Parkway Potential

Exploring urban soil management & effects on growth rates of newly planted California native parkway trees

June 2024

TreePeople ARLA UC RIVERSIDE CAL GRO California Native Landscape Design

Authors
Alejandro Fabian, TreePeople
Dustin Herrmann PhD, TreePeople
Daniel Hirmas PhD, UC Riverside, Texas Tech
Acelia Larios MPH, CAL GRO

Photography
Andres Daniel, CAL GRO

Recommended Citation
Fabian, Alejandro et al. *Parkway Potential: Exploring Urban Soil Management and Effects on Growth Rates of Newly Planted California Native Parkway Trees*. TreePeople. 2023

Funding Agency
Accelerate Resilience LA (ARLA)
A sponsored project of Rockefeller Philanthropy Advisors

ARLA

TreePeople
12601 Mulholland Drive | Los Angeles, CA 90210
treepeople.org

CAL GRO
California Native Landscape Design
www.calgro.org

Table of Contents

Acknowledgements

The project discussed in this report takes place in the South Los Angeles neighborhood of Watts, on the unceded land of the Tongva and Chumash Nations whose members continue to inhabit that space, the Los Angeles Basin, and diasporic communities abroad.[1]

Watts' identity has long been characterized by the resilience of its community in response to systemic marginalization and their contributions to the allied American Civil Rights movement. The perspectives earned through these experiences continue to develop within black and brown communities today and contribute significantly to ongoing reinvestment initiatives, although primarily through volunteer labor.

Community perspective is specialized knowledge. Neighborhood improvement projects intending to strengthen local environmental health and climate resilience should prioritize the development of pathways to incorporate community perspective through paid contributions in the same way that they would employ academic researchers and other skilled laborers.

We are grateful for the support of the many project contributors that we have learned from and their ongoing neighborhood improvement work. We hope that the information included in this report can be useful to their projects.

Project Contributors

Jennifer Licona, Jordan High School Eco Club
Moses Massenburg, New Beginnings Community Garden
Angie, ThinkWatts
Watts Finest Car Club
Ricardo Guzman, Amigos Nursery
Flora Ito, Theodore Payne Foundation
Adrian Fabian, CAL GRO

Santos Amaya, TreePeople
Ojani Casillas, TreePeople
Mario Dagonel, TreePeople
Eileen Garcia, TreePeople
Kyle Kohlbrenner, TreePeople
Gemma Lurie, TreePeople
Jonathan Manikan, TreePeople
Monica Pineda, TreePeople
Debe Stevens-Browder, TreePeople

Clarissa Carretta, UC Riverside
Alyssa Duro, UC Riverside
Diane Johnson, UC Riverside
Simmi Tomar, UC Riverside

Prologue

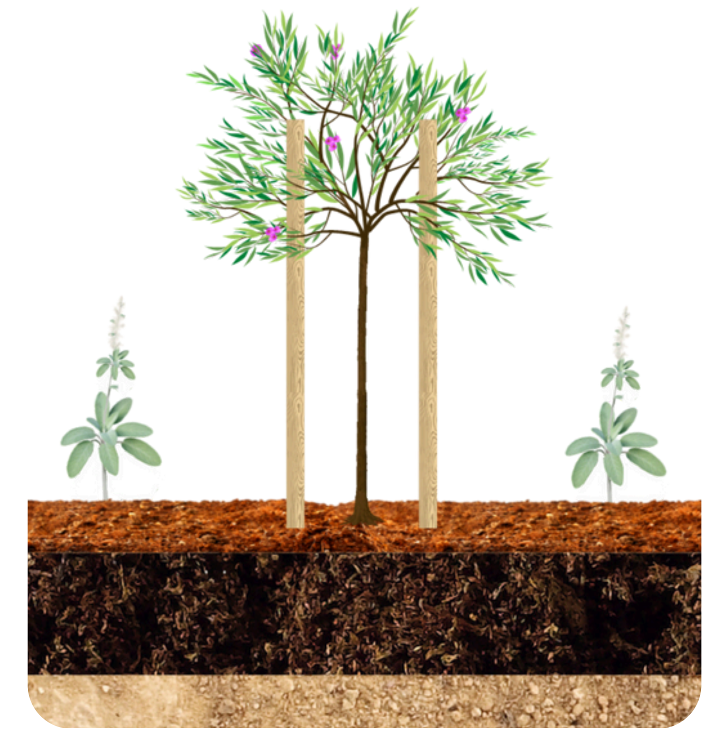
Parkways, or the narrow strips of uncemented earth that separate the sidewalk from the street, hold enormous potential for neighborhood environmental health and resilience projects. This is especially true in the City of Los Angeles, where parkways are publicly owned land on which residents can legally plant and maintain their own landscaping.[2]

In just 1 residential block in the neighborhood of Watts, we found 1/5 acre of bare soil—enough publicly accessible land to plant and cultivate approximately 117 fruit trees. This unplanted land was made up of 3.5 feet wide parkways which separated the sidewalk from the street around the perimeter of the entire block.

Community greening and planting projects intending to make use of the potential these parkways bring will likely be limited by the impacts of urbanization on the health of their neighborhood soils. Specific limitations of urban soils—compaction, contamination, and low water holding capacity—significantly reduce the land's ability to support the growth of trees and other plants.[3]

Community growers and gardeners interested in nurturing their soil to grow and strengthen their local ecosystems for food production, shade and cooling, will first need to develop methods to improve the health of soils impacted by decades of pollutant inputs, compaction, and drying.

Observing how different soil management strategies impact the health of urban soils and



rates of plant growth can provide useful guidance in developing urban soil management strategies.

This Parkway Potential project collected soil characteristics data from 4 surface-soil management techniques on observed growth rates of newly planted parkway trees.

For this study we prioritized low-cost management practices that can be implemented using free or low-cost resources available to residents in the City of Los Angeles. This report outlines the design and implementation of the study as well as some of the observed changes in tree growth and soil properties relative to 4 soil treatments

This report also includes detailed management guidance for community-scale projects interested in implementing these practices in their own neighborhood soils.

Urban Soils

Soil—the foundation of life—is made up of communities of fungi, bacteria, insects and other organisms living within an environment of crushed minerals, organic material and pockets of air and water. Like all communities, soils are vulnerable to sources of stress in their environment. Soils within urban spaces face multiple sources of stress.

Surface Sealing

Oxygen content, water access and water retention are all impacted in soil that has been "sealed" under or surrounded by concrete and asphalt. These stresses on soil are known to negatively impact biodiversity and plant growth. 48% of LA City is covered by impervious surfaces.[4]

Soil Compaction

Compaction occurs when soil is compressed, shrinking the pores within the soil that hold air and water.

Compaction reduces the growth of plants by restricting the movement of water through the soil and increasing the risk of flooding.

Human Inputs

Debris mixed into soils from previous land use can impact the movement of water within the soil. Pathways made by debris causes water to move quickly through the soil column resulting in less available moisture to support the growth of recently introduced plants.

Contaminant input from industry, agriculture, transportation infrastructure, etc. all impact soil's ability to support new plant growth. Different contaminants can move to groundwater or into food crops, and ultimately into human bodies. Contaminants can originate from local sources or travel on dust particles in the air to reach places far from their source.

Figure 1 - A study team member begins preparing a tree well within a 3.5 feet diameter parkway

Community Concerns and Priorities

The purpose of this study is to compare 4 soil management practices and their impacts on soil health and growth rates of trees planted in heavily urbanized soil. This study will help us to better understand soil health factors relating to local priorities and concerns regarding neighborhood greening.

Resilience

Tree resilience was a commonly expressed concern for residents who had experienced circumstances in which fallen, sick or invasive trees represented a financial liability in the past. Resilience concerns were commonly expressed in connection with watering responsibility and tree maintenance costs.

Soil Health

Possible soil contamination was a concern for residents living near a multi-use railway and the Jordan Downs housing redevelopment project. Soil contaminant concerns included the risk of exposure to heavy metals by gardening in contaminated soils and inhalation of dust from construction sites.

Holistic Benefits

Community growers and gardeners advocated for the prioritization of fruit producing trees or native flowering trees which could support the population of local pollinators. This was identified as a priority need to support existing networks of food producing residential gardens intended to catalyze self-sufficiency.

Project Design

Treatment Site Locations

We planted 25 size 15 trees within a canopy expansion project area in the Los Angeles neighborhood of Watts. These trees were planted in parkways as groups of 4 treatments across 5 residential blocks (4 treatments + 1 control = 5 trees per block x 5 replications = 25 trees total).

For this study, we prioritized parkways with compacted soils which received heavy sunlight. Each of the 5 treatment groups were installed in parkways near railways (dotted black line) and housing development sites (solid red line) identified by community members as areas of concern for soil contamination.

Parkways within this planting area varied in diameter between 1 foot to 6 feet when measured perpendicular to the curb and roadway.

Tree Selection

We selected *Chilopsis linearis* "Desert Willow" trees to accommodate City of LA parkway planting restrictions, which approve *Chilopsis linearis* for planting in parkways from 6 feet diameter down to 2.5 feet in diameter.

Although the city urban forestry guidelines identify additional species for planting in 2.5 feet diameter parkways, *Chilopsis linearis* is one of few native California trees approved for smaller parkways and was readily available for purchase at a local nursery.

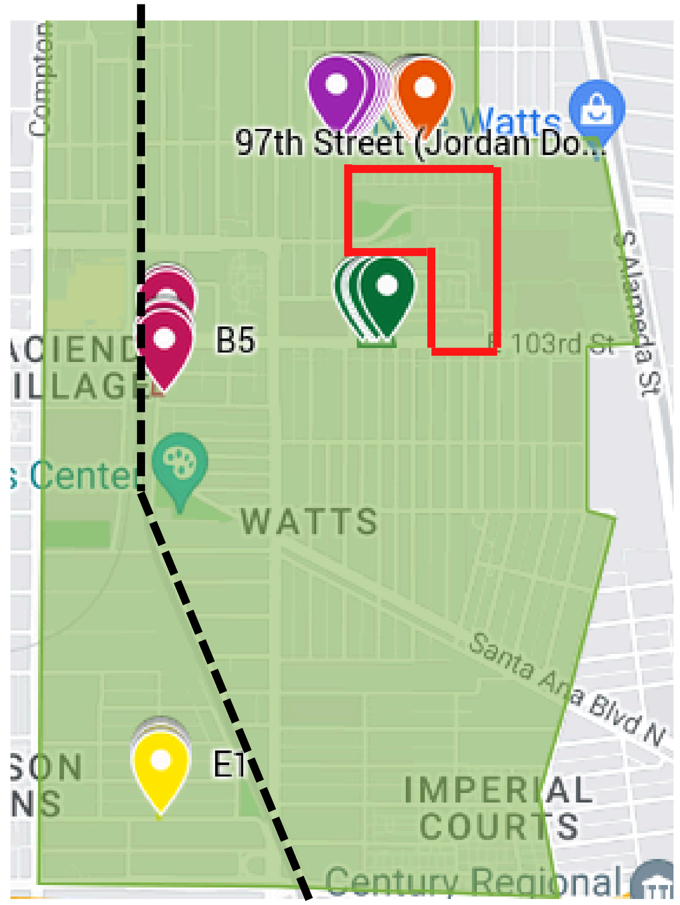


*Figure 2 - TreePeople tree canopy expansion project area showing 5 treatment groups near a **railway** and the **Jordan Downs housing development site** in Watts*

Tree Installation

All trees were planted within a manually prepared well dug to be approximately 2 feet deep by 2 feet wide. After installation, each tree was supported with a pair of 10 feet tall wooden stakes set 1 foot away from the trunk line of each tree and driven 2 feet into the soil.

