

Yuhao Zhang
Shijiazhuang Foreign Language School
Hebei, China
China, Factor 1: Plants

Research on the Occurrence, Prevention and Control of Wheat Midges in Jizhong Region

Background

In the 1950s, wheat midges caused disastrous damage in China. Later, due to the usage of *hexachlorocyclohexane* (HCH) and the planting of insect-resistant varieties, the occurrence of wheat midges was basically controlled in the 1960s. While in the 1980s, owing to the prohibition of the usage of HCH and the negligence on the prevention and control, wheat midges caused catastrophic harm again. Since then, its harm has been increasing. According to the statistics, the occurrence area of wheat midges reached 2.7 million square hectares in 2008¹, which is especially serious in Hebei, Tianjin and other regions. With the continuous strengthening of the prevention and control of agricultural diseases in Hebei province in recent years, the occurrence area of such pests is decreasing year by year. However, people in recent years rely on the chemical pesticides to control wheat midges too much. In the meantime, there are a lot of improper operations during the process of chemical control such as choosing chemicals randomly and overusing them. All of those can damage the ecological balance and harm the human eventually. As a result, the usage of the pesticides is becoming a controversial issue. This passage will analyze the present control mechanism, simultaneously discussing the safety and sustainability of pesticides and provide another two eco-friendly measures to prevent and control wheat midges.

Abstract

This article selects Gaocheng County as an example, analyzing the occurrence of wheat midges and the prevention and control mechanism during the growth cycle of winter wheat on Jizhong Plain. The paper is divided into three parts. The first part introduces the agricultural location of Jizhong Plain; In the second part, the occurrence, prevention mechanism and control measures of wheat midges are discussed and a case is studied. The third part discusses the current usage of chemical pesticides, analyzing the safety and sustainability of its use. And finally proposes a suggestion that increase the usage of biological measures and field management in pest control.

Key Words: wheat midge chemical pesticide usage Jizhong Plain

I. Brief Introduction

Located in the middle region of north China plain, the Jizhong Plain is one of the most important wheat production areas in China. And Shijiazhuang, the provincial capital of Hebei province which is in the hinterland of central Hebei province, has been affirmed as the national high-quality wheat production base by the Ministry of Agriculture for a long time. As for the natural condition, the Jizhong plain is on the alluvial fan of Taihang mountain pass, thus making the land rather fertile. What's more, it lies in the eastern temperate monsoon climate zone of China, with four distinct seasons and good hydrothermal conditions. As a result, the wheat here grows quite well. Nevertheless, the good natural conditions of Jizhong Plain also provide a hotbed for some types of agricultural pests, becoming a frequent occurrence area of wheat midges.

II. The Occurrence and Control of Wheat Midges

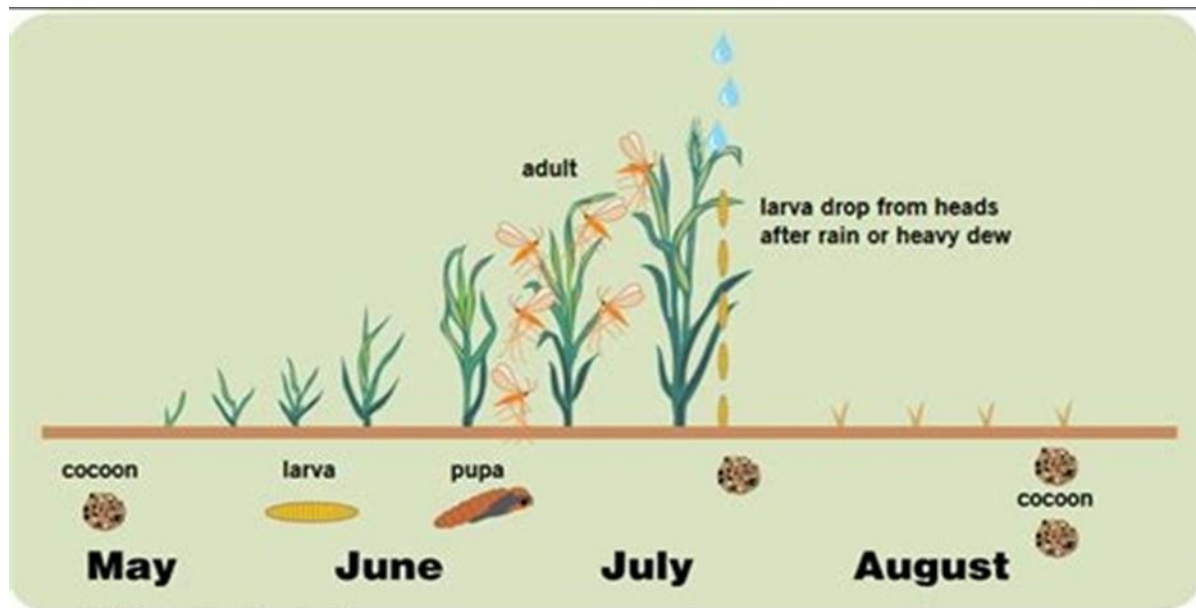
A. Biological Characteristics of Wheat Midges

