SMART FARMING STUDY: USE OF CLEVER INFRARED SENSORS

Climate change, manifesting itself in storms, floods and especially droughts have continued to trouble businesses all over the world. This change has significant, often negative, impact on farming systems globally. It is projected that semi-arid regions of the world will expand, with increased and sporadic temperature spikes, and decreased and sporadic precipitation. In many areas, the crop varieties and species currently grown by farmers cannot tolerate these stresses, with resultant losses in productivity, and potentially negative consequences for food security.

Kansas State University runs several research programs aimed at the identification of technological opportunities to minimize economic and environmental impact and increase food security in the changing climates.

One of the sites for these programs is at K-State's Northwest Research and Extension Center, which maintains long-term cropping system studies to evaluate cropping intensity and tillage effects on water use, yield formation and critical soil properties. The ultimate goal of the program is to maintain or increase productivity of crops in water-limited, semiarid conditions.

Study to the effect of limited transpiration

Two years ago, Kansas State University researchers, along with colleagues from Colorado State University, originated a study on sorghum diversity and adaptation. The project, now with over two years of data, was recently extended with Robert Aiken, Crops Research Scientist, at Kansas State's Northwest Research—Extension Center at Colby.

The project goal is to identify and select varieties of sorghum that have the trait 'limited transpiration'; the ability of plants to retain their productivity with reduced water loss. Plants that have this trait will be more likely to survive and maintain their yield in semi-arid regions as they are able to reduce their water loss through evaporation.

As it is projected that more regions in the world will become semi-arid, it is essential for food security to breed crops that can maintain productivity in these challenging environments.

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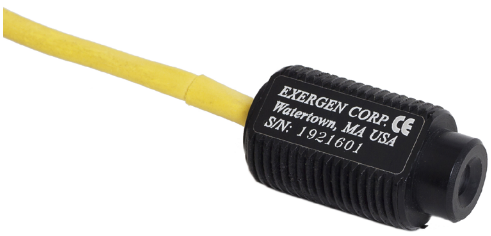
Adapted breeding
One of the most potent ways to ensure crop health and productivity in a changing climate is plant breeding: changing the traits of plants in order to produce desired characteristics. The goals of plant breeding are to produce crop varieties that exhibit unique and superior traits for a variety of agricultural applications. Examples of those traits are water use efficiency, nutrient use efficiency and pest/disease resistance.

In the study, breeders aim to breed sorghum varieties that show ‘limited transpiration’ and will thus be able to improve adaptation to dry climates.

Role of temperature measurement
In the extended study various sorghum varieties are being grown in semi-arid conditions while the research team aims to identify and select the varieties with limited transpiration.

Limited transpiration is a trait that is not visible from the outside of a plant. You can’t select for it by using visual traits. It can only be identified by measuring leaf temperature in combination with ambient temperature and relative humidity. These are critical parameters in the Penman–Monteith equation to calculate evapotranspiration (moisture loss). Plants with limited transpiration have a higher leaf temperature than plants without this trait, as the leaves are less ‘cooled’ by the evaporation of moisture.
To calculate evapotranspiration accurately and identify the varieties with limited transpiration, it is essential that the leaf temperature is measured accurately and repeatedly, in the range of 0,1°C accuracy and repeatability.

Exergen IRt/c
Aiken selected the Exergen IRt/c.03 sensor with germanium detector and embedded thermocouple in the sensor housing for accurate ambient temperature measurement. The IRt/c.03 sensors are, like all IRt/c sensors, passive devices that don’t drift and need no maintenance or recalibration in the field



Exergen’s proprietary technology – unpowered IR sensors – has advantages over powered sensors or contact sensors.

“We were familiar with Exergen’s IRt/c line as we had used them in a previous study. The work relies on accurate temperature measurement which is the essential part of our study,” Aiken said.

Scaling up
Exergen IRt/c sensors are employed to measure leaf temperatures locally, with a high degree of accuracy. For larger areas the method can be scaled up by using drones with thermal cameras that can measure large areas. Thermal cameras lack the accuracy and repeatability of IR sensors. Yet when both techniques are combined, you get a system with the best of both worlds: accuracy and reliability of the IRt/c, whilst scaling up for large areas with thermal cameras. Using this smart farming concept will provide the hope to increase the quantity and quality of products while optimizing even human labor, with a positive result on worldwide food security.

[You can find the complete Tech Note on this subject here]

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