



ACLP II
ADVANCED
ARIZONA CERTIFIED
LANDSCAPE PROFESSIONAL

Plant Diseases, Disorders and Pests



Plant Diseases and Disorders



Root rots and wilts of the xylem and phloem

VASCULAR DISEASES

What is a vascular wilt?

- A pathogen, such as a fungus or bacteria, invades the vascular system
 - Enters either roots or shoots
- Clogs flow of water in xylem
- Causes wilting, decline and possibly death

Symptoms include...



Texas Root Rot

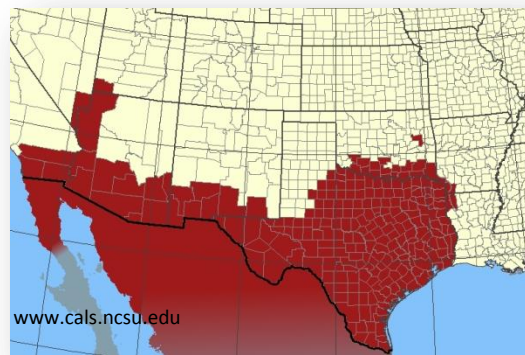
Symptoms

- Rapid wilting of limbs
- Leaves turn crispy brown and remain firmly attached to the limb
- Disease may impact plant quickly over a few days (entire plant impacted) or can slowly kill a tree over a few years (limbs dies back)



Texas Root Rot

- *Phymatrottrichopsis omnivora*, soil borne fungus
- Considered a necrotroph, killing root tissue and then using the dead tissue as a food source
- Native to our soils, extending to Texas and into Mexico
- Resides deep in soil, which is why plants may be unaffected for many years
- Very large host range, only monocots are truly immune

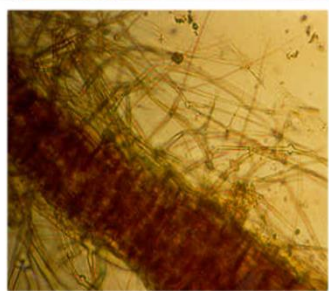
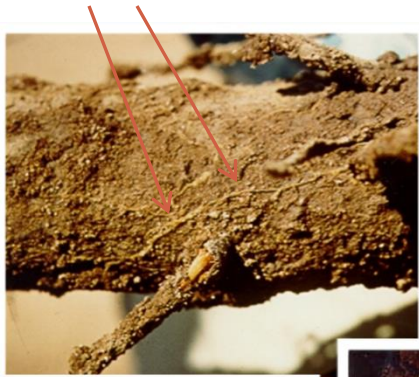


Texas Root Rot

- Most often seen in late summer during monsoon season with moist, warm soil conditions, 59-95° F, with rapid growth at 82.4°F
- Favors alkaline (pH 7.2-8.5), calcareous, with high content of clay soils
- Acidic soils or those with high sodium content inhibit the fungus
- May be present in 'spotty' areas on a property, potentially impacting one tree and not another or may take out an entire hedge at one time
- Hot spots in the Valley: McCormick Ranch, Scottsdale, South Tempe, Chandler, Gilbert, Mesa, Glendale, Goodyear- any sites that were once a cotton field

Texas Root Rot

*Mycelia strand seen with
10X hand lens*



*Spore mats seen after a
rain storm in summer may
be from pathogen*

Identification

- Look for pencil- sized roots, leaving soil on root (3/4" thick x 6-9" long)
- Inspect root for net-like mycelia strands that wrap root (not the white cottony stuff you've seen before)
- White spore mats around tree may be seen after a summer rain
- Send to lab for confirmation

Texas Root Rot

Treatment or Prevention

- Susceptible plants.. well, there are too many to list! See list in resources for guide
- **Tolerant** woody ornaments include **palo verde varieties, mesquite varieties, jojoba, desert willow, hackberry, cat claw, creosote, and ocotillo**
- **Immune** plants include all monocots: **grasses, palms, lily-family plants such as Agave and Yucca and also bamboo**
- Although there are some fungicides that may kill this fungus, it resides so deeply in the soil it is difficult for the fungicide to reach the pathogen



What killed the tree?



- ✓ Susceptible species
- ✓ Leaves turn crispy brown and remain firmly attached to the limb
- ✓ No impact on adjacent monocots
- ✓ Lab test confirmation



Confirmed: Texas root rot killed the tree!



Symptoms
include...



