DEVELOPMENT OF INSECTICIDE APPLICATION TECHNOLOGY TO RICE PLANTHOPPERS THAT ARE IMPORTANT TRANSBOUNDARY PLANT PESTS IN ASIA

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Sachiyo Sanada-Morimura has been the Group Leader of Pest Management Group, Kyushu Okinawa Agricultural Research Center, NARO, since 2018. She received her Ph.D. from Tokyo University of Agriculture and Technology in 1999. She joined the National Agricultural Research Center, NARO, under the Research Fellowship for Young Scientists program of the Japan Society for the Promotion of Science, and worked there until she moved to her present research institute in 2008. Her main work focuses on insecticide resistance in rice planthoppers.

Mizuki Matsukawa earned her Ph.D. from Nagoya University in 2016. She has been working on methods to control rice planthoppers in Vietnam and Cambodia as a researcher at Japan International Research Center for Agricultural Sciences (JIRCAS) since 2016.

ABSTRACT

Rice planthoppers migrate from the northern part of Vietnam to the southern part of China and western part of Japan every year. They increase drastically in their immigrated areas and cause serious damage to rice. They are known to develop resistance to various insecticides which is one of the most important factors causing serious damage around Asia in recent years. In this presentation, we introduce the collaborative research project of the National Agriculture and Food Research Organization (NARO) and Japan International Research Center for Agricultural Sciences (JIRCAS) to develop insect pest management strategies for rice planthoppers in Asia. NARO has monitored the susceptibilities of insects to various insecticides (i.e. organic phosphate, carbamate, pyrethroid, phenylpyrazole, and neonicotinoid) in Japanese populations of rice planthoppers every year for a long-term period, while noting the development of resistance to some insecticides. For imidacloprid susceptibility in Nilaparvata lugens, which shows a very strong development of resistance, we compared the progress of insecticide-resistance development in many populations in Southeast Asia and East Asia. As the result, it has been revealed that the modes of insecticide resistance development have synchronized among insect pests in northern Vietnam, southern China, and western Japan. It shows the importance of monitoring insecticide susceptibility throughout Asia, not only in immigrated areas but also in areas of emigration, and share the information for solving the insecticide-resistance problem. NARO has developed a new method for monitoring insecticide susceptibility and created the general manual for monitoring. In addition to briefly explaining the contents of this manual, we introduce our efforts to expand its use in Asia.JIRCAS has conducted a research activity titled “Population dynamics of rice planthoppers and relationship with agricultural activities in Vietnam” under the JIRCAS research project “Development of technologies for the control of migratory plant pests and transboundary diseases” since 2016. It aims to clarify 1) the population dynamics of planthoppers and natural enemies, 2) the insecticide resistance of planthoppers against the insecticides used by farmers, and 3) the tolerance to planthoppers of the variety used by farmers in the central and northern part of Vietnam. These are important components to consider for establishing an integrated pest management (IPM) system to control rice planthoppers in Vietnam. JIRCAS collaborates with the Plant Protection Research Institute and five sub-departments of Plant Protection under the Ministry of Agriculture and Rural Development in Vietnam, and NARO in Japan. Our current results are briefly introduced in this presentation.


