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Assessment Of Pesticide Residues In Major Agricultural Products In Dong Thap Province, Viet Nam

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***Abstract* — In Vietnam, pesticides play an important role in the agricultural production industry with the number of pesticides used increasing sharply in recent times. Environmental pollution due to pesticides, pesticide residues in agricultural products has been causing many risks for health. Dong Thap is a key agricultural province with a variety of farming products including rice, vegetables, and fruits. Some common types of vegetables and fruits were monitored for pesticide residues. The detected residues were still under certain regulated standards.**

Keywords — Dong Thap; pesticide; agricultural products; residues

I. INTRODUCTION

The use of pesticides (plants protection products) to protect crops from harmful insects and plant diseases has recently increased worldwide. An estimated value of US$4.5 billion for the usage of pesticides was reached [1]. Besides the advantages for agricultural production, pesticides also lead to huge risks to human health such as eye diseases, skin diseases, cancer, Parkinson's, memory loss, low birth weight babies [2], [3]. In Vietnam, the use of pesticides in agricultural production has increased sharply recently, in the period 2001-2010, the amount of pesticides used was about 36-75.8 thousand tons, the amount of active ingredients calculated by area is about 1.24 – 2.54 kg/ha [4]. According to international experts, up to 80% of plant protection drugs in Vietnam are being used improperly, unnecessarily, and very wastefully, 30% of farmers use pesticides in contravention of regulations such as failing to ensure water quantity, without labor protection, using pesticides at wrong concentrations [5]. In rice alone, there have been 3321 pesticides; For vegetables, there are also 260 pesticides, etc. Experts warn that the use of plant protection drugs is at an alarming level, even in some places, there is a phenomenon of farmers "being addicted" to use plant protection drugs [6]. Many reports have assessed pesticide residues on agricultural products and set the alarm for high levels of pesticide residue in common agricultural products [7], [8]. In 2007, there were 5,207 cases of pesticide poisoning and 138 deaths and about 35% of blood samples had pesticide residues detected [9].

Dong Thap province is located in the Mekong Delta, the area in which produces over 90% of the total rice production of Vietnam. In addition to rice as a staple product, many other types of vegetables such as water spinach, leaf mustard, green onion, bitter melon, corn, courgette, calabash, wax gourd, and chili, etc. for domestic consumption and export. Changes in temperature and humidity created conditions for harmful insects and diseases that caused severe harm to crop production in general and in vegetable production particularly, and this lead to the increasing use of pesticides [10]. In 2015, Dong Thap province had a rice-growing area of about 551,350 ha; the area of main fruit trees such as mango, tangerine, orange, longan is 9,000 ha, 1,995 ha, and 1,640 ha, respectively [11]; total vegetable production is 183,956 tons. The more use of pesticides, the more residues can be detected. In order to provide evidence on the current status of pesticide use in Dong Thap province in recent years, a thematic study "Evaluation of pesticide residues in some major agricultural products, in Dong Thap province in the period of 2013 - 2017" was conducted.

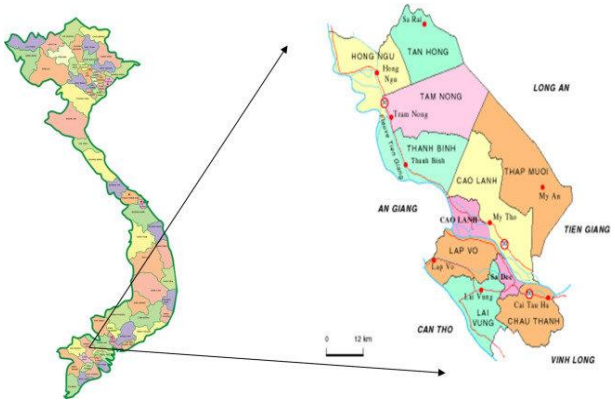

Figure 1. The geographical location of Dong Thap province, Viet Nam [12]

