. Controversies against the tree invariably surface which creates confusion among its stake-holders whose

livelihood is now closely linked with it. This paper reviewed the root spread of Eucalyptus which is seldom reported as its major controversy.

## Controversies against Eucalyptus

In India the hate against some trees, both the native and exotic ones, has perpetuated for quite some time. There are at least 3 contrasting cases of hating trees which surfaced during the last over 5 decades and include native Chir pine (*Pinus roxburghii*) in the Himalayas, Poplars (*Populus* species) in Kashmir valley, and Eucalyptus (*Eucalyptus* species) in some states. These hate drives have been very strong and were pushed up with a lot of speculative environmental concerns without supportive scientific evidences and explanations. Each case study is unique and had involved local public, environment lobby, political and even legal ecosystems. At times, the issue became so emotive, sensitive and concerning that the highest legal institutes like state high courts were carried away with these drives and issued virtual removal of Poplar in Kashmir valley and banned planting Eucalyptus in Karnataka (Nautiyal et al., 2021).

There is a long history of growing both the native and introduced Poplars in Kashmir valley for centuries and the tree has been well integrated in the local social, industrial, forestry and agriculture ecosystems for its immense values to the locals. The tree was especially targeted during the last over 1.5 decades period when it was virtually made a villain for its floss which is cotton like fine fibrous element attached with seed to help its dispersal for natural regeneration. Initially it was claimed that the tree's pollen (floss was mistaken as pollen) is causing numerous health hazards

including pollen allergy and respiratory problems (Dhiman 2014). The matter was taken up in the Hon'ble J&K High Court to address the claims that it is causing a serious public health disorder.

By the time, the scientific and technical evidences provided were being seriously debated against this false narrative of pollen allergy, COVID epidemic was spread throughout the globe including India and Kashmir valley. The Poplar floss thereafter was deliberately and ignorantly connected with the spread of COVID virus during the peak of this epidemic with claims of the imminent danger to the public health. The Court accordingly ordered immediate harvest and removal of all those Poplar trees which produce floss and avoid its further planting in the valley. The state administrative and forestry establishments initiated the action and a few Lakh of such trees were immediately felled out of estimated number of 15 million Poplar trees in the valley. The author *suo-moto* filed an affidavit in the Hon'ble High Court with scientific facts that Poplar and its floss cannot be held responsible for spreading COVID infection. The Court directed the state forest department to constitute an expert committee to give opinion on this matter. The Court, based on the recommendations of the committee, issued the final order amending its original perception and saved the millions of remaining trees with further accepting the recommendation of the committee to plant Poplar of male clones to avoid "Floss Problem". This man-made controversy was finally put to rest and Poplar culture is now thriving well and supporting a huge economic activity in wood based industry and farmer's income support (Rizvi 2025, Dhiman 2025b).

Chir pine hate in the Himalayas was somewhat similar to Poplar controversy and was also man-made on speculative environmental concerns. Chir pine occurs in the low and mid Himalayas from Pakistan to Nepal and Bhutan and is a native tree to this region which has naturally evolved over the long period of time and got established. The tree was in the focus for research during the early phase of establishing research infrastructure and many of the original research findings in India were related to this tree which also includes the one named as "Longifolene" that was extracted from Chir pine turpentine and was named after the original and old name *P. longifolia* syn. to *P. roxburghii* of this tree. Chir pine was considered so important tree in those days that its cone was made the official logo of the Forest Research Institute, Dehradun which still exists after so many changes in the Indian forestry research establishment in the country.

A few environmentalists had raised the issue that the fires and degradation in lower Himalayas are associated with Chir pine with further claims that this tree was introduced by

Britishers in the locality for commercial wood and resin production. The tree was claimed to destroy the native flora especially that of oak (*Quercus leucotrichophora*) forests though there are reports that such changes, if any, may be associated with climate change (Nautiyal 2015). Oak is reported as people's-friendly tree for providing much needed fuel and fodder compared to Chir pine trees. With moratorium on green felling in the Himalayas post-Indian Forest Policy 1988, the tree is now thriving and expanding well even without making much of its plantations and the controversy has gradually disappeared.

