

Problems in the Use of Pesticides by Farmers and Countermeasures

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Abstract Pesticide safety is an important guarantee for food security. At present, there are many problems in the process of choosing pesticides by farmers, such as low discernment ability and difficulty in retroactive blame, slow replacement of medical equipment, slow promotion of technology assistance, lack of professional knowledge, difficult to grasp the key points of application, improper use of pesticides, large resistance to reducing quantity and increasing efficiency, etc. In order to use pesticides rationally and realize safe production, countermeasures and suggestions on pesticide application are put forward from the aspects of drug development and application, promotion of biopesticides, change of farmers' concept and cultivation of new farmers.

Key words Farmer; Pesticide safety; Agricultural technology; Medical equipment

1 Introduction

China is a big agricultural country and has always attached great importance to agricultural production. Since the beginning of the 21st century, the Party Central Committee and the State Council have successively issued 19 "No.1 Central Documents", and grain production has achieved "18 consecutive harvests". Agricultural security and food security are the basis for the stable development of Chinese society. More and less food is a tactical issue, whereas food security is a strategic issue^[1]. China attaches great importance and gives firm support to land subsidies, cultivated land protection, agricultural technology popularization, agricultural mechanization popularization, farmland irrigation, grain price protection, fertilizer research and development, pesticide safety, and key seed technology research, and has gradually established a complete supervision system for agricultural production safety. Among them, pesticide safety is particularly important, which plays a vital role in improving food production and crop quality. Since the implementation of the *Regulations on the Control of Agricultural Chem* in 2017, it has played an important role in achieving a bumper harvest in agriculture. However, there are still some problems to be solved in the process of pesticide application by farmers. To ensure rational pesticide application and achieve safe production, this paper summarizes the problems in the process of pesticide application by farmers and put forward countermeasures and suggestions.

2 Problems in the use of pesticides by farmers

2.1 Low discernment ability of farmers and difficulty in retroactive blame There are many varieties of pesticides on the market, and even the same variety has different manufacturers, trademarks, specifications, as well as all kinds of compound products. It is so difficult to distinguish drugs that farmers do not know how to choose in front of dazzling drugs, and can only distinguish relying on the oral introduction of pesticide operators and oral teaching of other farmers, but lack full understanding of drug properties. In addition, with the gradual popularization of the internet in rural areas, the subject of pesticide management has become diversified, and some farmers buy pesticides through online channels. Accordingly, the phenomena such as illegal operation, unqualified operation, sale of fake and banned pesticides, and mixing inferior drugs have also appeared. Farmers have low ability to identify the authenticity of drugs, and due to the habit of not asking for drug purchase vouchers or not keeping drug purchase records for a long time, it is difficult to trace the responsibility when drugs go wrong. In the face of agricultural delays and economic losses caused by pesticides, farmers can only bear the loss themselves. Meantime, because most farmers do not have the corresponding awareness of drug testing and tracking and the corresponding testing knowledge and equipment, they are unaware when drugs lead to the reduction of crop yield and quality, but blindly look for other non-drug reasons.

2.2 Slow replacement of medical equipment and slow promotion of technology assistance In the selection and use of medicinal equipments by farmers, knapsack electric sprayer still accounts for the vast majority, and even the traditional manual knapsack sprayer is still partially used, while the new pulse mist sprayer, stretcher type diesel engine, electromotor, etc., have not been widely used in the process of pesticide spraying. Besides, the use of aircraft or UAV medicinal equipment that is more convenient, efficient and fast is even rarer. This is closely related to the current agricultural situation in China. "Large country and small farmer" is the basic national agricultural situation in China, and small-scale family management is the original system of agriculture^[2]. The mode of agricultural operation is gradually transition-

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ning from small scale family operation to association and cooperative operation. Scientific and technological equipment is quite expensive for farmers, and the purchase of advanced equipment will greatly increase the cost of agricultural production. Meantime, farmers do not have the skills to use and maintain the corresponding equipments. Even if the pesticide application operation is completed by renting advanced technology equipment from professionals, the cost is far greater than the use and maintenance of traditional equipment.

