UNIVERSITY OF CALIFORNIA
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Optical and Thermal Remote Sensing of Turfgrass Response to Different Deficit Irrigation Strategies in Central and Southern California

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Technical Completion Report
Project Period: March 1, 2017 – February 28, 2019

Project Summary

The US west is generally arid and subject to droughts, yet some of the largest cities across the nation are in this region. Irrigation demand is usually the most significant component of total outdoor water use in urban sectors in southern California. The main objectives of this study were to develop water conservation strategies for irrigated turfgrass in southern California and to quantify the impact of different deficit irrigation regimes on turf health and quality using remote sensing technologies. Bermudagrass showed much higher performance under deficit irrigation compared to tall fescue. Consequently, bermudagrass is recommended for Southern and Central California where improving irrigation water use efficiency of urban landscapes is crucial for maintaining urban green infrastructure while conserving water resources. We found no remarkable water savings due to limiting watering days to only multiple days per week as compared with a no watering restriction scenario. There was on average 12% over-irrigation relative to the desired irrigation level by the smart irrigation controller when data compared to CIMIS stations near the experimental sites. Therefore, the smart ET based controller showed promising performance for autonomous landscape irrigation in urban settings. Our results showed that multispectral imagery (using a drone-mounted camera and handheld sensors) is an effective way to detect drought injury in irrigated landscape. On the other hand, cellphone attached thermal cameras showed lower accuracy and their application is not suggested for precise monitoring of landscape health and its response to drought.

Outreach

The results of this study were disseminated among a diverse body of clientele through nine oral and poster presentations. We disseminated information about turfgrass irrigation best management practices using smart irrigation controllers and discussed water savings achieved using efficient deficit irrigation strategies in Southern California in Orange County (9th annual Urban Landscape and Garden Education Expo, 2017) and Coachella Valley (CV Water Counts Academy on Desert Water Agency, 2017). We also presented the results of this work to the scientific community and among peers at 2019 ASABE annual international meeting, 2019 SSSA International soil meeting, 2018 tri-societies annual meeting, and 2017 WERA1022 multistate research project's annual meeting.

Notable Achievements and Awards

The research team was awarded two extramural funds (by USGA through Turfgrass and Environmental Research Grant and by UC ANR through Competitive Grants Program) to expand the work initiated using this seed grant.

Publications & Products

- Cheung, K., Pourreza, A., Zuniga-Ramirez, G., Reiter, M., Haghverdi, A. (2019). Identification of drought stress in turfgrass using hyperspectral and multispectral remote sensing, 2019 ASABE Annual International Meeting, Boston, MA (Oral presentation).
- Cheung, K., Pourreza, A., Zuniga-Ramirez, G., Reiter, M., Haghverdi, A. (2019). Identification of drought stress in turfgrass using hyperspectral and multispectral remote sensing, ASABE CA/NV Sectional Meeting, Tulare, CA (poster presentation).
- Haghverdi, A., Reiter, M., Ghodsi, S., Singh, A. (2019). Evaluating the Performance of Smart Evapotranspiration-Based Controllers in Southern and Central California. Soil Science Society of America International Soils Meeting, Jan 6-9, San Diego, California (oral presentation).
- Haghverdi, Amir, (2017), *Smart Landscape Irrigation Controllers*. CV Water Counts Academy. Desert Water Agency. Palm Desert (oral presentation).
- Haghverdi, Amir, (2017), *Smart Landscape Irrigation Management*. 9th annual Urban Landscape and Garden Education Expo. UCANR. Irvine, (oral presentation).
- Haghverdi, Amir, (2017), *Urban landscape irrigation: ET-based smart deficit irrigation management*, WERA1022 Multistate Research Project's Annual Meeting, Twin Falls, Idaho (oral presentation).
- Haghverdi, Amir; Somayeh, Ghodsi., (2017), *Developing Urban Irrigation Water Conservation Strategies Using Smart Soil Moisture Sensor-Based Controllers*, "ASA, CSSA, and SSSA Annual Meeting". ASA, CSSA, and SSSA. Tampa, FL (oral presentation).
- Pourreza, A., Zuniga-Ramirez, G., Reiter, M., Haghverdi, A. (2019). Identification of Drought Injury in Turfgrass Using Hyperspectral and Multispectral Remote Sensing. Soil Science Society of America International Soils Meeting, Jan 6-9, San Diego, California (oral presentation).
- Reiter, M., Pourreza, A., Zuniga-Ramirez, G., and Haghverdi., A. (2018). Multispectral and Thermal Remote Sensing of Turfgrass Response to Deficit Irrigation in Central California. 2018 ASA and CSSA Meeting, Nov. 4-7, Baltimore, MD (poster presentation).
- Singh, A., Sharifi, M., Ghodsi, S., Haghverdi, A. (2019). Monitoring the Impact of Multiple Water Conservation Strategies on Turfgrass Using Ground Based Remote Sensing Tools. Soil Science Society of America International Soils Meeting, Jan 6-9, San Diego, California (oral presentation).