



# Study of Major Insect Pests on Rice and Corn in Four Provinces in Red River Delta of Vietnam During 2018-2022

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## ABSTRACT

Harmful pest insects, if not controlled, can negatively affect people, plants and their surrounding environment. In Vietnam, all crops are regularly impacted by pest insects. In serious cases, crops can be totally destroyed by insect pests. Harmful insects that damage crops often grow fast and increase rapidly. Therefore, research on insects is crucial for managing pests, protecting crops, and forecasting pest situation in the following years. This study aimed to collect data regarding changes of pests on rice and corn as two main crops in four provinces in Red River Delta of Vietnam, including Thai Binh, Nam Dinh, Ha Nam, and Hung Yen, from 2018 to 2022. Primary data were collected from reports of government agencies and official statistics. Based on these data, this study evaluated changes of pest insects in five years, discussed reasons for such changes and response methods, and forecasted pest's behavior in the following years. Significant findings of this study include the fact that Vietnam has to face many difficulties to develop its agricultural sector. For insect management, an essential action is to do ground surveys to gather all related data including weather data, pesticide data, crop yield, and product quality. This information is meaningful for finding out causes of changes, understanding relationships between insects and surrounding factors, and predicting the situation in the following years.

**Keywords:** Pest insect for rice, Red River Delta, Vietnam

## Introduction

Agriculture is one of the most important sectors in global economy. For this reason, agricultural development

is one of the most powerful tools to end extreme poverty, boost shared prosperity, and feed a projected 9.7 billion people by 2050. Agriculture is also crucial to economic growth. It accounts for 4% of global gross domestic product (GDP). In some least developing countries, it can account for more than 25% of GDP (World Bank report on Agriculture and Food on March 31, 2023).

As we know, the main role of agriculture is to provide food for humans in the world. Currently, global population is more than 8 billion. It is growing by more than 80 million a year. This increase is most likely to continue for most of this century. According to a report by the Food

Received January 12, 2024; Revised January 26, 2024;

Accepted January 27, 2024

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and Agriculture Organization of the United Nations (FAO), as many as 828 million people were affected by hunger in 2021, which was 46 million more from a year earlier and 150 million more from 2019. Climate change, disaster, epidemic, human activities, population growth, and war are increasingly threatening global food security and put great pressure on the agricultural industry.

Although agriculture is an important sector, it is also one of the most sensitive and vulnerable sectors to climate change, extreme weather, and insect pests, especially due to COVID-19 related imported and exported disruption. Climate change and extreme weather events have a major impact on crop production and agricultural pests. As generally adaptable organisms, insect pests respond differently to different types of climate change, such as changes of CO<sub>2</sub> concentration and temperature. Changes in climate can affect insect pests in several ways. They can result in expansion of their geographic distribution, increased survival during overwintering, increased number of generations, altered synchrony between plants and pests, altered interspecific interaction, increased risk of invasion by migratory pests, increased incidence of insect-transmitted plant diseases, and reduced effectiveness of biological control agents, especially natural enemies (Sandra *et al.*, 2021).

Agriculture is not only affected by natural conditions, but also influenced by humans' activities such as wrong agricultural practice and excessive use of pesticides. These factors can also reduce crop yields. Same as in almost all other developing countries, agriculture is a bone economic sector in Vietnam, where it plays a significant role in livelihoods and employment of about 27.5% of the population according to data of the General Statistics Office, 2022. Vietnam's agriculture not only ensures national food security, but also contributes to a large proportion of Vietnam's total export turnover for many decades. In the agricultural sector, rice is the most important crop with 43.2 million tons of production and about 7.1 million tons of milled rice for exportation annually. The Red River Delta and Mekong River Delta are the most important agricultural regions in Vietnam. While these two deltas are highly productive regions, they are vulnerable to natural hazards and effects of human-induced environmental changes as well as pest insects.

The Red River Delta is located in the center of North Vietnam. It is likely a bridge for North East, North West, and North Central regions, facilitating exchanges with other regions in the country and expanding exchanges with other countries in the region and the world. The Red River Delta includes a fertile delta, a midland fringe with a number of mineral resources, tourism resources, and the Gulf of Tonkin with great potential. Thanks to the capital Hanoi, the Red River Delta

holds the position of the economic, scientific, technical, and cultural center of the country. Noi Bai airport in the capital city and Hai Phong port in a big city are gateways to the region and the world. Therefore, the Red River Delta has a particularly important position in the socio-economic development of the country.

