

Tree Root Growth After Planting

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Topics covered in this presentation

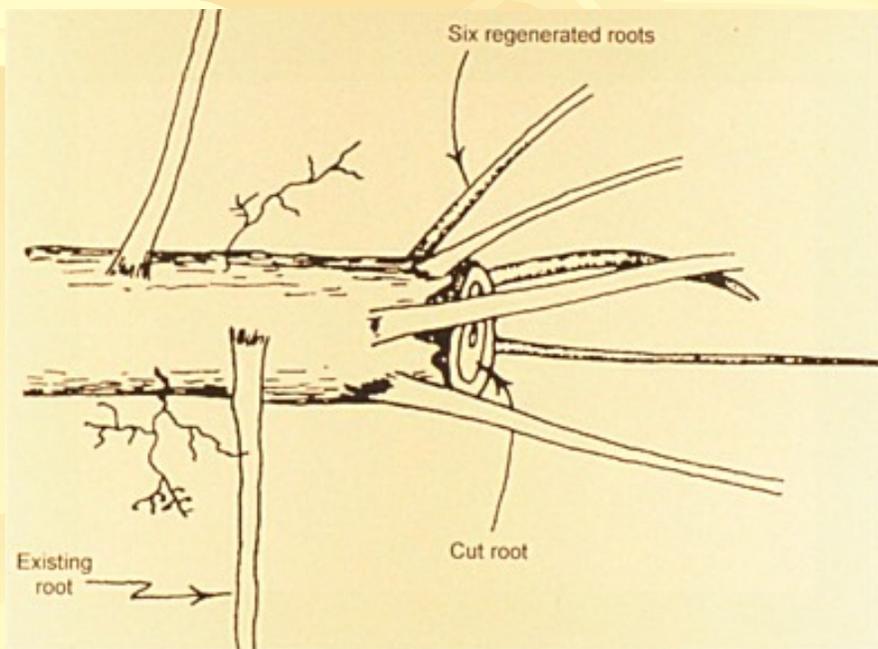
- **Growth from cut ends**
- **Developing root flare**
- **Lateral root spread**
- **Root depth**

Roots emerging from root ball

- In warm climates, roots emerge from the root ball within weeks after planting
- In cooler climates, there may be a several month lag time before new roots emerge, especially when planting in fall and winter



Roots emerging from a cut root



- New roots emerge primarily from the ends of a cut root
- Some new roots emerge from a few inches behind the cut
- Some existing lateral roots are stimulated to grow when the main root is cut

Roots emerging from a cut root

- The white roots are the new ones that are growing in response to the cutting; they are just one week old



Roots a few months after root initiation



- Roots grow quickly after planting when weather and soil conditions are suitable for root growth
- Note the lighter colored roots that emerged from the cut roots
- Arrows indicate where roots were cut
- Note that new roots emerged mostly from cuts and grew away from the trunk

Roots 6 to 12 months after root initiation

- Roots quickly grow into the surrounding landscape soil



Roots after three years



- About ten roots emerging from a cut root after three years may look like this
- One or two are likely to become larger than the others in a few years from now

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Root and trunk thickening at the base

- The trunk base thickens on many trees where roots emerge from the trunk
- This swollen area has been called the **root flare** or **root collar** or **root crown**
- This is a key area on any tree; if root flare does not develop appropriately, or if it is injured, trees can become unstable and fall over
- Some young trees do not have a visible root flare

Roots growing from the root flare

- Typically, 6 to 10 roots grow from the base of the trunk
- These enlarge to become the main roots on the tree
- Depending on the particular species or cultivar, these may rise up from the soil because roots often increase in diameter on the top more than on the bottom
- Never cut or damage these roots because they are largely responsible for the stability of the tree, i.e. they hold the tree upright



Removing six inches of soil from the root flare



- Main roots should grow more or less straight from the trunk as shown here
- They typically grow close to the soil surface and branch within about 4' of the trunk
- An air spade excavated these roots; no defects were found

Close up of root flare with soil removed

- A closer view shows that the small diameter roots and the mycorrhizae are interspersed with the main horizontal roots
- This is a very healthy root system



Root flare on forest grown trees



- Root flare causes no problems where there is adequate soil space for expansion
- Note the abundant flare at the base of all these trees

Root flare can destroy infrastructure



- Roots at the base of certain trees become extremely large and can displace curbing, sidewalks, and pavement
- The curbing and pavement were lifted by up to two feet next to each of the trees on this street

Root flare lifted the curb two feet

- Curb was destroyed by roots expanding in diameter
- Most communities cut roots and replace the curb instead of allowing trees to grow and remain healthy
- We need to be more creative than this