Verticillium Wilt

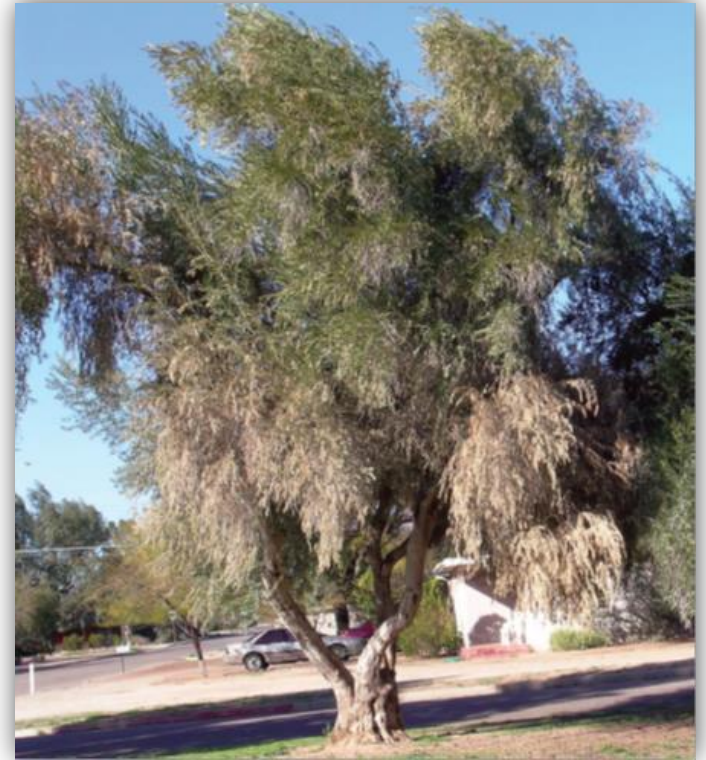
Symptoms

- New leaves roll inward
- Leaves turn dull grey and then brown
- Leaf drop, twig dieback
- Entire limbs may be lost, while remaining tree stays healthy leading to a progressive death
- Increased suckering may occur



Verticillium Wilt

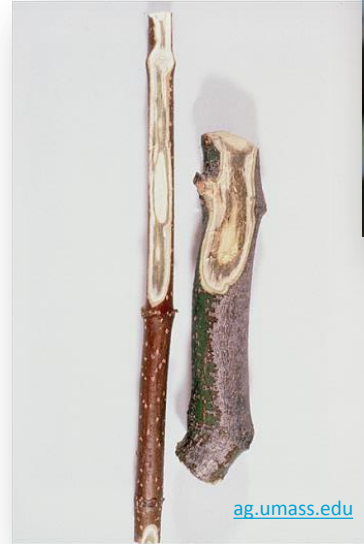
- Soilborne fungal pathogen, *Verticillium dahliae*
- Transmitted through roots, travels through xylem
- Clogs xylem causing wilt
- Persists in the soil for many years
- Concerning disease of olive trees in our region
- Some *Verticillium spp.* are host specific, others have wide host range



Verticillium Wilt

Identification

- Dark streaks on infected limbs (not always seen on olive)
- Wood with infected tissue does not conduct water or nutrients, leading to wilting
- Roots do **NOT** become rotted, as they do with other disease like Texas Root Rot
- Lab sample for positive ID



Verticillium Wilt

- Susceptible woody-landscape plants include **olive**, pistache, ash, maple, pecan, carob, almond, apricot, cherry, peach, California pepper, elm, rose and privet
- Resistant or immune plants includes all cacti, all monocots such as grasses, palms, iris and lilies and all gymnosperms such as juniper, pine and cypress, plus cultivars bred for resistance, such as Swan Hill olive

Verticillium Wilt

Treatment and Prevention

- Select resistant varieties for future plantings
- Remove affected limbs and hope to maintain the remaining tree until symptoms develop
- No treatment available



Verticillium-
resistant cultivar

Verticillium Wilt

Testing

- Select branches with wilt, yellowing or drying leaves
- Cut several branch sections that are ½-1" diameter, 6" long
- Wrap in aluminum foil to prevent drying
- Do not expose to high temperatures (pack in a cooler bag if sampling in the warm season)
- Do not send dead wood!



OTHER PLANT DISEASES



Symptoms include...



Powdery Mildew

Symptoms

- Grey or white superficial spots on leaves and stems
- Chlorosis along with necrotic spots
- Growth reduced due to photosynthesis reduction
- Premature death of foliage



Powdery Mildew

- Very common on select species in springtime
- Plants commonly seen in our region:
 - Chitalpa, rose family, jasmine
- Many hosts, but disease is host-specific
- Disease onset with warm temperatures, moderate to high humidity and NO surface water
- Low light and poor air flow

Powdery Mildew

Treatment and Prevention

- Improve airflow
 - Treat with labelled fungicides
 - Heritage, Compass
 - Horticultural oils
 - Ultrafine oil
 - Potassium salts
 - M-Pede
 - Sulfur products
- With any pesticide application, read label
 - Confirm the product can safely be applied to host plant
 - Pest is listed on label
 - If you are unsure, contact your distributor or the manufacturer's rep for clarification
 - You **must** be a licensed applicator to apply these products. Please read label before selecting and using any pest control products.



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Symptoms include...



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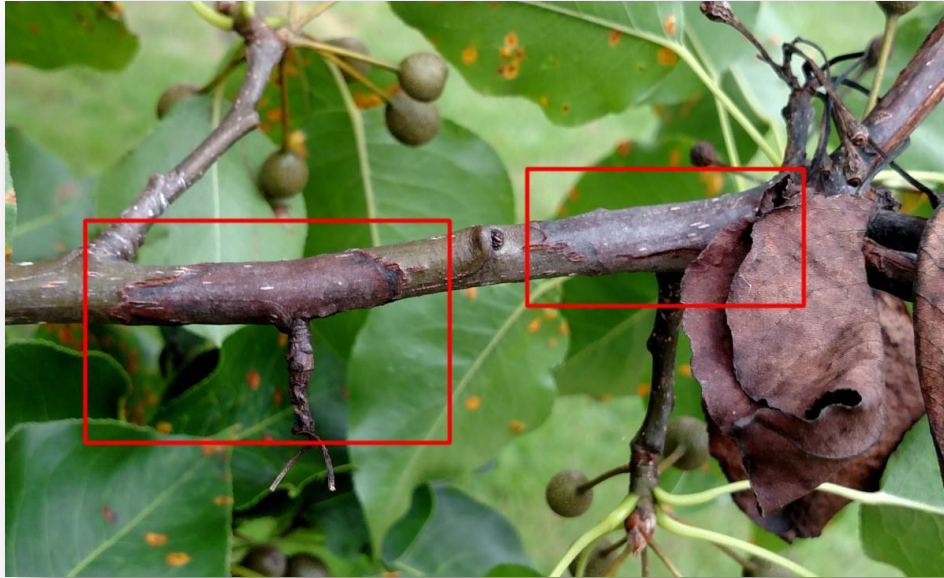
Fire Blight