2.3 Lack of professional knowledge and difficult to grasp the key points of use

Most farmers are limited by their own cultural quality, and lack the knowledge of pest control and safe and accurate drug use, but blindly purchase pesticide relying only on the introduction and recommendation of operating personnel. In the process of spraying, farmers do not have comprehensive and accurate consideration of specific spraying time, wind speed, temperature, humidity and other influencing factors required by different drugs, which will lead to weakened or too strong drug effects on crops to a certain extent, and result in a waste of drugs and manpower, and even unnecessary pollution of soil, air, water, *etc.*, thus affecting the improvement of crop yield and quality. Meanwhile, farmers also lack reasonable disposal means for packaging materials of discarded drugs, which are often discarded everywhere or mixed with other garbage after use, and farmers are unaware of the serious harm pesticide waste can do to the environment and crops. The packaging materials of drugs are mostly plastic and glass products that are difficult to decompose naturally, and there are certain drug residues in drug waste, which will cause serious pollution in soil, water quality and other aspects, directly affecting the normal growth and development of crops, adversely affecting the incremental quality of food, and even endangering human health.

2.4 Improper use of pesticides and large resistance to reducing quantity and increasing efficiency

In order to promote the development of green agriculture, the Ministry of Agriculture and Rural Affairs issued the *Action Plan of Zero Growth of Pesticide Use by 2020* in 2015. On this basis, the standardized use of pesticides is gradually optimized. However, due to the lack of pharmacological knowledge of farmers and the promotion of dealers, the promotion of reducing pesticide quantity and increasing efficiency has encountered obstacles. It is difficult for farmers to accurately distinguish the medicinal properties of drugs, while dealers often recommend strong drugs in order to show the efficacy of their recommended drugs, and also suggest increasing the dosage for immediate effect. Some farmers do not apply pesticides in accordance with relevant instructions on the drug packaging, leading to unreasonable concentration configuration, excessive dosage and overuse of pesticides. Excessive use of drugs can lead to excessive pesticide residues. Relevant studies have found that excessive use of pesticides will lead to increased resistance of diseases and pests, which is also the main reason for the occurrence and spread of diseases and pests year by year. In order not to waste drugs,

some farmers mix pesticides of previous years with newly purchased pesticides, and mix and match drugs of different types, such as weeding, disease and insect control, and even medicinal properties that repel and resist each other. In order to promote products, some dealers bundle and sell some unregistered drugs in the form of gifts or combination sets, and recommend farmers to use together. Improper mixing of drugs not only can not achieve the ideal application effect, but will greatly reduce the efficacy. It can not effectively control pests and diseases, or will directly damage crops in severe cases, thus affecting the yield and quality of food.

3 Countermeasures and suggestions for the safe use of pesticides

The situation of soil pollution, water pollution and crop reduction caused by pesticide safety problems is often seen in news reports. For example, in the early summer of 2022, some farmers improperly used a pesticide called "Renhuanmajiao" at the time of winter wheat harvest, there was a phenomenon of seedless wheat, a large reduction of production or even no grain harvest. It is necessary to pay more attention to pesticide safety and take more effective measures, in order to further increase the quantity and quality, and make food security an important supporting material for rural revitalization and a solid backing for national rejuvenation.

3.1 Strictly checking before use and establishing effective accountability mechanism

Investment in agricultural science and technology innovation is increasing year by year in China, and the types of pesticides developed are particularly complex. Before the pesticide is officially delivered to the manufacturer for mass production and then put on the market, it must be repeatedly tested in accordance with the corresponding national standards to ensure the efficacy and safety of the pesticide, and solve the basic problems before mass production. It is necessary to strengthen the supervision of pesticide manufacturing enterprises and set the threshold of pesticide production qualification. The large-scale production of drugs by manufacturers should be strictly approved and recorded, while some illegal small workshops and black dens should be severely punished. In the production process, manufacturers should pay attention to clearly mark the properties, application steps, application methods and taboos of the drug, and vigorously promote the use of two-dimensional code of the drug according to the current status of rural network popularization, to achieve "a bottle, a code" and "a bag, a code". The application of pesticide two-dimensional code should be strengthened to ensure that the production of pesticide products meets the standards and the sales channels are standardized^[3]. The two-dimensional code is used to help farmers identify the authenticity, and voice broadcast function is also developed to provide a more convenient, efficient and easy-to-operate way for the display of efficacy, application method and application taboos of drugs, which is also an important basis for follow-up traceability.

