

## THE UTILIZATION AND EFFECTS OF PLANT PROTECTION CHEMICALS ON THE ENVIRONMENT AND HUMAN HEALTH IN HUONG THUONG COMMUNE, THAI NGUYEN CITY - THAI NGUYEN PROVINCE

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ARTICLE INFO		ABSTRACT
<b>Received:</b>	<b>24/4/2021</b>	This paper presents the situation of managing, utilizing and the impact of plant protection chemicals on the environment and human health in Huong Thuong commune, Thai Nguyen city, Thai Nguyen province. 63 household in 3 villages were randomly selected to be interviewed about the situation of using and the effects of plant protection chemicals. The results showed that the drugs used were mostly pesticides, accounting for 57%, of which those in group II and group III occupied 80%. Drugs group IV accounted for only a small proportion of 20%. Products having chemical origin still made up a large proportion of 72% totally. The organization of training and propaganda to guide people using plant protection products has been concerned by the authority, but only 35% of the interviewees were willing to change the current use of drugs. The proportion of people who fully knew safe procedures for using drugs was low, which has affected the environment and the health of the people.
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## NGHIÊN CỨU TÌNH HÌNH SỬ DỤNG VÀ ẢNH HƯỞNG CỦA HÓA CHẤT BẢO VỆ THỰC VẬT ĐẾN MÔI TRƯỜNG VÀ SỨC KHOẺ CỦA CON NGƯỜI TRÊN ĐỊA BÀN XÃ HUỐNG THƯỢNG, THÀNH PHỐ THÁI NGUYÊN - TỈNH THÁI NGUYÊN

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THÔNG TIN BÀI BÁO		TÓM TẮT
<b>Ngày nhận bài:</b>	<b>24/4/2021</b>	Bài báo này trình bày kết quả nghiên cứu tình hình quản lý, sử dụng và ảnh hưởng của hóa chất bảo vệ thực vật đến môi trường và sức khỏe của người dân trên địa bàn xã Huống Thượng, thành phố Thái Nguyên, tỉnh Thái Nguyên. 63 nông hộ trong 3 xóm được lựa chọn để phỏng vấn trực tiếp. Kết quả nghiên cứu cho thấy thuốc được sử dụng chủ yếu là thuốc trừ sâu, chiếm 57%; trong đó, thuốc nằm trong nhóm II và nhóm III chiếm 80% lượng thuốc được sử dụng. Thuốc bảo vệ thực vật nhóm IV chỉ chiếm tỉ lệ nhỏ vào 20% lượng tiêu thụ. Thuốc có nguồn gốc hóa học vẫn chiếm một tỉ lệ lớn tới 72%. Việc tổ chức tập huấn, tuyên truyền hướng dẫn người dân cách sử dụng hóa chất bảo vệ thực vật đã được các cấp quan tâm, tuy nhiên chỉ có 35% người dân được phỏng vấn muốn thay đổi cách sử dụng hóa chất bảo vệ thực vật hiện nay. Tỷ lệ người dân biết đầy đủ các quy trình an toàn về sử dụng hóa chất bảo vệ thực vật còn thấp. Điều này đã làm ảnh hưởng tới môi trường và sức khỏe của người dân.
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## 1. Introduction

Plant protection chemicals constitute any substances or mixture of substances intended for preventing, destroying, repelling, or mitigating any herb, pest and diseases. They can also serve as plant regulators, defoliant, or desiccants [1].

Despite their benefits as improving productivity, protecting crop losses, and controlling the vector diseases; plant protection chemicals can be hazardous to both humans and the environment [2]. People exposing to chemicals could have early health investigation as liver function, immune function, neurologic impairment, and reproductive effects [3] – [5]. The high risked groups exposed to chemicals include agricultural farm workers, chemicals salesmen and people who live surrounding the agricultural area [6]. In process of using, the possibility of hazards may be higher, farmers are at increasing risk since they handle various toxic chemicals including pesticides, raw materials, toxic solvents and inert carriers [7], [8].

Countless chemicals are environmentally stable, prone to bioaccumulation, and toxic [9], [2]. Because some chemicals can persist in the environment, they spend years remaining there, causing environmental pollution, which can expose general population to chemicals residues, including physical and biological degradation products present in the air, water, and food [10], [3].

As an agriculture-based country, Vietnam started to import plant protection chemicals in the late 1950s [11], from then, the amount of chemicals used in protecting plant increase annually, from 100 tons/ year in the 1950 [12] to 35,000 tons/ year in 2002 and 105,000 tons/year in 2012 [13].