Symptoms

- Blossom and terminal branch begin wilting
- Branch tips become water-soaked and turn light brown to brownish black
- Darken scorched leaves remain attached to limbs as they wilt and dangle
- Mostly a localized infection



Fire Blight



- Bacterial disease commonly seen on pear and other rose family plants caused by *Erwinia amylovora*
- Bacteria enters bloom or wound and causes wilting of branch tips
- Oozing from stems may also be seen
- Common just after bloom in springtime

Fire Blight

Treatment and Prevention

- Transmitted by bees or water
 - Keep water off foliage
- Application of Agrimycin 17 (Streptomycin Sulfate) at precise times for control
 - First application at 20-30% bloom
 - Second and additional applications
 - Check label, there are application restrictions and precautions
- Sanitize pruning equipment between cuts
- Remove by cutting 6" beyond damage, sanitizing equipment after each cut



Symptoms include...



Sooty Canker

Symptoms

- Initial infection localized on twig or branch
- Discoloring of foliage, lack of vigor
- Crown thinning
- Brownish, moist appearance on limbs
- Bark cracks and peels away revealing black fungal spores
- Limbs wilt or dieback
- Sapwood under canker is killed
- Once **trunk** is infected, tree usually dies
- Commonly seen in summer months



Sooty Canker

- Caused by fungus *Nattrassia mangiferae*, (formerly *Hendersonula toruloidea*)
- Pathogen enters bark wounds: mechanical damage, extreme temperatures, insect damage
- Attacks smooth and thin-barked trees such as ficus, citrus, ash, mulberry and sycamore
- Stressed trees more readily attacked, especially those under drought stress



Sooty Canker

- Disease is spread by pruning tools, birds, wind and rain
- Infections can occur year round, but fungus is more active in warm temperatures 85-105°F with high humidity
- Sooty canker prefers some tree species in arid areas, while attacking other species in more humid, coastal areas

Sooty Canker

Treatment and Prevention

- Avoid excessive pruning, lifting canopies to expose tree to sunburn
- Prune during cooler months when pathogen is less active
- If canopy is exposed and vulnerable to sunburn, consider painting limbs with latex paint (not ideal but an option as a last resort)
- If detected, remove limb **12"** below infection
 - Sanitize equipment between each cut with 4:1 water/ bleach solution
 - Avoid using chainsaws or equipment that can't be sanitized
- Copper fungicides, such as a Bordeaux mixture, may be used to treat cut to help prevent further spreading down the limb

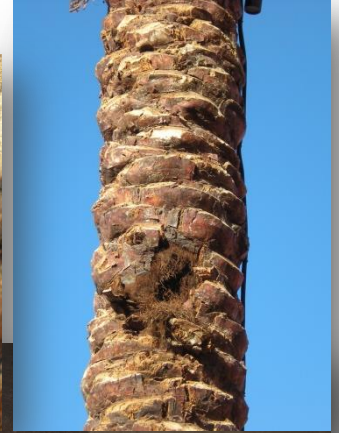
Symptoms include...



Thielaviopsis Trunk Rot

Symptoms

- Sudden trunk collapse, often in the upper 1/3 of trunk
- Often no symptoms present before failure
- Bleeding from wounds or cracks may be seen
- Lowest fronds dry prematurely and hang from canopy
- Fermenting smell coming from rotting tissue in trunk
- Crown is often healthy and shows no decline
- Symptoms may be similar to abiotic issues



Thielaviopsis Trunk Rot

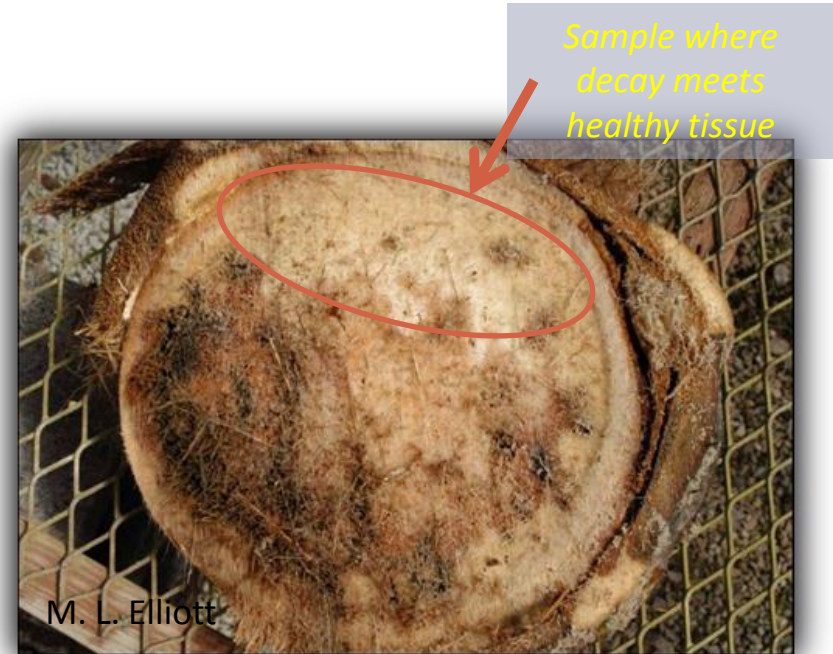


- Caused by fungus *Thielaviopsis paradoxa*
- Cross section of trunk shows rotting tissue isolated to one side
- Rot moves from the outside to the inside of trunk
- Rotted tissue will be soft to touch
- Fungus can not degrade lignin in tree so the trunk fibers are left intact, leaving behind 'stringy' black tissue

