CIMMYT
International Maize and Wheat Improvement Center

informa
No. 1832 • 22 February -01 March 2013

Getting insights from high above: new remote sensing platform in Obregón

With funding from MAIZE and WHEAT CRPs, the Global Conservation Agriculture Program acquired a new remote sensing system consisting of a multispectral and a thermal camera, software, and methods allowing for semi-automated image processing. The two cameras were delivered in February by Pablo J. Zarco-Tejada, director of QuantaLab remote sensing laboratory, Instituto de Agricultura Sostenible (IAS), Consejo Superior de Investigaciones Científicas (CSIC), Córdoba, Spain. Zarco-Tejada along with three technicians spent several days at CIMMYT-Obregón to train a pilot and CIMMYT staff on the equipment use.

The thermal camera helps to measure a water stress indicator: plant canopy temperature. Plants under water stress close their stomata to reduce transpiration, which increases crop canopy temperature as a result of reduction in evaporative cooling. Consequently, temperature differences between well-watered and water-stressed plants can be used to detect water stress accurately and at early stages. This will be used by MasAgro to measure the impact of tillage on crop water use efficiency, but it will also enable CIMMYT to develop a diagnostic tool based on the Crop Water Stress Index to help farmers determine the right time to irrigate wheat in the Yaqui Valley, Mexico. Once validated, the Crop Water Stress Index may also serve to identify the best time to irrigate plots at the research station.

The multispectral camera measures the light reflected in green, red, and near-infrared ranges. While a dense plant canopy can absorb more than 95% of the light in the visible range (violet to red), it reflects most of the light in the near-infrared range. Information on the light reflectance in the visible and near-infrared ranges helps to estimate ground cover and leaf area index, parameters usually correlated with biomass and yield. With two spectral channels in the red-edge region (in between the red and near-infrared ranges), the camera also allows to estimate the canopy chlorophyll content or greenness. Chlorophyll content is closely related to the nitrogen status of the crop, but it can be used to detect other nutrient deficiencies as well. Furthermore, the potential of using the multispectral camera in an airplane as a 'flying GreenSeeker' could enable researchers to diagnose nitrogen needs to optimize yield for around 1,000 hectares in about 1 hour, at a resolution of about 4 meters.

Within a few weeks, a hyperspectral camera will be added to the system. This camera with a spectral range between 400-1,000 nanometers is capable of acquiring 320 spectral bands and can be used to obtain images at a resolution as fine as 0.20 meters. It will be used to study the potential of the multispectral and hyperspectral sensors mounted on an airplane to diagnose nitrogen status and derive nitrogen recommendations to improve wheat quality (high protein content, low percentage of yellow berry, etc.). The hyperspectral imager also enables stress detection using other narrow-band vegetation indices related to the light-use efficiency, such as photochemical indicators, and quantification of chlorophyll fluorescence related to the canopy photosynthesis. Since all sensors can be mounted on the airplane simultaneously, it may be possible to diagnose irrigation and nitrogen fertilization needs during one flight. Thus researchers can develop diagnostic tools and recommendations for in-season nitrogen and water management to achieve higher nitrogen and water use efficiency. ▶