While the controversies surrounding Poplar and Chir pine have by and large ended, it still surrounds Eucalyptus in the country. There are numerous claims in favour and against Eucalyptus. A large number of its proponents and opponents invariably make claims and counter claims many of which are based on speculative environmental concerns without authentic scientific explanations. The main claims against the tree have been its excessive use of water and nutrients leading to dried conditions around its growing locations, and creating shade and allelopathy in and around agriculture fields leading to crop failures (Shyam Sunder 1994). Some other narratives include it being invasive; have adverse social and environment effects, native biodiversity and birds and animals; and many others (NewGen Eucalyptus 2019). Many of these claims are false narratives created by its critic opponents to push their agenda to hate the tree.

Claiming Eucalyptus as invasive tree is not true by any technical, scientific and practical realities. Eucalyptus an introduced tree has been continuously grown since its introduction in 1790 in the country. For any species to be invasive, it needs to expand and replace the native vegetation; should have natural reproduction for such an invasion, and enough breeding population to sustain odd stresses. The tree has been extensively planted within and outside natural forests over a very large geographical area of the country and produces viable seed which does not get natural germination and regeneration. It therefore failed to expand beyond planted spots to any forest areas and other ecologically sensitive ecosystems. However, the tree often coppices well if it is harvested at right age, season, and appropriate height from ground level. The coppice potential of the tree reduces over the subsequent coppicing cycles and hence the coppiced Eucalyptus fails to expand and sustain after a few cycles.

Eucalyptus does not have genetically related/sister species in India. It therefore does not outcross/breed with any of the native trees and does not interfere with the genetic makeup of the native trees and their genetic pool. The tree is therefore no threat to our native ecosystem, species and

gene level diversity. It is a safe introduced tree from biodiversity perspective provided it is not deliberately planted by harvesting the native forests. The tree on the other hand is effectively and efficiently helping in conserving and protecting the diversity & ecology of native forests by shifting a huge wood production pressure to non-forest areas where it is grown. In the absence of Eucalyptus, it would have been extremely difficult to protect the natural forests and their biodiversity against heavy demand for tree based needs of the country. According to Poore (1987) the proliferation of Eucalyptus plantations in India, arouses strong feelings both for and against and the arguments by its opponents and supporters, have often been based more on prejudice/wrong perception than the balanced scientific considerations.

This paper reviews the root spread in the planted Eucalyptus with summaries of 4 relevant case studies in addition to inputs from others to substantiate, with photographic evidences and scientific datasets, how deep and wide is its root spread. There are many other debatable claims against Eucalyptus which could not be discussed here due to the paucity of space. The main goal to write this paper is not to promote Eucalyptus plantations but to make the readers aware of the scientific reasoning for better understanding of such claims and disclaims and also to enable them to make their own rational judgment about the correctness of such claims.

### Case Studies

Four case studies, two from India and two from other countries- one each from Ethiopia and Laos are summarized from the original publications which are in the public domain and are related to root spread of planted Eucalyptus. These studies are pertinent in the present context as they are related to 2 main tree species namely *E. camaldulensis* and *E. tereticornis* which are extensively grown in India. A couple of these studies are reported from the agroforestry production system which is also the main land-use for Eucalyptus production in India. Summaries predominantly present the root spread related traits for better connect with the title of this paper and its space economy by ignoring other studied traits. Most of the datasets from these studies were reworked from the original ones to suite the theme whereas pictures are presented in original and are duly acknowledged.

### Case study 1. *E. camaldulensis* in forest stand, Ethiopia (Source: Schume et al., 2022)

This study was conducted in Ker Jarso site which is located near Durbete Town in Achefer District, Ethiopia. The site is located at 1945 m a.m.s.l. which receives a mean annual precipitation of 1499 mm and the mean annual temperature as 17.7°C. *E. camaldulensis* stand was 10 years old and had 4881 trees/ha with 24.3 m dominant height and 408 m<sup>3</sup>/ha standing GS (ob). The forest stand had a sparse layer of herbaceous plants which covered approximately 20% of the soil surface. Roots were examined by excavating 39 m<sup>3</sup> soil/tree in the form of 2 semi-circular rings and side trenches. The root spread was studied up to 3.10 m soil depth and up to 3.50 m horizontal distance from the tree base. Though maize crop was grown 80 cm away from the tree rows during the start of 10<sup>th</sup> year growth, datasets were given for only crop growth and yield in agroforestry plots.