II. METHODOLOGY

2.1 The selection of sample and location of study

Located in the Mekong River Delta, along with An Giang, Long An, Tien Giang, Cần Thơ, Bac Lieu, Kien Giang, and Soc Trang provinces, etc., Dong Thap province plays an important role in supplying food for the whole country and exporting agricultural products, especially rice and vegetables. The four districts of Dong Thap province were selected for the study,

namely Cao Lanh, Lai Vung, Thanh Binh, and Thap Muoi. They have similar economic, social, and environmental conditions, but only differ in farming methods and agricultural products. Farmers in the districts mostly use pesticides to control pests and diseases in their annual crops. Data were collected using forms to collect secondary information on the results of the assessment of pesticide residues in food in some districts of Dong Thap province provided by the Department of Agriculture and Rural Development of Dong Thap province between 2013 and 2017. Descriptive analyzes are used to describe: Percentage of detection of pesticide residues in tested fruits, vegetables, and rice samples; average concentration of pesticide residues in samples of fruits, vegetables, and rice; compare with the standards of food safety according to current regulations including Circular 50/2016/TT-BYT dated December 30, 2016, of the Ministry of Health regulating the maximum limit of pesticide residues in food. The detected amount surpasses the regulated amount is not allowed for commercialization.

2.2. Data processing, analysis, and estimation

Cross-sectional descriptive statistics and quantitative methods were used throughout the study to describe the current status of the usage of plant protection drugs in the selected districts.

Data on pesticide residues in fruits, vegetables, and rice are entered and managed by excel software and analyzed by SPSS software. Data were collected using forms to collect 1200 secondary information on the results of the assessment of pesticide residues in food in some districts of Dong Thap province.

III. RESULTS

Table 1. General information on some common vegetables and fruits monitored for pesticide residues

Types of vegetables	**2016**	**2017**
Leaf mustard	6	8
Malabar spinach	0	2
Morning glory	0	3
Green onion (scallion)/ garlic chives	2	9
Water celery	2	1
Calabash/wax gourd/ luffa	2	7
Yardlong bean	3	0
Cucumber	3	3
Bitter melon	4	1
Sweet potato	2	0
Rice	5	0
Chili	4	0
Types of Fruits	**2016**	**2017**
Orange	6	7
Lemon	3	1
Longan	15	4
Guava	0	6
Tangerine	7	7
Dragonfruit	0	4
Mango	26	7

3.1 Type of vegetables and fruits monitored for pesticide residues

Leafy vegetables include leaf mustard, different type of spinaches, morning glory, green onion, water celery and others such as cucumber, bitter melon, wax gourd are those commonly grown for domestic demand. Among 1200 inspected samples, 33 samples of vegetables and 57 samples of fruits were monitored for pesticide residues in the year 2016. In the year 2017, the number of monitored vegetables and fruits was 34 and 36, respectively (table 1). These groups of vegetables and fruits are planted in the majority and most consumed annually.

3.2 Residual concentration of pesticides in some common vegetables and fruits.

Retrospective data analysis of those pesticides in 2016 shown in table 2 that, there were six groups of vegetables and fruits with pesticide residues detected. In which, only one type of pesticide residue was detected in five monitored groups of vegetables and fruits. The main groups of pesticide residues consisted of chlorpyrifos (an organophosphate and its derivatives), insecticides (permethrin and imidacloprid), fungicide (hexaconazole) in which chlorpyrifos ethyl found in many types of vegetables including sweet cabbage, leaf mustard, bitter melon with the concentration of 0.707, 0.229 and 0.04 mg/kg respectively. In Longan fruit, both chlorpyrifos ethyl and hexaconazole were detected at 0.02 and 0.034 mg/kg, correspondingly. However, these residues are still within the allowable range according to Circular No. 50/2016/TT-BYT (table 2).