Thielaviopsis Trunk Rot

Treatment and Prevention

- Since fungus only infects new wounds, sanitizing pruning equipment is essential!
- Stressed palms are more likely to succumb to infection
- Only a pathology lab can provide you a positive id
 - Collect trunk sample showing margin of diseased tissue into healthy tissue
- Immediate removal of all parts of the palm are necessary to prevent spread to nearby trees, especially if recent pruning wounds are present



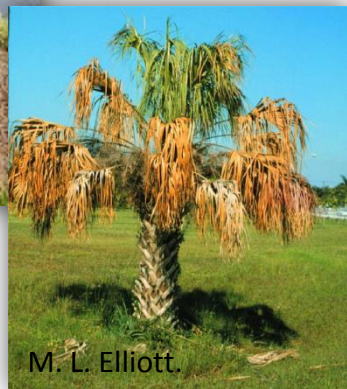
Pathogen enters palm through open wounds, including those made during pruning with chainsaws and spikes.



Symptoms include...



Ganoderma Butt Rot



- Caused by fungus *Ganoderma zonatum*
- Wide host range: **all palms!**
- Not been a well documented pest in our area, but now seen more and more
- Once the classic *Ganoderma* conk is seen, the palm should be removed

Ganoderma Butt Rot

Symptoms and Signs

- Woody tissue degradation (lignin & cellulose)
- Mild to severe wilting on all leaves but leaf spear
- General decline, more dead lower fronds than normal
- Slowed growth and off-color fronds
- Evidence of conks
 - Conks
 - Originate from inside trunk
 - Starts as a white mass, soft to touch
 - Irregular or circle shaped and flat on palm side
 - Older conk turn reddish-brown on top, somewhat shiny
 - Up to 8" wide and 2" thick

Ganoderma Butt Rot

- Fungal spores spread from conk, into the soil where it germinates, can also move in wind and water
- Does not rot roots, but uses roots to move up to woody trunk tissue
- Can be moved from infested soil to new planting site during transplanting
- It is unknown how long it takes this pathogen to kill a palm after infection has occurred

Ganoderma Butt Rot

Treatment and Prevention

- Disease is not impacted by environmental factors or maintenance practices
- If a conk is discovered, declined palm and other nearby palms should be closely monitored
- Remove conks and dispose in plastic bag to prevent spread
- The presence of a conk indicates decay is extensive in trunk, palm is at risk of failing
 - Risk assessment should be performed, removal should be considered
 - Root mass should also be removed
- Replanting with the another susceptible species is **not** recommended

Which disease it is?

don't jump to conclusions just yet....



NOT *Thielaviopsis*
This palm failed due
to abiotic factors

*Looks can be deceiving, it's best to pull a
lab sample for ID certainty.*

- Ganoderma butt rot
 - Rots from inside out
 - Bottom 3-5' of trunk
- Other possible disorders
 - Bird damage, physical damage causing 'bleeding'
 - Lightning may cause quick collapse
 - Poor drainage, over or under watering can cause similar failures or wilting symptoms
- Lab testing is always the best way to determine the culprit

How do I know for sure a pathogen is the 'root' of my plant problem?



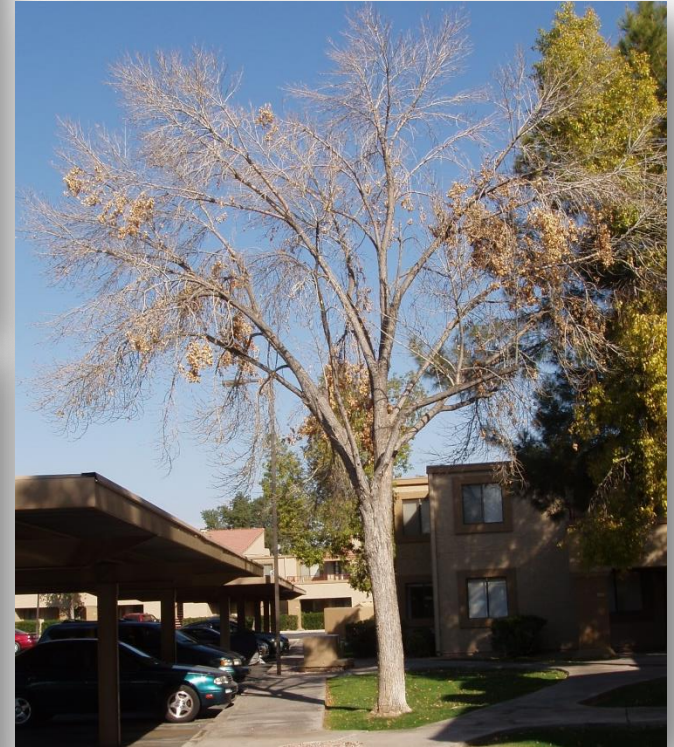
Symptom: stippling caused by spider mites



Sign: conk is a 'sign', but it is still recommended to test for ID

- Unless you can physically see 'signs' of a pest or pathogen, it may be difficult to know with 100% certainty
- Lab samples help eliminate the guessing game
 - Helps prevent wasted time and money on treatments for a disease or pest that is not present
 - Encourages responsible pesticide use in our community

Symptoms include....



