SUSTAINABLE LAWN MANAGEMENT AT UCLA

2020 SUSTAINABILITY ACTION RESEARCH

UCLA
Institute of the Environment and Sustainability

MEET THE TEAM

BONNY BENTZIN, PROJECT STAKEHOLDER
UCLA Deputy Chief Sustainability Officer

CHRIS GALLEGO, PROJECT STAKEHOLDER
UCLA Grounds Superintendent

JUSTIN WISOR, PROJECT STAKEHOLDER
UCLA Director of Custodial and Grounds

JASMINE SUMMERS-EVANS , TEAM LEADER
2nd year Environmental Science major

Jasmine grew up helping her grandmother garden, which helped her foster a deep appreciation for landcare and natural environments. Working on this SAR team has allowed her to further explore her interest in the intersection of sustainability and environmental health and inspired her to continue learning more about soil science. In addition to SAR, she works to reduce food insecurity on campus as an outreach coordinator for the CalFresh Initiative at UCLA.

ELIZABETH TANNER , TEAM LEADER
3rd year Ecology, Behavior, Evolution major

Elizabeth's childhood in North Carolina and participation in the Envirothon prompted her interest in lawn management and the importance of fostering healthy soils. This SAR team gave her the opportunity to affect the sustainability-related practices of UCLA's lawn care. Outside of SAR, Elizabeth is a Zero Waste Ambassador working to help UCLA achieve its 90% waste diversion rate goal and acts as Co-President for the Ecology, Economy, Equity: E3 club on campus. In her free time, she enjoys going on hiking and camping trips.

MADELEINE FARRINGTON, TEAM MEMBER
3rd year Environmental Science major

Madeleine grew up helping her parents turn their compost system in the backyard and participating in park clean-ups on weekends. Since arriving at UCLA, she has been introduced to greater complexities surrounding environmental degradation, throughout every facet of life. By studying Environmental Science she hopes to help reimagine everyday practices and necessities in more holistic, sustainable ways. Outside of SAR, she enjoys hiking, reading, and taking on creative projects.

LIANA HUANG, TEAM MEMBER

2nd year Environmental Science major

Liana's appreciation for the magic of soil stems from her weekly trips to the farmer's markets in Sacramento, where so many different fruits and vegetables were displayed in front of her. It blew her young mind that all these colors and shapes were nurtured by one thing: soil. While not working on this SAR project, she coordinates events for the Earth Month campaign and recreates Asian foods from her childhood.

CLARE SCHUMANN, TEAM MEMBER

2nd year Environmental Science major

Clare developed her appreciation for the environment from a young age, growing up right next to California's Mount Diablo State Park. When she began to notice the increasing number of wildfires in California, she realized she needed to center her academic interests on learning about the environment and how to prevent climate change. This SAR project has allowed her to further develop her interest in sustainable agriculture practices. In her free time, she enjoys finding new trails to run on and cooking.

KRISTEN TAM, TEAM MEMBER

1st year Environmental Science major

Kristen grew up in a time when her family and city had just started to compost. This was new to everyone, and she initiated educating her family and church congregation on how to compost. She was invigorated by how diverting food waste from landfill reduced methane pollution and recycled nutrients to fertilize new crops. She saw the Lawn Management Team as a perfect way for her to contribute to research that circulates UCLA's compost back to fertilizing campus lawns. Outside of SAR, she enjoys staying active and competes on UCLA's Club Triathlon and Sailing teams, as well as hiking and camping with family and friends.

INTRODUCTION

UCLA's green spaces inspire thousands of students, staff, faculty, and campus visitors to spend time outside each day. Not only are they important for recreational purposes, but campus lawns also add aesthetic and financial value to the UCLA community. Yet, just how green is the management of these lawns? Over the past five months, the SAR Lawn Management Team explored this question and searched for ways to contribute to campus sustainability efforts. Our team's interest in this research is rooted in a national collegiate movement to make lawn management practices more self-regenerative and organic, rather than additive.

We created a pilot project to assess how using compost instead of chemical fertilizer affects soil health and lawn appearance. This involved monitoring nutrient levels in the soil from two lawn plots on campus that receive differing levels of sunlight before and after the application of compost and chemical fertilizer. In addition, we acknowledge the importance of the UCLA community's preferences on this issue, so we created a student survey to further inform our decisions. Our findings from both soil testing and the survey have been used to provide UCLA Facilities Management with actionable recommendations for moving forward. We hope that our work can be used by UCLA's leadership and other higher learning institutions to guide sustainable changes for the treatment of curated green spaces.

Portola Plaza plot in February after being mowed and aerated

BACKGROUND

Improving the condition and strength of our soils by fertilizing with compost may foster an environment with greater resilience against changes in climate. Such practices may allow UCLA to reduce overall water consumption and decrease reseeding frequency, ultimately resulting in healthier greenspaces across campus. Additionally, UCLA's actions carry enormous influence, and a successful transition to compost on our grounds may pave the way for more campuses across the country to invest in organic lawn care.

Understanding of the implications of exposure to chemical fertilizers- on both humans and the environment- is quickly growing. Both compost and chemical fertilizer provide key minerals and nutrients to lawns. However, Dr. Tarafdar of the Central Arid Zone Research Institute summarized the main distinction between the two as compost feeds the soils, while chemical fertilizers feed the plants [1]. While feeding plants can result in short term plant growth, it is not a long term solution. However, fostering healthy soils can support plant growth for years to come. Looking further, there is variability in nutrient content; plant yield, vigor, and health; and effects on soil tilth to be considered. Additionally, transport, application, and cost differences must be assessed. Chemical fertilizers are popular because they are easily accessed, applied, and are available in a range of predetermined nitrogen, phosphorus, and potassium (N-P-K) levels. Unfortunately, they often have a higher chance of nutrient runoff or leaching into surrounding environments due to their high solubility [2].

Compost, on the other hand, has its own set of advantages. When applied to lawn, organic matter is released slowly, both preventing leaching and the need for frequent reapplication. Its high organic matter content also improves soil structure and water holding capacity. This increased water retention can then reduce watering needs and irrigation costs. Additionally, the high microbial content in compost increases nutrient cycling and suppresses pathogens due to heat released from decomposition [3]. Given UCLA's Southern California location, protecting local waterways from runoff and decreasing campus' water needs are critical issues.