In the Red River Delta, Thai Binh, Nam Dinh, Ha Nam, and Hung Yen are four provinces that produce on agriculture the most. They provide many agricultural products to the market, especially Capital City Hanoi. Besides crucial products such as rice, corn, peanuts, and soybeans, these provinces also have many high-quality processed agricultural products. Accordingly, improving the quality of agricultural products in this area is very meaningful for food security and development of The Red River Delta.

## MATERIALS AND METHODS

### Study area site descriptions

Being one of two great deltas of Vietnam, the Red River Delta is a fertility land being enlarged by alluvia from system of the Red and Thai Binh river. The climate of the Red River Delta is tropical and sub-tropical. It is dominated by monsoon winds of Southeast Asia, including the southwest wind during summer time and the northeast wind in winter. Besides seasonal variations of the monsoons, which are significant everywhere in the Basin, tropical depressions and typhoons sometimes attack coastal areas in North Vietnam from May to August, which bring strong wind and heavy rain. Administratively, the Red River Delta covers 11 provinces and cities (including Hanoi, Bac Ninh, Vinh Phuc, Ha Nam, Hai Duong, Hai Phong, Quang Ninh, Hung Yen, Nam Dinh, Ninh Binh, and Thai Binh) with a total of 85 districts and 96 towns. Its total area is 21,259,6 km<sup>2</sup>. Its population was 23,147,804 persons in 2021. With a small natural area and a large population along with rapid urbanization rates in recent years and the highest population density in the country, food security is an important issue in this area, although all provinces and cities in the region are involved in agricultural production. Ha Nam, Hung Yen, Nam Dinh, and Thai Binh are the four provinces that play the most important role in producing and supplying food (rice, cereal, vegetable, and so on) not only for the capital city Hanoi, but also for other provinces of Vietnam.

### Data collection

The survey was conducted from December 2022 to December 2023 in four provinces of Vietnam by the author under the supervision and support of National Institute of Agricultural Planning and Projection. Internal data were