Arizona Ash Decline

Symptoms

- Progressive branch dieback
- Necrotic leaf tips and margins
- Chlorosis
- Witches broom growth habit



Arizona Ash Decline

- Caused by a phytoplasma
- Spread by vectoring or phloem- feeding insects
- *Fraxinus velutina* cv. Modesto affected most
 - Also can infect wild *F. velutina*, *F. velutina* cv. Rio Grande
 - Disease more prevalent in the Phoenix Metro area than in other areas of the state
 - Could potentially be due to greater drought conditions
 - ‘Modesto’ could also be less drought tolerant therefore demonstrate more symptoms of disease

Arizona Ash Decline

Treatment and Prevention

- No treatment once infected
- Maintain appropriate irrigation and fertility for trees
- Select more resistant ash cultivars such as 'Rio Grande' or *F. uhdei* (than Modesto)
- Symptoms similar to drought, pull foliar tissue sample for confirmation of disease



Photo credit: Ursula Schuch

Symptoms include...



Photo credit: Ursula Schuch

Palo Verde Witches Broom

Symptoms

- Dense clusters of branches originating at one point along the stem
- Branches are soft and not woody
- They start to appear in small nursery containers, and also in small and mature trees
- They can grow to very large sizes and often break, causing serious structural problems for trees
- Most common in blue palo verde, but similar symptoms have been seen on desert willow, olive, red plum, and ash

Palo Verde Witches Broom

What we know

- The disease has been known and observed for decades
- Trees with broom have survived more than 30 years
- Broom on blue palo verde became very common in Arizona nurseries in the 1990's and is now seen on the majority of blue palo verde in the landscape
- The organism causing the broom is currently not known but is under investigation
- It is possible that insects transmit the disease but this has not been confirmed

Palo Verde Witches Broom

Treatment and Prevention

- No treatment is currently available to cure trees from witches broom
- Cutting out the broom will lead to new broom growth
- Currently the best prevention is not to plant blue palo verde

Sanitizing Pruning Equipment

- Why is this necessary?
- How do I do it in the field?
- Options for easy field sanitation practices

Sanitation Practices

Household disinfectants- Lysol

- Easy to find and most aren't corrosive
- Little research has been done regarding their effectiveness against plant pathogens
- Relatively expensive when compared to other

Chlorine bleach

- Inexpensive, effective, and easy to find
- Corrosive, can produce harmful fumes
- Mix up a 10-25% bleach solution and do a 30-minute soak
- The solution has a short lifespan—effectiveness is cut in half after two hours—so fresh batches should be made for each round of cleaning
- Rinse tools with clean water after soaking to prevent corrosion

Ethanol or Isopropyl Alcohol

- Not as effective on killing plant pathogens- use other products

Pine Oil Products

- Not as corrosive as some other disinfecting products on the market, but they're also not as effective
- Mix a 25% solution (one part pine oil to three parts water) and then soak the tools in the solution

Industrial Products

- *Quaternary ammonium compounds*: Green-Shield® and KleenGrow™.
- Hydrogen dioxides: ZeroTol® 2.0 and Oxidate® 2.0

Keep It Clean

- Keep tools clean
- Longer soaking may be needed for pruning surfaces that are not smooth
- tools should be disinfected after working on every plant; however, this is usually not practical.
- Rotate between several tools while working in the garden, one tool can be disinfected while you work with another
- After dipping your pruning tools, be sure to wipe away excess disinfectant to avoid injuring the next plant

How to improve sanitation practices

- Make sanitation practices a routine
- Have supplies handy- on trucks and at yard
- Make it a rule, no exceptions



Abiotic Disorders

Are we talking killer plants or plant killers?

Abiotic Disorders

- Weather conditions
- Air quality
- Soil conditions
- Soil grade
- Water quality (if irrigated)
- Water quantity
- Nutritional disorders
(likely due to another abiotic factor)
- Reflected heat or light
- Phytotoxicity
- Mechanical injury
- Construction damage
- Vehicular damage
- Equipment damage

Poor Cultural Practices Leading to Disorders

- Over pruning
- Over watering
- Under watering (or not watering properly)
- Inappropriate exposure
- Inappropriate fertilization
- pH or salinity issues
- Lack of plant protection
- Incorrect soil grade

Abiotic Disorders



Abiotic Disorders



One abiotic problem can lead to another abiotic problem, which can eventually lead to a biotic disease.