82.7% of all water and nutrient absorbing fine roots (< 2 mm) were concentrated within the first 1 m from trees and within 60 cm soil depth whereas the share of very coarse roots (> 50 mm) was 84% in this soil section within 1 meter from tree base. Regardless of the distance to the trees, 70.5% of the fine root mass was found in the top 60 cm depth, the remaining 29.5% was in higher depths. The penetration depth of the tap roots varied between 1 and 1.9 m and all tap roots had fallen <4 cm below 70 cm soil depth. The fresh root



Source: Schume et al., 2022

**Fig. 1.** Excavated root system of *E. camaldulensis* with wide spreading lateral roots. Two white arrow marked roots moving upward into the top soil

**Table 1.** Dry root biomass (g m<sup>-2</sup>) of roots of different thickness at different distances from trees

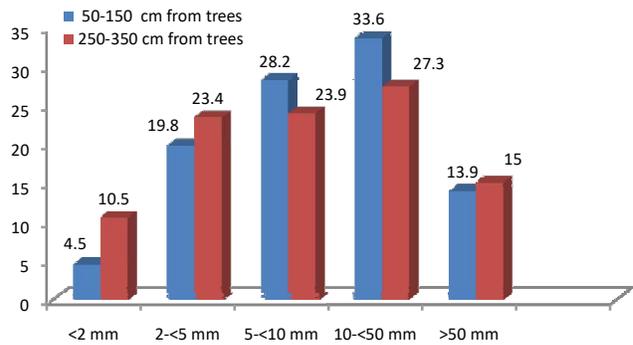
Distance from trees (cm)	Diameter class (mm)					Total
	<2	2-<5	5-<10	10-<50	>50	
50-150 cm	25.1	109.3	156.1	185.8	76.8	553.1
250-350	21.8	48.6	49.6	56.8	31.1	208.0
Average	23.5	79.0	102.9	121.3	54.0	380.6

mass density of the experimental trees was highest in the top 1 m soil horizon (0–10 cm) distance from the stem with 1164 g m<sup>-3</sup> across all root diameter classes. In 3 meters distance from the stem the respective value was only 313 g m<sup>-3</sup>. Root mass distribution in different soil depths is surprisingly similar between 1 and 3 m distances from the tree base with 62.9% and 57.6% in the top 60 cm of the soil.

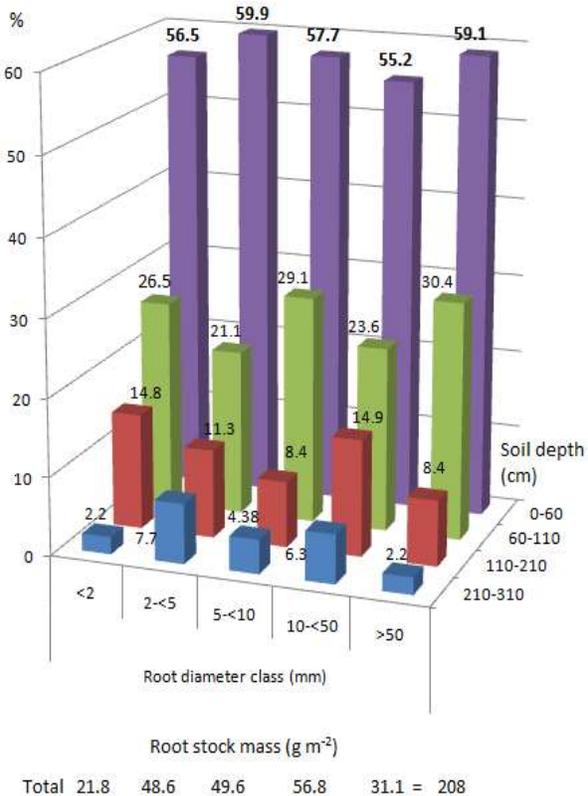
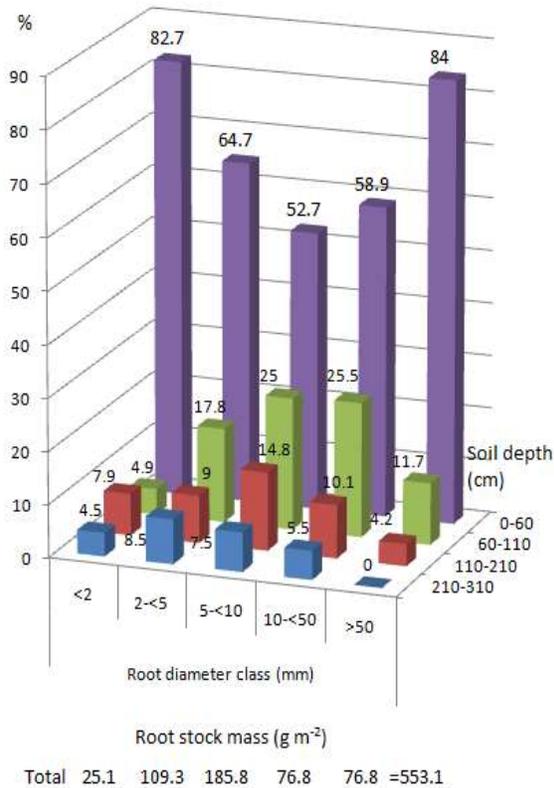
One of the datasets presented in this study also includes tap root traits of 9 trees which include tree dbh (7 to 18 cm), tap root diameter at 10 cm of stump (4.8 to 14.7 cm), tap root length (100 to 190 cm), and tap root fresh weight (803-3900 g). Regression equations were developed by the author (me) for predicting tap root No., tap root length and tap root fresh weight based on dbh and dbh<sup>2</sup> of trees. Out of the developed regression equations, Fresh wt (g) = - 564 + 19777\*D with R (adj.) of 71% and P= 005 was better predicted whereas tap root diameter= 1.93 + 55.1 D with R<sup>2</sup> (Adj.) 57 and P=0.18 has relatively low prediction. The predictions of tap root length based on dbh and dbh<sup>2</sup> were highly unreliable as its R<sup>2</sup> (Adj.) was just in single digit. It also had low and non-significant coefficient of correlation r<sup>2</sup> as 0.14 between tree dbh and tap root length. The regression equations for tap root No. and tap root fresh weight in *E. camaldulensis* provided some

