

World Food Prize Global Youth Institute

A Research on Pesticide Use Based on Green Agriculture

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Abstract

The main function of chemical and biological pesticides in food production is to control pests and diseases, and they are of great value to ensure the efficiency of food production. But the pesticide itself has some problems, and it can also be used irrationally by humans. Among them, the irrational use of pesticides is the main problem at present: the application of high-intensity pesticides in food production to improve food yield; agricultural production methods with high efficiency pesticides cause problems such as pesticide residues, farmland ecological environment pollution, natural resources destruction, and more seriously, it also brings serious quality and safety problems of agricultural products, endangering human health. Against this background, agricultural development urgently needs green transformation. Green agriculture aims at the production of safe and pollution-free green agricultural products, combining traditional agriculture and modern agriculture, with "modern", "quantity saving", "less pollution" and other characteristics. Based on the relevant requirements of green agriculture, this paper analyzes the pesticide use and food output (food output per unit area) in China and Hebei Province, draws relevant conclusions, and then solves the problems.

Keywords: Pesticides; Green agriculture; Food security

1. Introduction

With the continuous improvement of economic development and industrialization level, the mode of agricultural production has undergone great changes. The gradual transformation of agriculture from extensive operation to intensive form has greatly improved the land output rate (the average annual output yield per unit of land), ensured the situation that the land area has been reduced without reducing and even increasing production to the greatest extent, and alleviated the problem of food supply to a great extent. Among the many factors that promote food yield increase, pesticides and fertilizers are the two most active factors.

While the use of chemical pesticides and fertilizers increases food production, they also continue to remain and accumulate in the environment and agricultural products. Due to the accumulation of chemical substances in the biological environment and residues in agricultural products, the quality of food is reduced. Therefore, pesticides and fertilizers play both positive and negative roles in agricultural production.

1.1 *The meaning and requirements of green agriculture*

In different periods, experts and scholars have analyzed the meaning of green agriculture from different perspectives. In 2004, Bai Ying, a person from China Agricultural University analyzed green agriculture from the perspective of sustainable agricultural development, and proposed a new agricultural production based on the construction of a fine ecological environment in producing areas, the production of safe and high-quality products, and the high ecological and social benefits. Yan et al. proposed in 2009 that green agriculture should make full use of green high-tech means to implement agricultural ecological environment construction, achieve energy conservation, protection and improvement of agricultural ecological environment, and produce green products.

Based on the above analysis, the narrow sense of green agriculture is to produce green agricultural products, while the broad sense of green agriculture is to save resources, pay attention to ecological balance and production quality and safety of agricultural products, and maintain social development of sustainable agriculture; It uses advanced science and technology, industrial equipment and modern management to ensure agricultural ecological security and agricultural resource security, to ensure the safety of agricultural products, and to promote the comprehensive and sustainable development of society and economy. In short, green agriculture refers to all agricultural production modes that are conducive to environmental protection, to the quality and quantity of agricultural products, and to the sustainable development of production, so as to meet the living needs of urban and rural residents and ensure the sustainable development of the national economy.

In this paper, the requirements of green agriculture refer to the coordination of agricultural production and environmental protection, promoting agricultural development, increasing the income of farmers, while protecting the environment and ensuring that agricultural products are pollution-free. Green agriculture not only emphasizes the low toxicity, harmlessness and insecticide of agricultural products, but also ensures that agricultural products are not polluted and the environment is not polluted.

1.2 *Green agricultural technology*

Green agriculture uses various technologies and skills, machinery and tools, the implementation of relevant technical regulations and standards system, through the whole process of monitoring the production of quality and safety, pollution-free green agricultural products technology. Green agricultural technology has the characteristics of modern, quantity saving and no pollution or less pollution, involving production, processing, sales and other links, of which the production link is the source of green, grasping the production link is the basis to ensure the quality and safety of agricultural products. Green agricultural technology in the production link includes pre-production, mid-production and post-production green agricultural technology. Pre-production green agricultural technology mainly refers to conservation tillage technology, and post-production green agricultural technology includes straw returning technology, green processing technology and green storage and transportation technology. Green agricultural technology involves the most in production, and the representative ones are green agricultural technology of medicine saving and green agricultural technology of fertilizer saving. The green agricultural technology of drug saving mainly includes the promotion of highly efficient and multi-resistant new varieties, scientific application technology, mechanical drug-saving technology, etc. The green agricultural technology of fertilizer saving mainly includes soil testing and formula fertilization technology and slow and controlled release fertilizer technology. This article only introduces green agricultural technology in the production of green agricultural technology.