Incorrect Soil Grade

Causes

- Deep planting
 - Below grade in nursery container due to multiple seasons of topdress mulch applications
 - Hole dug too deeply
 - Settling of rootball, space backfilled on top of rootball



Darkened bark shows mulch level in nursery container

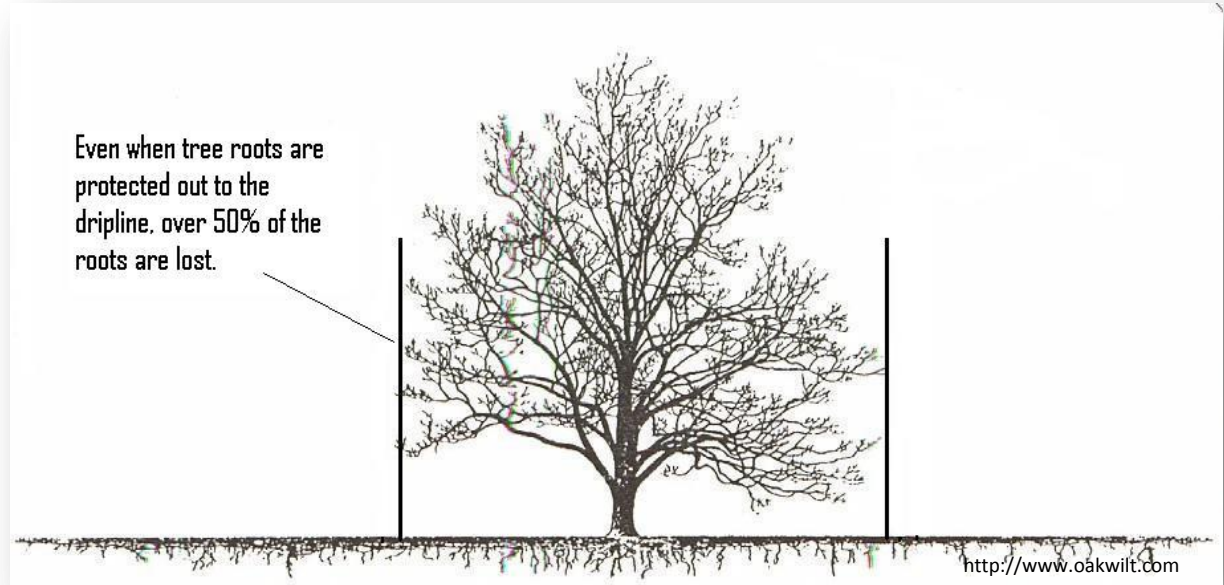
Incorrect Soil Grade



Incorrect Soil Grade

More causes

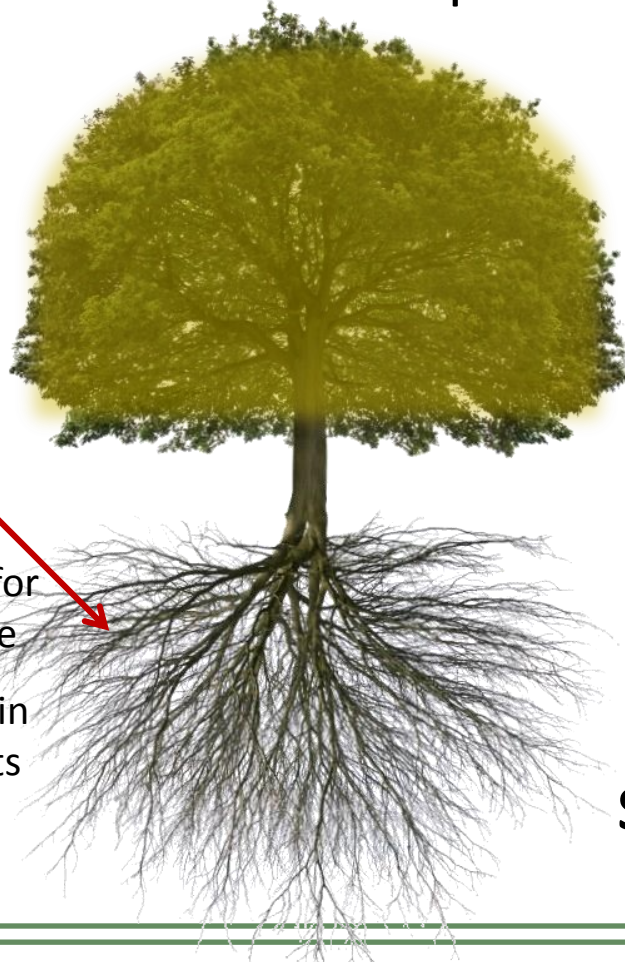
- Grade increased, decreased during re-landscape
- Street tree planted with grate, overtime, soil and debris gets added to space, covering root mass



What happens when a tree is planted too deeply?

1. Roots lack O₂

- O₂ required for aerobic respiration, releases energy for root growth & mineral uptake
- O₂ changes electrical charge in water & nutrients, allow roots to extract with less energy



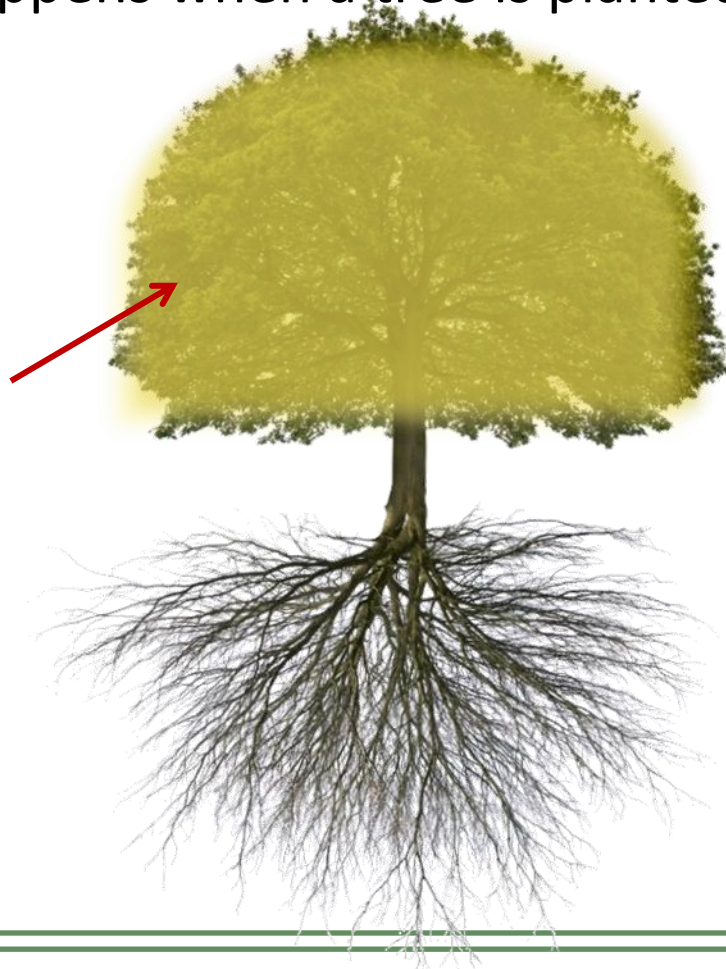
- Reduces permeability of roots to water
- Accumulation of toxins
- Water & minerals can't be absorbed
- **Process is accelerated in clay soils**