The wheat midge belongs to *Diptera, Cecidomyiidae*, commonly known as little red worm, wheat maggot, etc. It is widely distributed in many countries and regions around the world. And the central part of Hebei province is mainly dominated by *Sitodiplosis mosellana* (Gehin). There are five main forms in the life cycle of them: egg, larva, cocoon, pupa and adult. Eggs are long elliptic. The body surface is smooth, with a color of transparent to light red; Larvae are maggot-like, foot-less, elliptic in length, relatively flat and orange in color. They are resistant to moisture but fear drought, and can survive in soil for more than 10 months². Cocoons are orange to yellow, round in shape and have a strong stress resistance, which can survive in the soil for more than 12 years³; Pupae involve naked pupae and cocoon pupae which are both orange to red; Adults look like mosquitoes and fear high-intensity and high temperature, which generally appears in early mornings and evenings. They will also hide beneath the wheat plant when encountering adverse weather.

B. The Occurrence and Harm of Wheat Midges

The life cycle of the wheat midges run through the growth cycle of wheat. When the ground temperature at 10 cm rises above 10°C at the jointing stage of wheat, the overwintering larva starts moving; As the wheat entered the booting stage and the ground temperature is higher than 15°C at 10 cm, they begin to pupate. When the wheat enters the heading stage and the ground temperature at 10 cm is higher than 20°C, adults begin to emerge and reach the peak of emergence at the peak of heading⁴. Adults mainly lay eggs on the earing but not flowering wheat ears, and those eggs

need 3-7 days to hatch⁵. After hatching, the larvae burrow into the wheat and suck the serous fluid in the wheat grain, causing wheat to shrink or even empty grain, and lead to reduced production eventually. The larvae usually become old larvae after 15-20d damaging wheat grains. After the wheat enters the dough stage, the larvae climb on glumes and awns, falling to the soil surface automatically with rain or dew, and then drill into the soil to form a dormancy body for summer and winter, starting a new round of damage.



C. The Influencing Factor of the Occurrence of Wheat Midges

Wheat midges mainly live in soil. Their activities such as digging and pupating in soil are closely related to soil temperature, humidity and soil properties. The occurrence of wheat midges is also related to the characteristics of wheat varieties because of their strict selectivity of laying eggs. So, the factors affecting the occurrence of midges can be summarized into three aspects: climate, species and soil. Firstly, the influence of climate factors mainly reflects on the temperature and humidity. The temperature usually affects the time wheat midges appear, for example, if the spring temperature is relatively high, the overwintering larva will unearth early. The influence of humidity mainly reflects on the number of larvae. If the soil moisture in spring is higher, the overwintering larvae will also unearth early. Secondly, according to their spawning habit of laying eggs, wheat breeds with compact and tidy spikelet, straight long awn, or closely-combined inner and outer glume shell has a good resistance to wheat midges, which are not easy to be infected with them;

Finally, as wheat midges spend nearly 10 months in the soil as the form of dormancy, the structure, nature, moisture content, pH and other factors of the soil are all related to the occurrence of wheat midges. For example, wheat midges prefer alkaline soil⁶. The occurrence of midges in sandy loam with soft soil and strong water retention capacity is relatively high, while that in clay and sandy soil is relatively low.