Crop diseases are associated with crops almost throughout their lives. In order to eliminate or reduce the harm degree of diseases and insects, a variety of control technologies have been continuously innovated and discovered, and the application number of pesticides has continued to reach a new high. Drug saving green agricultural technology is a series of technologies that comprehensively take a variety of measures, such as agricultural measures, biological pesticides, pesticide auxiliaries, efficient application machinery, etc., to reduce the application number of pesticides, improve the efficiency of pesticide utilization, and ensure the effect of disease and pest control. The following are several kinds of green agricultural technologies: selection of high-quality multi-resistant crop varieties; Scientific application technology; Selecting green prevention and control measures for diseases and pests; Mechanical medicine saving technology.

2.The Usage Condition of Pesticides

2.1 Overview of domestic and overseas pesticide usage condition

Pesticide is the guardian of food safety of ordinary people. British scientist L-Cooping once pointed out that pesticides can reduce global crop losses by 30% to 35% every year, saving 300 billion US dollars in economic losses. If China stops using pesticides, 350 million people will go hungry. Fruits will be reduced by 78 percent, vegetables by 54 percent and grains by 32 percent. In addition, the latest data from the Food and Agriculture Organization of the United Nations also shows that by 2050, the world's population will reach 9.1 billion, and we will have to produce as much food as we have produced in the past 8,000 years to meet demand. Therefore, it is urgent to improve crop yield, and the use of pesticides to control crop diseases and pests is an important way to increase grain yield.

In recent years, developed countries, especially EU countries, have increasingly high requirements for the quality of agricultural products and environmental quality, and have made strict restrictions on the application of pesticides. This is mainly reflected in the variety, dosage, use method and circulation management of pesticides. When pesticides are used, there are clear requirements for the protection of water sources and residential areas. There are certain procedures for the transportation, mixing and spraying of pesticides, and pesticide packaging materials must be recycled. The Danish Parliament decided to cut pesticide use by 25 percent in 1986 and another 25 percent in 1997, while limiting the number of doses used. Other countries in the European Union have also explicitly pledged to reduce their total pesticide use by 50% by the year 2000 compared with 1990 levels, and many countries have already reached this target.

Developed countries in strict management at the same time, pay attention to the research and development of pesticide application methods, through advanced technology and equipment, so that a small number of pesticides fully play their role, which is why these countries in the case of reducing the amount of medicine by 50%, crop yields did not significantly decline. These countries pay attention to the implementation of the idea of integrated pest control, through the combination of biological, physical, mechanical and chemical methods to solve the problems of diseases, insects and grass. Of course, the dependence of crops on pesticides is not

formed in a day, from the production practice of developed countries, chemical pesticides are still the most important way of crop protection, but the level of pesticide application has been greatly improved, so that the use of pesticides can play a full role, reduce the side effects of pesticides to a minimum.

The application of pesticides in China is not optimistic, which can be summarized as many varieties of pesticides, low quality, large dosage, simple use method, low efficiency, high residual number of agricultural products, and serious environmental pollution. Although China began to advocate the idea of integrated pest management in the 1960s, due to the limited methods and means available at that time, and chemical pesticides have the characteristics of fast effect and low cost, coupled with the lack of scientific guidance for farmers, they have developed the habit of relying on chemical pesticides. In the application of chemical pesticides, China has long ignored the research and technical training of drug use methods, and the drug use methods are very simple and primitive, which not only causes pesticide waste, but also increases the resistance of diseases and pests to pesticides, and weakens the natural control of diseases and pests because natural enemies are killed in large numbers, leading to more and more drugs and times of use, and the control effect is getting worse and worse. Form a vicious circle of pesticide application. As for some farmers in violation of the national regulations on the use and management of chemical pesticides, the use of prohibited drugs caused human poisoning and even death accidents occur, and the number of pesticide residues in agricultural products exceeded the standard of more cases. Therefore, it is urgent to explore an effective way of pesticide use based on China's national conditions.