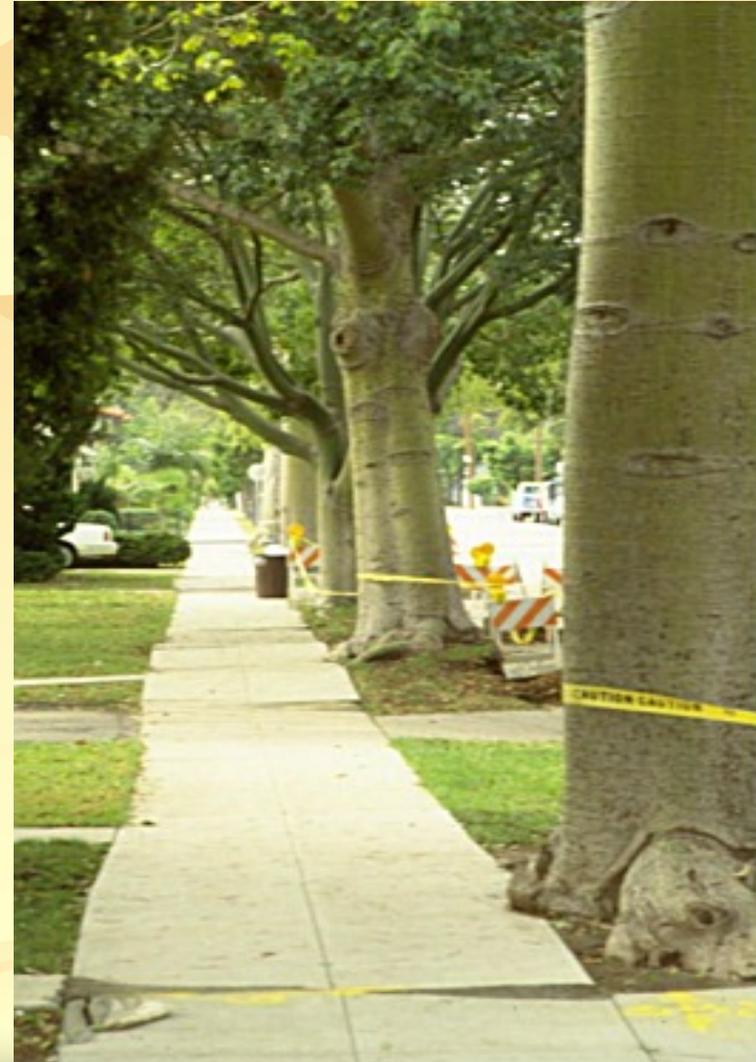
Root flare cut with chain saw



- Look closely at the two enormous cuts through the root flare at the base of the trunk
- This will initiate massive decay in the major roots and trunk base
- Trees are likely to become unstable as a result of this type of treatment

Root flare cut with chain saw

- Large roots were cut at the base of the trunk to accommodate the sidewalk
- This is like cutting off a portion of a person's anatomy because they can not fit into an airline seat



More root flare cut with a chain saw



- Large roots were cut at the base of the trunk to accommodate the sidewalk
- It is difficult to imagine what is preventing these trees from falling over

Close up of last photograph

- Most of the root system was cut when the sidewalk was repaired
- You have to wonder where the people that performed this operation stored their brain during this procedure



Palms develop a root flare



- Palm roots emerge from the trunk at the root initiation zone
- This zone can develop a swelling at the base of the trunk
- Palms that are planted too deeply have no swelling

Palms develop a root flare

- There is no swelling at the base indicating this palm was probably planted too deeply or soil was added to the area after planting



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Lateral root spread in the landscape

- Roots spread to beyond the edge of the canopy

Lateral roots grow horizontal



- About a six foot long portion of the root system was exposed
- The root flare is beginning to swell in normal fashion
- Long roots grow in the upper soil layers for great distances; they twist around objects often returning to their original orientation
- They are deflected by hard soil, growing instead in the looser soil which contains more oxygen

Lateral roots can grow quickly

- These red maples have been in the ground two years in USDA hardiness zone 8
- The root system already has grown to where the man is standing