UCLA's Groundskeeping team is continually looking for ways to improve upon best practices, which made compost's cultivation of a strong root system and increased moisture retention a prime candidate for research. UCLA's pristine lawns are blanketed with Bermuda, St. Augustine, and Kikuyu grasses that are currently fertilized biannually using Best 19-6-12 and Simplex granules. This practice has already taken one step in the right direction by switching to granular fertilizer from spraying liquid fertilizer since it is less toxic and less likely to run into storm drains. Current watering practices involve a periodic system- beginning with 3 sets of 10 minutes, then decreasing the water flow once lawns begin to flourish. Lawn maintenance includes regular mowing every 2-3 weeks in the winter and every week during the summer combined with grasscycling practices, which allows the grass clippings to recycle nutrients back onto the lawn [4]. The average lawn can produce as much as 8 tons of trimmings each year, almost equating to the full amount of nitrogen recommended to cultivate a healthy lawn [5]. Thus, grasscycling can reduce fertilization and water requirements by over 25% and mowing time by over 50% by eliminating the need to bag and dispose of the generated clippings.

Lastly, UCLA's aesthetics of picturesque brick and rolling lawns play a large role in attracting people from all over the world to the campus each year. When the university hosts events, groundskeepers fertilize the most popular spaces on campus more often [4]. These areas are also reseeded 1-2 times a year due to frequent destruction of the grasses, costing UCLA $15,000-18,000 per reseeding cycle. These costs include renovating, putting down fertilizer, and paying staff. After reseeding takes place, more water is also needed to prevent the seeds from drying out.

Our SAR team has been created to investigate the environmental impact of current practices with organic alternatives. Similar projects have surfaced at other universities as well. In 2011, the University of Colorado Boulder began implementing new, more sustainable methods of managing their lawns on campus. Their efforts involve using "compost tea," which is compost that has been brewed in water, in order to move away from herbicides and pesticides [6]. By the summer of 2014, the university noticed dramatic improvements in their lawn health. Some observed impacts included improvements in grass appearance and root structures' resilience when exposed to heat and stress. The university deduced that these specific changes were due to the compost tea and began to integrate it permanently within their irrigation system [7].

While not every university has the resources to invest in a compost tea brewer, there are still many ways to improve lawn health while also bolstering sustainability. In 2015, California Polytechnic State University (Cal Poly) took a different approach to fertilizers on their campus by creating their own compost. It is estimated that their compost application will divert 1.2% of the campus' total water usage- a large reduction considering how much water it takes to support a university's entire campus and student population. In addition to saving water, Cal Poly predicts that this transition to mulching campus green areas with compost will save $22,000 each year in lawn management costs [8]. On the East Coast, North Carolina State University (NCSU) began partaking in a transition to compost in 2015 by testing the differences between two plots of grass on a recreational field- one plot with compost and one without. The execution of NCSU's project is akin to our SAR team's pilot research in partnership with UCLA's Facilities Management. NCSU investigators carried out periodic soil sampling of the compost and control plot and found that the compost field demonstrated "improved soil health and compaction, resulting in turf growth very similar to the results achieved in synthetically fertilized areas" [9].

With other universities beginning to successfully integrate compost usage on their campuses, it is becoming clear that this modification can have a tangible impact on soil and lawn health. Our research team hopes to see similar positive developments on UCLA's campus within the next few years as well.

METHODOLOGY

The first step for our project was brainstorming on how to measure soil health comparatively. We developed an experimental procedure to determine plot divisions, compost and fertilizer applications, critical dependent variables to measure, and sampling frequency. Through ongoing communication with Facilities Management, our experimental process was refined to meet our stakeholders's needs while working within financial and time constraints.

PLOT LOCATIONS

Working with the stakeholders, we selected two plots of land in separate locations, with varying levels of regular sun exposure. Sun exposure can affect plant growth, making it essential to include plots with varying levels of sunlight to account for this confounding variable. The first plot is located on the east side of the Court of Sciences, in front of the Chemistry section of Young Hall (Appendix A). A large tree on the plot, as well as tall buildings surrounding the plot, offer continuous shade for a significant portion of the day. The second plot is located in a subsection of Portola Plaza, located to the west of the Physics and Astronomy Building (Appendix B). In contrast to the first, this area receives significant sunlight throughout the day since the plot is not bordered by any tall buildings or trees.

DIVIDING UP THE PLOTS INTO SUBSECTIONS

Having secured both plots of lawn, the next step was dividing up these areas to most effectively achieve reliability and validity in the results. Each plot was split into 3 subsections - an experimental fertilizer zone, an experimental compost zone, and a control zone. This allowed our team to test the compost's effect compared to both no application of fertilizers and the current practice of applying chemical fertilizer. All plots of both lawn spaces had a baseline of receiving fertilizer 7 months prior to our project period, as all UCLA lawn spaces are treated with chemical fertilizer granules in early August. In an effort to discern the true implications of compost use in contrast to fertilizer, we decided to reapply fertilizer in the “fertilizer” zone at the same time that we laid compost. Our control plot helped us understand the degree to which the baseline of 7-month-old fertilizer may be affecting the results of the experimental plots.

ACQUIRING FUNDING

The completion of the project totaled $1,975 overall. A large portion of this amount was for the soil sample testing. Since we were unable to find a UCLA lab that could efficiently fulfill the sampling needs of the project, the samples were sent to a third-party soil tester, Soil Control Labs, based in Watsonville, California. Their basic soil testing package was used for the first sampling, and their complete soil testing package was used for the following two rounds of samples, both of which include testing for various nutrient levels such as nitrogen, phosphorus, and potassium, as well as pH value and organic matter content.

Through discussions with our stakeholders, it was agreed that Facilities Management would cover the costs of purchasing compost and fertilizer, as well as the first round of soil testing, while our group would cover subsequent rounds through external funding. To do this, we applied for and obtained funding through The Green Initiative Fund at UCLA.

COMPOST AND FERTILIZER APPLICATION

The compost for this pilot study was provided by Athens Services, UCLA’s off-site waste management facility (Appendix C). The compost was created partly from food and organic waste collected from campus, creating a closed-loop waste management design where UCLA’s green waste was cycled back to replenish its lawns. Speaking to Robert Phillips, who works for Athens Services, provided more insight on compost processing [10]. As of right now, Athens is only creating agricultural grade compost that is intended for hearty crops. The ideal compost for our purposes, according to Mr. Phillips, is horticultural grade, which requires more space and a longer aging process to increase stabilization. This compost is less nutrient-rich, has a finer particle size, and is better suited for golf courses, sod farms, and lawns. Athens Services is planning to expand their storage space by 20 acres to produce this more refined compost by late 2021, which aligns well with UCLA's projected timeline to make this switch.