Table 2. Residual concentrations of pesticides in vegetables and fruits (2016)

Residues detected	Types of samples	Detected content (mg/kg)	Regulated standard (mg/kg) [13]
Chlorpyrifos Ethyl (Organophosphate pesticide)	Sweet cabbage, Leaf mustard, Bitter melon, Longan	0.707; 0.229; 0.04; 0.02	1
Permethrin (insecticide)	Yardlong bean	0.143	1
Hexaconazole (Fungicide)	Longan	0.034	0.05
Imidacloprid (insecticide)	Taiwanese mango	0.063	0.2

The results of monitoring pesticide residues on vegetables in the year 2017 showed that green onions and morning glory are the groups with the most active pesticide residues detected (abamectin and in green onion; mancozeb and copper oxychloride in morning glory; both of these leaf vegetables contained difenoconazole). The other detected residues included metalaxyl in the wax gourd; emamectin benzoate in leaf mustard; chlorpyrifos ethyl in cucumber and carbendazim in dragon fruit (Table 3). Chlorpyrifos ethyl was detected again in cucumber with the concentration of 0.087 mg/kg still under limited

standard in the year 2017. However, Chlorpyrifos Ethyl was decided to be abandoned trading in 2019 and completely banned of use on 12th Feb 2021 [14]. Carbendazim was decided to abandoned of trading in 2017 and completely banned of use on 03rd Mar 2019 [15].

Table 3. Residual concentrations of pesticides in vegetables and fruits (2017)

Types of samples	Residues detected	Detected content (mg/kg)	Regulated standard (mg/kg) [13]
Wax gourd	Metalaxyl (fungicide)	0.05	0.2
Leaf mustard	Emamectin benzoate (insecticide)	0.009	0.01
Cucumber	Chlorpyrifos Ethyl	0.087	0.1
Green onion (scallions)	Abamectin (miticide)	0.012	0.02
	Difenoconazole (fungicide)	0.016	0.02
Morning glory	Difenoconazole	0.014	0.02
	Mancozeb	0.414	0.5
	Copper Oxychloride	0.004	N/A
Dragon fruit	Carbendazim	0.009	0.05

In Viet Nam, pesticides were used diversely with 31 trade names belonging to 35 active ingredients. This includes pesticides, diseases, growth stimulants, herbicides, and raticide. Of the 35 active ingredients, up to 94.3% of the active ingredients were listed in the list of pesticides used in Vietnam according to Circular 03/2018/TT-BNNPTNT of the Ministry of Agriculture and Rural Development [16]. Research results show that there are pesticide residues on vegetables. These residues consisted of Chlorpyrifos Ethyl, Permethrin (2016) and Metalaxyl, Emamectin benzoate, Chlorpyrifos Ethyl, Abamectin, Difenoconazole, Mancozeb, Copper Oxychloride, and Carbendazim but most of these detected residues were still under the allowable limits, according to Circular 50/2016/TT-BYT effective on July 1, 2017. However, along with the changing in awareness and habits from small-scale and traditional production to developing commodity agricultural production, increasing the value of income per unit of cultivated area; increasing the application of scientific and technical advances to production, helping to reduce costs, improve productivity and product quality in association with sustainable value chains; change thinking from "agricultural technology" to "agricultural economy" in the agricultural sector system [17]. Dong Thap is the first locality in the country selected by the central government to pilot the construction and implementation of the agricultural restructuring project. Up to now, Dong Thap has created strong growth for the spearhead economic sector, which still has great potential. After a period of implementing the project, Dong Thap province is not only interested in what crops to grow, what to raise... but also focuses on changing farmers' production thinking, for example, minimize the use of pesticides, guarantee the isolation time of vegetables after spraying before marketing and so forth [18]. In the inspected fruits, the concentration of pesticide residues was also under-regulated standard. Dong Thap province has set a target that by 2020, the area for growing safe vegetables will be more than 1,000 hectares, developing areas specializing in safe vegetables and crops [10], [19], and this can help to increase the good practice in pesticide usage and reduce or minimize or eliminate negative effects of pesticide in vegetables and fruits or to human and environmental health.

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