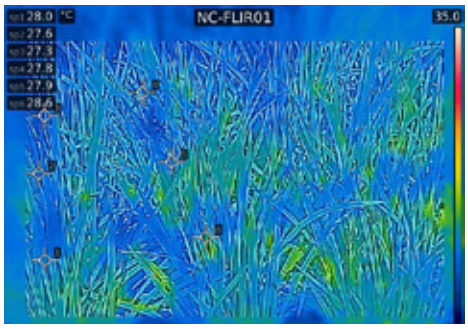
APPLICATION STORY

FLIR Systems contributes to visualization of agriculture with its compact thermal imaging infrared cameras

Japan's agriculture is faced with many serious problems, such as the aging of workers, a lack of successors, and trade liberalization under the Trans-Pacific Partnership. Research on optimization and automation of agriculture is under way to solve these problems with a focus on monitoring temperature images of crops during the cultivation process. Using fixed thermal imaging cameras, the researchers visualize surface temperatures of crops over a set period of time. This technology—which was not available in the past—is contributing greatly to agricultural optimization and automation.



Thermal imaging infrared camera FLIR AX8 generates infrared images of 80 x 60 pixels together with temperature information.

THE STUDY

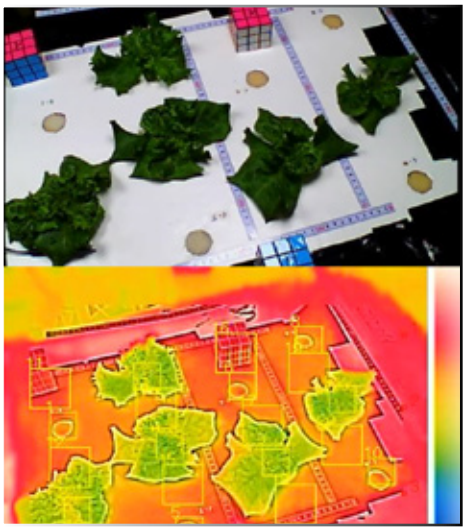
The study currently underway, titled "Development of plant growth estimation technologies combined with robust field monitors and micro-fluidic model simulating plant vascular system," is the result of a cooperative effort by researchers from several universities and support from the Japan Science and Technology Agency's CREST initiative, a funding program for team research.The research group includes Professor Ryo Miyake at The University of Tokyo (Graduate School of Engineering), Professor Atsushi Ogawa at Akita Prefectural University (Faculty of Bioresource Sciences), and Associate Professor Tetsushi Koide at Hiroshima University (Research Institute for Nanodevice and Bio Systems, or RNBS).

Koide and his team are in charge of collecting and analyzing data on the cultivation process for agricultural crops. The thermal imaging infrared camera FLIR AX8 provides temperature images of crops during the cultivation process.

AGING AGRICULTURAL POPULATION AND KNOW-HOW

"In order to hand down veteran farmers' expertise, it is necessary to collect various data," Koide explains. With the aging of workers and a shortage of successors in Japanese agriculture, efforts are gathering momentum toward automation in different segments. Japan is currently known as the world's fifth-largest agricultural power. However, more than 60-percent of the agricultural population is age 65 or older, while people under the age of 35 represent only five-percent of the working population.

The most important thing in Japan's agriculture is to inherit the know-how to nurture agricultural crops, but in recent years the number of successors is shrinking. Such know-how



The infrared camera FLIR AX8 continuously observes the growth of crops.

must be accumulated from a variety of other sources. Understanding how to use such data in an effective manner in the field is becoming increasingly important. Above all, it is critical to know how to prepare fertilizers and nutrients. For example, Koide notes that "there are almost no climates that are the same across Japan. The climate environment will change even in Japan, owing to various factors. In the past, the Tohoku region lacked sunshine, compared with normal years."