To prepare for fertilizing the grass (both with the compost and the chemical fertilizer), Facilities Management aerated the lawns. This process allows for air, water, and fertilizer nutrients to infiltrate into the soil quicker. On March 10th, 2020, several members of our team assisted UCLA Groundskeepers with the application process of the compost. A bulldozer was used to place the compost at the plot locations, and team members were taught to use shovels and rakes to distribute the mixture evenly across the grass of the designated plots. The final result was a thin coating of compost across the entirety of the experimental compost plots. Team members then used gloves to handle the chemical fertilizer, sprinkling it over the grass manually.

After the second soil sampling, Facilities Management expressed an interest in obtaining data on the effects of a second layer of compost being applied two months after the initial placement. Each compost plot in the experimental condition was then divided in half so that 50% of the area received only the initial round of compost and the other 50% received the initial and supplemental rounds of compost.

UCLA Groundskeepers assisting us with compost application in March

TESTING THE SOIL

Each round of soil testing required sampling from each of the plots. To do so, a soil extraction tool provided by Facilities Management was used. The device is a hollow metal tube with handles that can be manually inserted into the ground to extract cylinder-shaped portions of soil, reaching 4 to 5 inches deep into the soil layer. Several samples were taken within each plot to establish a representative sample. Next, each of the plot's samples was placed in separate plastic bags and labeled according to subsection and location. Facilities Management then shipped these samples to Soil Control Labs.

In addition to the samples that were sent to the lab, our group took another set of samples to measure moisture content. Through conversation with UCLA environmental engineering professor Dr. Jay, the team learned of a weighing and baking method to ascertain soil moisture levels that could be completed in any conventional oven. The team first took the soil samples' initial weights, then baked the samples at 400° Fahrenheit for four hours to remove all water content, then reweighed the samples.

Between winter and spring quarters, a total of three rounds of samples were tested, providing chronological data on the effects of compost versus fertilizer on nutrient levels and moisture retention.

Soil samples from 1st round of sampling in March

OPINION SURVEY

Quantifying the desire amongst UCLA students, faculty, and staff for more sustainable lawn practices is crucial to our final deliverable. Ultimately, our goal is to determine whether transitioning away from chemical fertilizer not only offered tangible environmental and aesthetic benefits, but also reflected the wishes of the UCLA community.

In order to measure community support for this initiative, a poster explaining the project was created during winter quarter incentivizing students to fill out a survey via a scannable QR code. The signage, which was to be placed at the two plots, was intended to draw the attention of students passing by. However, UCLA's transition to remote learning for the spring quarter due to the COVID-19 Pandemic altered these plans. Instead, the survey was distributed remotely through various online platforms, such as UCLA student based Facebook groups, student organization GroupMes, and departmental email LISTSERVs to maximize outreach.

The survey focused on student opinions on the importance of sustainable lawn management practices and visual differences between the plots. The aesthetics were judged using the images of one of the experimental compost plots taken before and after compost application. The questions were created with the help of our stakeholders and Nurit Katz (UCLA's Chief Deputy Sustainability Officer) to minimize bias and confusion in the questions. Specifically, the survey provided insight into respondents' opinions on the following topics:

- Interest in learning more about sustainability practices on campus
- Initial knowledge of differences between chemical fertilizer and compost
- Importance of reducing grass reseeding amounts
- Importance of decreasing campus water usage
- Importance of decreasing fertilizer runoff
- Importance of UCLA's green space aesthetics and usability in comparison to the importance of campus sustainability

CHALLENGES

From the beginning, our team experienced various challenges we had to overcome. An unassociated student group with UCLA's Renewable Energy Association (REA) contacted us intending to do similar research with the same stakeholder entities and resources. Fearing a duplicated project, we met with this team and conferred to aid each other in creating two separate pilot projects with different stakeholders: one on campus spaces with Facilities Management and one on The Hill residential spaces with Housing and Hospitality Services. Since the two zones operate under different management procedures, results may show that certain conditions are more conducive to undergoing a switch to compost than others. The end result of the two projects would be to expand the data set, strengthening the overall results acquired. However, it may be a few more quarters before the REA team fully collects and compiles their data.

A major component of our project relied on measuring various indicators of soil health. Therefore, finding a way to test soil nutrient levels throughout our project was imperative. Since an on-campus laboratory was not an option, and we were unable to acquire individual measuring tools, we had to outsource this work to Soil Control Labs. However, the testing package we used from this company did not provide moisture retention information. In response, our team discovered a way to measure this value using a simple home procedure.

The last issue proved to be less detrimental to our research project than initially projected. As we began to shift from the planning to the actualization phase, the COVID-19 Pandemic resulted in the UCLA campus transitioning to remote instruction. Fortunately, our extensive network of stakeholders, advisors, and SAR leaders allowed us to obtain the second two rounds of sampling despite our members no longer being present on campus. The only adjustment needed was to edit the survey to include images of the plots, instead of having survey participants able to visually compare the plots in person.