D. Case Study: The Occurrence and Present Treatment of Wheat Midges

1. The Analysis of the Geographical Condition of Gaocheng County

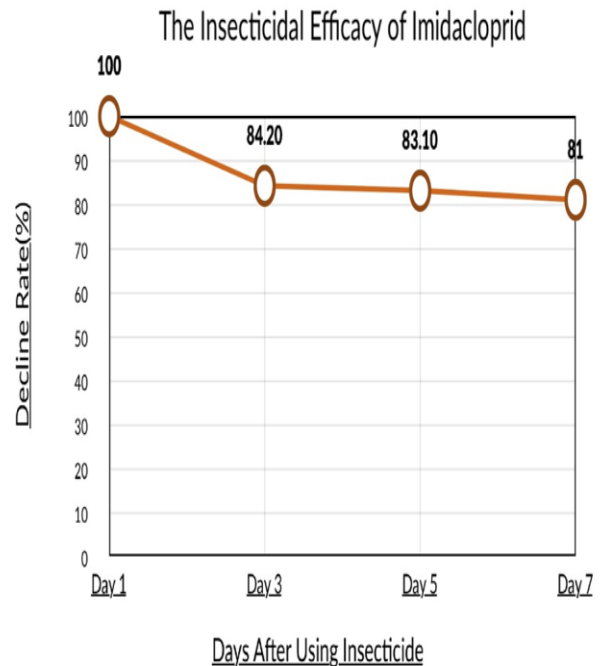
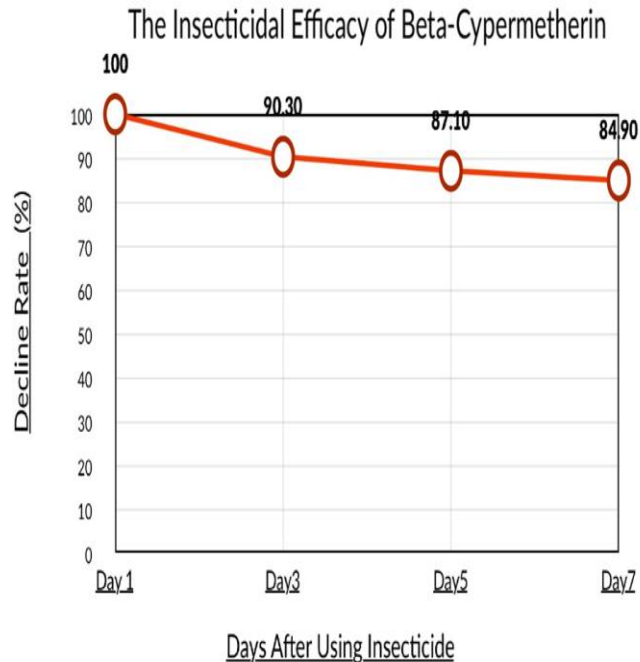
Gaocheng County lies in the southwest of Hebei province, at the eastern foot of the Taihang mountains, which is a warm temperate zone with semi-humid continental monsoon climate. Its natural conditions are superior: The four seasons are distinct. And the groundwater resources are rich. The water quality is all light and the agricultural infrastructure is good. With its rapid agricultural development, Gaocheng County becomes one of the most important grain production bases in Jizhong wheat region. Its wheat planting area reaches 500,000 mu and the output is 9000-10000 kilograms per hectare⁷. Excellent wheat resources provide a stable environment for the growth of wheat midges. In addition, it is known that the farmland in Gaocheng area is dominated by sandy loam with relatively high-water content. As wheat midges prefer wet land but fear drought and they are suitable to survive in sandy loam, so they occur frequently in Gaocheng County.

Site	Soil Texture	Crop	Water Content (%)	Field Capacity (%)
Shunzhong	Loam	Wheat	20.8	26.3
Nanying	Loam	Wheat	21.2	24.9
Kangcun	Loam	Wheat	19.1	23.5
Cangde	Sandy Loam	Wheat	16.1	19.7

2. Existing prevention and control measures in Gaocheng County

According to my investigation, the farmers of Gaocheng bought pesticides to prevent and control the adult insects at the end of April, which was the heading stage of wheat and the later stage of pupation of wheat midges. As for insecticides, many farmers prefer two kinds of pesticides:

β-Cypermethrin and *Imidacloprid*. By the date of investigation, this year's control of wheat midges is basically over.



E. The Comprehensive Control of Wheat Midges

The comprehensive control of wheat midges includes biological control and farmland management in addition to chemical control.

Biological control is the method that the farmers use one kind of organism to kill some of the others. It can be divided into three categories: insect control, bird control and fungus control. It is a way to reduce the population density of harmful organisms such as weeds and pests. It takes advantage of the interrelationship between biological species to suppress one or the other with one or a group of organisms. And its biggest advantage is that it does not pollute the environment, which cannot be compared with other non-biological pest control methods such as pesticides. The natural enemy of the pests is a significant part of the agricultural ecosystem. It is the most common way of biological control to use those natural enemies to control pests. Wheat midges have many natural enemies, such as parasitic wasps, predatory ants, spiders etc. Therefore, the main means of biological control towards wheat midges is to utilize this kind of relationship to kill the midges with artificially bred enemies like wasps.