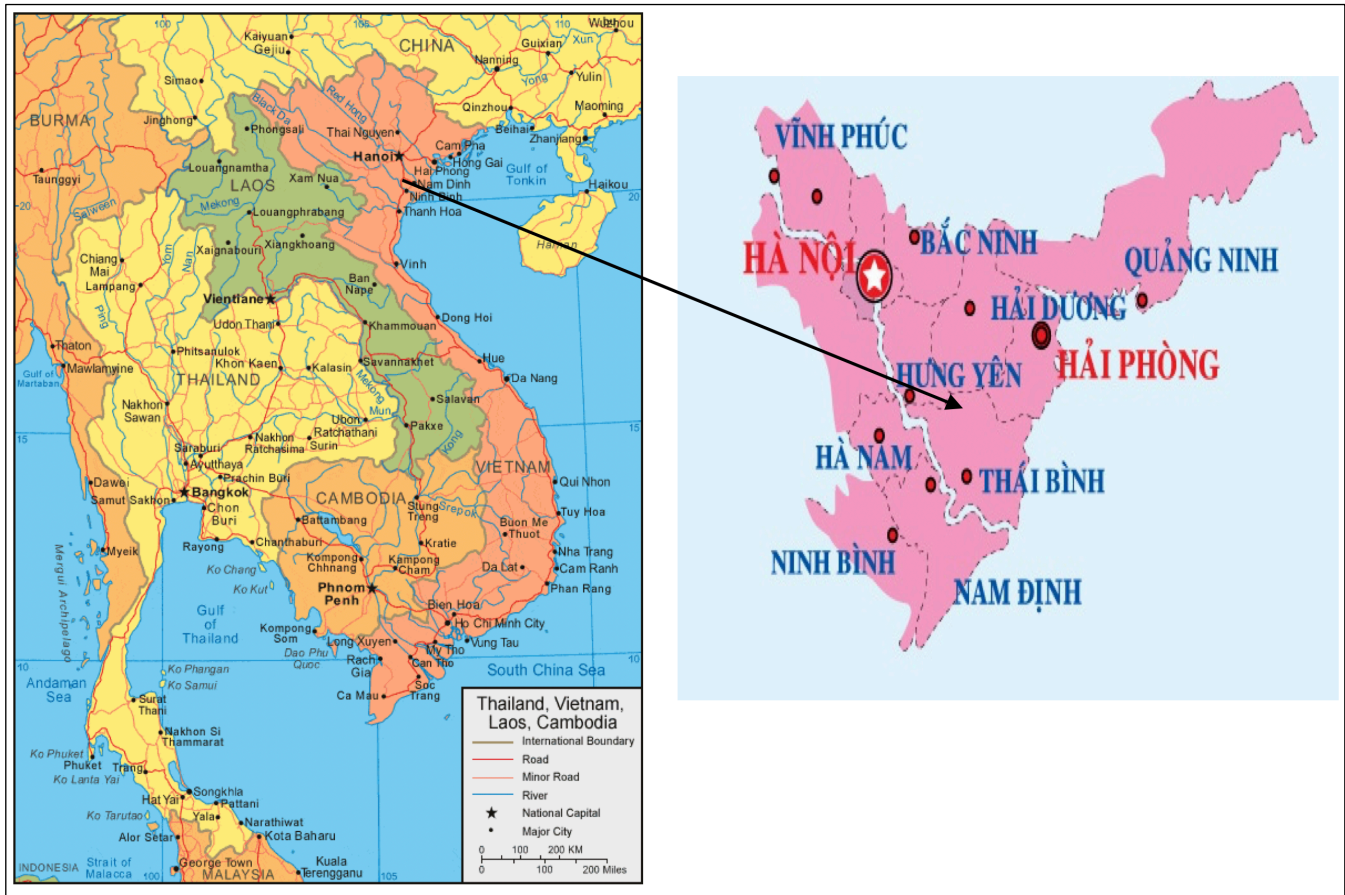


Fig. 1. Vietnam in Southeast Asia and Red River Delta provinces.

obtained from the National Institute of Agricultural Planning and Projection of Vietnam, the source of general information about reports of research projects in the organization from 2018-2022. Other data were taken from the following: 1) state organizations (General Statistics Office of Vietnam, Department of Statistics, Department of Agriculture and Rural Development of four provinces, having a department specializing in providing information or publishing periodical publications); 2) libraries, provinces, universities, and research institutes; 3) access to the Internet: Popular websites: <https://www.mard.gov.vn/>, <http://google.com>, <http://scholar.google.com>, <https://www.gso.gov.vn/>; 4) refer to other data sources including reports and statistics provided by the Department of Plant Protection under the Ministry of Agriculture and Rural Development of Vietnam; annual reports on socio-economic development and plant protection situation in four provinces (Ha Nam, Hung Yen, Nam Dinh, Thai Binh) from 2018 to 2022; books, textbooks, ebooks or scientific publications related to the last, and reports or theses of students of the university or other universities.

### Methods of data analysis

#### *Main method of collection*

Sequence of secondary data collection included 1) determining secondary information to be collected by listing them; 2) determining the source, the secondary information channel to get; 3) collecting overview, past information, and newest information; 4) performing in-depth information gathering; 5) synthesizing and evaluating.

#### *Method of analysis*

Actual data was reformed and analyzed using theoretical frameworks and tools proposed. Most conclusions were organized and presented in descriptive, table, graphs, and charts using excel spreadsheet.

## RESULTS

### Density of rice pests in four provinces

The autumn crop process is performed in the hot weather of the summer in North Vietnam, from May to

November. This season in North Vietnam, the temperature is essentially more than 30 degree, rainy and stormy. This is a good condition for insects to grow and damage crops. Table 1 shows pest occurrence in 4 provinces from 2018 to 2022.

### Density of pests on corn in four provinces

Collected data for two major pests of corn in four provinces belonging to the Red River Delta region of Vietnam during the period from 2018- 2022 are shown in Table 2.