Figure 3 - A vertical soil column excavated for sensor probe installation with a METER Teros datalogger visible in the foreground (left) and sensor probes installed against a vertical soil face at 10, 20, 30 and 50 cm depths (right).

Each of the 5 trees per treatment group were planted with varying surface soil management approaches to test for impact on observed canopy and trunk growth rates. Post-planting, all 25 trees were monitored and watered by a single team of TreePeople urban foresters following a standardized tree care protocol.

Changes in tree canopy diameter and tree trunk diameter were recorded for all 25 trees 6 months after planting.

Sensing with METER Teros

Soil hydrology data were also collected using METER Teros data loggers which were installed at 5 treatment pits in group "D." Data logger sites are identified with green location pins on Figure 2, page 7.

Sensor probes were installed at 10, 20, 30 and 50 cm depths to gather soil temperature, moisture and electrical conductivity data for each tree well in Group D. Each vertical column of sensor probes was installed 3 feet away from the tree planting wells to capture changes in soil properties outside of the direct influence of the tree well itself.

Changes in soil properties were monitored remotely over a 6 month growing period and compared to observed rates of tree growth across all sites.

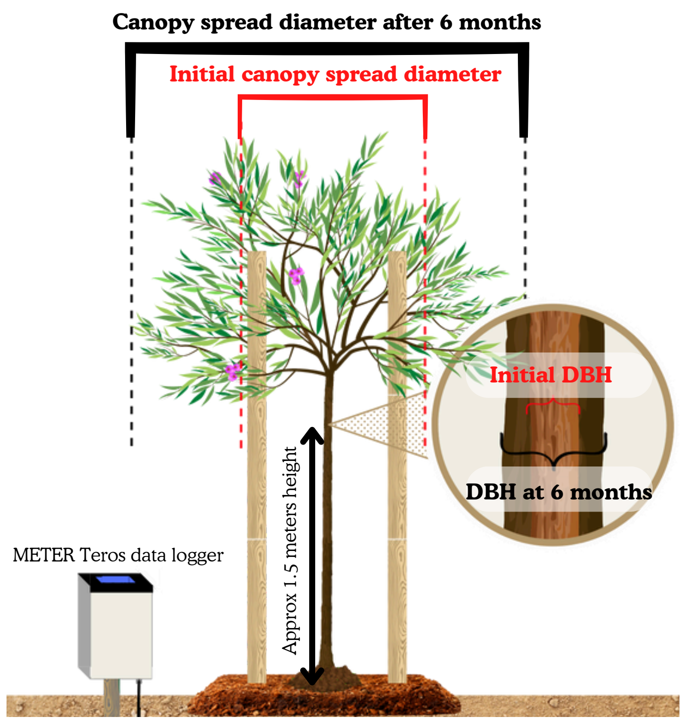


Figure 4 - A sample tree planting site with tree, stakes, data logger, sensor probes and soil treatment type (mulch) installed.

Treatment selection

We prioritized the use of four soil management practices that use mostly free materials available to residents in the City of Los Angeles and compared their effectiveness against plots without any soil treatment (control).

Above Ground Data Collection

Tree growth rates were calculated by measuring trunk diameter at breast height (DBH)—approximately 1.5 meters from the base of the trunk—and canopy spread diameter. DBH and canopy spread were measured at the beginning of the study and again after a 6 month period of growth. Growth changes were plotted as percent growth of original measured DBH and canopy spread for each tree and used to calculate average percent growth by soil treatment type.

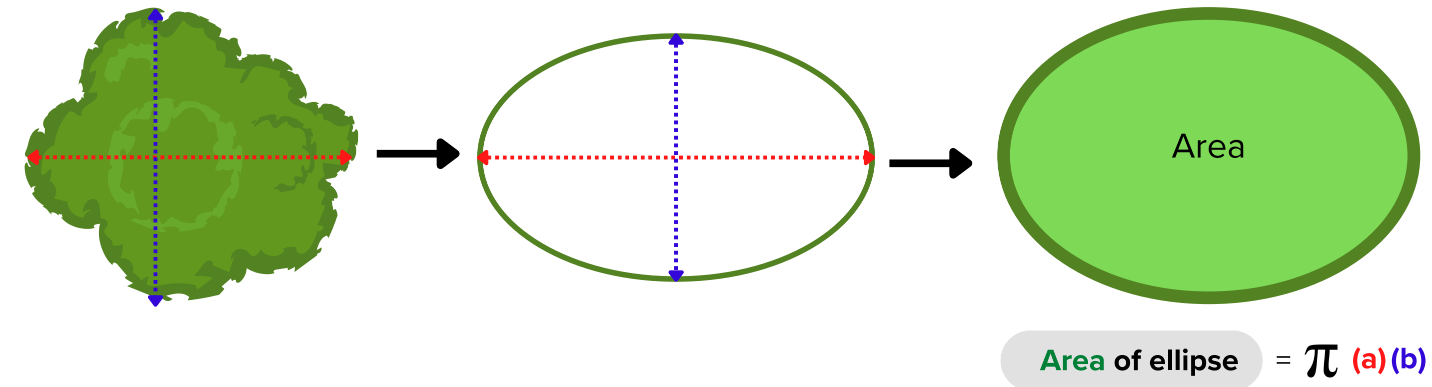


Figure 5 - We took two perpendicular measurements of the longest canopy spread for each tree and used those measurements to generate an ellipse. We then calculated the area of that ellipse as shown below.

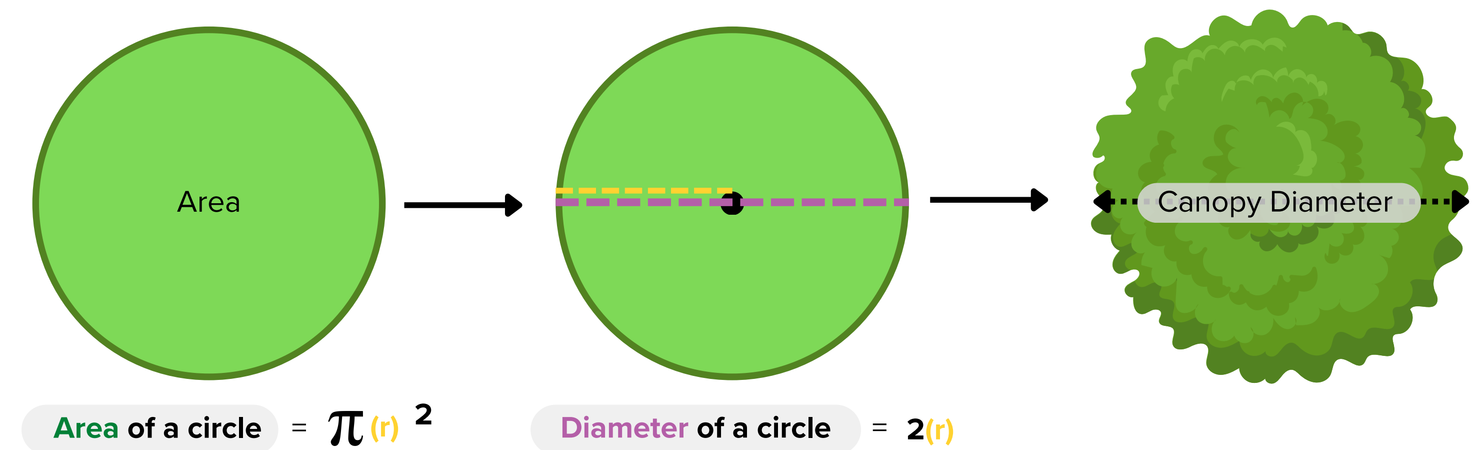
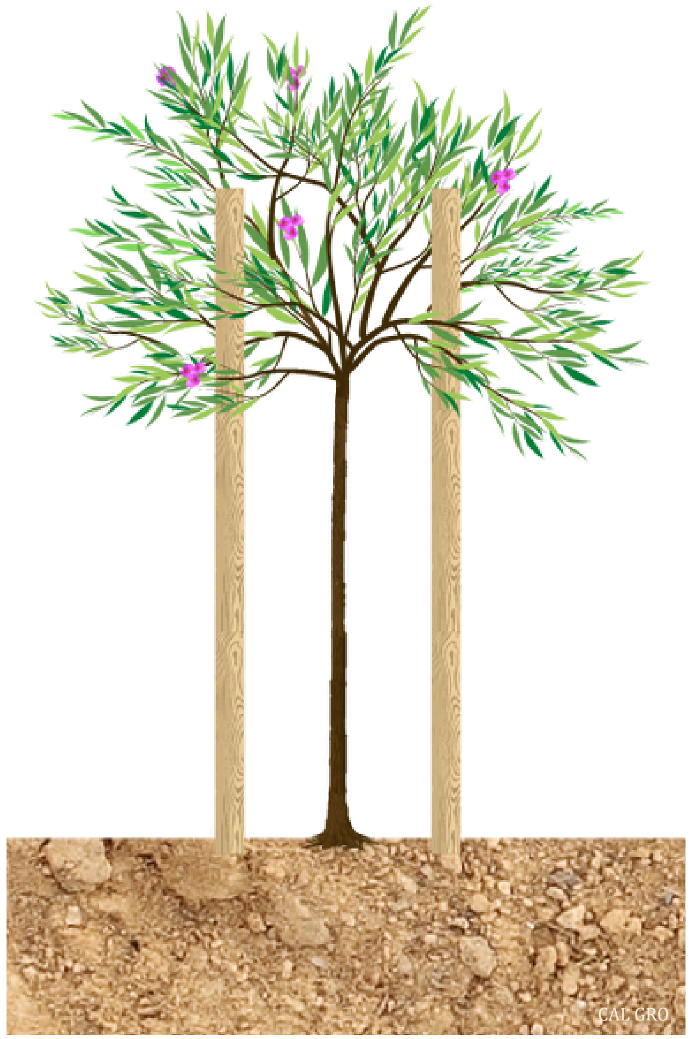


Figure 6 - We applied the area value of this ellipse to generate a circle of equal area. We then calculated the diameter of this circle to represent an approximate canopy diameter for a tree with an otherwise non-uniform canopy spread.