Field management refers to various management during the whole cultivation process from sowing to harvest of crops in field production such as weeding, topdressing, irrigation drainage, prevention and control of diseases and insects. It is the labor process that creates good conditions for the growth and development of crops. In order to get twice the result with half the effort, field management must take targeted measures according to the natural conditions and the characteristics of crop growth and development. As for the field management of wheat planting, the first step is reasonable close-planting, which aims at preventing the wheat planting density from being too high. Secondly, shallow tillage should be carried out immediately after wheat harvest to reduce the number of overwintering larvae. Deep soil tillage should be carried out during autumn sowing to destroy the overwintering site of wheat midges. In addition, in areas with serious occurrence of wheat midges, appropriate rotation should be carried out. Wheat rotation with rice, cotton, soybean, garlic and other crops⁸, which can effectively inhibit the occurrence of wheat midges.

III. The Safety and Sustainability of Chemical Pesticides Usage

Nowadays, in Jizhong region, the application of chemicals is the most common method to prevent and control various agricultural diseases, whose effect is rather obvious. However, the safety and sustainability of chemical pesticides are always controversial. In this part, *β-Cypermethrin*, one commonly used pesticide in the control of wheat midges, is discussed to put forward thinking and analysis on this controversial issue.

β-Cypermethrin is a common insecticide, which is mainly used to control *lepidoptera* pests on crops. However, it is moderately toxic to mammals through skin contact or ingestion. It is volatile and can irritate the respiratory system, skin and eyes when applied. Moreover, it is a broad-spectrum insecticide, which means that this pesticide kills both the targeted pest and beneficial organisms such as bees and fish simultaneously, leading to the death of many beneficial organisms so that the biological control effect is significantly reduced. When using this pesticide, it is required to spray evenly and thoughtfully, otherwise it will poison the wheat plant and pollute the surrounding water and air.

Through the above brief introduction, it is not difficult to find that pesticides can inhibit the damage of diseases and pests when they occur, and have a significant compensation effect on crop yield, ensuring that agricultural products do not suffer or suffer little loss. However, many pesticides have negative effects, such as killing beneficial organisms and polluting the

environment. At the same time, the application of many pesticides requires certain skills which may be difficult for some farmers to operate. The improper operation will aggravate the negative effects of pesticides, eventually causing some irreversible consequences.

According to my investigation of the author, most farmers in Jizhong area have a preliminary understanding of the negative effects of pesticide use, and can basically prevent the abuse of pesticides and use them on time. But they do not have a deeper understanding of this. When it came to pesticide residues, most people said they knew something about them but still ate food that had been sprayed.

From my perspective, Jizhong region should promote its mechanism of preventing and controlling wheat midges by increasing the proportion of biological control and field management to reach the goal of "green agriculture".

IV. Conclusion

Decades ago, Jizhong wheat area was under the dark cloud of wheat midges every year. However, with the development of science and technology, the pest control mechanism in Jizhong area is gradually established and improved, and the occurrence area of wheat midges is gradually reduced. However, in today's control system, the use of chemical pesticides accounts for the majority, which has led to a new controversial topic: the safety and sustainability of pesticide use, which once triggered a wide discussion in society. In my opinion, the long-term use of pesticides can induce genetic mutations in such pests, thus showing new traits of resistance to existing pesticides and becoming "super pests". Although there is still not enough data to prove this view, I still hope that Jizhong area can optimize the control mechanism, reducing the use of chemical pesticides, and adopt environmentally friendly biological control, field management and other measures to control. And finally realize the goal of "green agriculture".

Bibliography

- ¹ Zhang Yuejin, Wang Jianqiang, Jiang Yuying. “2008 年全国农作物重大病虫害发生预测”. *China Plant Protection*, 2008(3) : 38-40
- ² Song Zhijun. “小麦吸浆虫的发生规律及防治”. *Seed Industry Guide*, 2012(4): 21-22
- ³ Song Zhijun. “小麦吸浆虫的发生规律及防治”. *Seed Industry Guide*, 2012(4): 21-22
- ⁴ Zhang Junsheng. “小麦吸浆虫的发生特点及防治方法”. *Modern Rural Technology*, 2012(1): 24
- ⁵ Zhang Junsheng. “小麦吸浆虫的发生特点及防治方法”. *Modern Rural Technology*, 2012(1): 24
- ⁶ Wang Shucong. “小麦吸浆虫防治应注意的几个问题”. *Modern Rural Technology*, 2010(10): 27
- ⁷ Liu Qian. “Investigation on Insect Community of the Super-High-Yield Wheat Field in Gaocheng and Control of the Main Pests.”
- ⁸ Qin Juxian, Gao Jiushi, Wang Hongyan. “小麦吸浆虫综合防治技术”. *Modern Rural Technology*, 2007(9): 85-86