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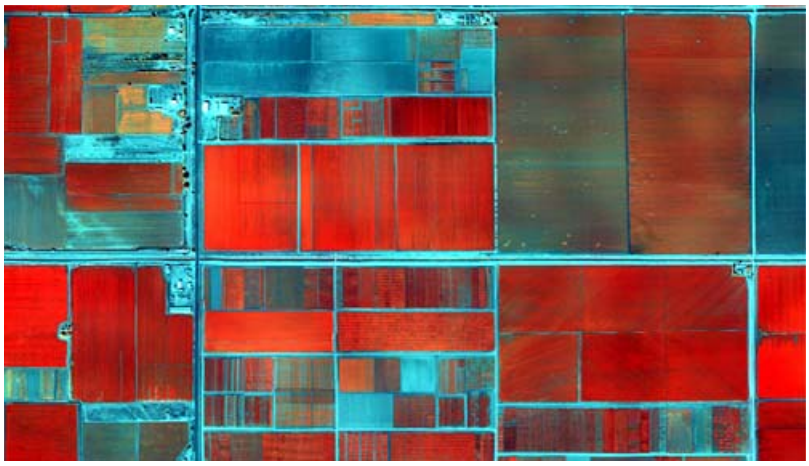
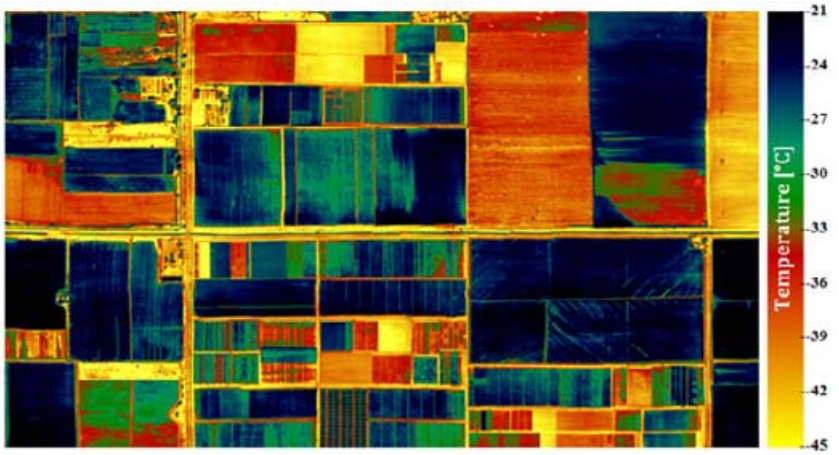
The multispectral and thermal cameras are fully operational and will cover the research station in Obregón on a weekly basis until the end of April, with the resolution ranging between 0.20 and 0.40 meters, depending on the flight altitude and the type of camera. This is detailed enough to identify individual plots.

The collaboration between CIMMYT and QuantaLab-IAS-CSIC will continue through the setup of the new hyperspectral camera, further research conducted on crop stress indicators, and the identification of successful remote sensing indices. Canopy temperature, normalized difference vegetation index, and other vegetative indices will be made available at minor cost to all interested scientists. These measurements could be used for phenotyping, physiological, and agronomic research.

For further information, please contact Iván Ortiz-Monasterio (i.ortiz-monasterio@cgiar.org) or Bruno Gerard (b.gerard@cgiar.org).



False color image of CIMMYT station at Obregon acquired from the multispectral camera at 1 m resolution on Feb. 15, 2013. Plots with dense vegetation are shown in red. The road on the left going N-S is N. E. Borlaug, while the road in the middle of the image going E-W is the division between blocks 710 and 810.



Thermal image of CIMMYT station at Obregon acquired from the thermal camera at 2 m resolution on Feb. 14, 2013. Well-watered (cooler) plots are shown in blue, while water-stressed (warmer) plots are shown in green and red. Roads and bare soil areas have an even higher temperature and are shown in yellow.

Maize lethal necrosis: Scientists and key stakeholders discuss strategies as the battle continues

A recently-emerged disease in Eastern Africa, maize lethal necrosis (MLN), remains a serious concern. A regional workshop on the disease and its management strategies was held during 12-14 February 2013 in Nairobi, Kenya. Organized by CIMMYT and the Kenya Agricultural Research Institute (KARI), the workshop brought together nearly 70 scientists, seed company breeders and managers, and representatives of ministries of agriculture and regulatory authorities in Kenya, Uganda, and Tanzania, as well as experts from the U.S.A.