2.2 Statistical data and analysis of pesticide usage and grain output in China and Hebei Province

Table 1 Pesticide use in China from 2013 to 2019 (Unit: 10,000 tons)

2013	2014	2015	2016	2017	2018	2019
180.77	180.33	178.30	174.05	165.51	150.36	139.17



Figure 1 Pesticide use in China from 2013 to 2019 (Unit: 10,000 tons)

As can be seen from Table 1 and Figure 1, the use of pesticides in China from 2013 to 2019 has been decreasing continuously, from 1,807,700 tons in 2013 to 1,391,700 tons in 2019, and the decrease has also increased significantly. This shows that the green development of China's agriculture continues to advance, and the zero-growth campaign of fertilizer and pesticide use has achieved remarkable results. The reduction in the use of pesticides in China does not mean less grain planting or a reduction in pests and diseases, which is closely related to the progress of pesticide research, the popularization and promotion of green agricultural technology (a technology that integrates various measures, such as agricultural measures, biopesticides, pesticide additives, efficient application machinery, etc.) and the improvement of people's awareness of promoting the development of green agriculture.

Table 2 Pesticide usage in Hebei Province from 2013 to 2019 (Unit: 10,000 tons)

2013/12/31	2014/12/31	2015/12/31	2016/12/31	2017/12/31	2018/12/31	2019/12/31
8.67	8.63	8.33	8.17	7.76	6.15	5.73



Figure 2 Pesticide usage in Hebei Province from 2013 to 2019 (Unit: 10,000 tons)

As can be seen from Table 2 and Figure 2, the use of pesticides in Hebei Province changed significantly from 2013 to 2019. Pesticide use has been decreasing, from 86,700 tons in 2013 to 57,300 tons in 2019. As in China, the decline has increased significantly. This shows that Hebei Province insists on implementing the relevant arrangements of the state for the use of pesticides, and keeps pace with the country to promote the development of green agriculture.

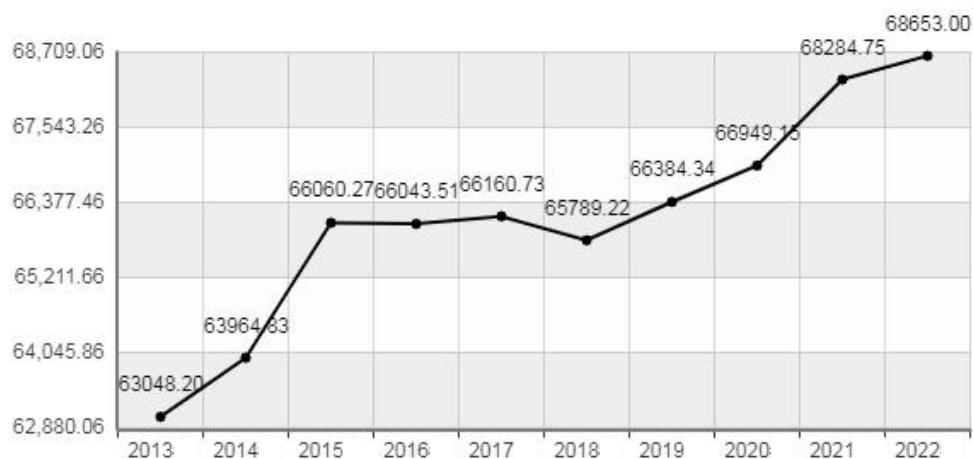


Figure 3 China's food production from 2013 to 2022 (Units: 10,000 tons)



Figure 4 Food production of Hebei Province from 2013 to 2022 (Units: 10,000 tons)

Figure 3 and Figure 4 show the grain output of China and Hebei Province in recent years. It can be found that China's grain output fluctuates but generally shows an upward trend, and the fluctuation of Hebei Province is more intense. Among them, 2018 is the most obvious "inflection point" in the two line charts: grain production in China and Hebei Province declined from the previous year. In 2018, China's grain sown area was 1.756 billion mu, 14.28 million mu, or 0.8 percent lower than the previous year. The use of pesticides is no longer a decisive factor in grain production as the sown area is reduced and grain production is reduced by 10.7 billion kilograms. This is the same as the conclusion of the analysis above: although the use of pesticides in China (Hebei Province) is decreasing, the overall trend of grain production is still rising, and there is no direct correlation between grain production and pesticide use.