**Table 2.** Root biomass per tree at different soil depths from ground surface

Soil depth (cm)	Root dry biomass (g m <sup>-2</sup> )		Root dry biomass (%)	
	50-150	250-250	50-150	250-350
0-60	347.6	119.8	63.9	57.6
60-110	116.3	53.4	21	25.7
110-210	56.8	24	10.3	11.5
210-310	32.3	10.9	5.8	5.2
Total	558.1	208	100	100



**Fig. 3.** Percent roots of different thickness away from trees (Drawn from datasets given by Schume et al., 2022)



**Fig. 2.** Root spread at different soil depths of 50-150 cm away from trees (left) and 250-350 cm away from trees (right) (Drawn from datasets given by Schume et al., 2022)

ready reference for estimating these traits using tree dbh for future studies which could gradually be refined with more datasets.

**Case study 2. *E. camaldulensis* with and without intercropping, Laos (Source: Edberg et al., 2022)**

This study was conducted at 4 different sites in Saravanh and Savannakhet provinces, South Laos. Studies on root spread and some other traits were conducted in 2 and 7 years *E. Camaldulensis* stands which were established in 2 spacing models of 9 X 1 m and 5 X 2 m without and with intercropping involving rice and cassava under similar silviculture protocols. Annual precipitation of these sites varied from 1800-2500 mm with mean temperature from 14-35°C. The root studies were conducted using the manual excavation of trenches and stainless steel soil cores (100 mm internal tube diameter). The study was conducted up to 60 cm depth with segregation of root samples in 0-20 cm, 20-40

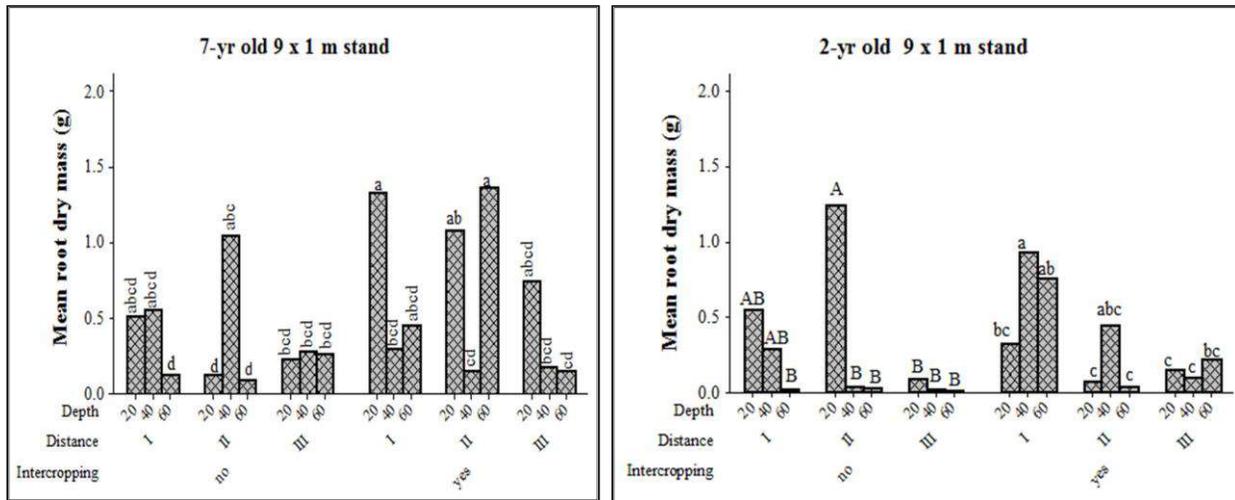
cm, and 40-60 cm soil depths and in distances from tree base up to 275 cm in 5 X 2 m stand and up to 450 cm in 9 X 1 m stand.