Calculating Tree Canopy Diameter

Tree canopies, when viewed from above, do not take the shape of a uniform circle. In order to calculate tree canopy area, we simplified the area of canopy as an ellipse, and applied it to determine the diameter of an equivalent circle. This allowed us to standardize our measurements of tree canopy diameter.



1 - No Treatment (Control)

Of the 25 total trees planted for this project, 5 were planted directly into parkway soil without the addition of any pre-treatment. Trees planted without any additional soil modification served as the control group for this study.

For each control site, a tree well was dug measuring approximately 2 feet wide by 2 feet deep. The soil that was removed by forming the planting well was used to create a berm or soil bowl around the tree, approximately 1 foot from the root base, to prevent surface runoff when watering.

Bare Soil Planting Considerations

Control site trees were planted with bare soil in order to compare rates of growth against trees with soil treatments that include surface mulching.

The City of Los Angeles' urban forestry guidelines standardize mulching of parkway trees with 4 inches of ground cover starting 4 inches away from the root flare at the base of the tree.

TreePeople's urban forestry planting procedure follows this same recommendation of mulching in order to protect newly planted trees from heat stress and water loss.

> ***Control site trees were planted with bare soil in order to compare rates of growth against trees with soil treatments that include surface mulching.***

Without a mulch ground cover layer at control sites, we anticipated these trees would have the slowest growth rates due to the loss of water through evaporation and heat stress at the roots.

Figure 7 - A tree planted in dry, sandy soil without pre-treatment (control)

Figure 8 - A tree planted with a mulch ground cover

2 - Mulch Ground Cover

5 trees were planted with the addition of a mulch ground cover layer. A 4 inch thick layer of mulch was placed on the surface of the soil 4 inches away from the trunk base to prevent rot. The mulch cover radiated outwards to a diameter of 2 feet. Mulch was only added to the surface, not mixed into the soil profile.

The addition of this mulch cover approach allowed us to assess differences in rates of growth for trees planted following the City of Los Angeles tree planting guidelines and TreePeople's standardized mulching procedure in comparison to trees planted with additional or no soil management.

Potential Benefits of Mulching

Compared to bare soil, the addition of a surface layer of mulch helps to control changes in temperature experienced by roots and microbes in the soil. This temperature control is achieved by introducing pockets of air and water which function as an insulating layer over the soil surface. This insulating layer helps to moderate the hot and cold temperature extremes which would otherwise shock newly planted parkway trees.

> ***A surface layer of mulch helps to moderate soil temperature, soil moisture and provides a safe space for beneficial insects and microbes***

Surface mulching also helps retain soil moisture and decreases the risk that newly planted trees will dry out between watering periods. A mulch layer also provides a safe space for insects and microorganisms to live, allowing them to break down organic material into the soil profile and improving the soil's capacity to support plant growth.

3 - Mulch and Compost Amendment

5 of the study trees were planted in parkway soils following a compost amendment procedure. The sites that received soil compost amendments were prepared with trenches measuring 2 feet wide by 20 feet long parallel to the sidewalk.

Soil within this 40 square foot area was then removed to a depth of 16 inches **Figure 10**. Following excavation, compost was added to the trench to form a 4 inch deep layer **Figure 9**. The excavated soil was then thoroughly mixed back into the trench with the added compost to form a 4:1 soil-compost mix.

Mulch and Compost Benefits

Similarly to mulch, a compost amendment introduces shredded organic material to improve soil water retention and to support biological activity from microbes and insects. Unlike surface mulching, soil compost amendment brings the benefits of water retention and nutrient availability directly into the soil profile.

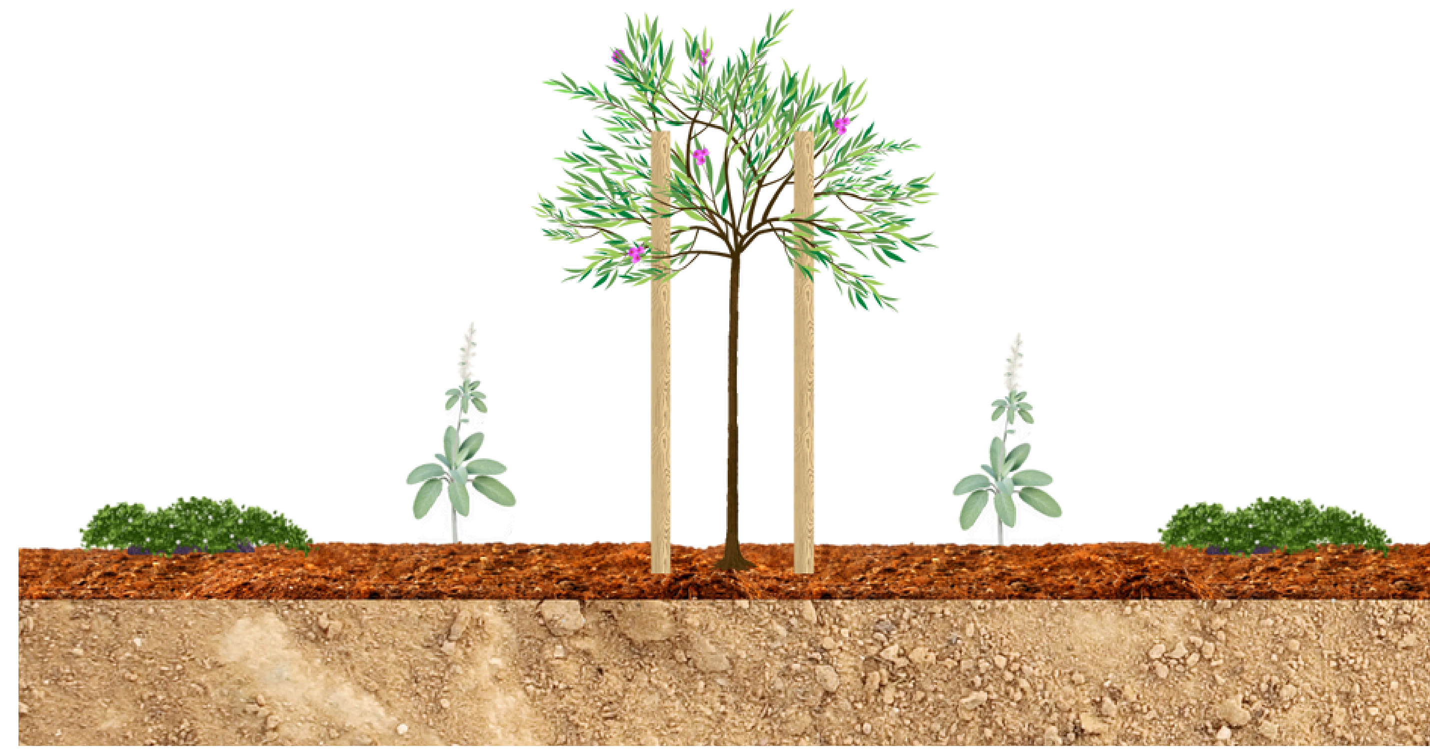
> ***Compost amendments nurture improvements in water retention and nutrient availability within the soil profile***

An additional benefit of compost amendments in urbanized soil is the potential to "dilute" the concentration of soil contaminants. Because compost can be slightly alkaline or acidic, it is important to monitor the pH of compost amended soil in order to reduce the risk of mobilizing contaminants such as lead. **Compost amendments, on their own, will not remove or eliminate the presence of contaminants in the soil.**[5]

Figure 9 - A compost amendment trench measuring 20 feet length by 16 inches of depth. A 4 inch layer of compost is added to be mixed with the soil that was removed from the trench.

Figure 10 - A study team member measures the depth of an amendment trench prior to mixing in compost.

Figure 11 - A tree planted with California native companion plants within a shared berm and a layer of mulch ground cover. All native ground cover were transplanted from 4" nursery pots. The turf growth seen in this image was not present until after the installation and watering of trees and soil treatments.



4 - Mulch and Native Companion Plants

Planting spaces for 5 parkway trees receiving companion plants were divided into 2 feet by 20 feet tracts with a tree marking the center line similarly to treatment 3.

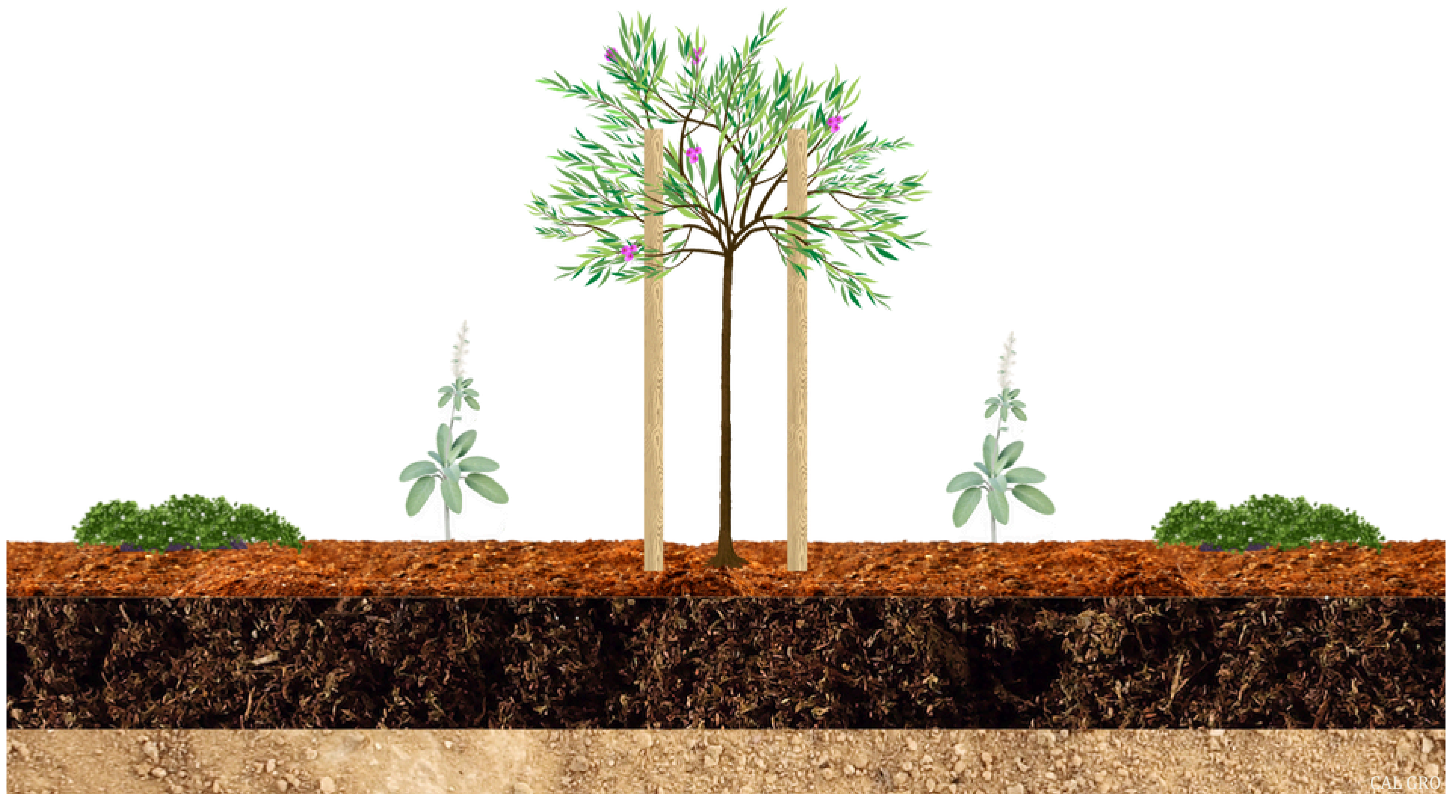
1 *Salvia apiana* "White Sage" and 1 *Baccharis pilularis* "Coyote brush" were planted at 2 and 4 feet distances on either side of the tree. After installing plants, mulch ground cover was added to the soil berm with a 4 inch depth.