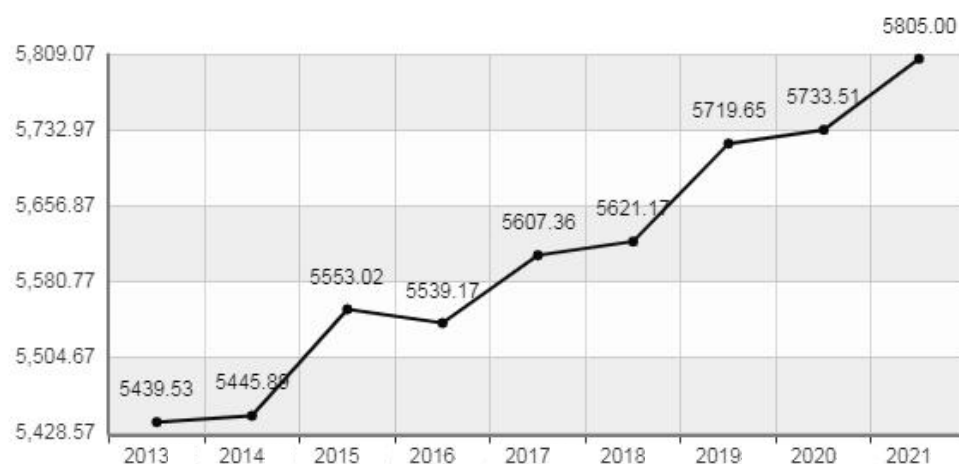


Figure 5 China's food production per unit area from 2013 to 2021 (Unit: kg/ha)



Figure 6 Food production per unit area of Hebei Province from 2013 to 2021 (Unit: kg/ha)(Data for 2019 and 2020 are missing)

Figure 5 and Figure 6 show the grain yield per unit area of China and Hebei Province from 2013 to 2021. It can be found that the grain yield per unit area of China is constantly increasing. This paper tries to prove that the grain yield reduction is caused by the reduction of land area, rather than the impact of reducing pesticide use through these two sets of data.

Of course, with the reduction of pesticide use, agricultural products are also greener and the ecological environment has improved.

We should note that at present, China is actively changing the use of pesticides, promoting green agricultural production methods, and has achieved many good results. However, we still need to know that China is a populous country, and food has always been the most important agricultural product affecting the national economy and people's livelihood. There are still some problems in China's food production, which is not only the use of pesticides, so it is a long way to ensure national food security.

3.Conclusions and countermeasures

3.1 Conclusion

The use of pesticides in China is becoming more rational and efficient. At the same time as the use of pesticides continues to decrease, food production continues to

increase. In many factors, the status of pesticides is becoming more and more "low", and it has become a "rare guest" from the previous "regular guest". It is difficult for us to see that it is because of the improper use of pesticides that grain production is greatly reduced. This is largely due to the promotion of our green agricultural technology and the promotion of drug-saving green agricultural technology. The improvement of farmers' awareness of green production also makes them continue to implement green agricultural production methods.

In the process of pesticide use, it will inevitably bring environmental pollution, ecological damage, and "poisoning" of agricultural products... In this paper, Liu Feng pointed out the existing problems in the use of chemical pesticides in exploring the application strategy of chemical pesticides based on food security:

3.1.1 Pesticide toxicity

The toxicity of pesticides has a lot to do with the effect of pesticides, such as the "herbicide" for weeds in farmland, the "one kill Ling" for eliminating pests, and the "dichlorvos" with obvious efficacy, and the drugs with trace amounts and according to the instructions for pesticide use, generally do not have excessive pesticide residues. However, that effect will not be very large, so in their daily work farmers are excessive use of pesticides, resulting in pesticide poisoning accidents. Excessive pesticides not only cause great damage to animals and plants, but also threaten people's lives. Some highly toxic pesticides, even in small amounts, may cause adverse reactions in people's bodies. Moreover, with the increasing application of herbicides, the resistance of weeds will continue to increase, and malignant weeds will become the dominant population. In the end, it did not kill the weeds, but inhibited the normal growth of crops, and even died seedlings.

3.1.2 Pesticide residues

In the growing process of crops, the use of fertilizers and pesticides will enhance the growth of crops. However, with the change of time and environment, pesticides will appear in different degrees of residues in crops. Pesticide residues will not change in any environment and any period of time, and farmers will not exceed the safety threshold if they apply the pesticide at reasonable intervals according to normal operating procedures.

