Centre for Chemicals Application Technology of China Agricultural University

Centre for Chemicals Application Technology (CCAT) of China Agricultural University (CAU), is one of the important parts of the National Key Laboratory of Chemicals Application of the Ministry of Agriculture. Cooperating with Hohenheim University and Julius Kühn Institute (JKI) in Germany since 1985, CCAT of CAU was established with the help of Hohenheim University and Application Techniques Division of JKI with some key apparatus and equipment, and also financially supports from the China National '211' and '985' projects. Application techniques in practice highly influence the chemicals utilization, including the biological efficacy of chemicals, the residues of chemicals, and harms of chemicals to water bodies, biotopes and neighboring crops. Application technique is the key to chemicals manageability as well as user protection. The CCAT focuses on developing plant protection procedures and optimizing the use of chemicals by means of advanced techniques and equipment to minimize the risks of chemicals application.

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Professor He Xiongkui, the Director of the CCAT, is the Member of International Standards Committee of ISO/TC 23/SC 6 Plant Protection Machinery and Application Technology, the Member of National Standardization Committee for Plant Protection Machinery and Application Techniques, the Secretary General of Beijing Pesticide Society, the Member of the German Engineer Society, the Talent of New Century and the Scientist of National Modern Agricultural Industry Technology System. The research team of the CCAT consists of several young potential professors, engineers, postdoctoral students and more than 20 MS/PhD students now. So far there are more than 100 MS/PhD students graduated from the CCAT, many students have become backbones in universities, institutes and international pesticide companies.

The CCAT, covering more than 2000 m^2, is equipped with advanced test instruments and varieties of plant protection equipment, such as the indoor boom sprayer system for testing spray at a uniform speed, LS-55 quantitative fluorescence analyzer for the liquid deposition, the high-speed photography for capturing droplet movement detail, the spray scanner or patternator for measuring the droplets distribution under a boom, the nozzle tester for measuring flow rate of the nozzles on/off the boom or the nozzles on the orchard sprayer, the wind tunnel, various kinds of boom sprayers, orchard sprayers and agricultural aviation equipment, and so on. These measurement systems and devices ensure the capability of carrying out a series of frontier scientific studies in the field of application techniques. In recent years, the spraying systems based on manned aircraft, oil-powered single-rotor unmanned aerial vehicles (UAV), electric-powered single-rotor UAV and electric-powered multi-rotor UAV from the different domestic corporations were investigated and tested for winter wheat, rice, cotton and some fruit trees application by CCAT. A large number of experimental results will lay the foundation for the sustainable development of aviation application.

International Workshop of Drift and Anti-drift Technology-2017

International Workshop of Drift and Anti-drift Technology-2019

International Conference of Plant Protection Machinery and Application Techniques-Wuhan 2018

International Conference of Plant Protection Machinery and Application Techniques-Qingdao 2019

Establishment ceremony of CCAT-DJI cooperation lab-2018

ISO-TC23-SC6 Canada annual meeting 2018

Sino-German PMC project kick-off meeting 2019

Sino-German PMC project kick-off meeting 2019-1

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Research projects and achievements by the CCAT of CAU

Centre for Chemicals Application Technology (CCAT) of China Agricultural University （CAU）insists on the concept of 'Green Plant Protection', taking safe, economic and efficient pest control as the target, and puts emphasis on researching, testing, training of plant protection machinery and chemicals application techniques. The CCAT has been working on the following research fields: the basic theory of application techniques, the atomization of chemical liquid, the deposition and drift of chemicals droplets, the precision application with fewer losses to the environment and the development and application of high-efficiency plant protection equipment. Up to now, the CCAT has been presiding over and undertaking more than 30 important national, provincial and international cooperation projects on plant protection equipment and application techniques, including National Natural Science Foundation of China, National Science and Technology Plan project, National Key Basic Research Program of China, National Key Research and Development Plan, Sino-Germany Cooperation project and so on.

With the support of these funds, some original scientific results have been achieved. Based on the ultraviolet imaging, the laser double beam irradiation and the scanning electron microscope, the chemicals droplet movement detecting system was built from the nozzle atomization to the deposition on the target. Guided flow anti-drift spraying, recycling spraying, precision orchard spraying, low-voltage static electricity spaying, low altitude and low volume aviation spraying techniques were invented. The CCAT also developed 16 types of plant protection equipment, such as the knapsack boom sprayer, the self-propelled high clearance anti-drift boom sprayer, the guided baffle plate type sprayer, the self-propelled amphibious air-assisted anti-drift boom sprayer, the precision electrostatic air-assisted sprayer, the recycling tunnel sprayer, the variable rate orchard sprayer based on laser scanning sensor, the automatic profiling precision variable-rate self-propelled crawler orchard sprayer, the autonomous navigation self-propelled orchard sprayer, the multi-rotor UAV for plant protection and so on. To improve the pesticide use efficiency, different kinds of automatically variable spray machinery were designed by the CCAT. An automatic targeting sprayer was developed based on infrared detection, which changed continuous operation to targeted spraying. This system saved 50%-75% spray liquid in apple orchards. In order to solve the spray drift in orchard, a new tunnel sprayer was developed, and the results showed that the spray recycling could be up to 70% when canopy density was small. To explore the relationship between droplet deposition and air volume, the variable-air-volume orchard sprayer (VAVOS) based on canopy characteristics was developed, which laid a foundation for the development of profile modeling sprayer. A newly automatic profile modeling variable-rate sprayer was developed successfully, the techniques of automatic target detection, multi-sensors, electrostatics, and air-assisted spraying were combined within this system. Each nozzle's flow rate and fan's air volume were changed in real-time according to the canopy parameters of fruit tree acquired by laser scanning sensor. The technique can improve the uniformity of the deposit and reduce the drift. The Lidar scanning technology can also obtain crop canopy feature in wheat and maize fields. Analysis of canopy crop characteristics model can determine the crop production, calculate the leaf density index and leaf area index for precision spraying. These techniques and devices realized the plant protection mechanization.

The CCAT has published more than 100 scientific papers with 78 SCI/EI indexed and 9 monographs, obtained 19 invention patents authorizations, and participated in constitutions of international, national, regional and industrial standards. Up to now, the CCAT has successfully organized 7 sessions of 'International Workshop on Plant Protection Machinery and Application Techniques' since 2008 and 2 sessions of 'International Workshop of Drift and Anti-drift Technology'. The CCAT won the first prize of Agricultural Science & Technology Award of China in 2013 and won the first prize of Science & Technology Progress Award of Education Ministry in 2006. The CCAT has signed cooperation agreements with more than 20 domestic plant protection machinery or chemical enterprises. The CCAT also keeps long-term and close relationships with many universities and institutes from Germany, USA, UK, Denmark, Italy, France, Poland and etc. The students from the CCAT have the opportunities to visit these institutions for further training every year. International experts also come to China often for academic exchanges. The CCAT will continue to contribute to improving the safety and efficiency of chemical application in the future.

China Agricultural Science and Technology Award

Ministry of Education Science and Technology Progress Award


National Spark Program Project Certificate


Pesticide application test of model 3WQF120-12 UAV in cotton field


autonomous navigation self-propelled orchard sprayer


paper


patent


automatic profiling precision variable-rate orchard sprayer based on LIDAR detection


Self-propelled amphibious air-assisted anti-drift boom sprayer


Standardized test of boom sprayer in rice-Hubei 2018


Autonomous navigation self-propelled crawler orchard sprayer


Self-propelled high clearance anti-drift boom sprayer