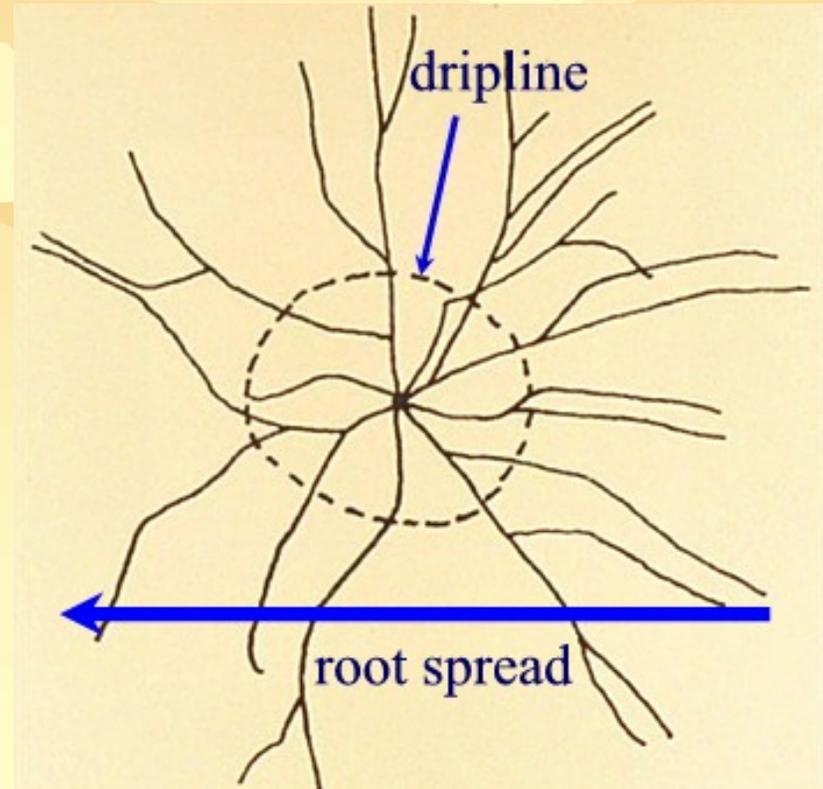
Twenty foot root system in one year



- These oaks have been in the ground one year in hardiness zone 9
- The root system already has grown to where the people are standing
- Note the faint white line on the ground from the trunk to where the man is standing; this is a root that we painted white

Roots spread to outside the dripline

- Roots quickly spread to outside the canopy edge (dripline)
- The dripline is indicated by the dashed line
- The black lines are the roots
- Roots commonly extend as far as **two to three times** the dripline
- This means that if the tree crown is 10 feet wide roots can be found out about 20 to 30 feet, sometimes farther

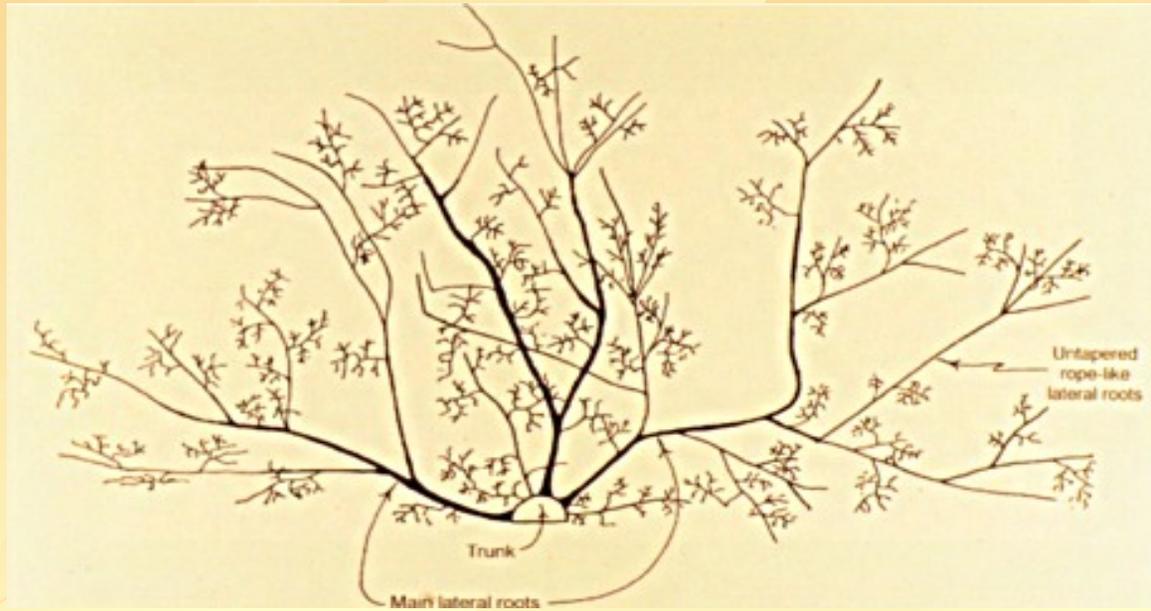


Roots fill soil quickly



- Roots of these maples are likely to grow laterally and quickly fill the turf area in this photograph
- Within several years after planting tree roots will be intermingled with the turf roots on this entire slope

Typical lateral and fine root growth



- Main lateral roots grow more or less straight from the trunk
- Some twist and turn as they grow in cracks and crevices filled with oxygen or are deflected by curbs, rocks and foundations
- Small diameter feeder roots and mycorrhizae can be found growing all along the main roots as shown above