The sales link must be strictly supervised, and a long-term

mechanism for pesticide management supervision that adapts to the new situation should be established. Relying on the internet, a big data platform for pesticide production and sales can be built to crack down on fake and shoddy products and illegal sales. The National Agricultural Technology Center organized and launched plant protection agencies to carry out nationwide pesticide application "safety inspection" activities from April to November 2022. The normalization and irregular spot checks of such inspection activities should be promoted to achieve intelligent, informationized and accurate dynamic supervision. Business operators are required to take the initiative to display the production specifications and sales vouchers of drugs in the sales process, provide customers with sales invoice, and strictly implement the operation and sales ledger system.

Through broadcasting, propaganda pages, propaganda of grassroots party members and other means, farmers can be cultivated with the awareness of risk and rights protection, purchase useful and effective legal drugs in formal channels, and form the habit of requesting and retaining vouchers when purchasing pesticides. Relevant departments should also further deepen the relevant provisions on the production and operation links on the basis of existing laws and regulations, and then force manufacturers and merchants to strictly regulate management, so as to establish an open, transparent and orderly traceability and accountability mechanism for pesticide production and sales.

3.2 Promoting the upgrading of plant protection equipment and helping the modernization of agricultural industry The modernization of agricultural industry needs to actively develop new pesticides and advanced instruments and equipment, promote the replacement of pharmaceutical equipment, and promote the widespread application of the latest pharmaceutical equipment. In recent years, China has made many vital achievements in the innovation and creation of medical equipment, such as pulse mist sprayer, unmanned aerial vehicle, *etc.* New medical equipments have the characteristics of reducing the amount of drugs, avoiding drug waste, improving the control effect and utilization rate of pesticides, and reducing the pollution to the environment. However, the cost of upgrading medical equipment is so high that the actual promotion and application effect is not obvious. Hence, it is necessary to vigorously promote efficient plant protection equipment, drive the implementation of modern pesticide technology, and let agricultural equipment technology take root in the field.

General Secretary Xi Jinping emphasized "the implementation of various support policies and the protection of farmers' enthusiasm for growing grain" during the investigation and research in Heilongjiang^[4]. Only by reducing the cost of farming and making farmers profit from growing grain can we mobilize and protect farmers' enthusiasm for growing grain. It is necessary to increase subsidies for the replacement of medical instruments, give full play to the role of the government in providing backstop compensation in the replacement process of medical instruments, and guide enterprises and social groups to assist in all aspects of the replace-

ment of medical instruments through tax relief and other ways. Through the update of technology, the market price of related equipment is gradually reduced, and a number of measures such as replacing old with new, government subsidies, and farmer co-operation are adopted to achieve the renewal of farmer's medical equipment. Therefore, farmers can make full use of advanced medical equipment to complete the relevant pesticide application operations in a convenient and scientific way, ensuring that the replacement of medical equipment will not bring additional costs to farmers and will not discourage farmers' production enthusiasm. The mechanization and digitalization of the rational use of pesticides must be promoted, so that farmers are willing to farm, want to farm, and can farm with confidence and courage.

At the same time, it is necessary to ensure the quality of the new generation of medical equipment, set industry access standards for pesticide equipment such as UAV, and improve the safety performance, durability, operability and convenience of medical equipment. The actual utilization of medical equipment should be monitored and investigated regularly by freely training the use and maintenance of medicinal equipment for farmers, regularly inspecting medicinal equipment, and carrying out spray inspection, leakage inspection, functional inspection, *etc.*, to timely discover and solve problems, and ensure the basic performance of medical equipments.

3.3 Rationally applying pesticides and vigorously promoting biopesticides Most farmers believe that making full use of pesticides is an important way to improve food production, resulting in excessive dependence on pesticides, excessive use of pesticides, and even improper use of pesticides. Therefore, it is necessary to actively guide farmers to use pesticides correctly and rationally, increase the publicity of rational use of pesticides, and change the concept of improper drug use. Rotating or alternate use of drugs should be promoted to address resistance to crop pests and diseases. Professional and technical personnel should be selected to provide targeted guidance on the use of pesticides and standardize the use of pesticides by farmers, allowing pesticides to return to the normal status of disease and pest control during the growth of crops.