RESULTS

I. NUTRIENT AND MOISTURE LEVELS (Appendix D and E)

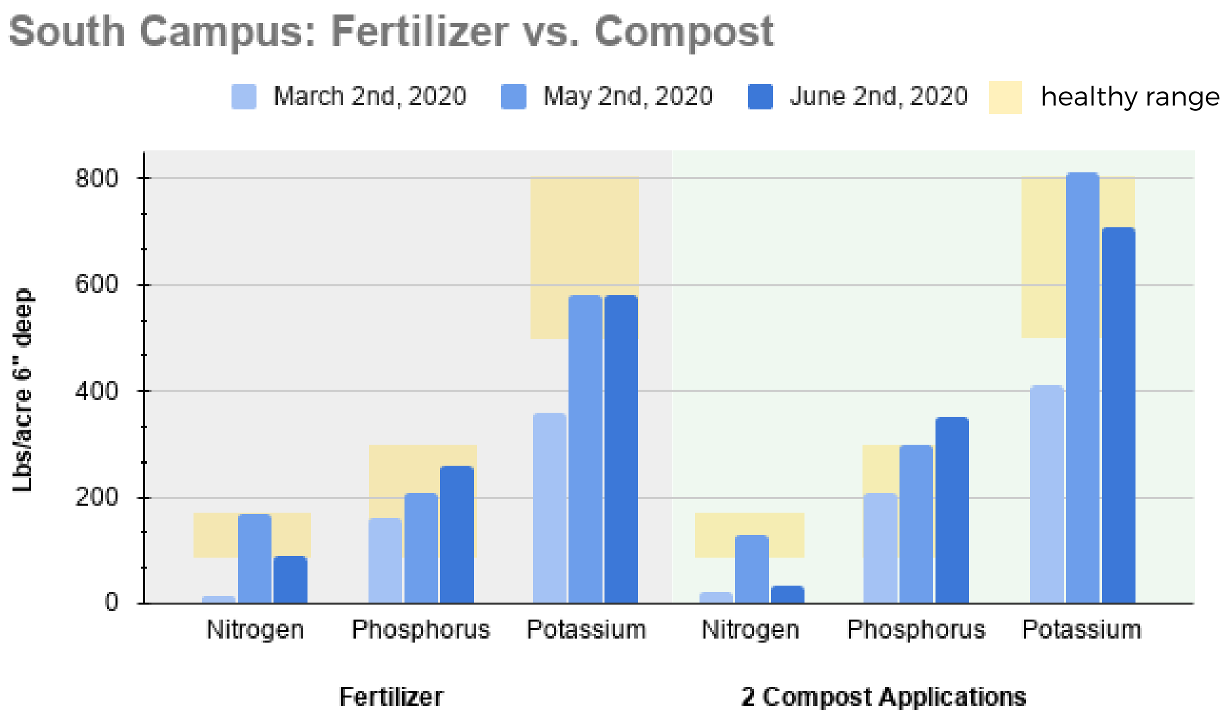
The soil sampling data provided information on many aspects of soil and lawn health. However, this report primarily focuses on four factors that most strongly indicate soil health for our purposes: nitrogen, phosphorus, potassium, and moisture retention. These factors were selected because nitrogen is a vital nutrient for grass growth and for creating grasses of bright green color, phosphorus facilitates strong root growth and more resilient grass, potassium aids in the movement of water and nutrients through the plant, and moisture retention allows the soil to more efficiently use water.

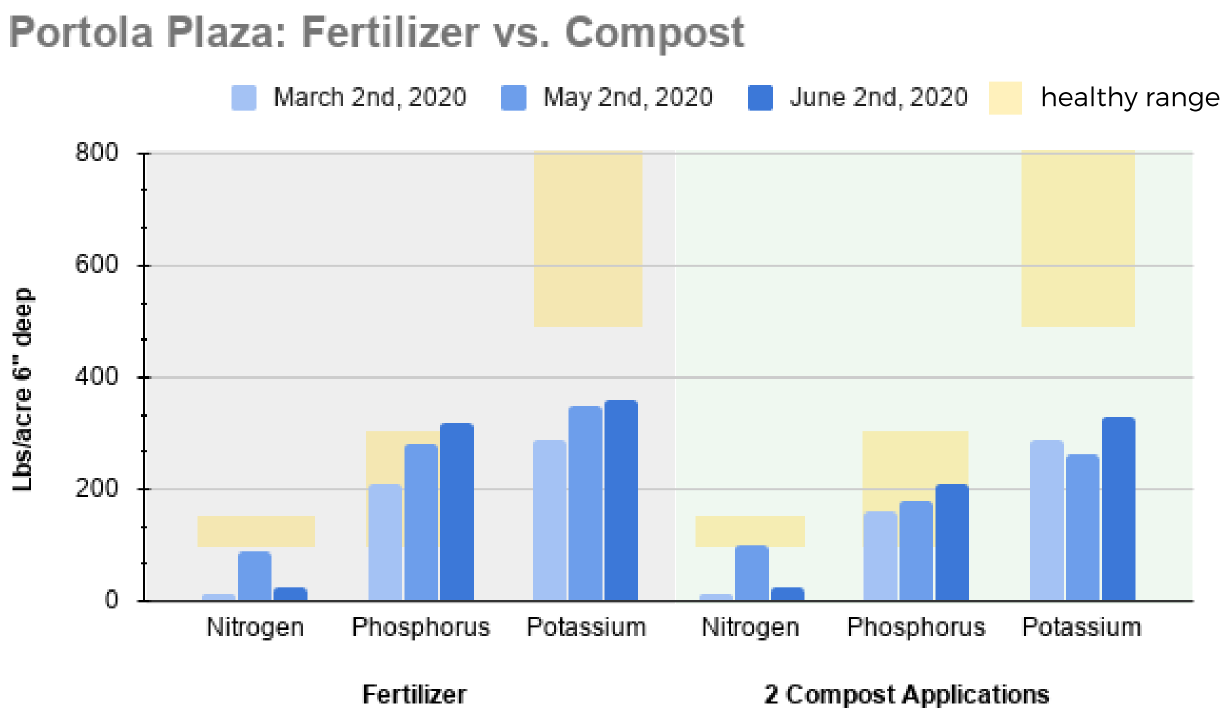
The results revealed that the initial total available nitrogen content was low in both the South Campus and Portola Plaza plots. Throughout the experiment, we saw that the total available nitrogen value increased in all of the Portola Plaza plots but still remained below the recommended value. At the South Campus plots, we saw a similar trend of the values increasing, but not still reaching the recommended level.

The observed phosphorus values in our initial sampling revealed that the levels were within the recommended range for both the Portola Plaza and South Campus plots. Throughout our experiment, The South Campus double compost plot phosphorus value increased slightly above the recommended range, while the other three South Campus plots increased but remained within the original recommended range. At the Portola Plaza plots, the phosphorus values increased to slightly exceed the recommended values in the compost, fertilizer, and double compost plots. The control plot saw minimal change in phosphorus values throughout the experiment.

The potassium values were below the recommended range for all four plots at both locations in our initial testing. Throughout our experiment, we saw that the values for the Portola Plaza plots increased toward the recommended range in the compost, fertilizer, and double compost plots. The compost and double compost plots' potassium values increased more than the fertilizers', making the compost and double compost plots the closest to the recommended value. The control plots' potassium values decreased throughout the experiment, making their levels further from the recommended value.

Soil Nutrient Levels (Soil Control Labs)





The moisture retention values at the Portola Plaza plot saw a slight increase in all of the plots over the course of the experiment, with the compost plot showing the largest increase during the 3 month period. The South Campus plot also saw slight increases in all four plots; however, the double compost plot saw the largest increase in moisture retention.

Additionally, the soil sampling report provided suggestions for values of nitrogen, phosphorus, and potassium in pounds per acre that, if added, would make the soil healthier. Over the course of the project, nitrogen values saw a decrease in the South Campus control, compost, and double compost plots over the course of the experiment. Meanwhile, the fertilizer plot increased in recommended additional nitrogen levels. The Portola Plaza plots had a decrease in the control and fertilizer plots, and no change in recommendations for the compost and double compost plots. The suggested values for phosphorus decreased to 0 for all plots except the Portola Plaza control and fertilizer plots. The Potassium levels decreased for all South Campus plots except the fertilizer plot, which saw an increase. The South Campus double compost plot saw the largest decrease in additional nutrients required, with the recommended values reaching 0. Conversely, the Portola Plaza Plots saw decreases in the control, fertilizer, and compost plots. The double compost plot only saw a decrease in the recommended additional phosphorus value.