Development of insecticide application technology to rice planthoppers that are important transboundary plant pests in Asia
NARO
JIRCAS
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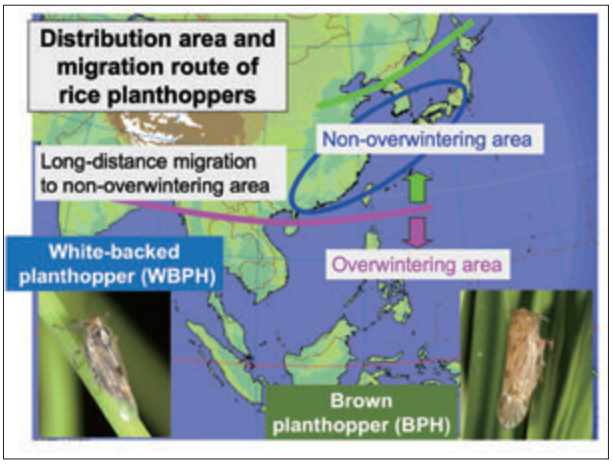
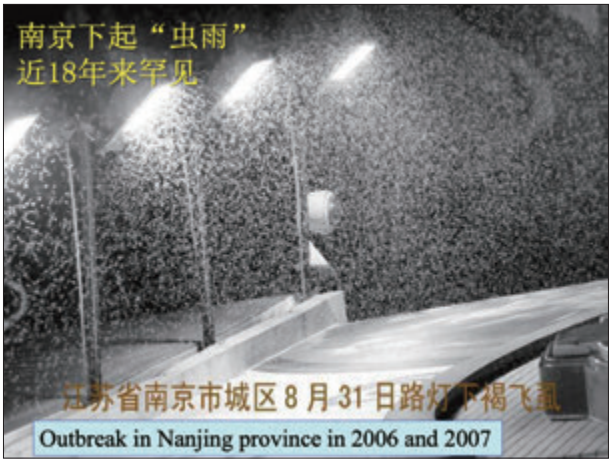
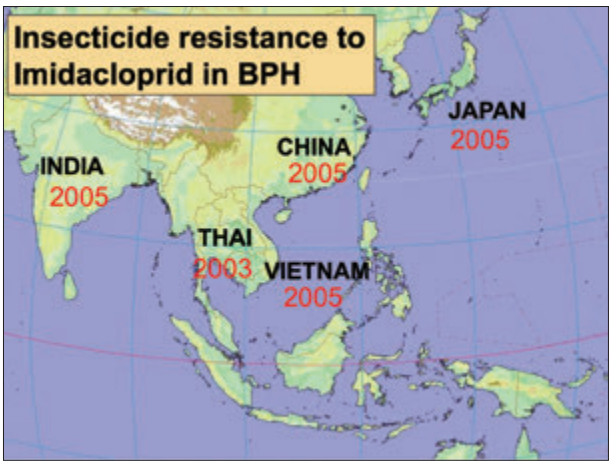
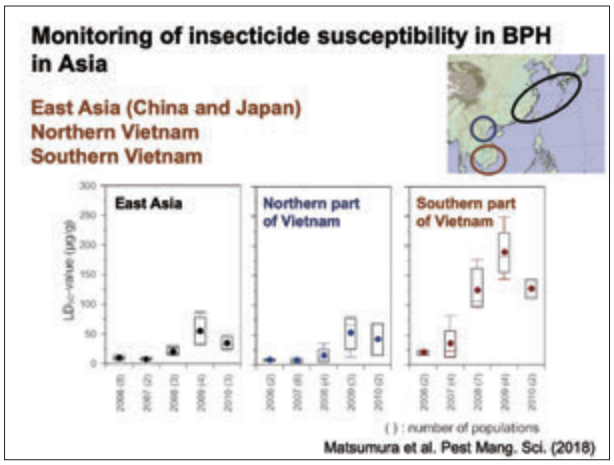

Distribution area and migration route of rice planthoppers
Non-overwintering area
Long-distance migration to non-overwintering area
White-backed planthopper (WBPH)
Overwintering area
Brown planthopper (BPH)

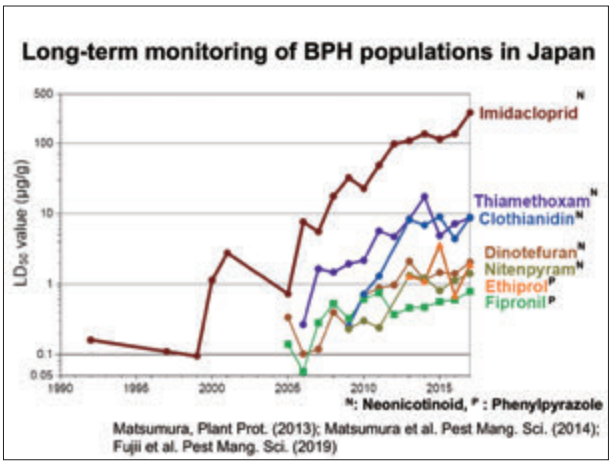

Hopperburn in a paddy field for whole crop silage
(Kumamoto pref. Japan, 2014)


南京下起“虫雨”
近18年来罕见
Outbreak in Nanjing province in 2006 and 2007


NARO
Challenge from NARO for insecticide resistance management


Insecticide resistance to Imidacloprid in BPH
JAPAN
2005
CHINA
2005
INDIA
2005
THAI
2003
VIETNAM
2005