Mulch and Companion Plant Benefits

Tree growth relies on a complex network of fungi and bacteria to transport nutrients and water through soil. These networks have been shown to be less effective when soil is compacted or influenced by human inputs. Some California native plants can grow quickly in disturbed soils and have the potential to support the establishment of these biotic networks through fast growing roots.[6]

The integration of native flowering gardens in tree planting projects was proposed by local gardeners and agriculturalists as a method to improve pollinator biodiversity.

> ***Native companion plants provide a living ground cover for trees and a local hub for pollinator species***



5 - Mulch, Compost and Native Companion Plants

The remaining 5 trees were planted with a soil compost amendment, native companion plants and a mulch ground cover layer to determine the cumulative impact of these interventions on tree growth.

After installing trees and cover plants in amended soils, a berm using removed soil was constructed with a perimeter surrounding the tree and cover plants to prevent water loss to runoff as shown in the picture to the right. A 4 inch thick layer of mulch was added over the berm and planting bowl, maintaining a 4 inch distance from plants and the tree trunk in order to prevent rot. This berm and mulch design is identical to the method applied to Treatment 4.

Mulch, Compost and Companion Plant Benefits

We anticipated that the addition of all 3 soil improvement interventions would result in the highest amount of water retention of all treatments while also promoting pollinator diversity similarly to treatment 4.

This approach shares the same benefits as mulch with cover plants and mulch with soil compost amendment while also demonstrating differences in observed growth when all treatments are installed in unison.

Figure 12 - A tree planted with California native companion plants Salvia Apiana and Baccharis Pilularis within a shared berm and a layer of mulch ground cover.

Observations

Observations - Control

Trees planted without any soil management saw the lowest percent growth rates for both canopy spread and trunk diameter of all treatments after 6 months.

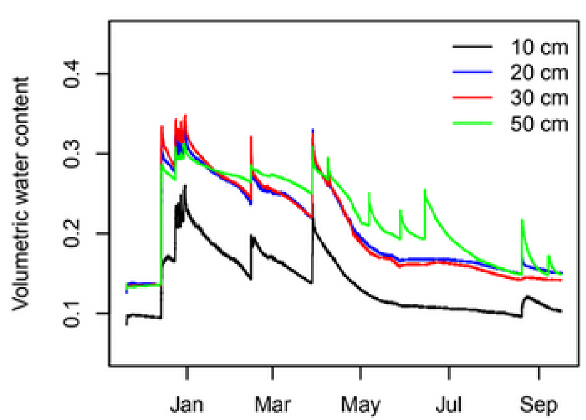


Figure 13 - Volumetric water content of control site D1. Note low moisture content at 10 cm.

Soil temperature and hydrology data captured from D1 Control revealed low moisture levels 10 cm from the surface of the soil pit.

Comparably low moisture content data can be explained by surface evaporation of water from the top 10 cm of the soil profile due to a lack of an insulating layer.

Loss of moisture from evaporation at the surface likely contributed to fluctuations in temperatures recorded by the 10 cm probe and represented in the graph in figure 14.

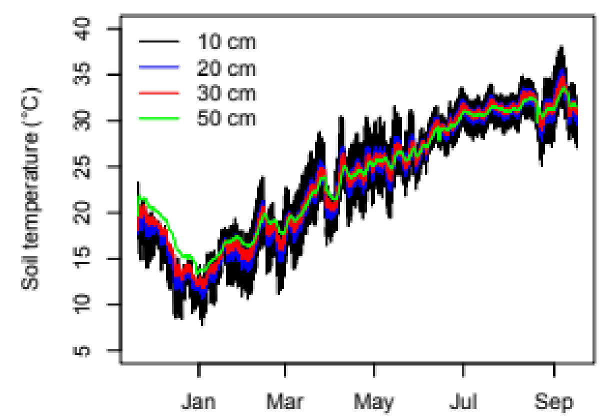
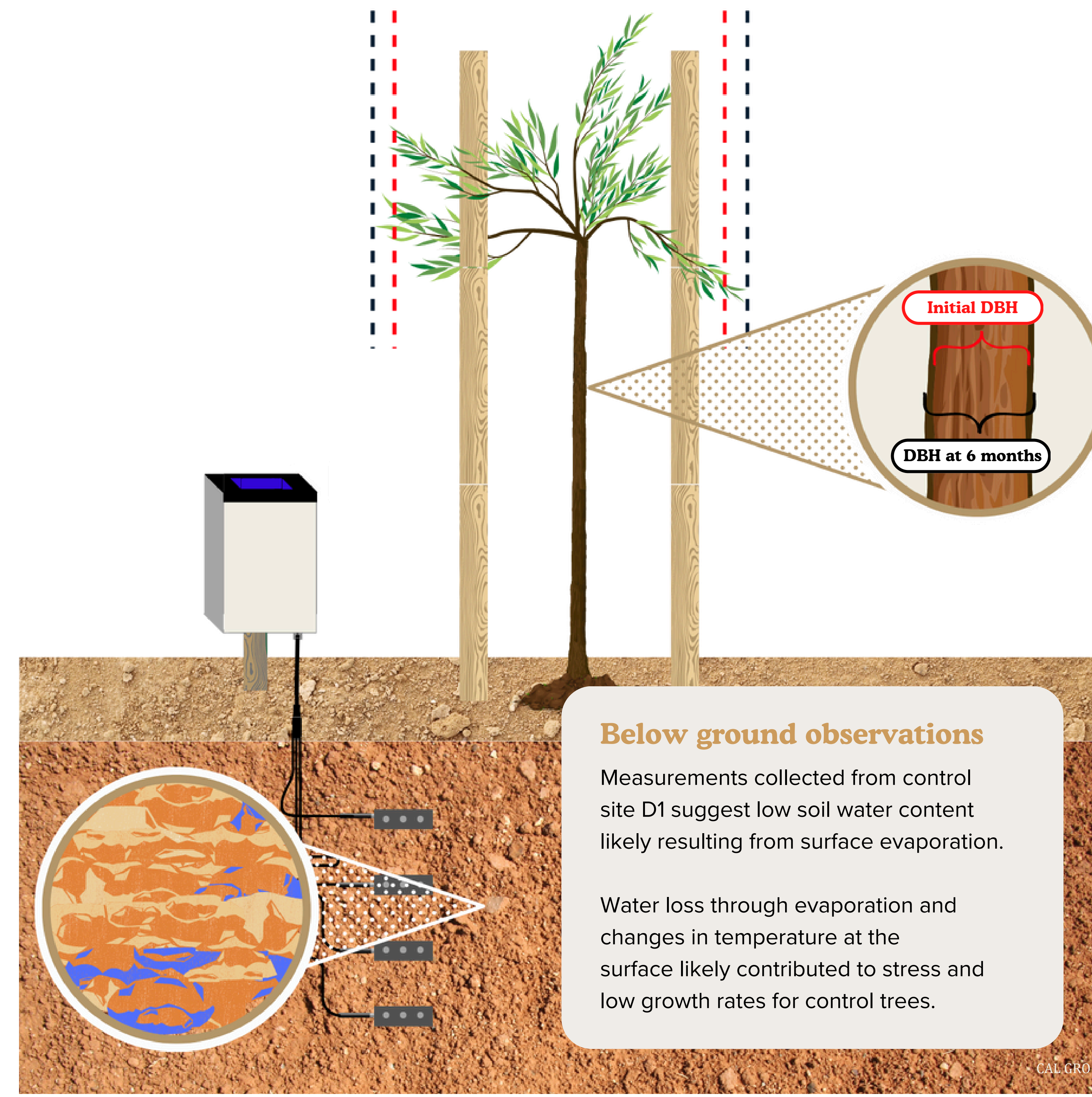


Figure 14 - Soil temperature data captured from site D1, control showing temperature fluctuations at 10 cm depth.

Decreased water availability and increased fluctuations in temperature within the first 10 cm of soil can explain the low percent growth of tree canopy diameter and DBH observed across control sites.