II. SURVEY (Appendix F)

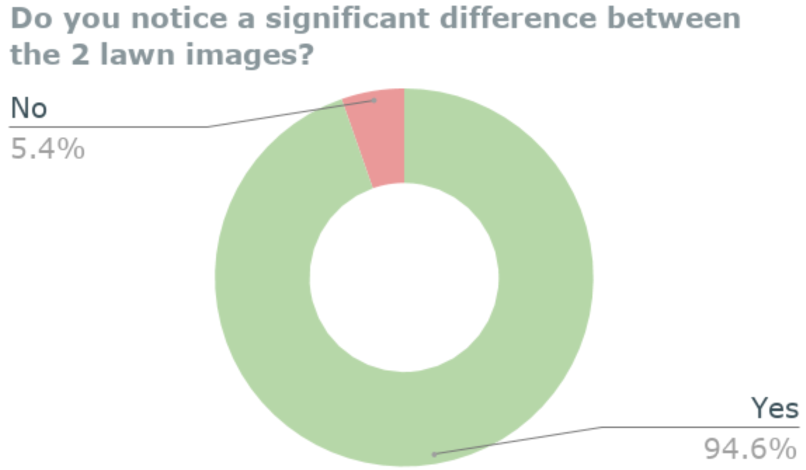
During the experiment, we surveyed UCLA students on their knowledge and opinions of UCLA's lawn management practices. The survey asked questions on a scale of 1-5, with values of 1 or 2 suggesting low interest/knowledge, 3 suggesting indifference, and 4 or 5 suggesting high interest/knowledge. Of the 261 students surveyed, 93% (242/261) of students agreed that lowering the water use on our green spaces through switching to compost is very important, 89% (233/261) stated that preventing synthetic fertilizer from being washed into waterways is very important, and 71% stated that reducing reseeding frequency through transitioning to compost is very important to them. Additionally, when presented with unlabeled before and after pictures of the South Campus compost plot, 95% (247/261) of students said they noticed a difference in the grass aesthetics, with 96% (241/250) of those students confirming that the lawn after compost appears healthier.

