小麦吸浆虫成灾规律与控制

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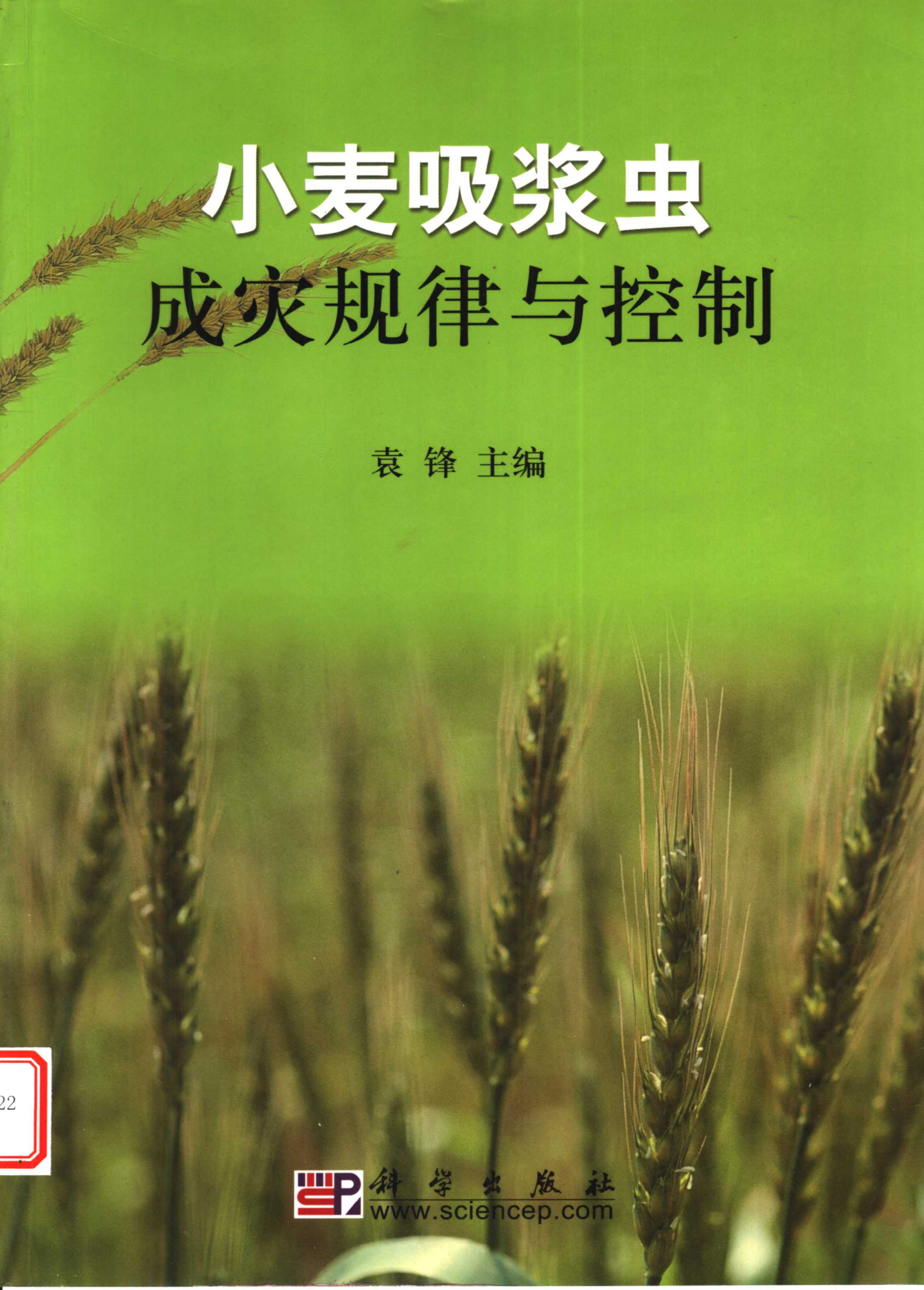

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The Wheat Blossom Midges *Sitodiplosis mosellana* (Gehin) and *Contarinia tritici* (Kirby): Their Plague Principle and Control