Above ground growth observations

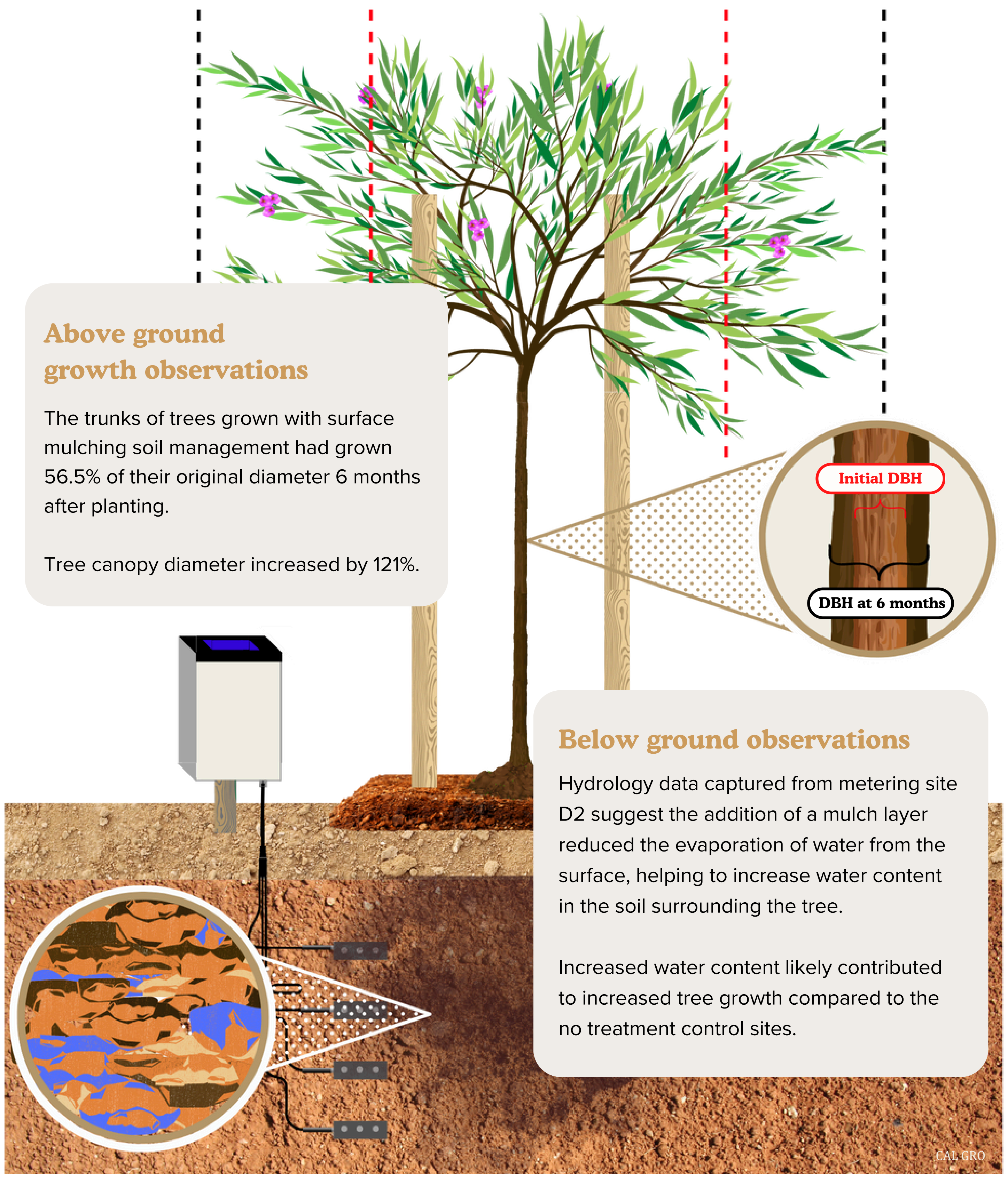
Trees planted without soil treatments saw a 20% growth in crown diameter spread and 9% trunk diameter growth 6 months after installation.



Below ground observations

Measurements collected from control site D1 suggest low soil water content likely resulting from surface evaporation.

Water loss through evaporation and changes in temperature at the surface likely contributed to stress and low growth rates for control trees.



Above ground growth observations

The trunks of trees grown with surface mulching soil management had grown 56.5% of their original diameter 6 months after planting.

Tree canopy diameter increased by 121%.

Below ground observations

Hydrology data captured from metering site D2 suggest the addition of a mulch layer reduced the evaporation of water from the surface, helping to increase water content in the soil surrounding the tree.

Increased water content likely contributed to increased tree growth compared to the no treatment control sites.

Observations - Mulch Ground Cover

Hydrology data captured by sensors at mulch treatment site D2 demonstrate an increase in soil water content at the surface compared to water content data collected from control site D1.

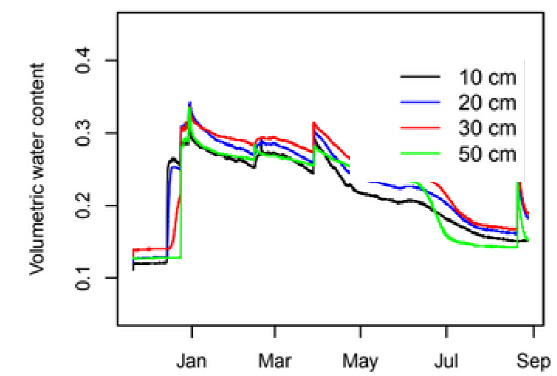


Figure 15 -Soil water content measured at site D2, mulch ground cover. Note higher water content measured at 10 cm (black).

Sensor probes at site D2 also observed a decrease in temperature fluctuations near the surface compared to control site D1. A slight decrease in maximum temperature was also noted compared to temperature measurements found at the control site.

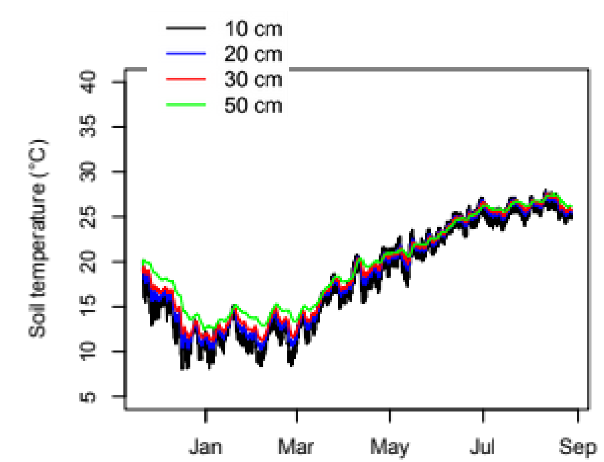


Figure 16 - Soil temperature measured at site D2 demonstrating less fluctuations compared to the control site D1.

Impacts on Soil Temperature

Soil temperatures at 10 cm were 7°C to 10°C lower than temperatures recorded at the same depth in control site D1.

Increased water retention from the surface to 10 cm depth likely mitigated temperature extremes felt by the tree at site D2. This mitigation of temperature fluctuation can be explained by an increase of soil heat capacity which is a function of soil water content.

Reducing extreme temperature variation through the use of mulch ground-cover to increase soil water content may help to optimize soil health and could contribute to improved tree growth rates.

Observations - Mulch and Compost

The addition of a compost amendment decreased bulk density measured at site D3. A decrease in bulk density—the mass or amount of soil in a given volume of space—implies an improvement in soil porosity at site D3.

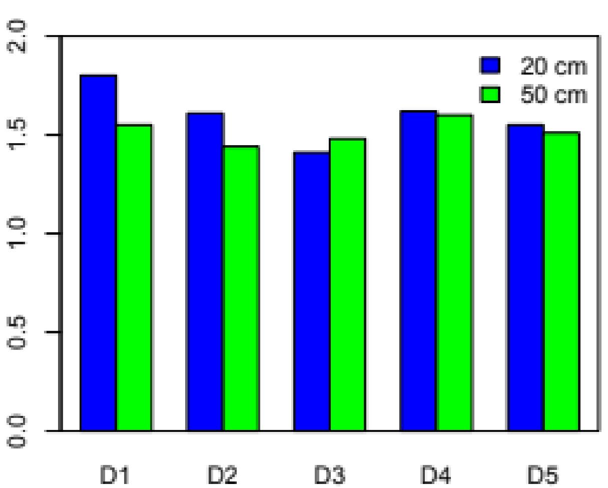


Figure 17 - Bulk density in g cm-3 of all 5 metering sites. Note lower density measurements in site D3.

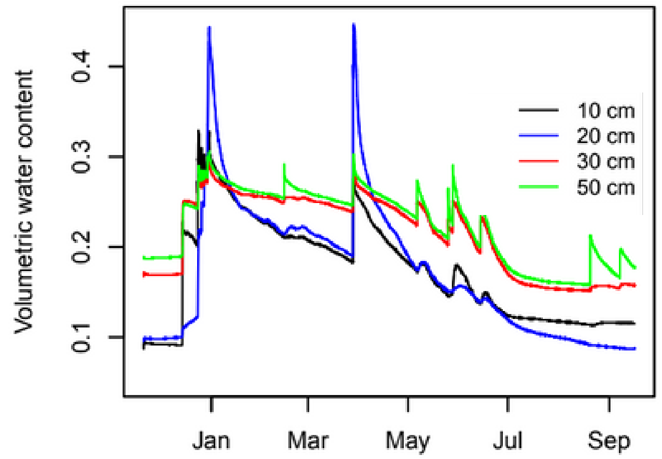


Figure 18 - Volumetric water content measured at site D3. Note spikes in VWC, likely from the development of preferential flow paths.

The increase in soil porosity resulting from the compost amendment improved water content down to 50 cm depth. The amendment also resulted in preferential flow paths of water through the soil during watering events as shown by the rapid increase and decrease of water volume at 20 cm (blue) followed by increases at 50 cm (green).