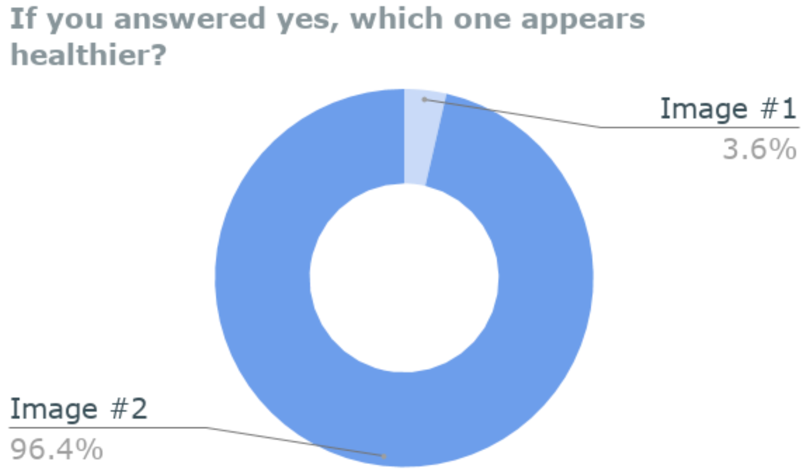
Image #1

Before compost

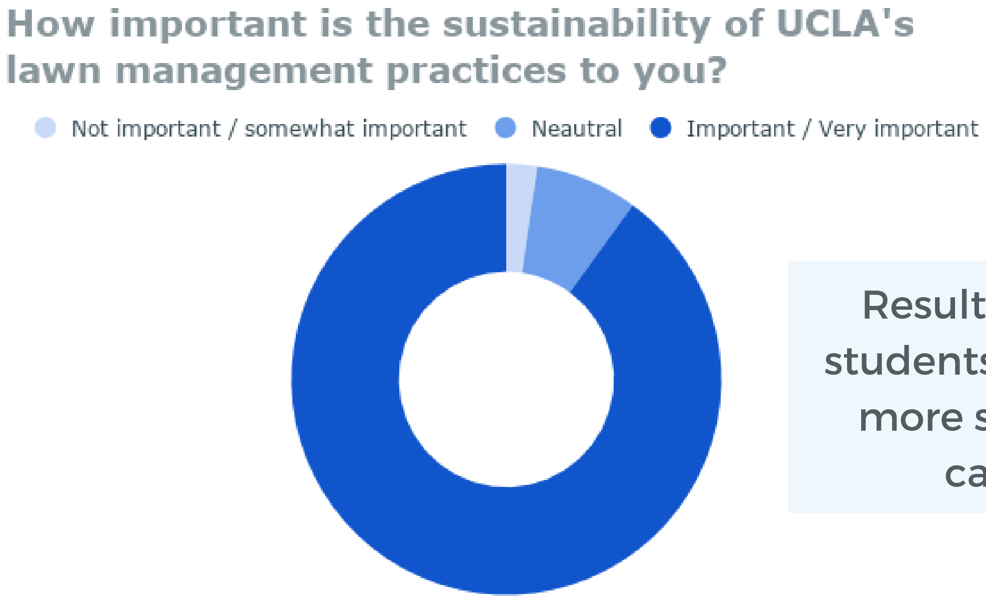
Image #2

2 months after first compost application

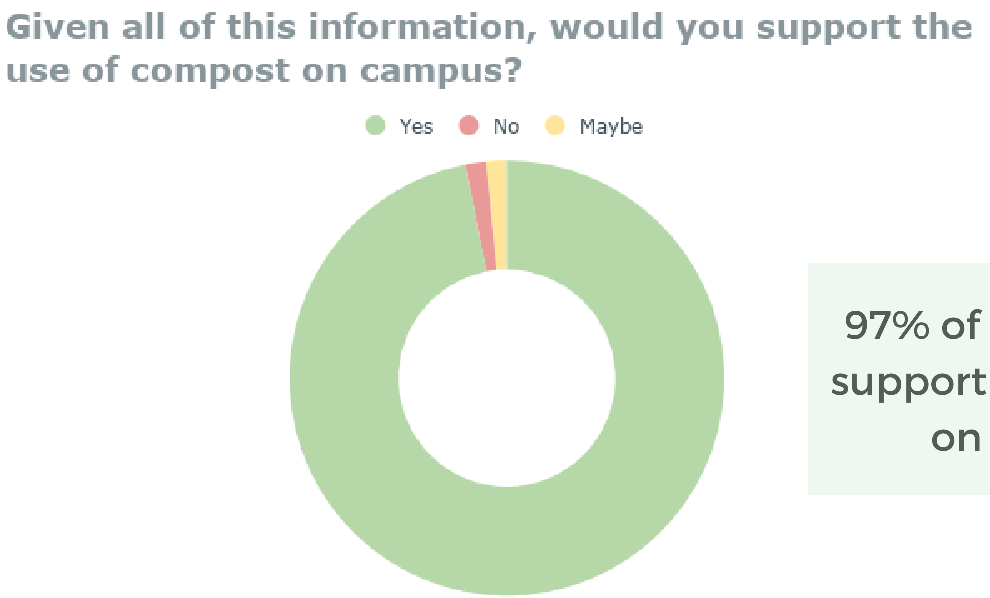




Acknowledging that a switch to compost usage may have no effect, or even a positive effect on aesthetics, only 47% (122/261) of respondents stated that the aesthetics of UCLA's lawns were very important to them, while 90% (234/261) of respondents stated that the sustainability of UCLA's lawn management was very important to them. Lastly, we informed respondents that if implemented, compost would be applied once or twice a year during low student use periods and could result in a loss of usability of that space for a couple of weeks. Ultimately, 97% (253/261) of respondents indicated that they would still support compost usage given these potential restrictions.



Results highlight students' desire for a more sustainable campus



97% of respondents support compost use on campus

DISCUSSION

This research emphasizes the role of university policy in improving resource allocation for lawn management. The current cost of the Best 19-6-12 and Simplex fertilizer granules total $12,474.20 per year. The compost from Athens is free aside from transportation costs, which are $350 per 10-yard long container. For 20 containers a year, this totals $7,000. By switching from fertilizer granules to compost, UCLA would save approximately $5,474.20 in material costs annually.

However, these decisions also extend into water usage and reseeding regularity, which may both have significant cost implications as well. Since water meters combine building water with landscaping, Facilities Management is currently unable to measure how much water is used solely for landscaping. Nonetheless, after applying compost, our results showed that soil moisture levels increased, indicating that irrigation requirements could be less in the future if compost is utilized. Furthermore, the survey results suggest a strong student interest in organic lawn maintenance practices and campus sustainability. Understanding that large portions of the community support these sustainability initiatives allows UCLA to consider changes that have been stymied by assumptions that the change would be too arduous for Facilities Management teams or unsupported by the public. Stakeholders Chris Gallego and Justin Wisor noted that the biggest challenge that UCLA may face to transition to organic compost fertilizer might be in training the groundskeepers on implementing new methods. Both concurred that this can be accomplished upon proper training and explaining the environmental and cost benefits behind the new methods.

As our society takes steps to shape a more sustainable future, turning linear supply and consumption chains into circular patterns of reuse and repurposing is becoming increasingly necessary. By transitioning lawn management practices to utilize compost sourced from its very own organic waste, UCLA can be on the front lines of this movement, serving as an example and inspiration to other large institutions. Looking beyond this project, our team intends to continue collaboration with UCLA's Renewable Energy Association Research Team and hopes that this research will serve as a guide for future projects. Our team also encourages Groundskeeping to further reduce water usage through repurposing lawn spaces to increase usability for students by creating more outdoor study spaces. One example of this is the 45,500 square-foot lawn in front of Murphy Hall that has been replaced with drought-tolerant landscaping, which will help save roughly 3 million gallons of water annually. These efforts are all contributing to UCLA's overarching sustainability goal of reducing potable water usage per capita by 20% from campus baseline levels by the end of this year [9]. To date, the university has already reduced its water usage by about 8% since 2000, equating to roughly 100 million gallons of annual savings.

UCLA has the opportunity to divest from chemical fertilizers and instead, invest in locally made compost. By doing so, this can improve soil health and consequently, reduce water consumption and reseeding regularity. Students are calling for more responsible lawn management practices, and it is time for UCLA to step up and enforce these healthy and affordable changes.

Kristen and Elizabeth applying the first round of compost in Portola Plaza

THANK YOU

Chris Gallego, Justin Wisor, Bonny Bentzin, UCLA Facilities Management, UCLA Groundskeepers, and The Green Initiative Fund

Elizabeth, Liana, Jasmine, Kristen, Madeleine, Clare

WORKS CITED

[1] Rafiee, Ata, and J C Tarafdar. "Compost vs. Fertilizers: What's the Difference? Researchgate, 11 Nov. 2017, www.researchgate.net/post/Compost_vs_Fertilizers_Whats_the_Difference.

[2] Jones, Clain. Comparisons of Manure, Compost, and Commercial Fertilizers. Montana State University. 2 Feb. 2020.

[3] Anas, Brittany. "CU-Boulder to Replace Herbicide Use on Campus with 'Compost Tea'."Boulder Daily Camera, MediaNews Group, Inc. , 5 June 2011,www.dailycamera.com/2011/06/05/cu-boulder-to-replace-herbicide-use-on-campus-with-compost-tea

[4] Gallego, Chris. Stakeholder communication. May 21, 2020.

[5] "Grounds Conservations & Preservation." Facilities, 6 Feb. 2017, www.facilities.ucla.edu/services/landscape-grounds/grounds-conservation-preservation

[6] Kuta, Sarah. "CU-Boulder Team Studying Effects of 'Compost Tea'." Boulder Daily Camera, MediaNews Group, Inc. , 6 Oct. 2014, www.dailycamera.com/2014/10/06/cu-boulder-team-studying-effects-of-compost-tea/.

[7] Elliot, Dennis K, et al. Cal Poly State University San Luis Obispo 2015 Drought ResponsePlan. 24 Apr. 2015, afd.calpoly.edu/sustainability/docs/drought%20response%20plan%202015.pdf.