Chief Editor

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内 容 简 介

小麦吸浆虫是小麦的主要害虫，分布于欧洲、亚洲与北美洲，中国、美国、加拿大、英国、德国、芬兰等十多个国家均有严重危害，造成灾害的记录。本书是作者在国家自然科学基金资助下，进行“小麦吸浆虫成灾规律及控制策略与防治方法”（编号 39770499）的研究总结，在重点进行麦红吸浆虫成灾规律，滞育与化学物质变化，地理分布与地理种群遗传分化及基因流研究的基础上，收集国内外关于小麦吸浆虫研究的文献资料，编写成的专著。

全书分为十二章，全面介绍了麦红吸浆虫与麦黄吸浆虫的形态与超微结构特征及麦田瘿蚊科昆虫的种类与鉴别，小麦吸浆虫的危害，地理分布与遗传多样性和基因流，生物学特性，休眠与滞育，灾害与成灾规律，环境条件中气候、土壤、天敌、农药、地形地势、水利工程、种植制度、品种更换等自然因子与农业生产措施对小麦吸浆虫种群数量动态与暴发成灾的影响，田间调查与预测预报，控制策略与防治措施等内容。是全面反映国内外关于小麦吸浆虫研究成就和进展内容最丰富、最新颖的一本专著。

本书可供昆虫学研究、教学和植物保护工作者参考。

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前　言

小麦吸浆虫是小麦的主要害虫，以幼虫潜伏在麦颖内，吸食正在灌浆发育的籽粒汁液，轻则使籽粒发育不饱满，或形成秕粒，重则造成空壳，一般使小麦减产 10%～20%，重则减产 70%～90%，个别田块甚至绝收，严重影响小麦的产量和品质，甚至根本不能食用。

危害小麦的吸浆虫（wheat blossom midges）主要有两种：麦红吸浆虫 *Sitodiplosis mosellana*（Gehin）（wheat midge）与麦黄吸浆虫 *Contarinia tritici*（Kirby）（wheat blossom midge），属双翅目 Diptera 瘿蚊科 Cecidomyiidae，分布于欧洲、亚洲与北美洲，严重危害的有十多个国家，如美国、加拿大、中国、英国、德国、芬兰等均有严重危害，造成灾害的记录。

中国何时发生吸浆虫尚未考证清楚，但在元代仁宗延佑 7 年（公元 1314 年）鲁明善撰写的《农桑衣食撮要》中已有关于防治吸浆虫的记述，说明在中国历史上劳动人民早已注意到小麦吸浆虫的危害并予以防治。明朝、清朝与中华民国时期，江苏、河南、陕西、湖北等省区均有小麦吸浆虫严重发生与危害成灾的田块或地区。1946～1952 年小麦吸浆虫在全国小麦主产区暴发成灾，1949 年新成立的中华人民共和国政府高度重视，组织广大科技工作者进行小麦吸浆虫发生规律与防治研究，于 1950 年提出有效防治措施，领导与组织广大农民群众进行防治，到 1955 年小麦吸浆虫的严重危害得到控制，在我国与世界害虫防治史上写下了光辉的一页。1956～1982 年的 27 年中全国再没有出现小麦吸浆虫严重成灾的现象。1983 年小麦吸浆虫的严重危害在陕西关中部分地区又开始出现，1984～1991 年在黄河流域等冬麦区大范围暴发成灾，而且发生面积和每亩虫量远超过 1946～1952 年。人民政府高度重视，组织领导科技工作者进行小麦吸浆虫再猖獗的研究，领导广大农民群众进行大面积防治，到 1992 年小麦吸浆虫大范围的灾害现象又得到控制。但 1997 年在陕西长安县，1998 年在西安市霸桥区，1999 年在河北保定地区仍有个别成灾田块出现。2001 年在河北省南和县麦红吸浆虫大面积发生，1.3 万 hm^2 小麦受害，2002 年春季该县麦田麦红吸浆虫虫口数量很大，在县政府的重视下，于吸浆虫化蛹期，经大面积施药治理，才避免了 2002 年的严重灾害。

