

Kong Luen Heong · Jiaan Cheng
Monina M. Escalada *Editors*

Rice Planthoppers

Ecology, Management, Socio Economics
and Policy



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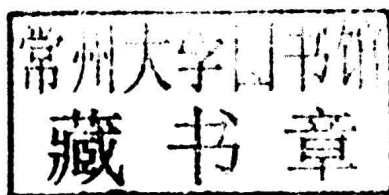
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With 45 figures



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ADVANCED TOPICS IN SCIENCE AND TECHNOLOGY IN CHINA

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Zhejiang University is one of the leading universities in China. In Advanced Topics in Science and Technology in China, Zhejiang University Press and Springer jointly publish monographs by Chinese scholars and professors, as well as invited authors and editors from abroad who are outstanding experts and scholars in their fields. This series will be of interest to researchers, lecturers, and graduate students alike.

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Foreword

Rice has been cultivated in China for more than 7000 years and is the staple food of more than half of the world and about 80% of Asian population. The yield per unit area has been increasing significantly since the 1st Green Revolution in 1960's. However, the intensification of rice production using the technology developed in the 1st Green Revolution has caused negative externalities, such as environmental pollution, more pest and food safety problems. With ever increasing population, rice production has to be further doubled in the next 50 years with limited land and water available, and it might be the only way to produce more rice through increasing yield per unit area.

Although China and many countries in the world are making progress in increasing yields per unit area, a substantial amount of food is also lost to insect damages. For example, China's rice production loses about a million tons every year and more than 2 million tons in some abnormal years due to the planthopper problems. The historical data indicated that planthopper problems are getting worse under the traditional intensified agricultural practices with increasing chemical fertilizer and insecticide inputs. Realizing this, scientists in Zhejiang University working with scientists from the International Rice Research Institute (IRRI), initiated the first international planthopper workshop at a modest scale in 2006. This was to be followed by a larger planthopper conference held in IRRI in 2008. More recently, in November 2012 Zhejiang University co-sponsored the International Rice Planthopper Conference that was held in the University's new campus in Zijingang, Hangzhou. A hundred and seventy scientists from 9 countries presented 93 papers and posters of a wide range of topics ranging from genetics, ecology and sociology related to managing rice planthoppers.

Zhejiang University is one of the largest universities involved in agricultural research in China. The University proudly houses the National Key Laboratory of Rice Biology jointly with the China Rice Research Institute and the National Key Discipline of Plant Protection. These institutes focus research on pest issues, especially for rice pests. Professors from Zhejiang University led a consortium of research partners and won a prestigious National Basic Research Program of China to further explore the mechanisms for frequent outbreak of rice planthoppers and develop sustainable management strategies to improve planthopper management in China. The Zhejiang University led the consortium

working closely with the IRRI developed a comprehensive research program to address issues related to molecular biology, ecology, management and policies related to the planthopper pests.

The research had demonstrated that unlike other insect pests, planthoppers with high fecundity and high adaptability to intensified rice ecosystems are secondary pests that are frequently induced by inappreciated crop practices, especially in insecticide misuse. The 2012 Conference had focused on addressing the ecological, management and sociological issues surrounding the planthopper problem. Most had come to realize that such a pest problem cannot be fixed by technology alone, and the integration of biological and ecological technology, social sciences and policy research is necessary. This book provides summaries and analyses of key research works that will bear on developing management strategies. Clearly China, as well as other countries, will need to focus on developing more sustainable “green” approaches to solving pest problems and reaching higher yield per unit area simultaneously. I hope that this book will be a good guide to scholars, researchers and students seeking for ideas and materials.

Jianhua Lin
President
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June 2014

Preface

The International Conference on “Rice Planthoppers: Ecology, Management, Socio Economics and Policy” was held in Zhejiang University’s new campus in Zijingang, Hangzhou, November 21–23, 2012. The Conference brought together researchers from Australia, Cambodia, China, Indonesia, Japan, Myanmar, Philippines, Korea, Thailand, the FAO and IRRI. This Conference came about as a result of numerous outbreaks of planthoppers in China, Philippines, Thailand, Indonesia, Bangladesh, India and Myanmar from 2005 to 2012. Planthoppers are generally not pests as they are well controlled by natural biological control services that are abundant in rice ecosystems. However, when such services are compromised, their populations grow exponentially into outbreaks destroying crops, causing a symptom called “hopper burn”. In addition, planthoppers are also vectors of several virus diseases that will destroy newly planted crops in the seasons following the outbreaks.

In the 1970s and 1980s, the early days of the Green Revolution, planthoppers became major threats to rice production following high use of subsidized fertilizer and pesticides and when the subsidies were removed the pest subsided. These same pests have returned with a vengeance, causing even more destruction and misery to farmers throughout East and Southeast Asia. Today rice planthoppers have become rice’s most serious pest problems. In the last few years they have caused crop losses of more than 10 million tons.

The most seriously affected country was Thailand. From 2008 Thailand’s rice bowl in the central plains has suffered continuous outbreaks for 14 consecutive seasons. In January 2010 the government of Thailand announced a 16% reduction in their export forecasts. Thousands of farmers had lost their crops and in February 2010 the government announced a release of US\$ 60 million to compensate farmers’ losses. Economists quantified the 2010 dry season crop loss due to planthopper attacks to be more than US\$ 50 million at farm gate price. In addition, the government spent more than US\$ 1 million to launch 28 control campaigns in 14 provinces and released emergency funds of about US\$ 16 million to purchase insecticides for distribution which contributed to the sustained outbreaks. In June 2011, the Rice Department in collaboration with the Thai Agro Business Association (TABA) and IRRI launched a campaign to “stop the use of abamectin and cypermethrin” in rice. These two types of insecticides were major culprits to

pest resurgences. The campaign reduced on-farm use of these insecticides but applications remain high as retailers very quickly introduced other products into the market.