Symptom #1: Wilting

What happens when a tree is planted too deeply?

2. Slowed rate of photosynthesis

- Mineral deficiencies will develop
- Plant organs do not function properly

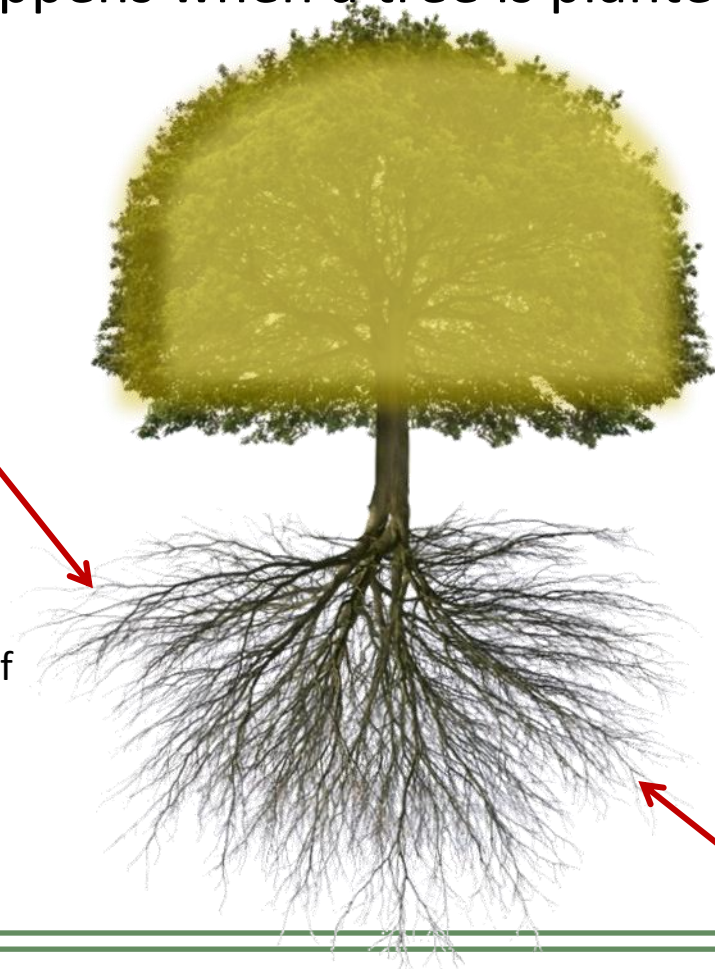


**Symptom #2:
Slowed growth
& yellowing**

What happens when a tree is planted too deeply?

3. Root dieback

- Fewer functioning roots to do their job of absorbing and anchoring

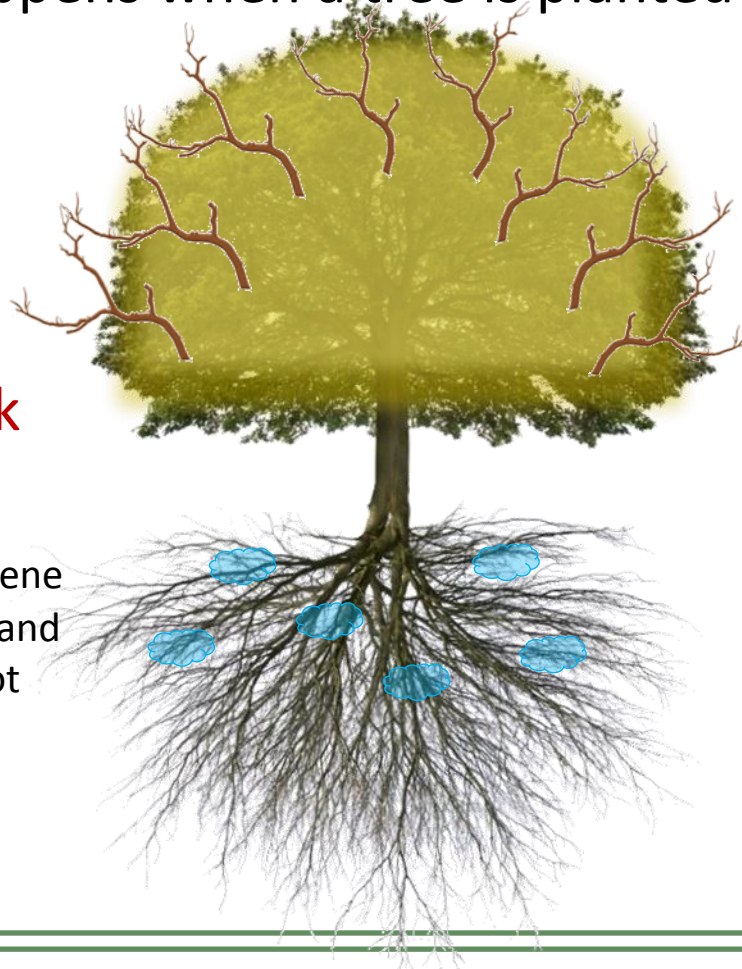


**Symptom #3:
Stunted plant**

What happens when a tree is planted too deeply?