The effect of age, spacing and intercropping on the root system of *E. camaldulensis* existed in the shallow depths and well spread horizontally in both pure and intercropped stands with further no significant effect of intercropping rice and cassava, and plantation model (9 x 1 m and 5 x 2 m spacing model). The main lateral roots were confined to shallow depths and along horizontal distances from tree base in both pure and intercropped stands. The root system of 2-year-old *E. camaldulensis* trees in the 9 x 1 m spacing stands had 4-6 main lateral roots (>5 mm) in both pure and intercropped stands with 4-5 in intercropped and 5-6 in pure stand. The corresponding number of secondary lateral roots (<5 cm) was 12-22 in pure Eucalyptus and 12-13 in intercropped stands. Intercropping in 7-year old 5 x 2 m and 9 x 1 m



Source: Edberg et al., 2022

**Fig. 4.** Typical root system of 2-year old *E. camaldulensis* trees in monoculture (A) and intercropped (B)

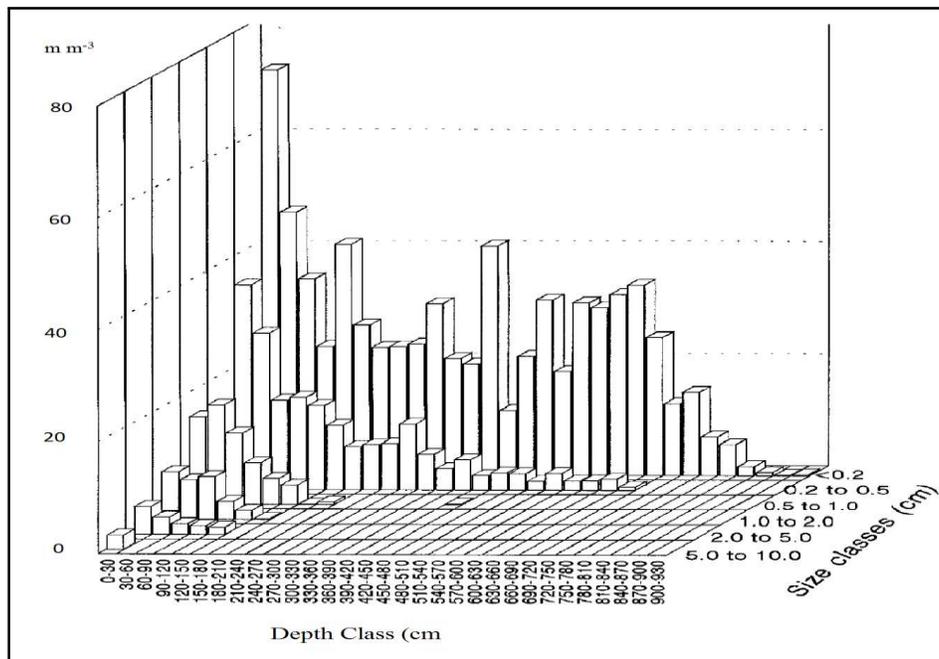


**Fig. 5.** Root spread traits in 7-year old and 2-year old *E. camaldulensis* stands with and without intercrops (Reproduced from Edberg et al., 2022)

spaced plantations produced no significant differences on total root dry mass whereas it was significantly different in young plantation at 9 x 1 m spacing which significantly decreased with increasing distance from the tree base but