The publicity of green organic and pollution-free agricultural products must be strengthened, and farmers are guided to use green prevention and control technology to replace some non-essential and alternative drugs through agricultural management, biological control, physical control and other auxiliary means, and gradually stop the use of old, low-end, high-risk and destructive pesticide varieties, so as to improve the growing environment of crops and increase crop quality. In January 2022, the Ministry of Agriculture and Rural Affairs jointly formulated the 14th *Five-Year Plan of National Pesticide Industry Development*, which clearly stated that priority should be given to the development of biopesticides such as microbial pesticides, agricultural antibiotics, biological and biochemical pesticides. Compared with traditional chemical pesticides, biopesticides have the advantages of non-toxicity,

less residue and strong safety, and will rarely cause damage to crops or create environmental pollution caused by improper use.

General Secretary Xi Jinping once pointed out that, "We should adhere to the self-reliance of agricultural science and technology, and accelerate the research of key core agricultural technologies"^[1]. The specific measures are as follows: actively promoting the landing of relevant measures, promoting the research of key core technologies in the field of pesticides, especially biopesticides; attaching great importance to the research and development of biopesticides with both safety and pesticide effects, optimizing all aspects of product research and development-input market-farmer use, reducing the market price of biopesticides; altering the disconnection between research and development and the market, guiding and supporting the healthy development of biopesticide enterprises, gradually optimizing the market structure of pesticide products, dynamically updating the list of biopesticide products, and making biopesticides become the mainstream of the pesticide market; calling on pesticide manufacturers to pay attention to the environmental protection of biopesticides packaging, marking the significant signs of biopesticides, fully reflecting the theme of environmental protection and effectiveness to make farmers more easily identify biopesticides, promoting the promotion and application of related products.

3.4 Sending pesticide professional technical knowledge to the countryside and helping the growth of new professional farmers Farmers are the direct users of pesticides, and the lack of knowledge about pesticides makes them rely on third parties such as sales personnel to understand the related properties of drugs. It is necessary to improve the vocational training policy and enhance the quality of training, to create a high-quality professional farmer team that adapts to the development of modern agriculture^[4]. Therefore, while strengthening the professional knowledge training of pesticides and pests for sales personnel, it is also necessary to promote the professional technical knowledge of pesticides to the countryside, carry out the teaching of pesticide knowledge for farmers, and help the growth of new professional farmers. At the critical time node of drug spraying, agricultural technology experts with corresponding experience and teachers and students in agronomy and related majors in colleges and universities are mobilized to become pesticide instructors who will walk into the fields to introduce drug use in each link, and provide scientific guidance on the amount and method of drug use in seed mixing and different growth stages of crops, as well as drug selection, relationship between different drugs, drug use skills, drug taboos, and use ratio, etc. As a result, pesticide knowledge can truly enter the countryside and help farmers, especially help rural land contractors update their drug cognition concepts, select the best drug, determine the best dosage and apply the best application method.

It is necessary to give full play to the role of grass-roots party organizations and provide convenient conditions for agricultural

propaganda training. Based on the current situation of agriculture, rural areas and farmers in the region, and relying on the "internet +" model, practical pesticide knowledge publicity and training programs are formulated to form a rule-based pesticide professional technology publicity and training model. Young talents, especially young farmers who return home to engage in agricultural production, should be organized to carry out specialized training on pesticide technical knowledge. As General Secretary Xi Jinping said, "It is necessary to let some young people love rural agriculture and cultivate a new type of professional farmers"^[4]. Scientific, practical and concise pesticide knowledge that can be easily understood should be taught to change farmers' wrong perception of pesticides. At the same time, the young farmers who have learned from the promotion and training of professional technical knowledge of pesticides are graded and certified, so as to help young people grow into excellent talents who have skills, understand agriculture and love rural areas, and grow into "a new type of professional farmers who love agriculture, understand technology and are good at management"^[5].

4 Conclusions

Agricultural security and food security are the foundation of China's stable social development. To hold the grain bag firmly in our own hands, we must attach great importance to all aspects of agricultural production, and pesticide safety is a crucial part. In recent years, China has attached great importance to the problem of pesticide safety, but it can not be ignored that there are still some problems in every link of pesticide safety production by farmers. The safe use of pesticides can be ensured by attaching importance to the research and development and use of pesticides, the publicity and application of pesticide technology, the upgrading of pesticide equipment, and the training of new farmers, which is conducive to promoting the incremental improvement of food quality, helping agriculture and rural modernization, and stabilizing the basic plate of agriculture.

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