从上看出，新中国成立 50 多年来，我国发生过小麦吸浆虫暴发成灾两次，中国人民在小麦吸浆虫发生规律和防治研究，以及灾害控制方面做了大量的工作，取得了很大成绩，特别是曾发生过吸浆虫严重危害的地区，基层干部和农民群众对小麦吸浆虫已有一定的认识，积累了一定的防治经验。但是事实告诉我们，小麦吸浆虫仍然是我国小麦生产获得高产、优质、高效的严重障碍，而且随着我国水利工程建设的不断发展，旱地变为水田的面积进一步扩大，小麦吸浆虫的适生区在扩大，小麦吸浆虫灾害仍然是小麦生产中的潜在危险。

前事不忘，后事之师。为了系统总结小麦吸浆虫的成灾历史及我国进行研究、控制吸浆虫灾害的经验教训，为今后小麦吸浆虫灾害的预防和控制提供理论基础，在国家自

然科学基金资助下，我们承担了农业倾斜项目“小麦吸浆虫成灾规律及控制策略与防治方法”（编号 39770499）的研究，1998～2001 年的四年中，研究重点集中在以下三个方面。

1. 麦红吸浆虫成灾规律的研究。

根据农业灾害学与系统控制论的原理与方法，以全国麦红吸浆虫主发区之一的陕西关中地区为对象，系统收集、整理小麦吸浆虫发生成灾的历史资料，1932～2001 年的气象资料、水利条件、种植与耕作制度等变化。结合田间调查与试验，在网室中进行了影响麦红吸浆虫种群变动与成灾的主要因子研究。通过研究，明确了麦红吸浆虫成灾的空间格局是分布不均大小不一的团块，麦红吸浆虫造成的小灾到大灾（Ⅲ、Ⅳ、Ⅴ级），或中灾到大灾（Ⅳ、Ⅴ级），均无明显的周期性。持续发生的 1950～1952 年，1985～1987 年两次大灾（Ⅴ级）相隔 32 年，但是否 30 年左右麦红吸浆虫暴发成灾一次，还有待历史的验证。详细分析了成灾体（小麦）、致灾因子（麦红吸浆虫）的特征特性，自然环境因子（地形地势、土壤、温度、降雨、光照、风、天敌）与农业生产措施（水利工程与灌溉、品种更换、种植制度、土壤耕作、施用农药、施肥、播期等田间管理措施）对麦红吸浆虫发生与暴发成灾的影响及交互作用。明确了影响麦红吸浆虫种群变动与成灾的关键因子与主要因子。将麦红吸浆虫灾害发生的过程分为七个阶段（孕育期、潜伏期、预兆期、暴发期、持续期、衰减期、平息期），根据灾害各阶段的特征，提出了控制灾害的策略与系统措施。

2. 麦红吸浆虫滞育与化学物质变化的研究。

麦红吸浆虫以滞育状态越夏和越冬，和一般昆虫不同的是有延长滞育，隔年或多年羽化的现象，这就给根据幼虫数量预测成虫发生量带来很大困难。为了探明麦红吸浆虫形态、生理生化与遗传之间的关系，开展了滞育与化学物质变化的研究。试验结果表明，麦红吸浆虫滞育存在着明显的多态现象，按状态分为裸露幼虫（naked or non-cocooned larva）与圆茧幼虫（cocooned larva），按滞育时间长短分为越夏滞育（oversummering diapause），越夏至越冬滞育（oversummer-autumn-wintering diapause），二次滞育（re-diapause）与延长滞育（prolonged diapause）四个类型。麦红吸浆虫在土壤中的滞育以结茧幼虫（圆茧）为主，裸露幼虫所占比例随季节变化。滞育期间不仅存在着滞育深度不同的个体，而且滞育深浅程度随环境条件而变化。分析了不同时期幼虫的糖原、甘油、游离氨基酸、蛋白质、RNA 等化学物质变化，证明一些化学物质可作为衡量麦红吸浆虫滞育不同深度的指标。

3. 麦红吸浆虫地理分布与地理种群遗传分化及基因流模型研究。

根据资料记载与我们的实际调查，麦红吸浆虫在中国分布于 23 个省（市、自治区），从北纬 48.3°（黑龙江克山县）到 27°（江西吉安县，湖南省邵东县，贵州铜仁县），从东经 100°（青海湟源县）到 131.8°（黑龙江密山市），但主发区集中在平原地区的河流两岸，如陕西渭河流域的关中平原，河南伊河、洛河流域及黄河两岸，江淮地区，汉水上游的南阳盆地，长江两岸，甘肃东部与宁夏引黄灌区，山东的南四湖（南阳湖、独山湖、昭阳湖、微山湖）周围与河流两岸及水库灌区，河北邢台地区的井灌区等。随着水利工程建设的发展，灌溉区面积的扩大，麦红吸浆虫危害有明显扩大蔓延的趋势。对河南、陕西、甘肃不同吸浆虫地理种群进行同工酶及 RAPD 分析表明，不同

