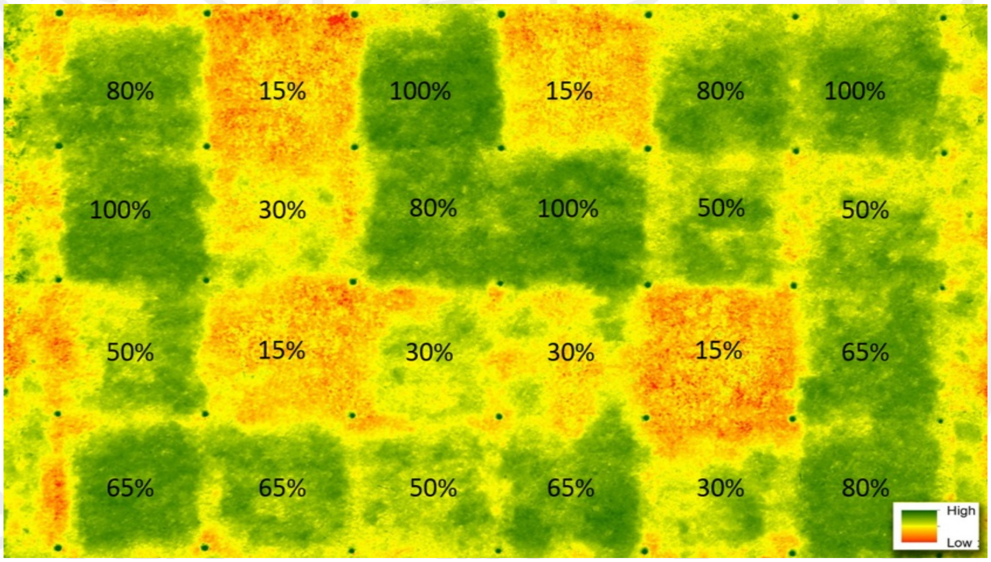
USGA® RESEARCH UPDATE

Small Unmanned Aircraft Systems Detect Turfgrass Drought

New technology may offer the use of small unmanned aircraft systems (UAS) for turfgrass management. Small UAS use remote sensing to measure turfgrass properties and diagnose plant stresses. Small UAS can cover an 18-hole golf course faster than handheld or ground-vehicle platforms.

Kansas State University is evaluating the ability of small UAS to detect drought stress in turfgrass across a gradient of well-watered to severe deficit irrigation. They compare the remote measurements with traditional (handheld) techniques. Local golf courses are monitored during the summer and fall to apply the research results.

A field study was conducted from June 29 through August 31, 2015, on creeping bentgrass mown at 5/8 inches under a rainout shelter. Six irrigation treatments included 100, 80, 65, 50, 30, and 15 percent replacement of estimated evapotranspiration (ET). Measurements were taken weekly with a digital camera, modified to include near infrared (NIR), green, and blue bands. The camera was



Kansas State University is evaluating the ability of small unmanned aircraft systems (UAS) to detect turfgrass drought stress. This photo is a near infrared (NIR), color-enhanced image of creeping bentgrass irrigation plots maintained as golf course fairway. The irrigation treatments are the percentages evapotranspiration (ET) replacement. The dark green (High) areas indicate there is more biomass (or healthy turf) in this image created with ArcGIS.

mounted on a hexacopter flown at 600 feet within three hours of local solar noon. Images were processed for eight vegetation indices (combinations of NIR, green, and blue bands) and the three individual bands were evaluated for the ability to detect drought stress. Additional measurements included soil moisture at three inches with a FieldScout TDR 300, visual quality, percentage green cover (digital image analysis); and NDVI with a handheld, FieldScout 1000.

After 64 days of irrigation treatments, soil moisture was highest in 100 and 80 percent ET plots and declined with ET treatment (see photo). Soil moisture was statistically similar between 80 and 65 percent ET, but higher at 100 than at 65 percent ET. Turfgrass quality was acceptable among 100 through 65 percent of ET, but quality declined after that and was unacceptable at 50 through 15 percent of ET. Green cover was similar among the 100 through 50 percent ET treatments, but it declined rapidly at 30 and 15 percent of ET. Significant bare soil was visible in 15 percent ET, and less so in 30 percent ET plots.

Measurements with handheld NDVI detected no differences among the 100 through 50 percent ET plots. Among the eight vegetation indices and three individual bands, the near infrared (NIR) band (see photo) and Green-Blue vegetation index [(Green – Blue)/(Green + Blue)] were most sensitive. These bands were the only ones that detected differences between 65 and 100 percent ET, which was similar to the trend in soil moisture described above.

The research indicates high-resolution remote sensing with small UAS can detect drought stress before it is visible to the human eye. Preliminary measurements of a golf course revealed interesting differences in fairways, tees, and greens between summer and fall. Additional research will be conducted in 2016.

Source: Dr. Dale Bremer, Kansas State University

Additional Information:

Evaluating small unmanned aerial systems for detecting turfgrass stress with an emphasis on drought

USGA Water Resource Center

What is ET

Case Studies in Water Use Reduction in California