## Discussion

### For pests of rice

In general, during the period of 2018 - 2022, three pests (*Cnaphalocrocis medinalis*, *Nilaparvata lugens*, *Scirpophaga incertulas* Walker) occurred relatively evenly in 4 provinces, accounting for quite similar proportions.

Over the past few years, both local authorities and relevant agencies such as District's Agriculture and Rural development division, Provincial's Crop production and Plant protection Sub-department, and Provincial's Agricultural Extension Center have implemented numerous training programs, technology transfers, timely dissemination of climate and weather information, and disease outbreak forecasts to enable farmers to adopt

effective pest and disease prevention measures. An exemplary approach is the application of Plant Protection Products following the 4-right principles: right product, right timing, right dosage and concentration, and right method. However, in various ways, harmful pests and diseases have continued to proliferate in many provinces, evading control measures due to several factors such as climate change, global warming, irregular weather, and the abundance of different types of plant protection chemicals in the market. Additionally, not actively monitoring pest and disease developments closely, lacking timely and effective prevention measures, and ice cultivation practices such as dense transplanting and prolonged water retention in the paddy field all resulted in reduced rice productivity. Below shows pest and disease situation in 4 provinces during the period of 2018 - 2022.

In 2018, it was observed that rice area in Hung Yen province was heavily infested by *Cnaphalocrocis medinalis* in comparison with the other three provinces, accounting for 41.67%.

The second highest infestation rate was in Thai Binh province, with a percentage of 25.00%. Due to a high amount of rainfall leading to increased humidity, this harmful pest species thrived. Provinces of Ha Nam and Nam Dinh experienced lower levels of rainfall and higher temperatures, resulting in a lower impact of *Cnaphalocrocis medinalis*.

Table 1. List of social wasps collected from Ulleungdo in 2022

Province	Pest	2018	2019	2020	2021	2022
HUNG YEN	<i>Cnaphalocrocis medinalis</i>	5	7	5	2	2
	<i>Nilaparvata lugens</i>	800	600	700	600	500
	<i>Scirpophaga incertulas</i> Walker	0.4	0.2	0.2	0.1	0.2
	<i>Pomacea caniculata</i>	2.5	3	3.5	4	2
HA NAM	<i>Cnaphalocrocis medinalis</i>	2	3	2	2	4
	<i>Nilaparvata lugens</i>	700	500	600	600	800
	<i>Scirpophaga incertulas</i> Walker	0.5	0.3	0.4	0.3	0.3
	<i>Pomacea caniculata</i>	6	5	6	8	5
NAM DINH	<i>Cnaphalocrocis medinalis</i>	2	3	5	2	2
	<i>Nilaparvata lugens</i>	1000	700	800	700	600
	<i>Scirpophaga incertulas</i> Walker	0.2	0.3	0.2	0.2	0.2
	<i>Pomacea caniculata</i>	6	4	5	4	4
THAI BINH	<i>Cnaphalocrocis medinalis</i>	3	5	6	5	5
	<i>Nilaparvata lugens</i>	600	500	800	600	700
	<i>Scirpophaga incertulas</i> Walker	0.4	0.6	0.2	0.3	0.1
	<i>Pomacea caniculata</i>	40	30	6	8	8

**Table 2.** Density of pests on corn in four provinces from 2018 to 2022

Province	Pest	2018	2019	2020	2021	2022
HUNG YEN	<i>Corn earworm</i>	3.7	3.5	2.8	2.5	3
	Fall Armyworm	1.3	1	2.6	4.5	1.2
HA NAM	<i>Corn earworm</i>	14.4	11.7	7.2	8	9.3
	Fall Armyworm	3.4	2.5	3.7	4	5
NAM DINH	<i>Corn earworm</i>	6	7	6	6.5	8
	Fall Armyworm	3.2	4	3.8	2.5	3
THAI BINH	<i>Corn earworm</i>	15	18	14	8	7
	Fall Armyworm	2.5	4.8	4.2	4.6	4.5

In Nam Dinh province, where the rainfall was low, it allowed *Nilaparvata lugens* species to proliferate and cause damage to rice during the flowering stage, presenting the highest infestation rate among the four provinces at 32.26%. Hung Yen province ranked second in terms of *Nilaparvata lugens* infestation rate at 25.81%. However, in Ha Nam province, despite having a similar climate to Nam Dinh, effective disease prevention measures resulted in a lower pest infestation rate of 22.58%. The *Scirpophaga incertulas* Walker species had a high density in Ha Nam province at 33.33% due to a high humidity. Nam Dinh province had the lowest density at 13.33% due to higher temperatures than other provinces. Regarding the *Pomacea caniculata* species, it covered a large portion of rice fields in Thai Binh province, accounting for 73.39% of the total among the four provinces. It was attributed to an extensive rice cultivation area which made control challenging. However, in Hung Yen province, the density was relatively low at only 4.59%.