地理种群存在一定程度的遗传分化。冬、春麦区的麦红吸浆虫种群之间存在一定的基因流现象，也存在着阻断基因流的机制，使遗传漂变能发挥作用，造成边缘种群的基因丢失与纯合度增加。冬、春麦两大区域范围内，种群间的基因流偏向于大陆——岛屿模型。中西部冬麦区为麦红吸浆虫遗传多样性的中心，西北春麦区为扩散区。在中西部麦红吸浆虫基因流模型研究的基础上，目前正在进行全国主要麦区麦红吸浆虫基因流模型的研究。

第一方面的研究结果，编入本书第五章：麦红吸浆虫灾害与成灾规律；第二方面的研究结果编入本书第四章：小麦吸浆虫的滞育；第三方面的研究结果编入本书第二章：小麦吸浆虫的地理分布与遗传分化。后二方面的主要研究结果分别由仵均祥（2002）与贺春贵（2000）撰写成博士论文。

在进行上述三方面主要研究的同时，我们也开展了其他方面的研究，收集国内外关于小麦吸浆虫研究的文献资料，特别是西北农林科技大学在不同时期，由周尧教授、朱象三研究员、张克斌教授、李修炼研究员领导的小麦吸浆虫课题研究组的研究文献资料，编写成这本《小麦吸浆虫成灾规律与控制》专著，力求从种类与形态，地理分布与遗传多样性，生物学特性，休眠与滞育，灾害与成灾规律，气候、土壤、天敌、农药、地形地势、种植制度、品种对吸浆虫的作用，田间调查与预测预报，控制策略与防治措施十二个方面，全面系统的反映国内外关于小麦吸浆虫研究的成就和进展，这就形成了这本书的主要特点，既全面系统反映小麦吸浆虫的研究；又重点突出新近的研究成果。

本书编写的分工，尽量发挥各人的研究特长，袁锋任主编，制定编写大纲，组织编写，编著了前言与第一、五、九章。花保祯编写第三、七章。仵均祥撰写第十二章，并与胡木林合作编写第四章。贺春贵编写第二、八、十章。董应才撰写第六、十一章。袁锋主编统稿，仵均祥、花保祯协助统稿。

我们能够在近 5 年中完成小麦吸浆虫成灾规律与控制的课题研究，并编写出版这本专著，主要是得到了很多单位和同仁的热情鼓励和大力支持。

国家自然科学基金委员会，生命科学部，农学学科组的领导和专家，指导与帮助我们选题，并给予资助，我们表示衷心的感谢。

在本项目研究和本书编著过程中，热情向我们提供或交换文献资料的有：西北农林科技大学周尧教授，朱象三研究员，张克斌教授，李修炼研究员，叶世光高级工程师（1990～1992 年本校硕士研究生，现在广西南宁市开发区工作），江西省农业科学院副院长叶正襄研究员，陕西省咸阳市植保植检站赵世德高级农艺师，陕西省仪址农校杜安泰副教授，南开大学卜文俊教授等，我们向他们表示衷心地感谢。

有许多同志直接参加了部分研究工作。陕西省植物保护总站刘延虹高级农艺师，帮助整理了该站保存的 1951～1999 年小麦吸浆虫发生与防治面积的档案材料。陕西省气象局张笙芳高级工程师整理提供了西安市 1932～2000 年的气象资料。西北农林科技大学祝传书结合硕士论文，进行了麦红吸浆虫幼虫滞育前后的变化及生态因子的影响研究。河北省邢台市植保植检站站长柴通海高级农艺师，南河县农业局长李山河，南和县植检植保站站长李月芬农艺师支持和协助我们在当地进行调查和防治试验。陕西省西安市长安区农技中心薛理靠农艺师等协助我们在该区进行调查和试验，并提供他多年在长安县观察调查研究小麦吸浆虫的资料。长安县斗门病虫测报站赵廷选高级农艺师提供他