The key objective of the meeting was to "establish a strong interface between research and regulatory institutions in Eastern Africa to effectively tackle the MLN challenge, including the ongoing efforts and further steps to identify and deploy disease-resistant germplasm, and to create a system that can ensure a constant flow of varieties," explained B.M. Prasanna, CIMMYT Global Maize Program director. Prasanna highlighted the difficulties faced by the maize farming community from the disease, and emphasized the need to accelerate deployment of MLN resistant maize varieties and to generate necessary awareness among the relevant stakeholders on management strategies. "It is necessary to break the MLN disease cycle and tackle the problem from multiple perspectives," added KARI director Ephraim Mukisira. He mentioned that besides partnering with CIMMYT on breeding for MLN resistant varieties, KARI will also be distributing seed of alternative crops to farmers in affected areas. "As a dairy farmer, I will be planting napier grass instead of maize this season," noted Mukisira.

The first signs of a new disease appeared in 2011 and 2012 in the Rift Valley Province, Kenya. A team of CIMMYT and KARI scientists identified it as MLN, a disease caused by a double infection of the maize chlorotic mottle virus (MCMV) and the sugarcane mosaic virus (SCMV) and transmitted by insects. According to Godfrey Asea, plant breeder and head of the Cereals Program at the National Crops Resources Research Institute (NACRRI), Kampala, MLN was also identified in Uganda. Furthermore, symptoms of MLN have been cited in Tanzania, said Kheri Kitenge, maize breeder at the Selian Agricultural Research Institute (SARI), Arusha.

Scientists, particularly breeders, have made significant progress in tackling the disease. Studies are already underway at two field sites (Naivasha and Narok) where responses of a wide array of inbred lines and pre-commercial hybrids are being evaluated under high natural disease pressure and artificial inoculation. Participants visited the Sunripe Farm in Naivasha, where they observed KARI-CIMMYT MLN trials under natural disease pressure. A trial under artificial inoculation in Naivasha featuring nearly 175 commercial maize varieties is showing high levels of susceptibility to MLN. Researchers remain hopeful as some of the elite inbred lines and pre-commercial hybrids developed under projects such as the Drought Tolerant Maize for Africa or Water Efficient Maize for Africa are showing resistance to the disease.

During the farm visit, KARI pathologist Anne Wangai and her team showed how to generate artificial inoculum for MCMV and SCMV, as well as the enzyme-linked immunosorbant assay (ELISA) based technique for pathogen diagnosis at the national agricultural research laboratories at the KARI campus. The participants observed an artificial inoculation of maize seedlings in the field, followed by a discussion on some of the major changes in maize seed demand resulting from MLN incidence.

"The maize seed industry is under stress in Kenya due to the need to replace some popular but MLN-vulnerable varieties as soon as possible," explained Evans Sikinyi, Seed Trade Association of Kenya (STAK) executive officer. All stakeholders agreed that the foremost priority is to identify and speed deployment of MLN resistant maize varieties. "We also have to enhance the diagnostic capacity in the labs and ensure there is a rapid response and surveillance on MLN," added Esther Kimani, general manager of phytosanitary services at the Kenya Plant Health Inspectorate Service (KEPHIS).

In the concluding session of the workshop, stakeholders identified key research areas and discussed partnership opportunities.

Strengthening partnership with Ningxia Hui Autonomous region

On 21 February 2013, Yuan Hanmin, vice president of the Ningxia Academy of Agriculture and Forestry Science (NAAFS), hosted Qu Dongyu, vice governor of Ningxia Hui Autonomous region, China, and the newly appointed CIMMYT cropping systems agronomist Allen Jack McHugh. Joining the meeting was a considerable entourage of television cameras, reporters, government officials, the Academy president, divisional chiefs, and translators.

Dongyu expressed his familiarity and friendship with CIMMYT, CGIAR, Australian Centre for International Agricultural Research (ACIAR), CIMMYT director general Thomas Lumpkin, and a wide range of Sino-Australian activities and marketing potential. He shared his opinion on zero tillage, which he believes is a key technology to address the considerable water resource issues that Ningxia faces. Surrounded by deserts on three sides, the Yellow River is a significant source of water, especially for the booming viticulture and goji berry industries. However, as limited water is transferred to higher value crops (grapes, goji berries, and vegetables), there is a significant concern regarding the loss of staple food (wheat and rice) cropping area.