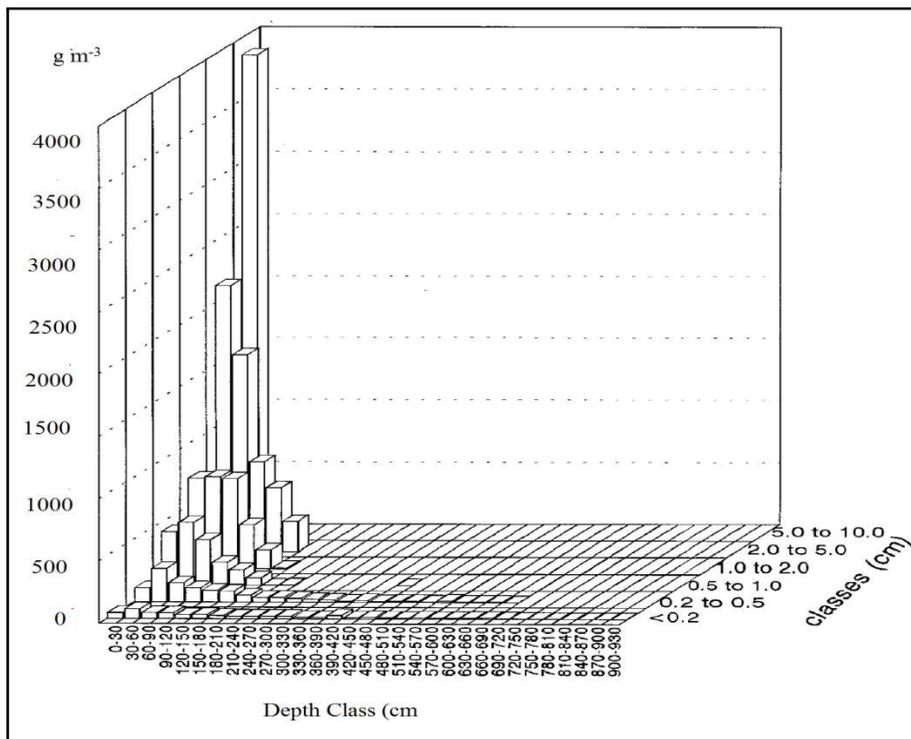
was non-significant between intercropped and pure stands.

Root dry mass was lower (0.33 g) in young 2-year old compared to old 7-year old stand (0.64 g). Mature stands had higher root dry mass at 60 cm depth and at 275 cm distance



Source: Kallarackal and Somen 1968

Fig. 6. Root length density ( $m\ m^{-3}$ ) in *E. tereticornis*



Kallarackal and Somen 1968

Fig. 7. Root weight density in *E. tereticornis*

compared to young stands where it was higher at both the 20 cm and 40 cm depth within 275 cm distance compared to other depths and distances from tree base. The root dry mass at 40 cm soil depth was significantly higher in 5 x 2 m spaced stand and for 9 x 1 m stand at the middle distances from the tree base whereas root dry mass at 20 cm and 60 cm depths was higher in 9 x 1 m stand compared to other spacing at 275 cm from the tree base.

Root dry mass at 60 cm soil depth was higher for pure stand than for intercropped stand at 275 cm distance from the tree base. The mean root dry mass in 7-year old 9 X 1 m stand was higher in 20 cm and 60 cm soil depths for the intercropped stand compared to pure stand. Root dry mass in 2-year pure 9 X 1 m stand at 20 cm depth was higher at 275 cm distance compared to 450 cm across all other soil depths and at 60 cm depth in the first 100 cm from the tree base at nearly all soil depths compared to other distances from tree base.

**Case study 3. *E. tereticornis* in research trial, KFRI, Kerala, India (Kallarackal and Somen 1968)**

This case study is based on 20 years old 6 Eucalyptus species namely *E. tereticornis*, *E. camaldulensis*, *E. urophylla*, *E. brassiana*, *E. pellita* and *E. deglupta* which were grown in an experimental plot of 14 Eucalyptus species at the sub-centre of the Kerala Forest Research Institute at Nilambur located at 50 m a.m.s.l. This trial was planted at 2 X 2 m spacing. The locality receives average rainfall of 2817 mm per year with an average temperature from 24°C to 31°C during the monsoon season. The phreatic aquifer in the locality was reported between 9.0 and 12.0 m during the summer season.

The root spread was based on the datasets of one *E. tereticornis* tree and its results were applied to support findings of all the 6 studied Eucalyptus species. The vertical extent of the root system in *E. tereticornis* was studied from two excavations made around the tree up to 9.5 m depth. Classification of the roots was done according to Bohm (1979) as central root bole of stem (>100 mm diameter), Coarse structural root (50-100 mm), Very large structural root (20-50 mm), Large structural root (10-20 mm), Medium structural root (5-10 mm), Small structural root (2-5 mm), Fine roots (<2 mm). The root length density and dry biomass density in different soil depths is given in Fig.6 and Fig.7 respectively.

