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The fertilizer crisis

The world is experiencing a shortage of fertilizers. Poor availability and higher costs are threatening food supplies. Fertilizers are indispensable for increasing crop yields to feed the growing population. Much research is focused on effective fertilizer management and on alternatives to inorganic fertilizers, which are carbon costly and non-renewable, to overcome the crisis

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  Sustainability, 2021

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  Applied Soil Ecology, 2022

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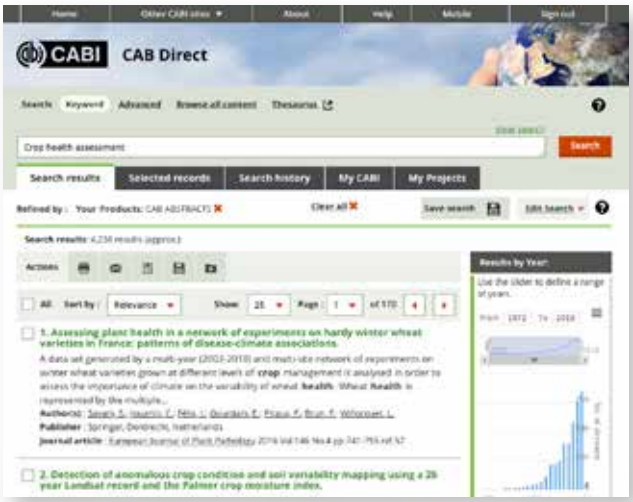

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Chemical Control of *Ceratovacuna lanigera* Zehntner with Multi-rotor Unmanned Aerial Vehicle

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Abstract: [**Objective**] The paper was to explore chemical control of *Ceratovacuna lanigera* Zehntner with multi-rotor unmanned aerial vehicle. [**Method**] According to the outlook characteristics of *C. lanigera*, multi-rotor unmanned aerial vehicle was applied for flying control test. Referred to the spraying characteristics of multi-rotor unmanned aerial vehicle, two kinds of microcapsule pesticides, ALY-1501 and ALY-1502, and two kinds of spraying additives, SP-641 and SP-642, were designed to control *C. lanigera*. [**Result**] The control effect of ALY-1501 at the dose of 2.25 L/hm² was 60.02% at 14 post administration and 54.14% at 5 d post administration; the control effects of ALY-1502 at the dose of 2.1 L/hm² were 76.35% and 81.35% at 1 and 5 d post administration, respectively. Compared to individual pesticide, the control effects of ALY-1501 were improved 1.42 – 1.47 times and 1.16 – 1.34 times by adding 0.9 L/hm² SP-641 and SP-642 in pesticide liquid, respectively. The control effects of ALY-1502 were improved 1.22 – 1.25 times and 1.15 – 1.16 times by adding 0.6 L/hm² SP-641 and SP-642, respectively. The control effects against *C. lanigera* at three flying speeds of 3, 5 and 8 m/s were 99.72% – 99.97%, 81.61% – 90.81% and 63.52% – 68.77%, respectively. [**Conclusion**] The results will provide a reference for application of multi-rotor unmanned aerial vehicle in prevention and control of *C. lanigera* in sugarcane field.

Key words: Multi-rotor unmanned aerial vehicle; Sugarcane; *Ceratovacuna lanigera* Zehntner; Chemical; Additive

Multi-rotor unmanned aerial vehicle aviation plant protection technology is a new technology developed in recent years, and it is the development and extension of agricultural mechanization in the air. Aircraft operation is one of the important characteristics and symbols of modern agriculture, and is a high-tech technology applied in agricultural production. Multi-rotor unmanned aerial vehicle, with series of aircraft composed of 4, 6, 8, 18 and 24 rotors as the carrier, is a new type of aviation plant protection machinery with drug cabinet and atomizing nozzle for spraying pesticides in the air, and it is an efficient spraying equipment instead of labor and ground machinery. Multi-rotor unmanned aerial vehicle spraying is featured by high efficiency, water saving, high quality, omnipotence, safety and convenience[1].

In foreign countries, agricultural aviation plant protection first originated in the United States. In 1918, the United States first sprayed pesticides with aircraft for eliminating cotton insects, creating the history of agricultural aviation[2]. By the 1950s, specialized and multi-purpose agricultural aircrafts designed for agriculture had successively emerged. Currently, agricultural aviation is most developed in the United States, Russia, Australia, Canada, Brazil, Japan, South Korea, etc.; due to large cultivated land area per household in the United States, Russia, Australia, Canada and Brazil, manned fixed wing aircraft is often employed in these countries; while in Japan and South Korea, due to small cultivated land area, micro small unmanned aircraft is often adopted[3]. In China, agricultural aviation plant protection technology is the first aircraft operation item; on May 22., 1951, a C-46 aircraft was sent by military aviation bureau to eliminate mosquitoes and flies in Guangzhou City, marking the birth of agricultural aviation plant protection enterprise in China[4]. Compared with ground spraying operation, aerial spraying is efficient, flexible, fast, with strong assault, playing an irreplaceable role in the fields of aviation plant protection, aviation fertilization and health and epidemic prevention. Currently, the annual control area of aircraft spraying against crop pests and diseases is 0.7 million hm²; the control area against grassland pests is 0.54 – 0.7 million hm²; and the foliar fertilization area of wheat reaches 0.14 million hm². However, aviation plant protection in China before 2010 was mainly employed for forest, grassland and large-scale farms, while it was rarely applied in the rural area with the planting pattern of unshared housing.

In recent years, with the rapid development of China's economy and the acceleration of marketization process, the rural labor force reduces and the aging problem is intensified, and the cost of agricultural labor increases sharply. In the price of agricultural products, the proportion of labor costs is much higher than that in foreign countries, so mechanization of agriculture and replacement of hands by machine hands has become one of the major reforms of agricultural production in China. However, it is difficult to meet the needs of agricultural production through manual and semi-mechanized operation against diseases, pests and weeds in the current crop production process. It is an important means to solve the shortage of agricultural labor force by developing and popularizing agricultural aviation plant protection technology vigorously. Development of multi-rotor unmanned aerial vehicle opens convenient ways for farmers in China. Aviation plant protection technology has attracted more and more attention in modern agricultural

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