Dongyu discussed with McHugh the International Conservation Agriculture Forum to be held during 28-30 May 2013 in Yinchuan City, Ningxia, China, and the Arabic Market Expo, which will take place in Ningxia later this year. Dongyu stated that the Expo is "an excellent opportunity for Australian and other wine producing countries to participate in market and crop development in Northwest China." He indicated that livestock associated researchers and industry would benefit from attending the event as well. After having covered a range of topics, including Dongyu's association with Lumpkin, and his time at CGIAR and the Chinese Academy of Agricultural Sciences (CAAS), McHugh noted that "the Vice Governor is a very congenial and astute personality, one which we should be grateful to have in our corner." He believes that with CIMMYT's continued involvement, the Global Conservation Agriculture Program will advance in Northwest China.

International Winter Wheat Improvement Program annual meeting

Representatives from 11 participating research institutes, ICARDA-Tashkent, and CIMMYT-Kabul gathered for the International Winter Wheat Improvement Program (IWWIP) annual meeting in Afyon-Karahisar, Turkey, during 19-20 February 2013 to summarize the latest season results and findings and to develop directions and work plan for 2013. IWWIP is a partnership between the Ministry of Food, Agriculture and Livestock of Turkey, CIMMYT, and the International Center for Agricultural Research in the Dry Areas (ICARDA) to develop new winter/facultative wheat varieties for the region of Central and West Asia and to facilitate global germplasm exchange.

Presentations during the meeting demonstrated that as germplasm development continues, several research areas (soil-borne pathogens, sunny pest screening, salinity evaluation, use of digital photo and normalized difference vegetation index for germplasm evaluation, climate change analysis, genetic gain study, VRN effect, drought screening, landrace evaluation, rust yield loss, common bunt evaluation, etc.) receive significant attention, which helps the program to improve its efficiency and better target the adaptation of new germplasm.

The 2013 work plan concentrates on implementation of IWWIP External Review recommendations. Other important planned activities include International Winter Wheat Traveling Seminar in Uzbekistan in May 2013, training activities, and International Winter Wheat Conference in 2014 in Turkey.

Tree planting ceremony in memory of the late Dr. Twumasi-Afriyie

On the morning of 21 February 2013, the staff of CIMMYT-Ethiopia and ILRI-Addis Ababa campus gathered by the ILRI main entrance in Addis Ababa, Ethiopia, to plant a tree in the memory of Strafford Twumasi-Afriyie, Ghanaian-born maize breeder and former CIMMYT colleague who succumbed to cancer on 03 January 2013, leaving a substantive legacy as a breeder and a significant contribution to food security in Africa. The ceremony was held in the presence of Twumasi's widow Veronica Twumasi-Afriyie and was preceded by ILRI coffee morning dedicated to the late Dr. Twumasi.

Informa is published every Friday by CIMMYT Corporate Communications. We welcome your input, preferably in both English and Spanish. The deadline for submissions is 3:00 p.m. on the Wednesday before publication. We reserve the right to edit all contributions. Please send proposed material to Connie Castro c.castro@cgiar.org.
web site: www.cimmyt.org

Weekly photo contest winners: Open grain storage in India

Our winner in this week's Informa photo competition is Surabhi Mittal, senior scientist – agricultural economist at the Socioeconomics Program at CIMMYT-India. The photo from Karnal, Haryana, India, shows open storage of grain, a type of storage that contributes to extensive post-harvest losses, especially under the current uncertain weather conditions. This year, India has recorded the highest rainfall ever for the month of February

As a bonus, Surabhi also sent us an image of women making cow dung cakes, which are later used as fuel for cooking in rural households of India. This particular photo was taken in the village of Barabanki, Uttar Pradesh, during a field survey for CCAFS.

Don't forget to send us your entries for next week's competition. From now on please email them to **Barbora Nemcova** (b.nemcova@cgiar.org)—or hand them over on a USB stick—and to look out for the winners on CIMMYT's flickr, where they are shared under a Creative Commons license. Congratulations to Surabhi and thank you to all our participants!