The root length density and root weight density had much variation in different layers of the soil. The study recorded the traceability of roots up to 9.3 m soil depth. Roots of larger size classes (structural roots) were found to a depth of about 2.0 m from ground level. At depths lower than 2 m, only roots with a diameter <5.0 mm were found. Maximum density of roots

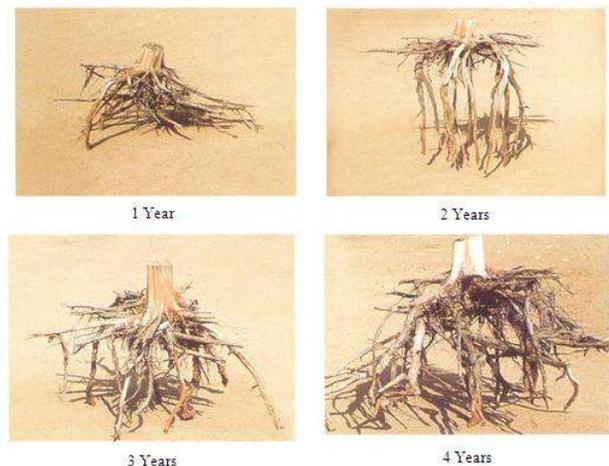
with diameter <2.0 mm was found in the upper 30 cm of the soil. Roots of lower size classes were found in all the soil layers. The root length density and root weight density was maximum in the upper 2 m depth of soil and was contributed by all the root thickness classes. Only select fine and light weight roots could penetrate deeper than 2 m depth with a few of them reaching up to 7 m and only a select one up to 9.3 m depth.

**Case study 4. Eucalyptus hybrid under water logged and alkaline conditions, Haryana, India (Jeet ram et al., 2008).**

The study reported root spread and related parameters from two sites as follow:

**Site-1:** Dhob-Bhali plot is located 6 km from Rohtak city. Eucalyptus hybrid plantation was of 18 years age having 807 trees/ha with average height of 22.6 m and average girth at breast height of 102 cm. The average annual rainfall of the site is 490 mm and the main source of irrigation is canal. The area has high pH values.

Observations recorded in a dug up open well indicated that the sinker roots reached up to a depth of 4.4 m below the ground level. The depth of ground water table was 4.70 m and the zone of capillary fringe above the ground water table



**Fig. 9.** Root system of 1 to 4 years age clonal Eucalyptus trees



Source: Jeet Ram et al., 2008

**Fig. 8.** Root length of Eucalyptus hybrid in Site-1 Dhob-Bhali, Rohtak(left); and Site-2: Puthi Village, Hisar (Right).

was between the depths of 2.50 m - 4.70 m. It was inferred that the Eucalyptus trees were absorbing capillary water of the ground water table.

Site-2: Puthi Village Hissar District had 5 year and 4 months old trees with average girth of 56 cm, and average height 18 m. Plantation was raised at 50 cm ridge. The average rainfall is 212 mm. It faces sub-surface water-logging during the whole, and surface as well as sub-surface water logging during the rainy season. The main causes of water-logging are seepage from canals, brackish ground water and absence of natural drainage.

An open well was dug up to observe the root zone in this strip plantation. The roots reached up to 3.35 m soil depth from the top of 0.50 m high ridge and 2.85 m from the ground level.

### Root Spread In Eucalyptus

Woody plants on an average are more deeply rooted than herbaceous ones (Kutschera and Lichtenegger 1997). Schenk and Jackson (2002) studied the average rooting profiles of 15 terrestrial biomes in different latitudes and reported that the soil depths of 1.1 m, 0.7 m, and 0.4 m correspond to cumulated root proportions of 95%, 90%, and 80%, respectively. According to Canadell et al. (1996) the rooting depths of herbaceous plants, shrubs, and trees are globally in the range of  $2.6 \pm 0.1$ m,  $5.1 \pm 0.8$ m, and  $7.0 \pm 1.2$ m, respectively. There is no precise definition of deep rootedness in any species, as such 4 m is assumed as the reference depth for mature Eucalyptus trees which is equivalent to approximately half that of  $7.0 \pm 1.2$  m

mentioned for trees.