3.1.3 Environmental pollution

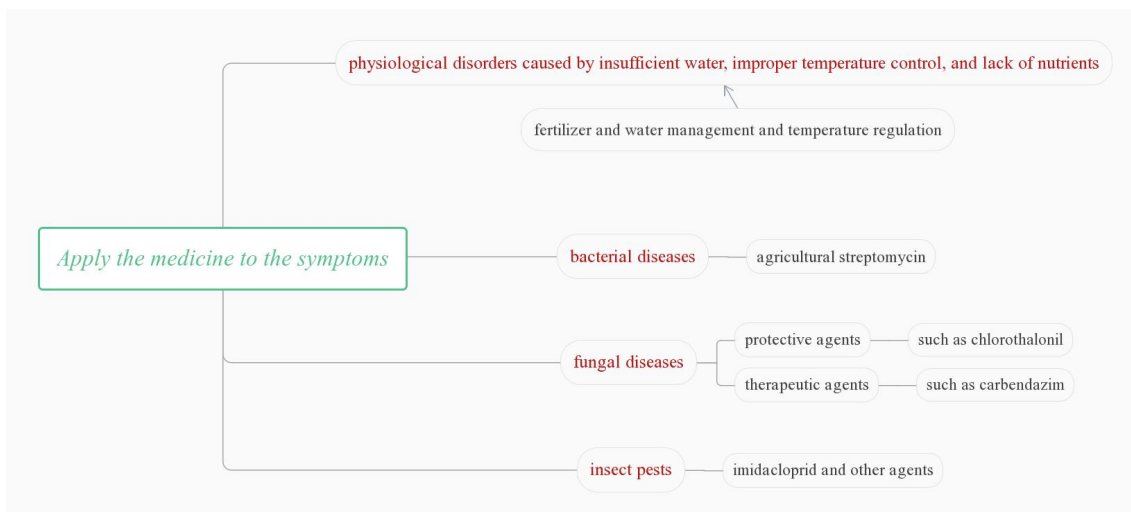
With the continuous improvement of science and technology levels in China, advanced technology and agricultural equipment are widely used in crop planting and application. In many areas, jet application machines are used, large areas of pesticide spraying, and pests and beneficial insects in the fields are dying in large numbers, and air pollution is serious. The harm of pesticides to the environment depends on the toxicity and dose of pesticides, and the actual harm caused by trace drugs to the environment is less, and the pesticides will not affect the safe and pollution-free production of fruits and vegetables within the scope of the environment. However, the reality is that most farmers have a low level of knowledge and poor awareness of environmental protection. In the process of planting crops, they only pay attention to the yield of crops and the economic benefits brought to them, ignoring the safety of crops and environmental pollution, and the use of pesticides is unreasonable.

3.2 Countermeasures

In this paper, five scientific and safe application technologies of chemical pesticides are proposed:

3.2.1 Apply the medicine to the symptoms

When crop diseases and pests occur, it is necessary to comprehensively analyze their growth status, characteristics of disease sites, environmental temperature and humidity, etc., quickly and accurately diagnose the types of diseases and pests, and select the most reasonable pesticides based on the occurrence rules and harm degree of diseases and pests, and spray them in the best control period. For example, physiological disorders caused by insufficient water, improper temperature control, and lack of nutrients can be effectively prevented through fertilizer and water management and temperature regulation. For bacterial diseases, agricultural streptomycin and other agents can be used to effectively control them. For fungal diseases, protective agents such as chlorothalonil and mancozeb can be used, and therapeutic agents such as carbendazim, methyl tolbutazine, metalaxyl and sclerotium can be selected. In view of insect pests, imidacloprid, aphidizin, Kliolin and other agents can be used for control.