Typical root spread on five species

TREE ROOT SPREAD	
<u>Species</u>	<u>Roots extend this many times the branch crown diameter</u>
Magnolia	3.7
Red Maple	3.0
Locust	2.9
Poplar	3.0
Ash	1.7

- Roots spread to about three times the branch crown diameter
- There is some variability among different species

Discovering root spread in the school of hard knocks

- Roots on these oaks spread well into this unpaved parking lot
- Soil sterilant was used to keep the parking lot clear of weeds
- The chemical was absorbed by the tree roots and the trees are dying back as a result



Die back from herbicide



- The side of the canopy toward the parking lot (the right side) was dead as a result of the soil sterilant
- Ring porous trees such as this oak often show symptoms on the same side of the tree as the root damage

Root spread in urban landscapes

- Roots of these trees fill the strip between the sidewalk and the street
- Roots grew under the sidewalk to the left and into the lawns of the homes along the street
- Roots want to spread under the street to the other side but can be deflected by the pavement
- This can result in a one sided root system



Roots can be deflected by pavement



- Many roots grow on or close to the soil surface
- When they meet pavement they often are deflected sideways or sometimes downward

Asymmetrical root system causes instability



- Roots were deflected by this sidewalk; as a result, most roots were growing parallel to the street
- When a wind storm blew through the city, the root plate broke free from the surrounding soil
- There were no roots under the sidewalk to stabilize the tree. If there were, the sidewalk would have been lifted
- The result is the unstable tree you see in this photograph

Asymmetrical root system causes instability

- Roots were deflected by this parking lot pavement
- These trees can become large because roots grow unchecked in the soil strip but are susceptible to blowing over in a wind storm because there appear to be no roots growing to the left or right side of the tree



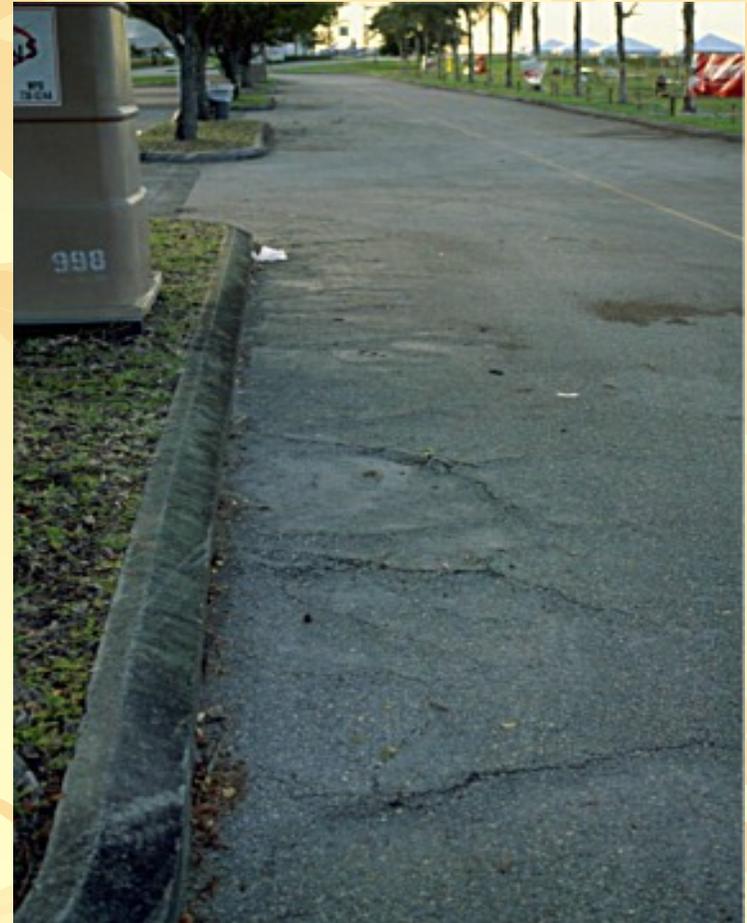
Roots under pavement



- Roots were able to grow under the curb and pavement; trees are growing well as a result.
- Some landscapes are designed inadvertently to allow roots to escape the parking lot island
- Curb and pavement often become displaced and can be regarded as a hazard to pedestrians when roots escape the island

Roots destroying pavement

- Roots can damage pavement when allowed to grow under it
- Note the lines of raised asphalt coming from the curb
- Roots from the tree on the left grew under the curb, grew up toward the surface, and are proliferating directly under the pavement



Roots not in the pits



- Trees with roots that can not escape the small planting pits often grow poorly
- Roots on the trees pictured here were able to escape the small soil area under the iron tree grates and grow into the soil beneath the turf to the left
- Without a specially designed system, roots could lift the sidewalk as they grow aggressively under the walk

Defying reason?