Table 3 presents root spread of some Eucalyptus species from the existing studies. The four case studies presented above were based on physical excavating soil by making trenches and holes around the trees to study root spread. A few others reported in the Table 3 may have been done the same way, yet many others may be based on the inferences and experience of the professionals and scientists reporting as some of them do not mention age of the studied trees.

Major Eucalyptus culture has now shifted to farmland where millions of farmers grow Eucalyptus to produce wood for wood based industry. The current Eucalyptus production systems could be divided into 3 types namely long production cycles of 8+ years grown at wider spacing for timber production, moderate production cycles of 4-8 years at moderate spacing for peeling log production, and short production cycles of 3-4 years at close spacing for chip wood production used in paper, MDF, PB factories; and poles (Dhiman et al., 2023). Most farmers grow it for a very short production cycles whereas a few of them grow it for 6-7 years. State forest departments grow Eucalyptus for longer rotations. The old Eucalyptus trees planted in the past are gradually harvested as a result such trees which could produce long and deep roots are gradually declining. Young Eucalyptus harvested at 3-4 years produce root system largely located in the upper soil layers, for example root system of 1 to 4 years age of clonal eucalyptus is reported a vertical spread up to 2.5 m depth (Kulkarni 2012).

**Table 3.** Root spread in Eucalyptus species

Species	Age (Years)	Soil depth (m)	Lateral spread (m)	Reference
<i>E. tereticornis</i>		3	3.5	Davidson 1985
<i>E. tereticornis</i>	20	9.3		Kallarackal and Somen 1968
<i>E. camaldulensis</i>	10	1.9	84% up to 1	Schume et al., 2022
Eucalyptus spp.		3.5		Rajan et al., 1987
Euca. hybrid	18	4.4		Jeet ram et al., 2008
Euca. hybrid	5.4	2.85		Jeet Ram et a.,l 2008
Clonal Euca.	14	1.47		Dhiman et al. 2020
Clonal Euca.	1 to 4	1.5 to 2.5		Kulkarni 2012
Clonal Euca.	9	Top <0.25	53%	Bouillet et al., 2022
Euca. hybrid	40	3.5		Dhiman et al., 2020
6 genotypes	2	Top < 0.3	50%	Shah et al., 2020
<i>E. globulus</i>		3.08		Mathur et al., 1986
<i>E. globulus</i>	9	1.3		Herrero 2014
<i>E. grandis</i>	7	8-10	20	Robinson et al., 2006
<i>E. grandis</i>	9	28		Dye 1996
<i>E. grandis</i>	7	8-10	20	Robinson et al., 2006

Eucalyptus is a major plantation tree in Haryana, Punjab and many other states. Hoshiarpur with 14.11% of total Eucalyptus trees (>10cmdbh) in Punjab (FSI 2006) and Ambala with 24.16% of Eucalyptus trees (>10 cm dbh) in Haryana (HFD 2023) are the leading districts with maximum share of planted Eucalyptus in these states. Major area of the Hoshiarpur in Punjab lies in Deep Water Level category (20-40 m depth) with some area under Very Deep Level Category of >40m depth (CGWB 2023a). Similarly Ambala district of Haryana falls under 2 categories of Deep Water Table (20-40 m depth) and Moderate Water Table (10-20 m depth) (CGWB 2023b). Root studies from clonal field trial reported above have shallow root spreads mainly restricted to 3 m soil depths. It was 9.3 m in 20 years old tree in KFRI study. Water table in Case study 4 from Haryana was 4.7 m against root spread up to 4.4 m in water-logged locations. Eucalyptus was planted there for bio-drainage purpose as water level existing in relatively upper soil layers.

Agroforestry is a different land use in which the competition around the trees is from shallow rooted agriculture crops compared to forest stands where other associated trees and bushes compete with trees with their longer and wider root spreads. Jourdan et al. (2018) advocated that *E. camaldulensis* based agroforestry adds a lot of crop residues and creates nutrient “hot-spots” in the upper soil layers (even at 60 cm depth) which facilitates production of more lateral roots, high root biomass, and specific root lengths in nutrient rich patches to acquire more soil nutrients. Based on the above, it can safely be assumed that the major Eucalyptus production system is for a short period during with its root system hardly elongating to deeper layers and in such cases the tree largely meets its water requirements from rain and irrigation water provided to agriculture crops. According to Mrdeiris et al. (2025), it is a hasty conclusion that some Eucalyptus species can contribute to reduced soil water.

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