In 2019, the distribution of the *Cnaphalocrocis medinalis* species in the four provinces was as follows: Hung Yen, 38.89%; Thai Binh, 27.78%, Nam Dinh and Ha Nam, 16.67% each. Among them, Hung Yen province had the highest proportion due to its cool weather, abundant rainfall leading to high humidity, suitable environmental conditions, and vegetation contributing to the development of the *Cnaphalocrocis medinalis* species. However, in Nam Dinh and Ha Nam provinces, their proportions were lower due to better pest control measures. For the *Nilaparvata lugens* species, its distribution density was relatively similar across the four provinces: Hung Yen (26.69%), Ha Nam (21.74%), Nam Dinh (30.43%), and Thai Binh (21.74%). Nam Dinh still held the highest proportion due to its lower rainfall and higher temperatures providing suitable conditions for the development of this pest species.

Regarding the density of the *Scirpophaga incertulas* Walker species, among the four provinces, Thai Binh had the highest proportion at 42.86%, followed by Nam Dinh and Ha Nam both at 21.43% each and Hung Yen at

14.29%, the lowest proportion. It was observed that by 2019, climate conditions with ample rainfall combined with the practice of flooding fields before sowing created favorable vegetation for a strong development of the *Scirpophaga incertulas* Walker species in Thai Binh province. Hung Yen province had high control measures, resulting in lower development of this harmful species. Alongside favorable weather conditions and extensive rice cultivation areas, the *Pomacea caniculata* species flourished primarily in Thai Binh province, similar to 2018. The remaining three provinces had very low proportions: Ha Nam (11.90%), Nam Dinh (9.52%), and Hung Yen (7.14%). By the year 2020, *Cnaphalocrocis medinalis* Gue, *Nilaparvata lugens*, *Scirpophaga incertulas* Walker, and *Pomacea caniculata* continued to cause damage in all four provinces.

The *Cnaphalocrocis medinalis* Gue species appeared the most in Thai Binh province with a proportion of 33.33%. This was attributed to the farming practice of keeping water in fields for an extended period. However, Ha Nam province had the lowest infection rate at 11.11% thanks to effective forecasting and disease prevention measures. Nam Dinh and Thai Binh, the two provinces with higher temperatures than the other two, had the highest infection rate of *Nilaparvata lugens* at 27.59% each. Ha Nam experienced the highest outbreak of *Scirpophaga incertulas* Walker, accounting for 40% due to high humidity levels in the air and the habit of maintaining water in the fields. The remaining provinces had an equal infection rate of 20.0%. Ha Nam and Thai Binh provinces had the highest density of the *Pomacea caniculata* species at 29.27% each, followed by Nam Dinh at 24.39%. Hung Yen had the lowest density at 17.07% due to implementation of large-scale pesticide spraying measures.

In 2021, the *Cnaphalocrocis medinalis* species continued to be the most harmful in Thai Binh province, reaching 45.46%. The continuous sunny and intermittent rainy weather created suitable conditions for its development. Infection rates of this species were equal among the three provinces of Hung Yen, Ha Nam, and Nam Dinh. The

*Nilaparvata lugens* species had similar infection rates in the four provinces, with Nam Dinh accounting for 28.00% and Thai Binh, Hung Yen, and Ha Nam each accounting for 24.00%. This was due to the preference of using disease-resistant rice varieties such as Bac Thom 7, BC15, TBR45, and so on by local farmers. In Thai Binh and Ha Nam, *Cnaphalocrocis medinalis* and *Scirpophaga incertulas Walker* species were main pest targets of the season, particularly *Scirpophaga incertulas Walker* in the fields, which was three to four times higher compared to the 2020 season. Their widespread distribution accounted for an equal proportion of 33.33%. Hung Yen province had the lowest rate at 11.12%. The *Pomacea caniculata* species had outbreaks in both Thai Binh and Ha Nam provinces, causing concentrated harm in low-lying fields near ditches and irrigation channels.