- Occasionally, trees appear to be defying reason, i.e, the tree appears healthy and the pavement is intact
- There can be several explanations for this:
 - pavement might have been added under the tree recently
 - the soil under the pavement may not have been compacted well
 - specially designed structurally soil may be present under the pavement
 - the existing soil may be gravelly
 - luck



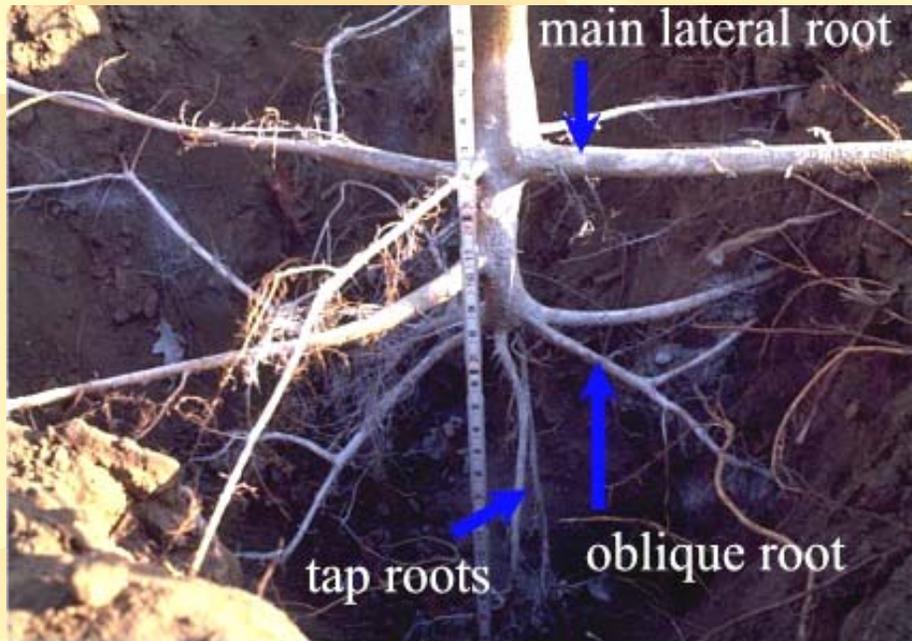
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Root depth in the landscape

- Depth of root penetration is controlled by many factors including genetics, soil oxygen, soil compaction, age, nursery production method, and other factors