4. Branch dieback

- Stress hormone ethylene accumulates in roots and causes collapse of root cells

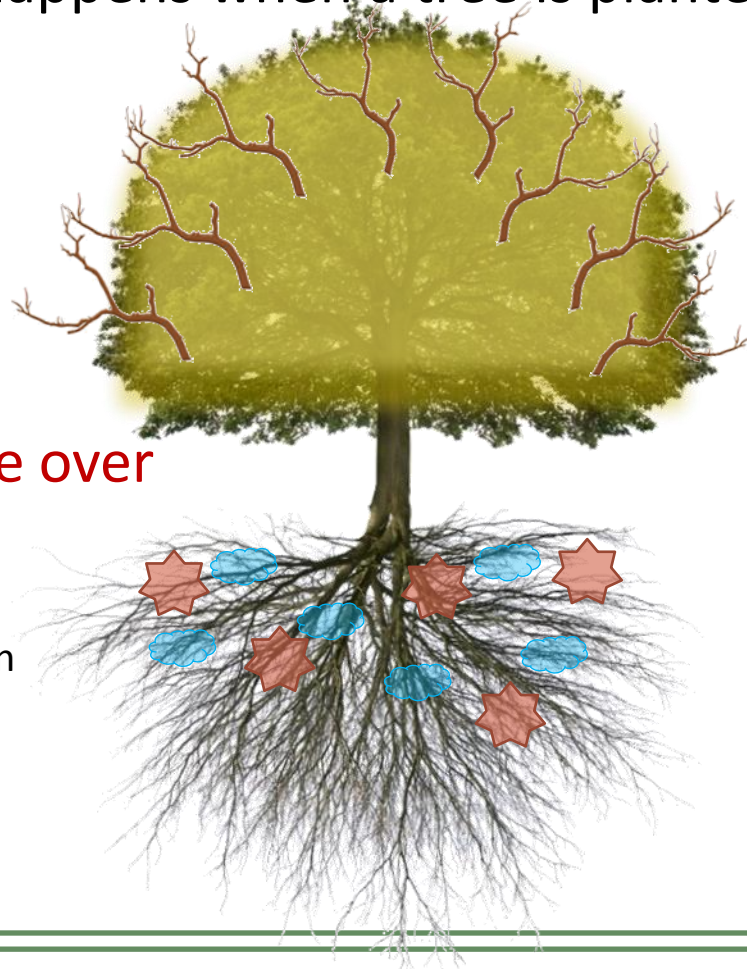


**Symptom # 4:
Continued
decline of tree**

What happens when a tree is planted too deeply?

5. Pathogens take over

- Opportune fungus like *Pythium* and *Phytophthora* begin clogging vascular system



**Symptom #5:
Wilting and
eventually death**

Incorrect Soil Grade

What else happens to a plant when it has been planted too deeply?

- *Girdling roots (stem and root-girdling roots) develop*
 - *Reducing vascular flow*
- *Trunk exposed to excess moisture, leading to decay*



Incorrect Soil Grade



Incorrect Soil Grade



Incorrect Soil Grade

Treatment for deeply planted trees

- If in the ground for a short time, carefully remove and replant at appropriate level
- If the tree is established, perform a root collar excavation to remove excess soil

Root Crown Excavation



Incorrect Soil Grade

Increasing soil grade can be detrimental....

- Reduces oxygen to feeder roots (we know what a lack of O₂ does to plants now, right?)
- Adding varying soil textures in layers can cause a soil **texture interface**
- Causes drainage issues
- Temperature and air exchange differences which leads to root problems

More on tree health and grade changes coming in the Tree Health Care class

Incorrect Soil Grade

Decreasing soil grade can also wreak havoc on established trees

- Loss of vital feeder roots, often located in upper 6" of soil
- Exposure of feeder roots to higher or lower temperatures, leading to root death
- Severed or weakened roots can not function to anchor or transport water and minerals

Environmental Stresses



Solutions

- Time of year to plant
- Plant choice
- Acclimation
- Other ideas

What was the cause?

Mechanical Damage



Mechanical Damage Solutions



Is this really a solution?

No, but this is a great solution





Improving Cultural Practices

- Crop rotation
 - Rotate flower species in annual beds to reduce disease pressure
- Air flow
 - Thin plants
 - Avoid overcrowding of plants
- Poor light issues
 - Plant selection: right plant, right place
 - Thin trees, if appropriate
- Appropriate irrigation practices
 - Avoid overwatering or saturated soil conditions
 - Leach soil regularly to move salts past root zone
 - Do not allow emitters or sprinklers to create chronically wet condition on above-ground plant parts
- Maintain the appropriate soil and mulch grade
- Manage plant fertility by fertilizing and/or mulching high-nutrient requiring plants