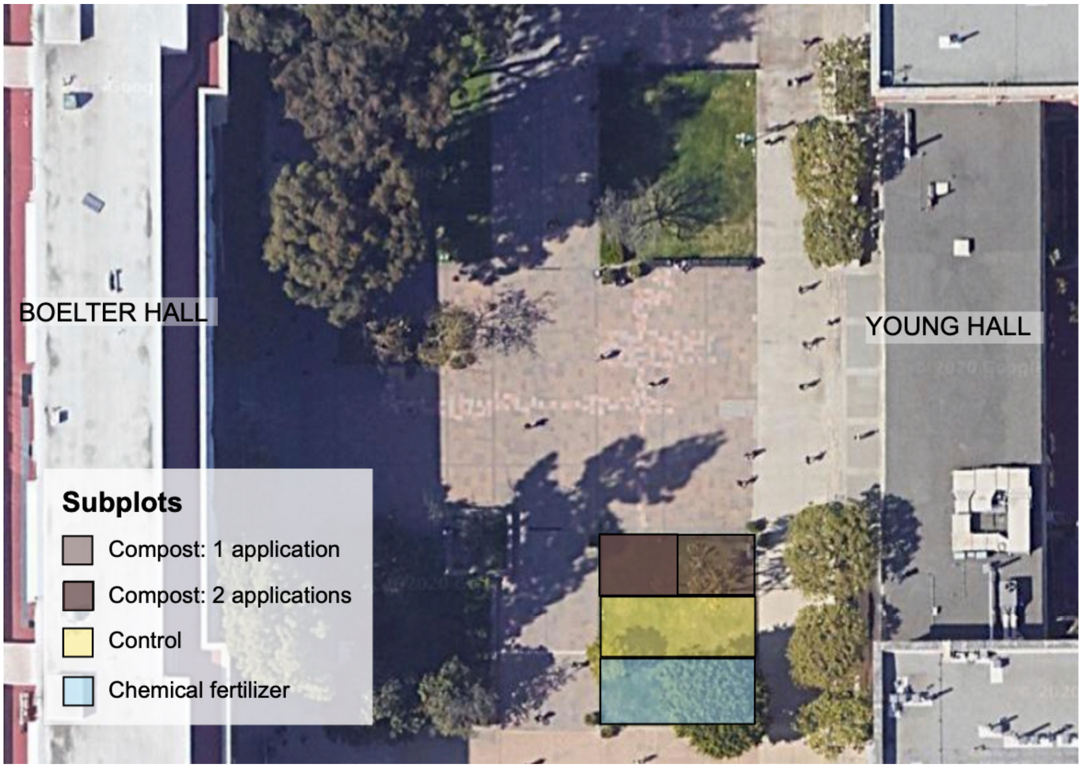
[8] Davis, Carla. "Students Study Compost as Alternate Fertilizer for Campus Recreation Fields."NCSU Sustainability, North Carolina State University , 10 Sept. 2015, sustainability.ncsu.edu/blog/2015/09/10/students-study-compost-as-alternate-fertilizerfor-campus-recreation-fields/.

[9] Hewitt, Alison. "UCLA Doing Its Part to Save Millions of Gallons of Water per Year." UCLA, UCLA, 10 June 2015, newsroom.ucla.edu/stories/ucla-doing-its-part-to-save-millions-of-gallons-of-water-per-year.

[10] Phillips, Robert. Personal interview. June 3, 2020.

APPENDICES

Appendix A: South Campus Plot



Appendix B: Portola Plaza Plot

Appendix C: Athens Services Compost Data

US COMPOSTING COUNCIL

Seal of Testing Assurance

American Organics
Soknaka Soun
20055 Shay Road
Victorville
CA 92394

Date Sampled/Received: 29 Apr. 20 / 30 Apr. 20

Product Identification
AO Compost SP1 4/2020

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	*Reported as* (*units of measure*)	*Test Results*	*Test Results*
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	1.0	1.6
Phosphorus	P_2O_5	0.50	0.80
Potassium	K_2O	0.77	1.2
Calcium	Ca	1.9	3.0
Magnesium	Mg	0.33	0.52
Moisture Content	%, wet weight basis	36.6	
Organic Matter Content	%, dry weight basis	39.0	
pH	units	8.11	
Soluble Salts (*electrical conductivity* EC_5)	dS/m (mmhos/cm)	7.8	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	100.0	

Appendix D: Soil Control Labs Recommended Nutrient Additions (lb/acre 6" deep)

South Campus Plots

Control

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	0	100
Phosphorus	150	50	0
Potassium	250	200	200

Fertilizer

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	0	0	125
Phosphorus	50	50	0
Potassium	200	200	250

Compost

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	0	100
Phosphorus	50	0	0
Potassium	250	200	200

Double Compost

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	0	100
Phosphorus	50	0	0
Potassium	250	200	0

Portotla Plaza Plots

Control

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	0	100
Phosphorus	100	50	50
Potassium	550	400	300

Fertilizer

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	25	100
Phosphorus	100	100	50
Potassium	600	550	350

Compost

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	50	125
Phosphorus	50	0	0
Potassium	600	600	500

Double Compost

Date	March 2, 2020	May 2, 2020	June 2, 2020
Nitrogen	125	50	125
Phosphorus	50	0	0
Potassium	600	600	600

Appendix E: Moisture Content Data

March 2, 2020

Location	Inital Weight (oz)	Final Weight (oz)	% moisture
South Campus (SC)	11.4	8.6	24.56%
Portola Plaza (PP)	12.1	9.2	23.97%

May 2, 2020

Location	Inital Weight (oz)	Final Weight (oz)	% moisture
SC control	8.1	6.7	17.28%
SC chemical fertilizer	6.35	5.25	16.00%
SC compost	8.95	5.6	37.43%
PP control	5.6	3.35	40.18%
PP chemical fertilizer	7.75	4.9	36.77%
PP compost	9.18	7.38	19.61%

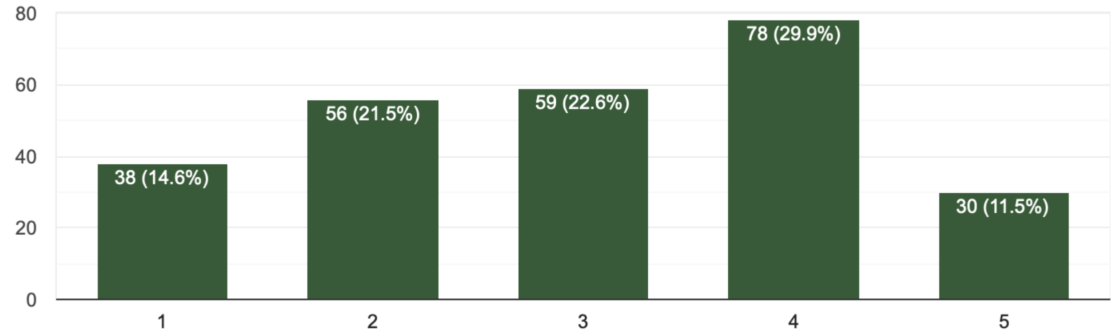
June 2, 2020

Location	Inital Weight (oz)	Final Weight (oz)	% moisture
SC control	4.8	3.5	27.08%
SC chemical fertilizer	4.8	3.5	27.08%
SC compost	5.2	3.9	25.00%
SC double compost	6.3	4.4	30.16%
PP control	4.7	3.5	25.53%
PP chemical fertilizer	5.8	4.2	27.59%
PP compost	6	4.3	28.33%
PP double compost	7.5	5.6	25.33%