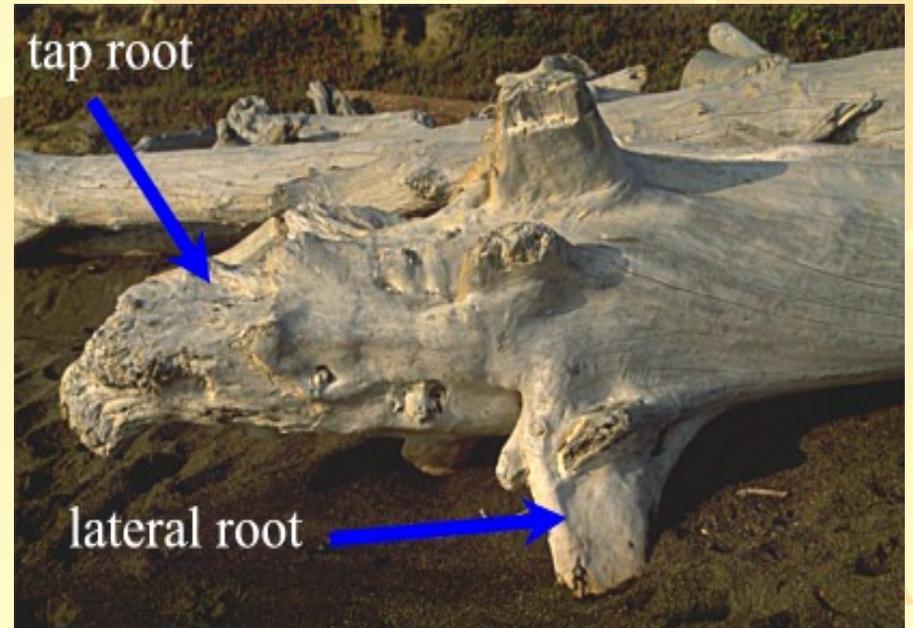
Roots can go deep on young trees



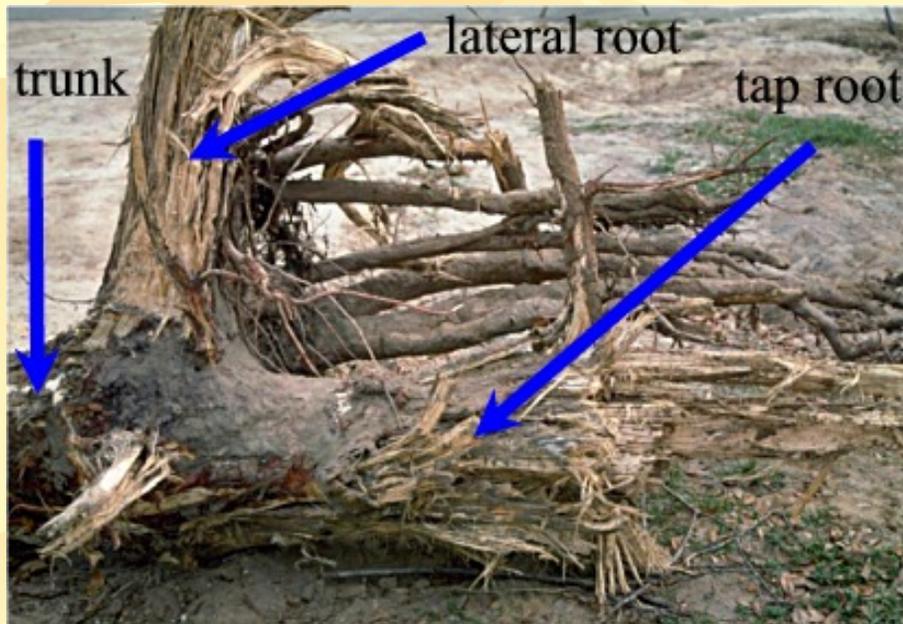
- Roots often grow down under the trunk in well drained soil when trees are young
- Two tap roots grew vertically under the trunk on this honeylocust three years after planting
- Several oblique roots are also visible, growing down at an angle
- Despite the deep roots, the largest diameter roots are the main lateral roots close to the soil surface

Tap root on older tree

- Here is a prominent tap root on a Monterey cypress
- These trees are growing in their native habitat along the coast where soils are gravelly, well drained, and deep
- These soil conditions allow tap roots and other deep roots to proliferate
- Despite the deep tap root, main lateral roots are evident directly under the soil surface



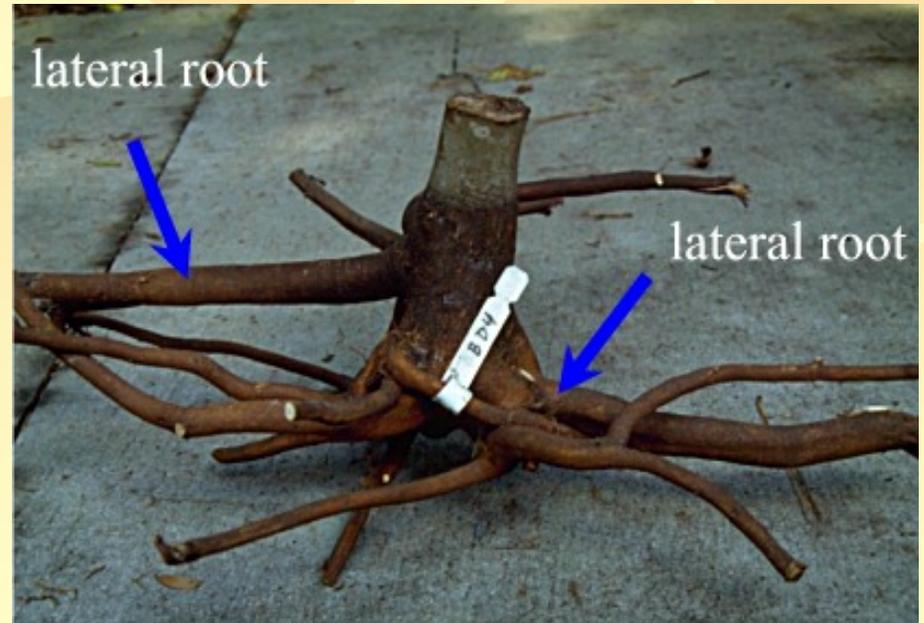
Tap root on a pine tree



- Here is a prominent tap root on a Loblolly pine in the southeastern US
- These trees are growing in their native habitat in deep sandy soil
- These soil conditions allow tap roots and other deep roots to proliferate
- Despite the deep tap root, a large main lateral root is evident directly under the soil surface

Red maple root system

- Red maple and some other trees do not develop many deep roots under any circumstances
- This five year old maple was grown in a nursery on deep sandy soil with nothing to restrict deep root penetration; all roots grew horizontally



Small diameter roots on surface



- Red maple and most other trees develop a large amount of small diameter, fine roots just under the soil surface
- Along with mycorrhizae, these small diameter roots are responsible for most of the absorption of minerals and water

Main lateral roots just under soil surface

- Most trees develop many of their main lateral roots just under the soil surface
- The small diameter fine roots and mycorrhizae grew from these main roots but they were removed before this photo was taken
- A few inches of the clay soil was removed to expose the lateral roots
- All roots on this maple were in the top 13 inches of soil