In 2022, it was a record-breaking hot year within the period of 2018–2022. Along with this, there were also thunderstorms and storms occurring throughout Vietnam. These affected disease outbreaks in the four provinces. The outbreak of *Cnaphalocrocis medinalis* Gue continued to be the strongest in Thai Binh province at 38.46%. The disease outbreak occurred in July and August due to occurrence of heavy rainfall. The second-ranking province was Ha Nam with 30.77%. Hung Yen and Nam Dinh both had a harmful disease density at 15.38% each. The proportion of *Nilaparvata lugens* was highest in Ha Nam province at 30.77% due to high air temperatures and dense transplanting that provided opportunities for the *Nilaparvata lugens* species to thrive. Hung Yen province had the lowest harmful rate at 19.23% due to proactive pesticide spraying and prevention measures. Ha Nam province still had the highest infection rate of *Scirpophaga incertulas Walker* at 37.50%, while Thai Binh province effectively controlled it with a harmful rate of only 12.50%. For the *Pomacea caniculata* species, similar to 2021, Thai Binh province continued to have the highest growth rate of *Pomacea caniculata* at 42.11%. This was due to heavy rainfall and prolonged maintenance of water levels in the fields. Ha Nam had a rate of 26.32% and Nam Dinh had a rate of 21.05%. Hung Yen had the lowest rate at 10.53%.

#### For pests of rice

Hung Yen province had the smallest maize cultivation area among the four surveyed provinces during the 2018–2022 period. The density of *corn earworms* appeared relatively consistent throughout the years, with the highest damage rate in 2018 at 3.7 individuals/m<sup>2</sup>. Fall armyworm species also had a significant presence. It mainly caused damage to maize crops, with the highest density recorded in 2021 at 4.5 individuals/m<sup>2</sup>.

In Ha Nam province, which had the largest maize

cultivation area, during the 2018–2022 period, corn earworm appeared frequently with the highest density among the four provinces. In 2018, the density was 14.4 individuals/m<sup>2</sup>, reaching its lowest in 2021 at 8.0 individuals/m<sup>2</sup>. For fall armyworm species, during the 2018–2022 period, this species appeared quite frequently, with the highest density in 2022 (5 individuals/m<sup>2</sup>). It was the primary source of disease for maize crops.

In Nam Dinh province, the maize cultivation area during the winter-spring season fluctuated over the years. The corn earworm was the third most prevalent species among the four provinces (ranging from 6 to 8 individuals/m<sup>2</sup>) following Thai Binh and Ha Nam provinces. It was the main harmful species for maize crops. The fall armyworm species also appeared alongside other pests on maize crops during the 2018–2022 period, causing severe damage to crops.

In Thai Binh province, which had the second largest maize cultivation area among the four provinces, corn earworm appeared with the highest density of 18 individuals/m<sup>2</sup> due to an extensive cultivation area, making it difficult to control despite preventive measures and public awareness campaigns. Fall armyworm species had the highest density in 2019 at 4.8 individuals/m<sup>2</sup>. This was a new harmful species with the potential to cause severe damage and significantly affect the productivity of maize cultivation areas.

## Suggestions

#### For Government office:

- Develop methods to manage data of other fields, including weather, crop yield, crop quality, and so on for easier access;
- Determine roles of local staff, management officer, government policy in pest control and pesticide management for crops;
- Give planting schedule for each crop annually and suggest farmers to implement the schedule.

#### For farmers:

- Follow the government's guide on crop cultivation, pesticide using, and crop varieties that need to be planted for each crop;
- While planting, if there are problems, remind or ask the local staff first and then implement strategy following the guide.

## Acknowledgement

This study is a part of Pham Thuy Linh's research

towards a Master's degree in Agriculture at Kyungpook National University, Korea.

### Conflict of Interest

The author declares that he has no competing interests.

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