1959～1990年观察、调查、测报小麦吸浆虫的资料。河南省栾川县植保植检站马新智农艺师，安徽阜阳县植保植检站徐新远农艺师帮助收集了当地的小麦吸浆虫标本，供我们在实验室进行生化分析。河北农业大学王勤英教授为我们提供了河北保定地区小麦吸浆虫的发生动态的信息。西北农林科技大学张管曲实验师帮助制作彩色图版，王素梅技师帮助描绘插图，付晓洁帮助计算机作图。第四军医大学李向党、杨家骥老师帮助进行电镜扫描观察和拍摄麦红吸浆虫超微结构照片。我们向他们表示衷心地感谢。

西北农林科技大学植物保护学院、昆虫研究所、作物病虫综合治理与系统学农业部重点开放实验室、植物保护资源与病虫治理教育部重点实验室、昆虫博物馆的领导张雅林教授，冯纪年教授，翁松鸿教授，杨家荣副研究员，刘卫军副院长，以及与我们经常工作在一起的同事沈林副教授，王应伦研究员，袁向群，杨宗武，吕林，全卫等同志，为我们提供了顺利开展研究工作的实验条件和方便，我们向他们表示衷心感谢。

本书的出版得到西北农林科技大学植物保护资源与病虫治理教育部重点实验室与昆虫博物馆的部分资助，我们向有关领导与同志表示最衷心感谢。

科学出版社霍春雁、李锋及其他同志为提高本书出版质量做出很多努力，我们向他们表示真挚感谢。

事实和经验告诉我们，小麦吸浆虫过去是，现在是，将来仍然是威胁我国小麦生产的大敌。随着农业生产的发展，产业结构的调整，农业生态环境的变化，小麦栽培管理水平的提高，它的成灾特点也将发生很多新的变化，这就要求我们与时俱进，继续深入调查研究小麦吸浆虫，监测小麦吸浆虫的数量变动，控制它的暴发成灾，为我们伟大祖国的繁荣富强做出更大贡献。

由于作者学术与文字水平有限，书中难免存在差错和疏漏之处，敬请读者批评斧正。

袁　锋

2003年4月5日

于西北农林科技大学

Preface

Wheat blossom midges are the serious pests of wheat, outbreaking and plaguing sporadically. They hide within the glumes of wheat during the larval stage, feeding on the developing wheat kernels within the glumes, causing the kernels to shrivel and deforme. Kernels may be aborted entirely, not fully develop, or only be slightly damaged. As feeding increases, yield and quality of wheat are reduced by 10 to 20 percent, even 70 to 90 percent when outbreaking. The loss of kernels lowers the yield, whereas damaged kernels reduces the grade of the harvested wheat.

The wheat blossom midges damaging wheat have two main species: Wheat midge (Orange wheat blossom midge), *Sitodiplosis mosellana* (Gehin), and Wheat blossom midge (Yellow wheat blossom midge), *Contarinia tritici* (Kirby). Taxonomically, they belong to the family Cecidomyiidae in the order Diptera. They are mainly found in Asia, Europe, and North America wherever wheat is grown, causing significant damage to wheat in China, Germany, Finland, the United Kingdom, Canada, and the United States of America, etc.

As for when the wheat blossom midge, occurred in China is not clear from the textual criticism, but in the book *Synopsis on Farming and Sericulture written* by Lu Mingsan in 1314 (Yuan Dynasty), there was the description on controlling the wheat midge. From Ming Dynasty, Qing Dynasty, to the Republic of China, there often were plague records on the wheat midge in the such provinces as Jiangsu, Henan, Shaanxi, Hubei, etc. During from 1946 to 1952, the wheat midge outbroke in all the main wheat growing regions in China. The Central People Government, the Peoples Republic of China, organized entomologists to study the bionomics and control measures of wheat blossom midges. By 1950, the effective control measures were put forward. By 1955, their serious damage was effectively controlled in China. During the 27 years period from 1956 to 1982, they did not cause any serious damage to wheat in China. However, from 1983, the wheat midge caused damage to wheat in some areas in central Shaanxi again. From 1984 to 1991, they outbroke widely in the winter wheat growing areas in the Yellow River valley, and the damaging acreage and the population abundance were much higher than those in 1946～1952. Under the leadership by the government, entomologists conducted research on their resurgence, their damage was controlled in the most areas by 1992. However, from 1997 to 2001, they still outbroke in Chang'an County, Shaanxi Province, and Nanhe County, Hebei Province.

