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EDITORIAL

Highlights in precision agriculture

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Precision agriculture, which can be also called precision farming, may be defined as a management strategy that uses information and communication technologies (ICT) to bring data from multiple sources to bear on decisions associated with crop production. As the introduction of this new technological and industrial revolution proceeds, biotechnology, new materials and nanotechnology, Internet of things (IoT), and new energy technologies have been infiltrating rapidly into agriculture. Advanced manufacturing of agricultural equipment, agricultural big data, and agricultural robots are being adopted by the industry and are gradually being introduced to all fields of production agriculture. Smart agriculture, as the upgrade of precision agriculture is often called, has developed a strong momentum in terms of research, development, commercialization and adoption.

Data acquisition is the first step in implementing precision agriculture and remote sensing can provide an important and convenient method for acquisition of data. Chenghai YANG provides an overview of commercially available high resolution satellite sensors that have been used or have potential for precision agriculture. The applications of these sensors in precision agriculture are reviewed and examples based on the application of the author's work are provided to illustrate how high resolution satellite imagery has been used for crop identification, crop yield variability mapping and pest management.

Multispectral and hyperspectral imaging are other powerful tools for acquisition data in precision agriculture. Yong ZHANG and Naiqian ZHANG review applications of imaging technologies in high-throughput phenotyping, the applications of imaging technologies in detecting and measuring plant morphological, physiological, and pathological traits, and discuss their advantages and limitations. Du-Han KIM et al. describe a real-time onion disease monitoring system using image acquisition that consists of a motorized driving system and a PTZ (pan, tilt and zoom) camera to take images of plants which, after image processing and analysis, can identify the disease areas of onion. Yongjun DING et al. introduce procedures for the extraction of hyperspectral images to detect immature green citrus fruit. After taking the hyperspectral images within citrus trees under natural illumination conditions, the successive projections algorithm (SPA) selects characteristic wavebands and three slope parameters which are used to identify the green citrus fruit. Construction of a detection model according to the Grey Level Co-occurrence Matrix (GLCM) identifies green fruit by analyzing texture features of separate areas. Results show that the developed algorithm has a great potential for identifying immature green citrus for early yield estimation.

Data modelling and interpretion is also an important step in precision agriculture. Yuxin MIAO et al. propose an integrated approach to site-specific management zone delineation. There are three basic approaches to management zone delineation using soil and/or landscape properties, yield information, or both sources of information. Authors suggest an integrated approach to delineate site-specific management zones using relative elevation, organic matter, slope, electrical conductivity, yield spatial trend maps, and yield temporal stability maps. It is concluded that the integrated approach combining soil, landscape and yield spatial-temporal variability information can overcome the weaknesses of approaches using only soil, landscape or yield information, and is more robust for

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management zone delineation. Taking the late blight potato disease as the subject, Alexey FILIPPOV et al. have developed a weather-based model to determine potential yield losses caused by the disease and optimize fungicide application. Muhammad WASEEM et al. focus on the suitability of common models for estimating hydrology and diffuse water pollution in North-eastern German lowland catchments with intensive agricultural land use, and review desired hydrological, hydraulic and water quality (nitrogen fate and transport in surface, subsurface and groundwater bodies). All those research results can be used in DSS (decision support system) of precision agriculture or smart agriculture.

VRT (variable rate treatment) is the essential part of precision agriculture or smart agriculture. Qing TANG et al. carried out high-speed wind tunnel evaluations of the droplet spectra of air induction nozzles. A series of air induction nozzles were tested and the parameters influencing the droplets distribution were studied and analyzed. UAV (unmanned aerial vehicle) is the symbol of modern agricultural machinery and has been widely utilized in precision agriculture. Weixiang YAO et al. researched the effect of UAV prewetting on pesticide droplet deposition during the flowering period of cotton. After prewetting, the mean droplet deposition quantity was obviously increased and the droplet deposition uniformity on the leaf blade was improved. The results provided a valuable reference for future research and practice to improve the effectiveness of pesticides applied to cotton by aerial applications.

Technology trajectory is also important in precision agriculture or smart agriculture. Beth CLARK et al. propose a framework for accelerating technology trajectories in agriculture in China. The results will provide the policy support to secure sustainable food production and to implement precision agriculture in China.

The articles in this special issue focused on hot topics in precision agriculture. All results and conclusions will be very valuable and helpful to the practice of precision agriculture. As the Guest Editors, we would like to thank all authors and reviewers for their contribution and hard work, as well as the FASE editorial team for their input and support.

Dr. Chunjiang ZHAO, Academician of the Chinese Academy of Engineering, is the director of the National Engineering Research Center for Information Technology in Agriculture (NERCITA), chief expert of the National Research Center of Intelligent Equipment for Agriculture (NRCIEA), director of the National Engineering Laboratory of Agri-product Quality Traceability, and director of the Key Laboratory of Agri-informatics (Ministry of Agriculture). He is also the chairman of the Intelligent Agriculture Committee of the Chinese Association for Artificial Intelligence (CAAI), Vice-President of the Chinese Society of Agricultural Engineering, and Vice-President of the Chinese Society for Agricultural Machinery. Dr. ZHAO has been mainly engaged in research on agricultural informatics, agricultural intelligent system, and precision agriculture technology and equipment. He has successively served as the chief expert of the National High Technology Research and Development Program of China (863 Program) "Digital Agriculture Technology and Equipment" in the field of Modern Agriculture, and the team leader of the technical expert group of the 863 Program "Application and Demonstration of Intelligent Agricultural Information Technology" in the field of Information Technology. He has also led the implementation of other national programs such as "Computer Agriculture", "Digital Agriculture", and "Precision Agriculture". Dr. ZHAO has won four Second Class Prizes of the State Scientific and Technological Progress Award, and the UN World Summit Award (WSA) on IT in 2003.

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