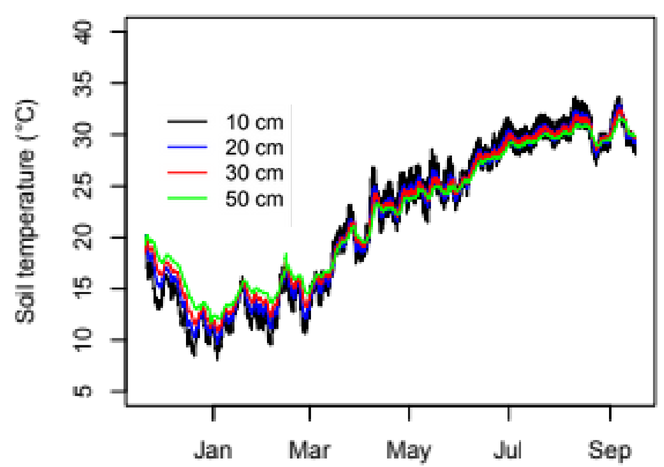
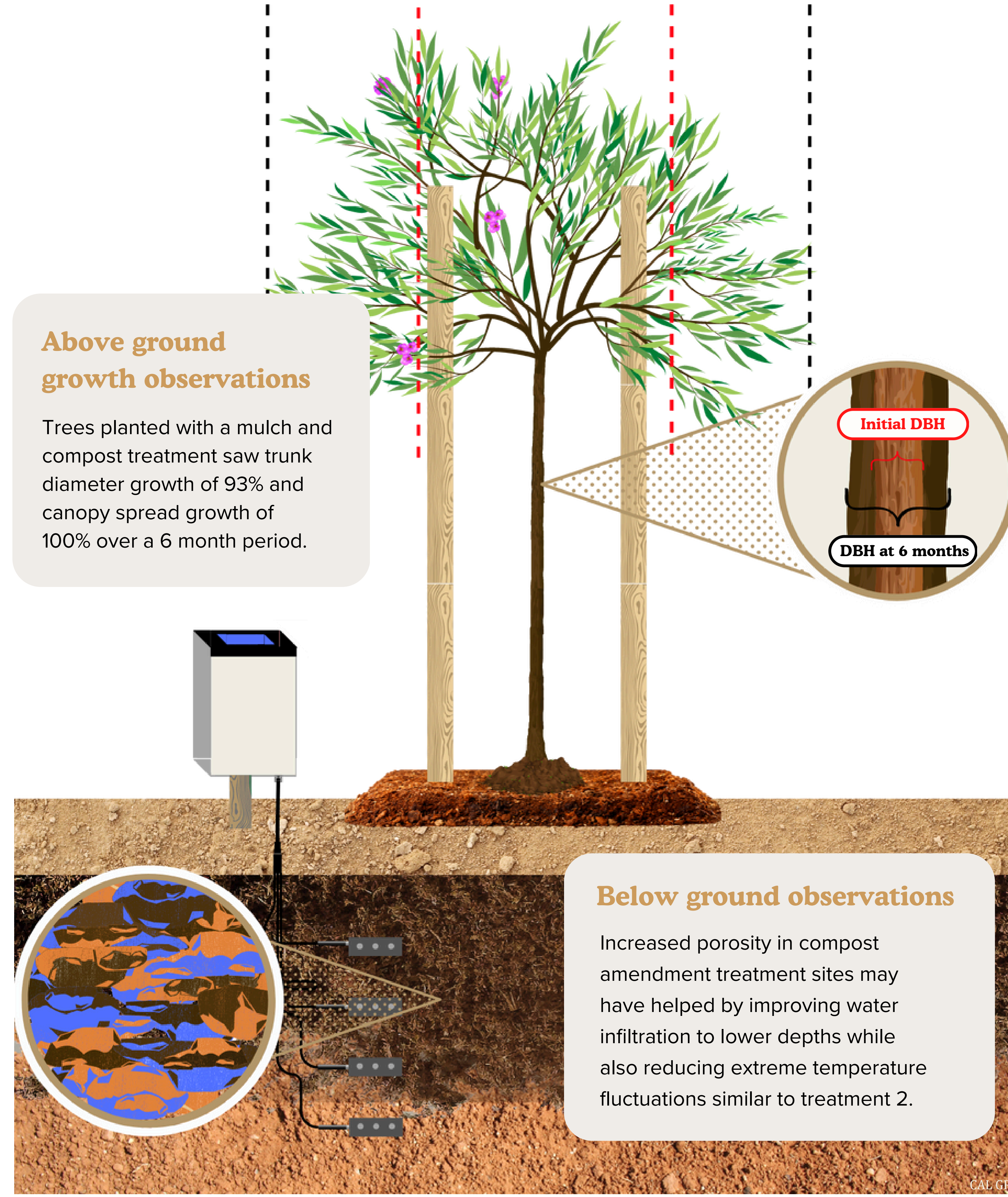


Figure 18 - Soil temperature data for site D3 with fewer fluctuations in surface temperature.

Fluctuations in soil temperature data were less than in the control site D1, indicating a positive impact from mulch and compost treatments.

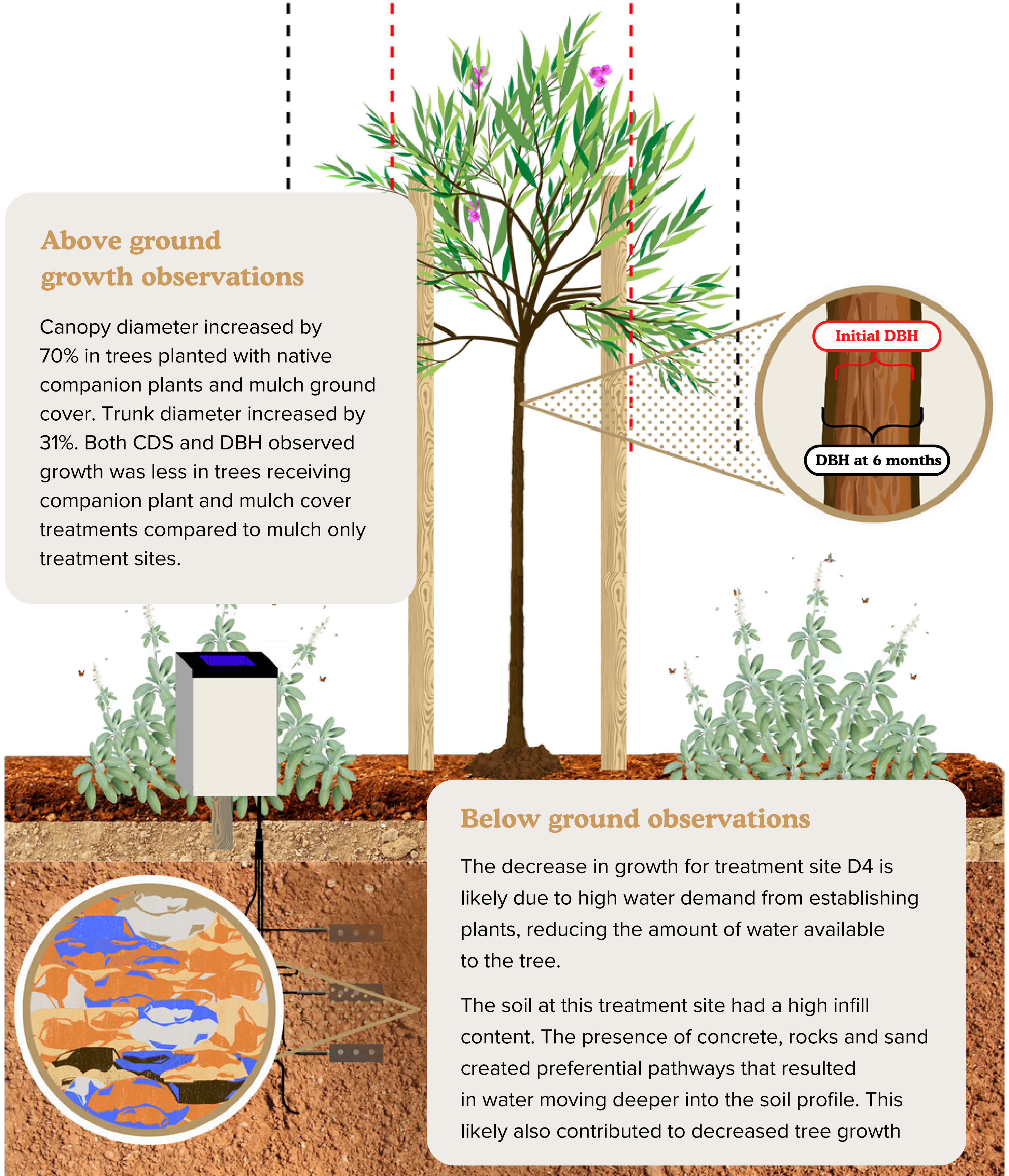


Above ground growth observations

Trees planted with a mulch and compost treatment saw trunk diameter growth of 93% and canopy spread growth of 100% over a 6 month period.

Below ground observations

Increased porosity in compost amendment treatment sites may have helped by improving water infiltration to lower depths while also reducing extreme temperature fluctuations similar to treatment 2.



Above ground growth observations

Canopy diameter increased by 70% in trees planted with native companion plants and mulch ground cover. Trunk diameter increased by 31%. Both CDS and DBH observed growth was less in trees receiving companion plant and mulch cover treatments compared to mulch only treatment sites.

Below ground observations

The decrease in growth for treatment site D4 is likely due to high water demand from establishing plants, reducing the amount of water available to the tree.

The soil at this treatment site had a high infill content. The presence of concrete, rocks and sand created preferential pathways that resulted in water moving deeper into the soil profile. This likely also contributed to decreased tree growth

Observations - Mulch and Companion Plants

Water content measured at 4 depths in the mulch and companion plants site revealed a rapid flux of water from the surface deeper into the soil profile. This behavior is represented by spikes in volumetric water content at the 4 sensor depths as shown in the graph below.

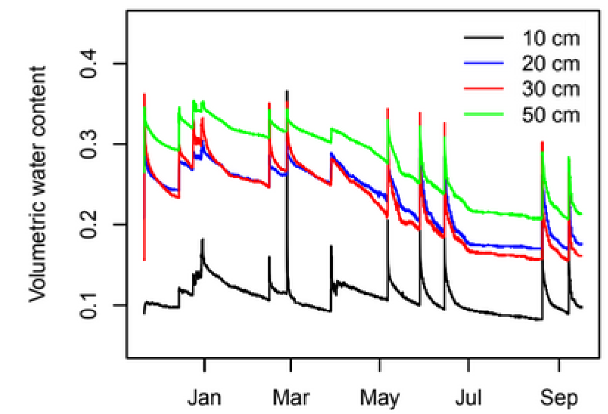


Figure 19 - Volumetric water content measured at site D4 with severe spikes during watering events indicating preferential flow paths from coarser soil texture and artifacts.

This rapid flow of water through the soil profile resulted in noticeably lower water content near the surface of the soil profile. These spikes were likely the result of coarser soil texture and a higher concentration of artifacts in the soil at plot D4.

The rapid flow of water through the soil profile in treatment plot D4 could have contributed to lower water availability for the tree at this measuring site.

Unfortunately, the coarse texture in the D4 pit made it difficult to compare the effects of the mulch and cover plants treatment on soil hydrology and temperature.

Figure 20 - Site D4 pit with coarse soil texture from gravel and construction backfill visible down to 50 cm.

Figure 21 - The addition of companion plants helped to create a barrier surrounding the planting space. This barrier reduced the amount of mulch lost to foot traffic and wind.

Observations - Mulch, Compost and Companion Plants

Effective porosity—the concentration of pores able to enhance the flow of water through the soil—was highest in the D3 and D5 treatment sites due to the mixing of compost into the soil profile.

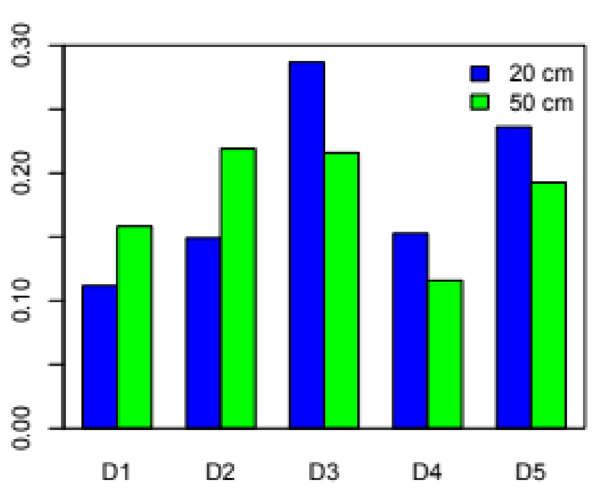


Figure 22 - Effective porosity of metered sites. Note compost amended sites D5 and D3.