It can be seen from above that there occurred twice serious damage of wheat blossom midges to wheat in China during the period of 50 years since the establishment of the Peoples Republic of China. A lot of research and work have been done on the bionomics, occurrence, and control, and made a great progress. But the fact tell us that the wheat blossom midges still are the big barrier to the wheat production of high yield, high quality, and high effectiveness in China. In addition, as the continuous progress of the irrigation works construction, the acreages of arid land becoming irrigated fields will increase further, the suitable areas for the wheat blossom midges are increasing. There-

fore, the wheat blossom midges are still the potential threat to the wheat production in China.

Remembering the preceding matters can be the teacher of later affairs. In order to summarize the outbreak and plague history on the wheat blossom midges and the experience of controlling them, and to provide a theoretical basis for their forecasting and control, under the financial support by the National Natural Science Foundation of China, we undertook the research program "The Outbreak and Plague Law, Control Strategies and Methods of Wheat Blossom Midges" (No. 39770499). During the 4 years period from 1998 to 2001, our researches stress mainly focuses on the following three aspects:

1. The plague principle of the wheat midge.

According to the principle and methods of the science of agricultural catastrophology and systematic cybernetics, with central Shaanxi, one of the main outbreaking areas of the wheat midge, as the research base, we systematically collected and analyzed the historical data of the plague and outbreak of the wheat midge, the meteorological data from 1932 to 2001, and the evolutions of the irrigation conditions, cultivation, and tillage system. In combination with field investigation and experiments, the main factors influencing the population dynamics and plague of the wheat midge were studied in the green house. Through analysis and study, the spatial distribution patterns of the plague of the wheat midge are described to be unevenly distributed and various sized masses. The wheat midge damages, from light plague to heavy ones (grade Ⅲ, Ⅳ, and Ⅴ), did not show any distinct periodicity. The sustainable heavy plagues occurred twice from 1950 to 1952 and from 1985 to 1987, separated by 32 years. Whether there occurs a heavy plague every 30 years or so, however, needs to be confirmed in the future.

The characteristics of wheat and the wheat midge are analyzed in detail. The influences of the natural environmental factors (such as topography, soil composition, temperature, precipitation, light, wind, and natural enemies) and the farming practices (such as irrigation works and irrigation, variety replacement, planting system, soil tillage, pesticide application, fertilizer application, and sowing time, etc) upon the outbreak and plague of the wheat midge and their interactions are also studied. The key and principal factors influencing the population dynamics and the plague of the wheat midge were made clear. The plague process of wheat midge can be divided into seven stages: sprouting, incubation, presage, erupting, sustaining, diminishing, and subsiding periods. Based on the characteristics of the various stages of the plague, the strategy and measures to control plagues of the wheat midge are put forward.

2. Researches on the wheat midge diapause and its chemical changes.

The wheat midge over-summers and overwinters in diapause state. However, it differs from other insects in that it has a character of prolonged diapause. Over-wintering larvae may remain dormancy until conditions are favorable for development, whether the following spring or several years later. This brings a great difficulty to forecast the adult abundance from the larval population in the soil. In order to discover the relationships between the morphological, physiological-chemical, and genetic characters of the wheat midge, the diapause and the chemical changes of the wheat midge were studied. The results showed that the wheat midge has polymorphism in diapause. They can be divided into non-cocooned and cocooned larvae based on diapause state, overwintering diapause,

over-summer-wintering diapause, re-diapause, and prolonged diapause based on the longevity of diapause. The wheat midge diapauses in soil mainly in cocooned larvae, the frequency of non-cocooned larvae varies with seasons. During the diapause period, there are not only individuals of various diapause strengths, but also the diapause strength varies with the environment conditions. The changes of some chemicals, such as glycogen, glycerine, free amino acid, protein, and RNA etc. were analyzed, indicating that some chemicals can be regarded as the indicator of diapause strength of the wheat midge.