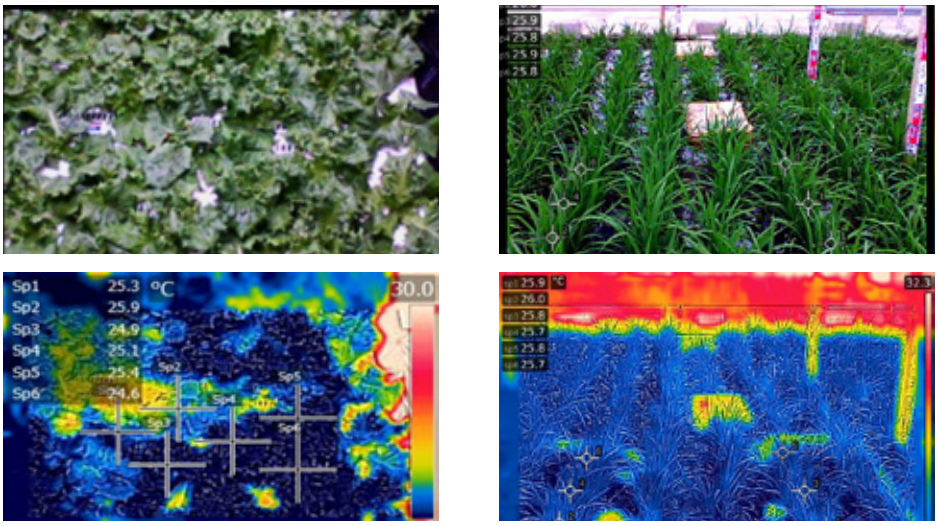
However, by using FLIR AX8, it has become possible to ascertain the surface temperature of agricultural crops. By accumulating temperature data, the researchers are working toward the "visualization" of agricultural crops to enable such new activities as calculating hours of sunlight in specific areas, in addition to identifying general temperature distributions.

In fact, annual meteorological forecasts have not always been accurate. However, if the team can collect temperature data, thermal images, and visible images in real time and periodically from a permanently installed fixed camera, it may be possible to adapt to environmental changes by adjusting the amount of fertilizers and nutrients accordingly.

WHAT AFFECTS RICE GRADES

Japanese agriculture, as noted earlier, is experiencing a shrinking number of successors. Meanwhile, crop breed improvement is highly active, as shown in the growing number of rice varieties. Currently, more than 800 rice varieties are registered in the country, as breed improvement is gaining momentum.

Infrared cameras play a big role in such breed improvement scenes. In recent years, Japan has seen abnormal weather patterns accompanied by rising temperatures. The higher temperatures affect not only the health of humans and animals, but also the growth of agricultural crops. In case of rice, if the temperature increases during the ripening period, it suffers a "high-temperature damage," as the plant grows with many immature white grains and the like. This is attributable not only



The sunlight hours and temperature distribution of leaves are measured using temperature data.

to excessively high temperatures, but also to how farmers manage water and fertilizers. Such high-temperature damage also influences the grade of the rice affected.

An infrared camera enables researchers to identify any association of temperature distribution data and thermal images in real time with the occurrence tendency of high-temperature damage. By introducing such cameras at an early stage, it may be possible to create an environment that minimizes damage to rice. In addition, by accumulating temperature data, the team can check sunlight hours and temperature distributions of rice and leaves, which may help reduce damage to rice by determining the suitable amount of moisture. Further accumulation of data will also help the team make decisions about whether to accelerate or delay cultivation in the following years, which would be impossible with existing know-how alone.

Infrared cameras are effective in these circumstances because they can monitor the state of leaf temperature in real time. Traditionally, agriculture scientists have measured the state of photosynthesis by placing plants in a chamber With an infrared camera, it is possible to measure the leaf temperature without giving stress to the leaves and clarify the relationship of the temperature with transpiration.

It is highly likely that rice management with such state observation will improve rice quality, as well as prevent grade decline caused by high-temperature damage and other factors. "In the future, we would like to further advance our research, so that infrared cameras can be applied to local crops of Hiroshima Prefecture," says Koide.

FUTURE PROSPECTS FOR AGRICULTURE

The goal for Koide and the research team is "to practicalize next-generation cultivation technology and to promote widespread use of image sensing technology among farmers while pursuing the ease of use of such technology." Conventionally, agricultural technologies have been developed based mainly on know-how and experience of farmers. It is quite a new experience for them to periodically acquire temperature data in real time and use such data to obtain a trend graph of the temperatures of rice and rice leaves. By keeping records of temperature trends, farmers may be able to measure the state of photosynthesis. FLIR AX8 plays a very big role in visualizing the trend of high-temperature damage.

Currently, the goal of participating universities is to discover sensors and sensing information that can be useful for next-generation cultivation technology. Kiobe's team believes FLIR infrared cameras–with their capabilities in collecting and processing temperature data and images–will greatly contribute to the development of agriculture.

More about FLIR Systems and our products can be found at:

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The images displayed may not be representative of the actual resolution of the camera shown. Images used for illustration purposes only.

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