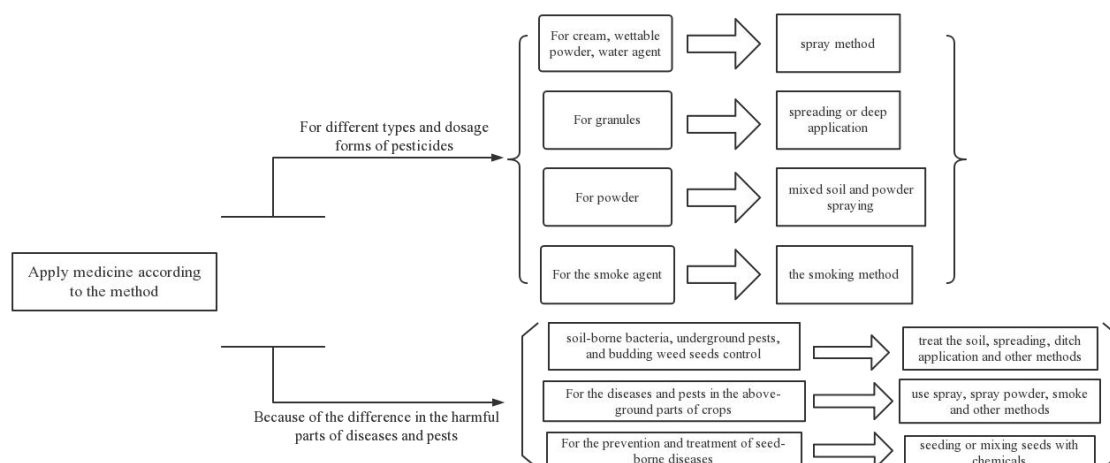
3.2.2 Appropriate drug use

When applying the drug, it must be in strict accordance with the guidance of agricultural technicians or the dosage prescribed by the pesticide label, and the dosage, spray concentration and frequency of the drug must be reasonably determined. If the spraying dose is too small, it is difficult to achieve the effectiveness of pest control; If the dose is too large, it will not only induce strong resistance, but also lead to excessive pesticide residues, harm the quality of agricultural products, and induce safety incidents. Therefore, in order to achieve the best control effect, it is not allowed to arbitrarily increase the concentration of the agent, the dosage of the agent and the frequency of application. It is necessary to choose a pesticide with low residue and low toxicity within the effective dose range as far as possible, and determine the frequency of application based on the damage degree of diseases and pests and the residual period of the agent, so as to avoid bad behaviors such as not weighing, arbitrarily increasing the number of spraying times, and casually pouring the drug.

3.2.3 Apply medicine according to the method

The word "law" has two meanings: (i) For different types and dosage forms of pesticides, the application methods are also different: For cream, wettable powder, water agent, spray method. For granules, the method of spreading or deep application can be adopted. For powder, mixed soil and powder spraying can be adopted. For the smoke agent, the smoking method is adopted. (ii) Because of the difference in the harmful parts of diseases and pests, the application methods are not the same: For

instance, soil-borne bacteria, underground pests, and budding weed seeds control can be taken to treat the soil, spreading, ditch application and other methods; For the diseases and pests in the above-ground parts of crops, it is best to use spray, spray powder, smoke and other methods; For the prevention and treatment of seed-borne diseases, the method of seeding or mixing seeds with chemicals should be adopted.



3.2.4 Alternate medication

Long-term use of a single pesticide, easy to cause bacteria, pests, and weeds produce strong resistance, such as internal fungicides, pyrethroid insecticides, if many years of continuous use, the control effect is greatly reduced; If the dosage, concentration and frequency of the drug are increased, the resistance of bacteria, pests and weeds is becoming stronger and stronger, and the difficulty of control is increased. However, if the use of pesticides with different active ingredients or different mechanisms of action but similar efficacy is adopted, the control efficacy of pesticides will be strengthened and the emergence of resistance will be suppressed. For example, the alternative application of pyrethroids, imidacloprid, anti-aphid and other pesticides can effectively control aphids; The alternative use of the pesticides such as manganese zinc and clew can effectively prevent downy mildew.

3.2.5 Mixing (compounding) drugs

According to a certain proportion of the mixture of two or more kinds of pesticides with different mechanisms of action, it can effectively control a variety of diseases and pests, reduce the cost of control, and delay the emergence of resistance

of bacteria, pests and weeds. If fenvalerate is mixed with dimethoate oxide, it can absorb and kill insect pests, and has a remarkable therapeutic effect on rapeseed and aphids. Metalaxyl combined with mancozeb can effectively prevent fungal diseases.

The above countermeasures and suggestions are the concrete development of the green agricultural technology mentioned above, and effectively solve the existing problems in the use of chemical pesticides pointed out by Liu Feng in exploring the application strategy of chemical pesticides based on food security.

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