3. The geographical distribution, genetic variation, and gene flow of the wheat midge geographical populations.

According to the data recorded historically and from our investigation, the wheat midge is found in 23 provinces (autonomous regions, cities) in China, from 48.3 °N (Keshan Co., Helongjiang) to 27° N (Ji'an Co., Jiangxi; Shaodong Co., Hunan; Tongren Co., Guizhou), from 100° E (Huangyuan Co., Qinghai) to 131.8°E (Mishan City, Heilongjiang). But they mainly occur along the banks of rivers in the plains, such as the Guanzhong plain of Weihe River valley, Yihe-Luohe River valley and along the banks of Yellow River, Yangtzi-Huaihe River valley, Nanyang Basin by Hanshui River, east Gansu and Ningxia Irrigation District of Pumping Water from Yellow River, the four lakes in Shandong Province (Nanyang Lake, Dushan Lake, Zhaoyang Lake, and Weishan Lake) and irrigation district using reservoir, Xingtai irrigation district using ground water, Hebei, etc. As the development of irrigation works construction and the expanses of the irrigation district areas, the damage of the wheat midge to wheat has a tendency to expand and spread greatly. Through the analysis on the isozymes and RAPD of various geographical populations of the wheat midge from Henan, Shaanxi, and Gansu, it indicates that the different geographical populations have some degrees of genetic variations. There exist gene flows between the populations of winter and spring wheat areas. There also exist mechanisms to hinder the gene flow, making the genetic drift plays a part, causing the gene loss and purity to increase. In the two large ranges of winter and spring wheat, the gene flow between populations tends to be the continent-islands pattern. The winter wheat areas of central to west China are the center of genetic diversities in the wheat midge. The spring wheat area of northwest China is the spreading region of the wheat midge.

The first part of the research results was compiled into chapter 5, the plague of the wheat midge and its emergent principle; the second part of the results into chapter 4, diapause of the wheat midge; the third part into chapter 2, geographical distribution and genetic diversity of wheat midge. The main results of the latter two parts were written in their Ph. D. dissertations by Wu Junxiang (2002) and He Chungui (2000).

Apart from the three main aspects of research mentioned above, we also conducted other aspects of research. The literature on researches of the wheat blossom midgs was collected from both China and abroad, especially the research literature in the Northwest Sci-Tech University of Agriculture and Forestry at various periods, such as Chou Io, Zhu Xiangsan, Zhang Kebin, Li Xiulian. The objective of compiling this book is to summarize the achievement and progress on researches of the wheat blossom midges both of China and abroad comprehensively and systematically from the following 12 aspects: species and morphology, geographic distribution and genetic diversity, biological

characteristics, diapause, plague and its emergent principle, effects of climate, soil, natural enemies, pesticides, topography, planting systems, and varieties on the wheat blossom midges, field investigation and forecast, and control strategies and methods. The main distinguishing features of this book are that it not only summarizes the research achievement of the wheat blossom midges comprehensively and systematically, but also highlights the recent research achievements

According to the individual speciality of each contributor, the compilation of the book is divided in labor as following: Yuan Feng, the editor-in-chief, made the compilation principle and outline, and wrote the preface, Chapters 1, 5, and 9. Hua Baozheng compiled Chapters 3 and 7. Wu Junxiang wrote Chapter 12, and co-wrote Chapter 4 with Hu Mulin. He Chungui contributed to Chapters 2, 8, and 10. Dong Yingcai compiled Chapters 6 and 11. Yuan Feng corrected the manuscript of the whole book with assistance of Wu Junxiang and Hua Baozheng.

One of the reasons that we can complete the research program *The Outbreak and Plague Law, Control Strategies and Methods of the Wheat Blossom Midges* within five years and publish this monograph is that we received warm encouragement and great support from many institutions and colleagues.

We wish to thank the leaders and specialists in Division of Agronomy, Department of Life Sciences, the National Natural Science Foundation of China, for their guiding and helping our selecting the topic and providing us financial support.

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The fact and the experience tell us that the wheat blossom midges used to be, are, and will continue to be the big foe to threat the wheat production in China. As the development of agricultural production, adjustment of the structure of production, the change of agro-ecological environment, and the increase of the cultivation and management levels of wheat, the outbreak and plague features will also emerge many new variations. These require that we should continue to investigate and study the wheat blossom midges in deep and further, monitor the population dynamics of the wheat blossom midge, and control their outbreak and plague.

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