Early root growth from transplanted tree



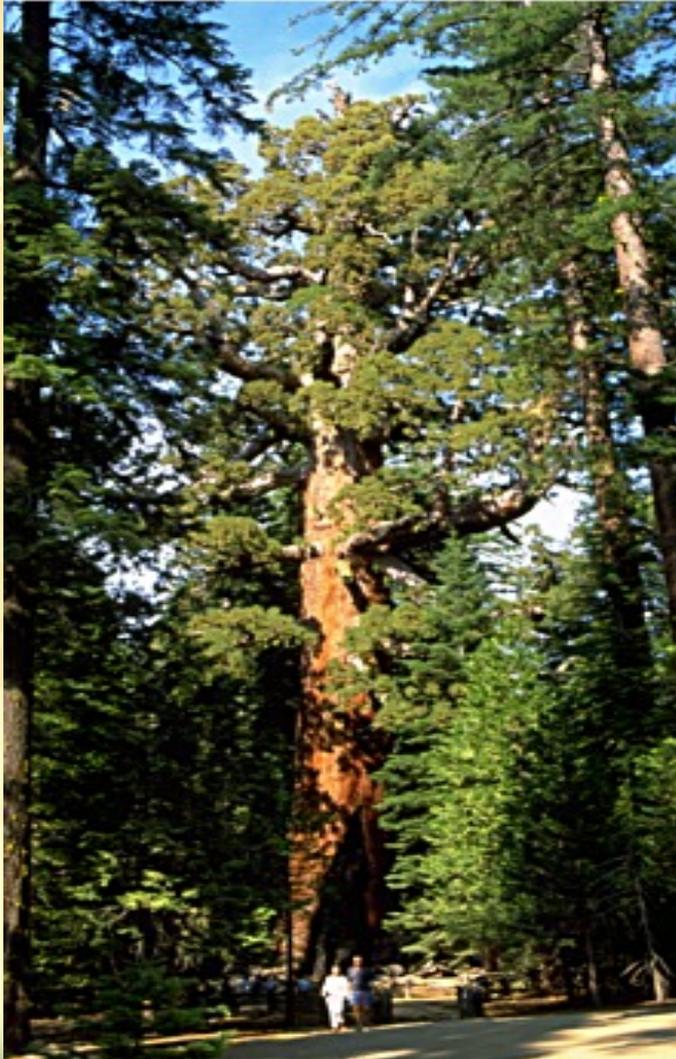
- This oak was transplanted into sandy soil 12 months ago in hardiness zone 9
- Roots were out about 8 feet from the trunk and most were close to the surface
- Note the abundance of white roots (they were painted white) within several inches of the surface
- The tip of the ruler is 14 inches below the surface

Shallow roots three years after planting

- This juniper was planted three years ago in USDA hardiness zone 8 from a 3 gallon container
- Roots (painted white) extended well beyond the dripline and were close to the soil surface
- No roots were more than 10 inches deep in this sandy soil
- Water table fluctuated between about 10 and 40 inches during the course of the year



Even huge old trees typically have shallow roots



- This giant sequoia (*Sequoiadendron giganteum*) is among the oldest and largest trees on the planet
- Roots are quite shallow as shown in the next photograph

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Even huge old trees typically have shallow roots



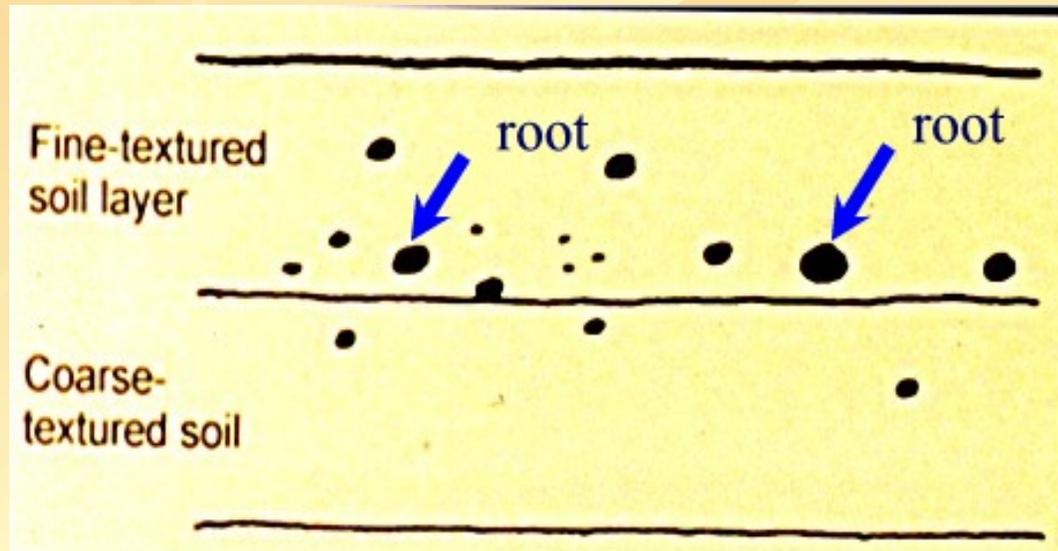
- Giant sequoia (*Sequoiadendron giganteum*) has a huge root plate, reaching to more than 20 feet across on old trees
- Note how the main lateral roots turn at the soil surface to remain quite shallow even on this very old tree