Monitoring of insecticide susceptibility in BPH in Asia
East Asia (China and Japan)
Northern Vietnam
Southern Vietnam
East Asia
Northern part of Vietnam
Southern part of Vietnam
( ) : number of populations
Matsumura et al. Pest Mang. Sci. (2018)


Long-term monitoring of BPH populations in Japan
Imidacloprid
Thiamethoxam
Clothianidin
Dinotefuran
Nitenpyram
Ethiprol
Fipronil
LD50 value (μg/g)
N: Neonicotinoid, P : Phenylpyrazole
Matsumura, Plant Prot. (2013); Matsumura et al. Pest Mang. Sci. (2014); Fujii et al. Pest Mang. Sci. (2019)

Manual for testing insecticide susceptibility

1. Training of monitoring method for testing insecticide susceptibility
2. Sharing information about BPH management among NARO, JIRCAS and PPRI (Plant Protection Research Institute).

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Challenge from JIRCAS for insecticide resistance management

Structure of the Project (2016-2021)

	Population dynamics	Proper insecticide use	Variety tolerance	Utilization of natural enemies

Out put: Component technique of IPM system

Field evaluation

Output: Manual for controlling planthoppers in Vietnam

Outcome: Avoiding the development of insecticide resistance and variety tolerance of planthoppers in Vietnam

Reduce the damage by rice planthoppers

Collaborated institutes

JIRCAS

Vietnam

- Plant Protection Research Institute (PPRI)
- Sub-department of Plant Protection under MARD

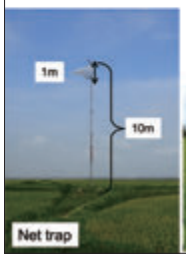
Vinh Phuc, Nam Dinh, Ha Tinh, Hue, Phu Yen

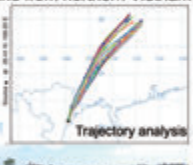
Japan

- Kyushu Okinawa Agricultural Research Center
- Institute of Agricultural Machinery
- Institute of Agrobiological Sciences

Population dynamics of rice planthoppers

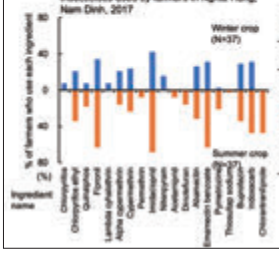
- Clarify the migration of rice planthoppers in the central and northern Vietnam
- Peaks were observed in Apr-May, and trajectory analysis showed the wind from northern Vietnam to South China





Effect of insecticide application to density of rice planthoppers in farmers' fields

- Clarify the insecticide use by farmers and its effect on the density of planthoppers in the farmers' fields
- Low effect on planthopper's density by number of insecticide application



Result of GLM analysis on variables affecting the density of rice planthoppers

Factor	df	Estimated value	χ2	P value
Location	1	0.6301119	4296.0328	<0.001*
Season	1	-0.309063	662.63372	<0.001*
Number of insecticide applied	1	0.0150648	22.469858	<0.001*
Spider	1	0.0190922	4534.7515	<0.001*
Mirdbug	1	0.0588981	6285.5591	<0.001*

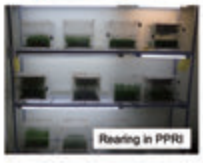
Monitoring of the insecticide susceptibility on rice planthoppers

- Monitor the yearly fluctuation of insecticide susceptibility on rice planthoppers in Vietnam using topical application (2018~)

Insect populations
Nam Dinh, Vinh Phuc, Hue, Phu Yen, Dong Thap

Chemical ingredients
Dinotefran, Nitenpyram, Thiametoxam, Clothianidine Imidacloprid, Pyraxsalt

- LD_{50} values in 2018 showed the similar tendency with BPH populations in Japan



NARO

Future Plans of Collaboration

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There is a fear that rice planthoppers would develop strong resistance against the popular insecticides and its outbreak would be occurred again in near future

Collaboration research on insecticide resistance, population dynamics and migration will be conducted to establish the management of insecticide resistance in Southeast and East Asia


Thank you for your attention!