D3 and D5 were more permeable to water at the 20 cm depth when compared to the other treatment sites and the control sites, indicating that the use of compost amendment can help to improve water infiltration.

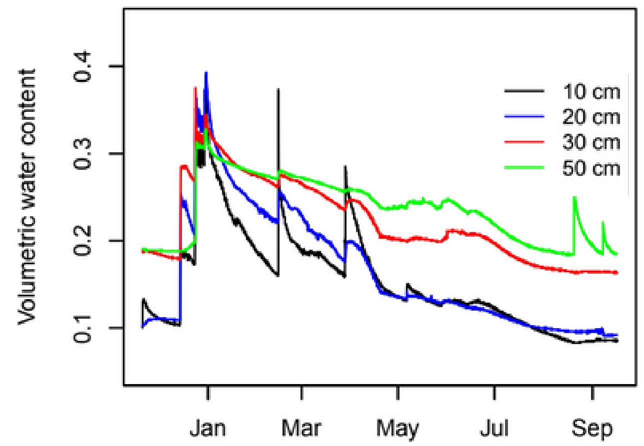
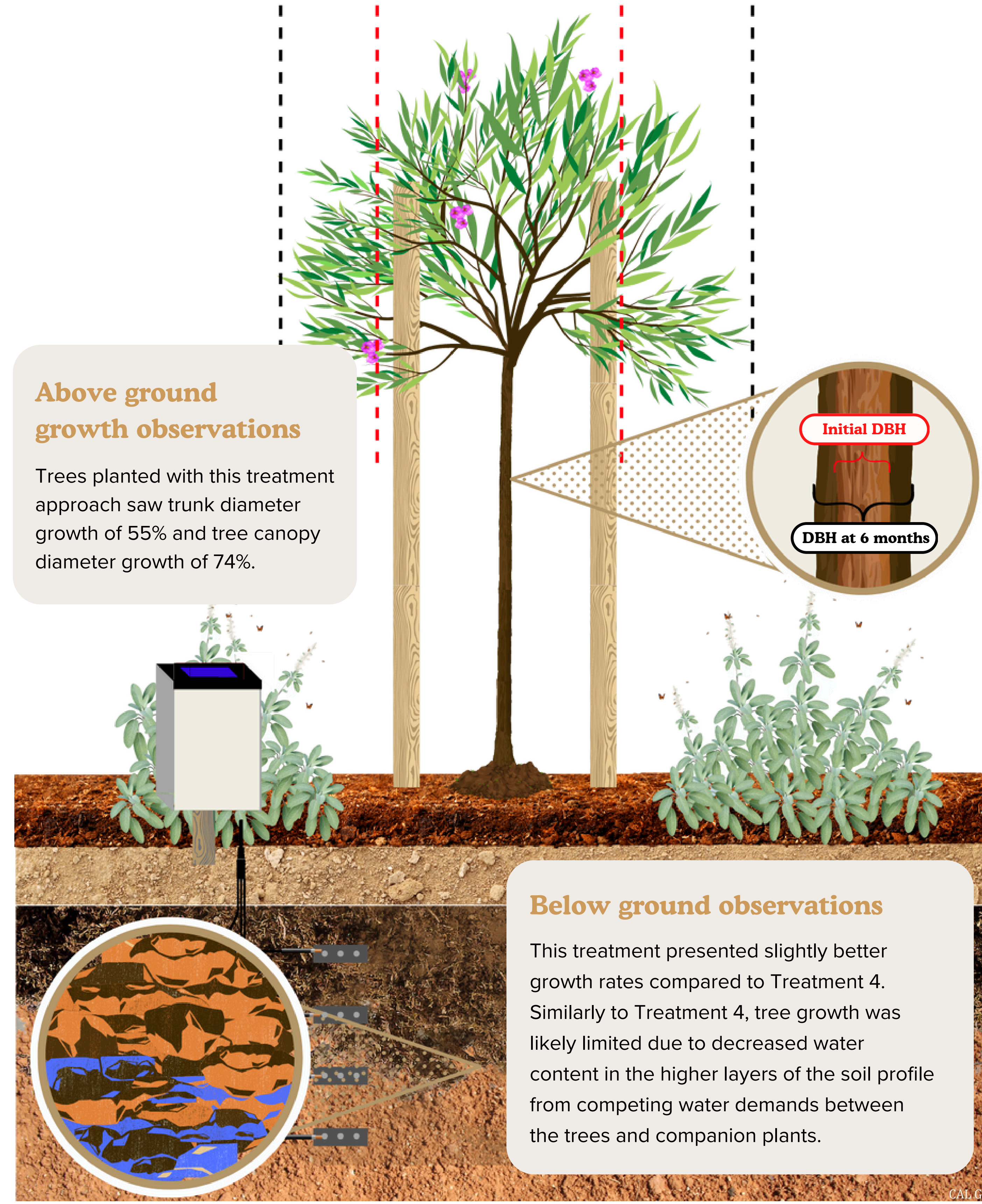


Figure 23 - Volumetric water content at site D5. Note the absence of VWC spikes found at compost amended site D3 (figure 18). Absence of preferential flow spikes and lower surface water measurements suggest the addition of native plants helped to hold water in root zones near the surface.

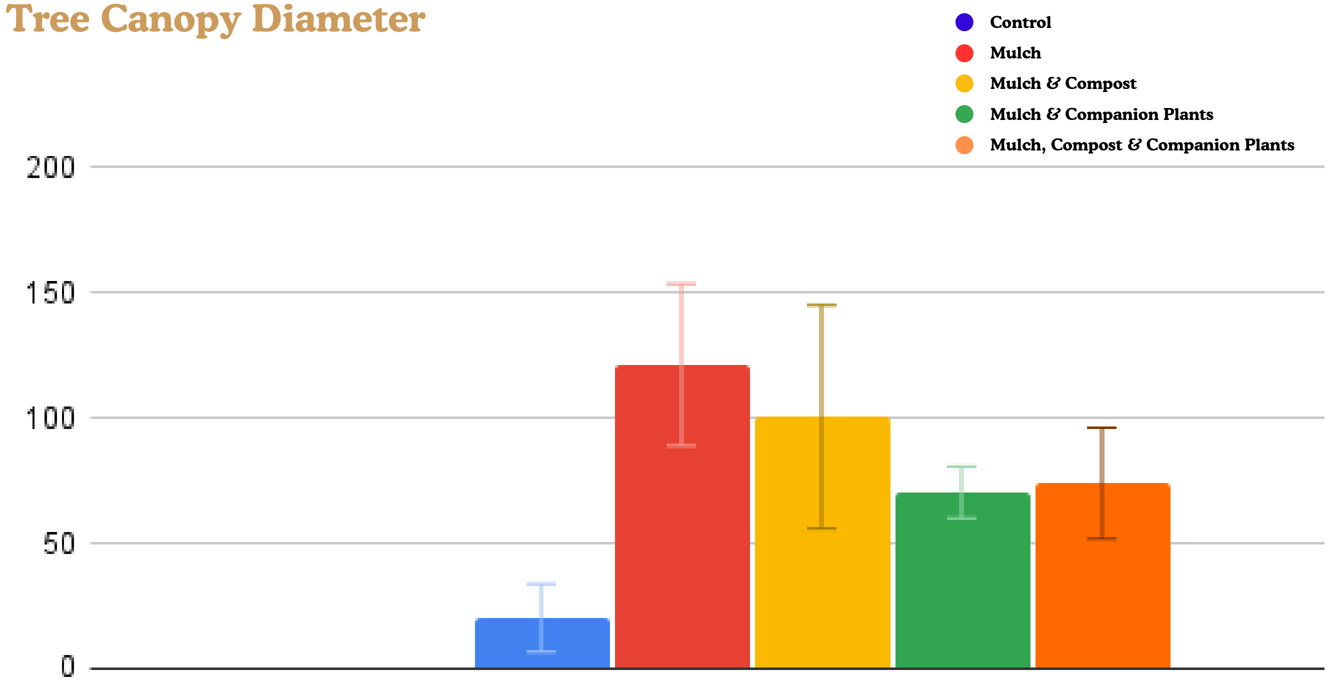
Unlike D3, site D5 did not reveal water content spikes from preferential flow paths although water content measured near the surface was lower in this treatment than in the mulch and compost only treatment site.

The lack of preferential flow paths deeper in the soil profile could be explained by water uptake by the companion plants. Lower water content near the surface may be the result of evapotranspiration losses through the companion plants, as well.



Summary of Results

Tree Canopy Diameter



Canopy Diameter Mean % Change, Standard Error

- The canopies of trees that were planted in soils treated with a **mulch ground cover** grew 121% of their initial measured size over a 6 month period. This was the largest observed rate of tree canopy diameter growth across all treatments.

- Trees grown with a **mulch ground cover with compost amendment** treatment demonstrated a canopy diameter growth of 100% their initial measured size.

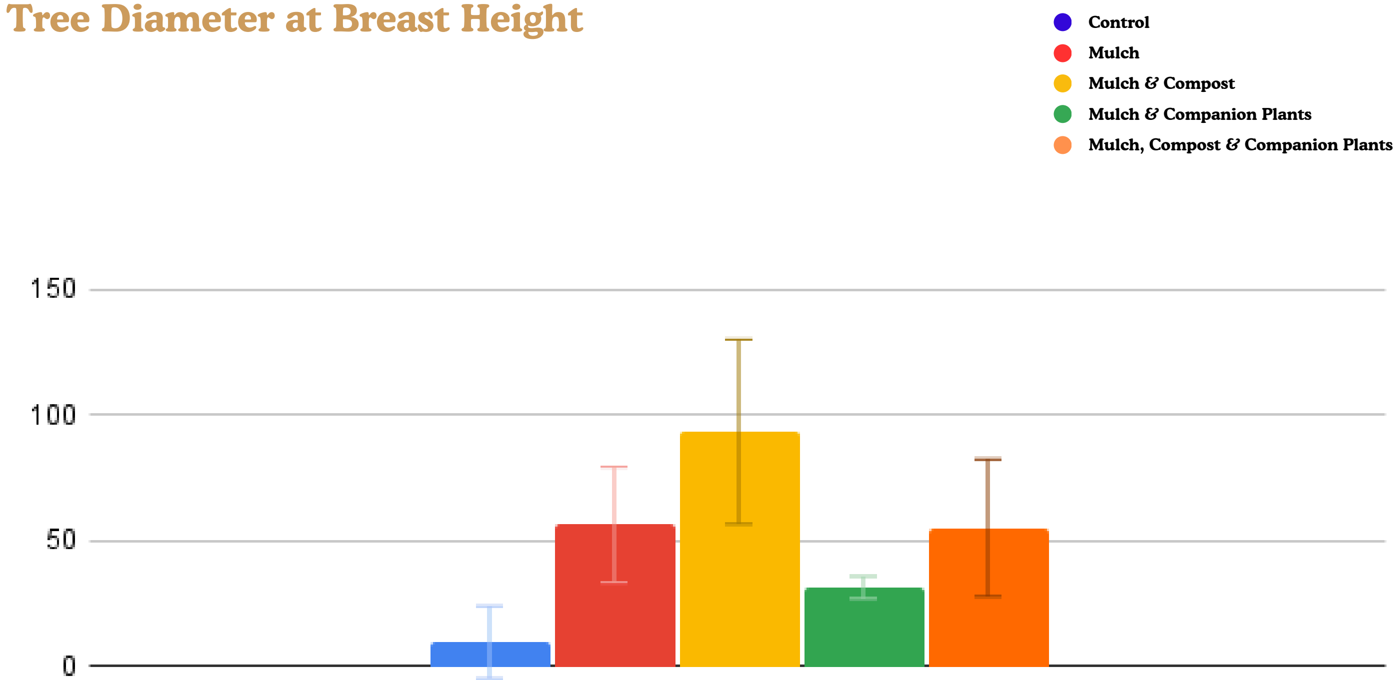
- **Mulch with companion plants** treatments saw an average canopy diameter percent growth of 70%.