Similarly, Indonesian farmers suffered the same threats and Java alone lost about a million tons in 2011. Losses in other years were however not quantified. Smaller patches of outbreaks had occurred in Malaysia, India, Myanmar, Bangladesh, Philippines and India while China continues to lose about one million tons a year. In 2012 the southern provinces of China suffered the worst planthopper outbreaks in the last 20 years. Besides economic losses, thousands of farmers have suffered crop failures, pesticide poisoning and severe debt problems which have forced them into poverty and hunger and even suicide.

Planthoppers are secondary pests that are normally under natural control. Outbreaks are symptoms of unsustainable practices that destroy vital biodiversity and ecosystem services triggering exponential population growth resulting in outbreaks. Although abnormal weather like droughts and floods can also trigger outbreaks, the most consistent factor in Asia is insecticide misuse. Insecticide misuse in Asia is due to weak marketing regulations that permit pesticides to be sold as FMCGs (fast moving consumer goods), like tooth paste and soap. In addition insecticide active ingredients are marketed in hundreds of trade names in plastic sachets packaging, like instant coffee and shampoo, and retailed by village general stores. To promote sales aggressive marketing campaigns are often used with numerous sales incentives, like gifts, free trips, lottery tickets and even a trip to Mecca. At the grass root level farmers rely on pesticide retailers for advice, recommendations and supply of pesticides, and this inevitably results in rampant misuse.

In the 2008 Planthopper Conference held at IRRI, scientists in attendance developed a consensus that planthopper problems are induced by insecticide misuse. Technologies such as resistant varieties alone are unable to solve the problem. In the 2012 Planthopper Conference, scientists further confirmed that planthopper problems are insecticide-induced and developed consensus that strategies to solve such problems would need intervention through the social sciences and policy reforms. Eleven papers from the Conference that addressed ecology, management, socio economics and policy were selected for this book. The first Chapter describes the planthopper problems in China in the last half century by Professor Jiaan Cheng who has been working on these problems since the 1960s. In Chapter 2, another veteran who has been working on planthoppers since the 1970s, Dr. K. Sogawa, describes how this man-made problem is occurring in all rice ecosystems in Asia. Chapter 3 is another synthesis paper prepared as a Working Paper for the Asia Development Bank (ADB) that summarizes the general findings from the Regional Research and Development Technical Assistance project that supported a lot of the work. Chapter 4 extends discussions into the realm of policy weaknesses in pesticide control and calls for reforms and the “professionalizing” of plant protection services similar to that of medical services. Dr. T. Wada, another planthopper veteran researcher, discusses the differences in the biology of rice planthoppers in tropical and temperature regions. This is followed in Chapter 5 by Professor Yonggen Lou et al. discussing

herbivore induced defenses in rice that can be useful in avoiding pesticide use. The huge amounts of insecticide used in rice especially in China, has resulted in rapid developments in resistance. Professor Zewen Liu et al. outline the mechanisms of insecticide resistance development in planthoppers in Chapter 6. Technologies alone are unable to manage planthopper problems and more ecologically based approaches are needed. Professor Geoff M. Gurr et al. in Chapter 7 explore the potential of ecological engineering methods for delivering ecosystem services that will render protection to rice crops. The pioneering work to introduce ecological engineering methods to manage planthoppers was carried out in Jinhua, China by Zhongxian Lu and his colleagues as described in Chapter 8. Farmers' insecticide applications are less than perfect and a large proportion of their sprays are unnecessary. In Chapter 9, Kong Luen Heong and his colleagues examined insecticide use and yield data from more than 5000 farms and found that there were very little productivity gains from farmers insecticide use. Planthopper outbreaks are unpleasant experiences that rice farmers are constantly fearful of. In Chapter 10, Monina M. Escalada et al. examine the social impacts of planthopper outbreaks on farmers in central Thailand. Finally in Chapter 11, Geoff A. Norton et al. use a resilience model to encapsulate the ecological, social and policy aspects surrounding the rice planthopper problem and suggest a conceptual framework for future use in tackling such a complex problem as the rice planthopper.

The last book on rice planthoppers published by IRRI in 2009 outlines new paradigms to chart sustainable ways to manage these secondary pests. We hope that this book will provide further thoughts into the new paradigms especially in the application of ecological engineering methods and in "fixing" the problem through policy interventions and reforms. The website <http://ricehoppers.net/> will continue to update on issues related to rice planthopper management and ecological engineering methods.

We are grateful to the Ministry of Science and Technology for providing the National Basic Research Program of China (No. 2010CB126200) and to Chinese National Natural Science Foundation for providing an International Cooperative Project (No. 30771420) to enable Zhejiang University scientists to work with IRRI scientists and to the Asia Development Bank for providing the Regional Research and Development Technical Assistance grant to IRRI that supported the research and Conference. In particular we are especially grateful to Dr. Lourdes Adriano, principal economist in the Bank who had provided great guidance.

Kong Luen Heong
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