Soil layering impedes root penetration

- Roots often proliferate at the boundary between two soil types
- Note the abundance of roots where the dark soil layer on top meets the brown layer beneath



Roots at the boundary of soil layers



- Roots proliferate at the boundary between two soil types
- Note the abundance of roots where one soil layer meets another

Shrub roots at the surface



- Roots of shrubs also predominate close to the soil surface
- Roots on these pittosporum plants were mostly in the top 8 inches in this sandy soil

Dead trees after planting



- Several 8-inch caliper trees died in the weeks following planting (left); others did not (right)
- All trees were planted several inches too deep
- Go to the next photo for an explanation

Poor drainage suffocated roots

- The large trees in the previous photo were planted into this sandy soil with a perched water table; standing water was found at 6 inches below the soil surface
- The next photo will show the root distribution of these trees in the nursery



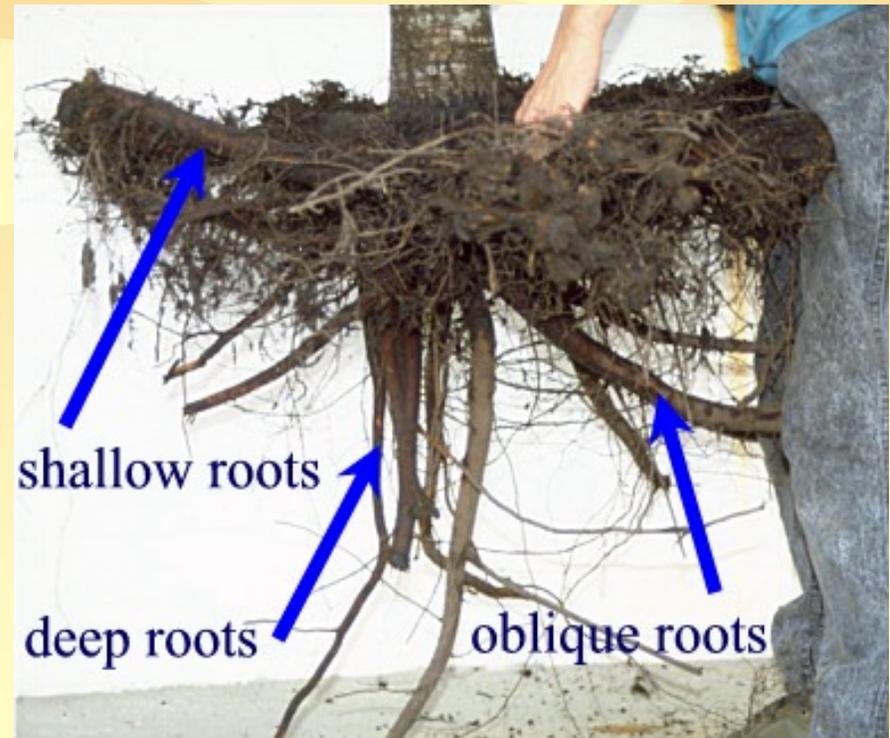
Deep roots in well drained nursery soil



- Trees in the nursery often have a number of roots growing straight down under the trunk
- Trees in the previous photo came from this nursery; note that there are many deep roots on this tree
- These deep roots would be submerged in the perched water table after planting so they could not carry on normal respiration
- This can quickly lead to inability to absorb water followed by tree death

Nursery root ball from well drained soil

- Trees in the nursery often have a number of roots growing straight down under the trunk as shown on this tree
- As trees grow older in the nursery, there is an abundance of small diameter fine roots growing from many main lateral roots close to the soil surface
- Oblique roots are those that grow down at an angle



Root growth in compacted soil

- Roots are deflected (see bottom 2 arrows) by the mechanical impedance and low oxygen present in the compacted soil.
- Most roots appeared to spiral around inside the original planting hole
- Several escaped by growing up the side of the planting hole. They proliferated once they reached the well aerated soil at the soil surface
- Large gaps in the root system can result from planting in compacted soil as shown above
- Note that there are no roots growing on the near side of the tree-most grew into landscape soil on the far side of the tree resulting in a one-sided root system.