- **Mulch and soil compost amendment with companion plants** treatments had an average 74% growth in canopy diameter.

- All treatments resulted in a higher rate of canopy diameter growth over 6 months when compared to the **control sites** which resulted in an average canopy diameter change of 20%.

- The growth rate benefits of mulch with compost amendment treatment were decreased with the introduction of cover plants, likely due to water uptake competition between the tree and the plants.

Tree Diameter at Breast Height



Breast Height Diameter Mean % Change, Standard Error

- Trees planted with **mulch treatment** had an average trunk diameter growth of 56%.

- **Mulch with compost amendment** treatments resulted in a trunk diameter growth of 93% of original measured diameter.

- Similarly to canopy diameter, the addition of **cover plants with mulch** resulted in a lower observed DBH growth of 31%.

- **Mulch and compost with cover plants** treatments resulted in 55% average DBH growth.

- All treatments resulted in higher rates of trunk diameter growth when compared to the **control sites** which demonstrated an average 9% growth over 6 months.

Tree Growth and Soil Hydrology

The use of mulch and mulch with compost amendment resulted in the greatest observed growth for both canopy spread diameter and diameter at breast height.

Hydrology and temperature data collected from the mulch only site D2 show that the addition of mulch increased soil water content by reducing evaporation from the surface. This increase in water content in turn helped to minimize extreme temperature fluctuations experienced in the soil profile over time.

Water potential data captured from compost amendment sites D3 and D5 showed an increase in water flow from shallow depths to sensors deeper in the soil profile. The addition of compost into the soil helped to decrease bulk density which contributed to improved water permeability at these sites.

Bulk Density and Soil Compaction

Bulk density is a measurement that refers to the mass or concentration of soil within a given volume, or specifically in this case a cubic centimeter.

Higher bulk density can help indicate soil compaction, while a lower bulk density can indicate greater porosity within the soil.

Bulk density measured at 50 centimeters, just below the direct influence of our treatments, was lowest in the mulch, and mulch with compost treatment sites.

Altogether, these results suggest that the addition of mulch and compost helped to improve water permeability and retention, reduced temperature fluctuation experienced at soil depths, and slightly improved soil compaction. These results are supported by the observed rates of tree growth at mulch and mulch with compost treatment sites.

Tree Growth and Native Ground Cover Plants

While the addition of compost and mulch improved overall soil water content, it also generated preferential flow paths leading to surface water loss. The addition of native ground cover plants demonstrated a reduced amount of water lost to deeper layers in compost amended sites, likely by holding moisture within the plant root zone.

The effect of native plants holding moisture within their root zones could explain the lower percent growth of trees in mulch with native ground cover treatment sites as resulting from water competition.

The addition of native ground cover also reduced the amount of surface mulch lost from the tree planting sites. The installation of a native ground cover contributed a visual barrier to foot traffic in the planting space while also contributing a shielding affect against wind from moving traffic and leaf blowing.

There is a further need to explore the impacts of native ground cover plants on urban soil management practices, specifically

considering variations in species and the timing of ground cover transplanting to maximize water retention near the root zone of established plants and trees and the longevity of treatment effects.

Polinator Hubs and Local Biodiversity

Native flora planted in mulch with compost amendment sites grew a considerable amount over the period of observation for this study.

The plants installed at sites such as the one demonstrated in the image above grew from 4 inch pots to a mature flowering stage within 6 months, drawing in pollinator insects and other fauna including birds.

Although an increase in pollinator presence was noted by project team members at these planting sites during tree care activities, the contribution of these plants to local biodiversity both above and below ground were not adequately assessed in this project's limited scope.

Future implementation of these methods should include metrics to better understand biodiversity contributions and rates of growth and establishment for California native flora installations.

Changes in watering needs over time for these companion plants also require further examination, especially when considering that California native flora generally do not need supplemental watering once they have sufficiently established in a planting space.

Parkway Potential and Planting Resilience

The installation of California native flowering trees and plants was met with enthusiastic support from most of the residents that our team engaged with over the life of this project.

One resident expressed a sincere gratitude for planting the sage shown in the picture to the left, specifically because she had been wanting to plant a parkway garden herself but was unsure of her right to do so.

Further developing soil management practices that empower local residents to mulch, protect and grow their own community, residential and parkway gardens is a natural progression for food and climate resilience projects in the City and County of Los Angeles.

Optimizing Soil Structure for Urban Soil Health

The observed improvements in soil hydraulic properties, movement of water to the subsurface and soil temperature control in sites D2 and D3 help explain the optimum tree growth seen in the mulch and mulch with compost treatments across this experiment.

Changes in soil hydraulic properties at the 50 cm depth, below the area we influenced directly, may be the result of movement of soil organic carbon (SOC), or the enhancement of soil moisture and temperature conditions that promote SOC production, both of which would impact the aggregation of the soil at that depth.

Cover plants added more carbon to the soil but with the trade off that they somewhat limited tree access to deeper pools of soil moisture partially explaining the slight decline in tree growth compared to the mulch and mulch with compost treatments.

These results suggest best management practices for plantings in urban soils include the use of compost amendment and mulch ground cover to enhance soil hydraulic properties. The addition of California native plants as ground cover or companion plants should be delayed until after soil hydraulic properties are enhanced to reduce water access competition between native plants and trees or primary crops.

Replication is especially important when trying to better understand hydraulic response to practices aimed at improving soil health in urban soils, especially considering the diversity of soil characteristics in urban spaces. Collecting soil property data specific to the plots and parcels where projects are intended to be implemented is needed to make informed decisions related to local soil health priorities.

Additional carefully-designed, relatively-small, detailed studies in urban soils can help reveal effective, scalable management strategies for soil health enhancement and can contribute to improvements in soil health relative to the desired use of neighborhood spaces.

Free Mulch and Compost in the City of Los Angeles

CD 1 - Lincoln Heights
1903 Humboldt Street, Los Angeles, CA 90031
Open every day: 7:00 a.m. – 5:00 p.m.
Mulch added Mondays and Thursdays

CD 2 - North Hollywood (Burbank)
Vineland Avenue and West Chandler Blvd,
San Fernando Valley, CA 91601
Open every day: 7:00 a.m. – 5:00 p.m.
Mulch added on Mondays and Thursdays

CD 4 - Griffith Park
Opposite 5400 Griffith Park Drive,
Los Angeles, CA 90027
Open weekdays: 7:00 a.m. – 5:30 p.m.
Compost and Mulch added everyday

CD 6 - Van Nuys
15800 Victory Boulevard,
San Fernando Valley, CA 91406
Open weekdays: 7:00 a.m. – 3:30 p.m.
Mulch added on Mondays

CD 7 - Lopez Canyon Environmental Center
11950 Lopez Canyon Road,
San Fernando Valley, CA 91342
Open every day: 7:00 a.m. – 5:00 p.m.
Mulch added daily

CD 10 - West LA
6001 Bowcroft Street, Los Angeles, CA 90016
Open weekdays: 7:00 a.m. – 5:00 p.m.
Mulch added on Tuesdays and Thursdays

CD 13 - Elysian Valley
3000 Gilroy Street, Los Angeles, CA 90039
Open every day: 7:00 a.m. – 5:00 p.m.
Mulch added on Mondays and Thursdays

CD 14 - East LA/Boyle Heights
2649 East Washington Boulevard,
Los Angeles, CA 90023
Open every day: 7:00 a.m. – 5:00 p.m.
Mulch added on Wednesdays

CD 15 - San Pedro
1400 North Gaffey Street, San Pedro, CA 90731
Open every day: 7:00 a.m. – 5:00 p.m.
Mulch added on Fridays

These locations are managed by the City of LA Sanitation and Environment Office. If any locations run out of mulch, please call the Lopez Canyon Environmental Education Center at 818-485-0703.

environment LA SANITATION CITY OF LOS ANGELES
zero waste • zero wasted water

References

1. Native Land Digital, Territories, Languages and Treaties Map. https://native-land.ca

2. City of Los Angeles, Residential parkway landscaping guidelines https://streetsla.lacity.org/sites/default/files/Residential_Parkway_Landscaping_Guidelines.pdf

3. D. Sinnet, J. Poole, and T.R. Hutchings. (2018): *A Comparison of Cultivation Techniques for Successful Tree Establishment on Compacted Soil.* Forestry. https://doi.org/10.1093/forestry/cpn039

4. Y.Chen, R.V. Pouyat, S.D. Day, E.L. Wohldmann, K. Schwarz, G.L. Rees, M. Gonez, E. B. de Guzman, and S. Mao. (2021): *Healthy Soils for Healthy Communities, Phase 1: Needs Assessment.* TreePeople. https://www.treepeople.org

5. Chammi P. Attanayake,Ganga M. Hettiarachchi, Sabine Martin, and Gary M. Pierzynsk. **(2015):** *Potential Bioavailability of Lead, Arsenic, and Polycyclic Aromatic Hydrocarbons in Compost-Amended Urban Soils*. Journal of Environmental Quality. https://doi.org/10.2134/jeq2014.09.0400

6. Egerton-Warburton, L, Graham R., Allen, E. and Allen, M. (2001): *Reconstruction of the Historical Changes in Mycorrhizal Fungal Communities Under Anthropogenic Nitrogen Deposition.* Royal Society. http://dx.doi.org/10.1098/rspb.2001.1844