Appendix F: Student Survey Results

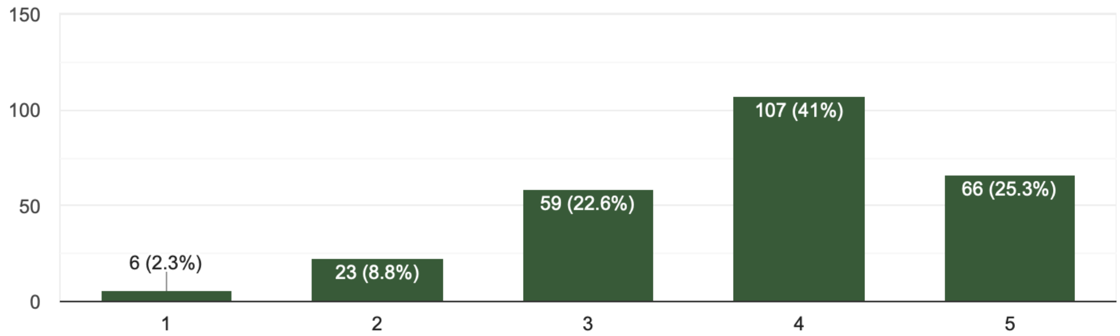
How familiar are you with the difference between synthetic fertilizers and compost?

261 responses



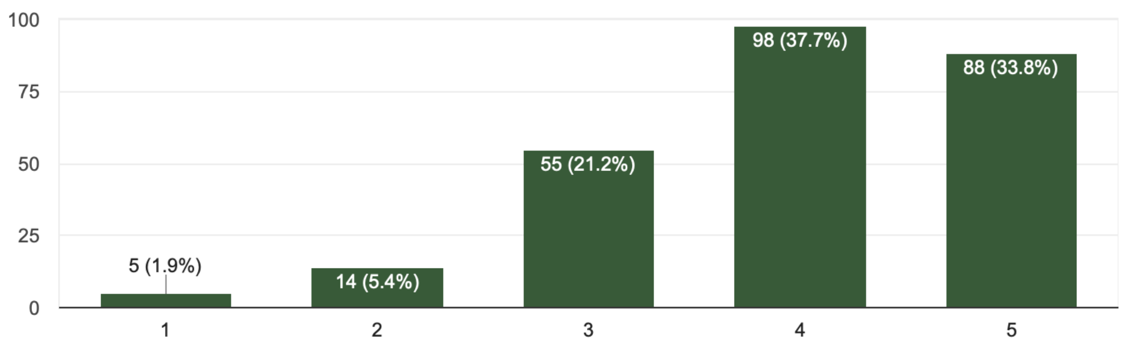
How interested are you in learning more about the topic of green space health management?

261 responses



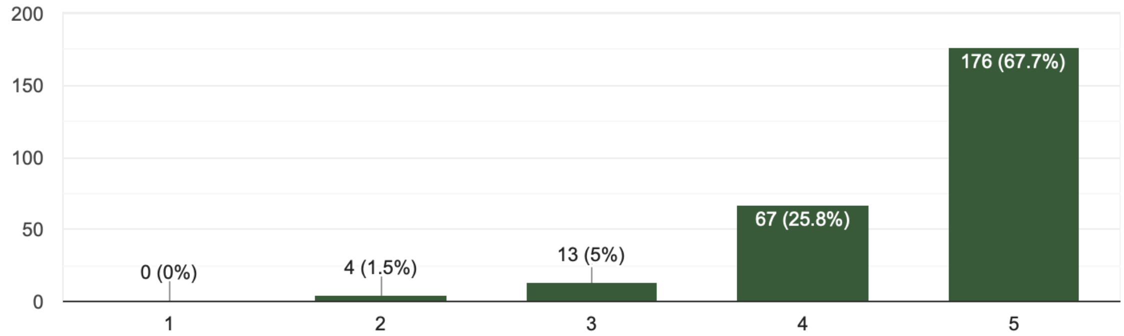
The use of compost could improve root strength, reducing the number of times Facilities Management has to reseed. How important is this to you?

260 responses



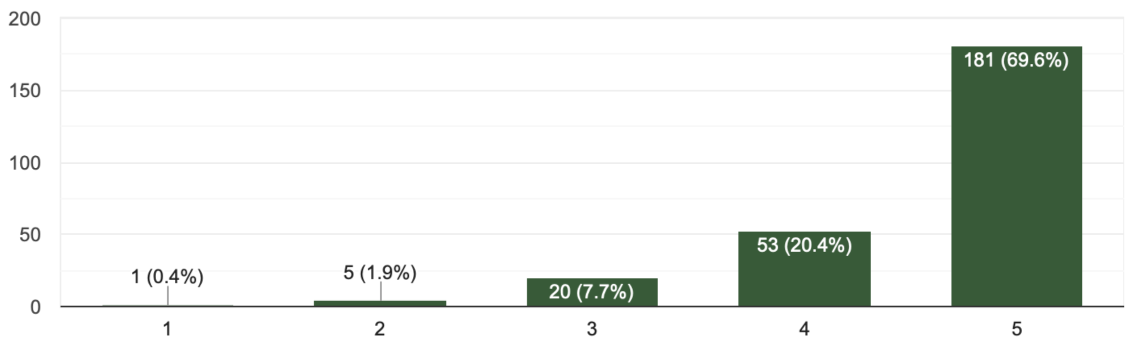
The use of compost could increase the soil's ability to retain water, thus lowering the water use on our green spaces. How important is a decrease in water usage by UCLA Facilities Management to you?

260 responses



Synthetic fertilizer can be washed into waterways in our watersheds such as Ballona Creek and the Santa Monica Bay, destroying native plant and animal habitats. How important is decreasing fertilizer runoff to you?

260 responses



Acknowledging that a switch to compost usage may have no effect on aesthetics, how important are the aesthetics of UCLA's lawns to you?

261 responses