Located in the Northern Midland and mountainous area, Thai Nguyen province is regarded as the economic, political and cultural center in the Northern region of Vietnam. This is an important market for the consumption of agricultural products, especially green vegetables, and Thai Nguyen city is considered as a key area of developing agriculture in province. Along with the general agricultural growth, vegetable production in Thai Nguyen city has been meeting the demand for quantity, gradually overcoming the shortage situation in the middle of the season, supplying high quality vegetables for people in Thai Nguyen province [14]. However, in the trend of intensive production, current vegetable production is revealing disadvantages including abuse of plant protection chemicals, which not only pollutes the farming environment but also causes contaminated vegetables, affecting the health of users.

Therefore, it is necessary to find out the using level of those drugs in Thai Nguyen in general and Thai Nguyen city in particular and the impact of them on the living environment, in order to raise awareness in the community's living environment protection.

The research was conducted to address those issues: (1) assessing the current utilizing of plant protection chemicals in Huong Thuong commune; (2) evaluating the effects of used drugs on human health and environment; (3) proposing solutions to improve the effectiveness of managing and utilizing the drugs in the studied areas.

## 2. Methodology

To understand the farmers' behaviors of using pesticides, 60 farmers in 3 villages of Huong Thuong commune, Thai Nguyen city, Thai Nguyen province were surveyed. Three selected areas were Cay Hamlet, Bau Hamlet, and Huong Trung hamlet. The study area represented the mix-social and economic areas of the district (with both of low and middle incomes households) [5]. Most of the households depended on agriculture and vegetable was the main crops.

The data were collected by surveying households using a questionnaire including 20 questions. Face-to-face interviews using the questionnaire were conducted. The questionnaires were developed by the research team, based on some needed information as types of used pesticides, the situation of pesticides, and their health condition after using pesticides.

### *Sampling*

Non-probability convenience sampling technique was employed in this research because of

limited resources and no sampling frame, this technique is considered to be the easiest, cheapest and least time-consuming. Subjects in this technique selected simply because it is convenient, easily accessible and readily available to collect data.

#### *Method of data analysis*

Microsoft Excel was used to record raw data, analyze statistically, and draw figures.

### 3. Results and discussion

#### 3.1. Current utilization of plant protection chemicals on vegetables in Huong Thuong commune

##### 3.1.1. Types and quantity of plant protection chemicals widely used in vegetable production

With strengths of agricultural land, suitable for growing vegetables and flowers, the whole commune has more than 130 hectares of land specializing in growing vegetables: cabbage, kohlrabi, beans, tomatoes... hence, plant protection chemicals are mainly pesticides and chemical fertilizers. The main types of substances being used are presented in Table 1.

**Table 1.** The number of main substances used in Huong Thuong commune

Types of substances	Huong Thuong commune		
	Number of types	Proportion %	
Classification by remediation target (pest and disease)	Pesticide	23	57
	Disease remedies	17	43
Classification by substances	Chemical products	29	72
	Bio-products	11	28
Classification by toxic group according to WHO	I	0	0
	II	14	35
	III	18	45
	IV	8	20
Included in category of vegetables	Included	40	100
	Not included	0	0

(Source: The analyzed data from research)

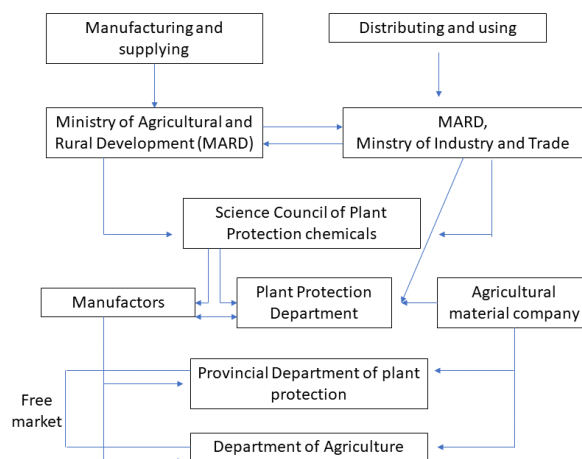
Table 1 showed that there were 40 types of substances being used to prevent pests and diseases in the process of vegetable production in Huong Thuong commune, and 57% among them was represented for pesticides, the rest are substances to prevent diseases. The proportion of chemical products accounted for 72%, which was much higher than the figure of bio-products. Besides, under the classification by toxic group based on WHO recommended classification, named as Group I, II, III, IV representing for extremely, moderately, slightly hazardous and unlikely to acute hazard respectively, 80% of chemicals utilized belonged to group II and III, 20% of consumption is from group IV, and there was no household using the products of Group I.

##### 3.1.2. Current situation of trading and using pesticides in the area

#### *Current situation of plant protection products trading*

In general, plant protection chemicals, which are manufactured by the central companies, are provided to the provinces through the Provincial Plant Protection Department, then being allocating district station, and down to the cooperatives (Figure 1). However, drugs that follow this path are often lacking in number and type. Recently, Huong Thuong commune shifted to focusing on growing vegetables, the demand for pesticides has been increasing, which lead the trading of plant protection shifting to privatization. Pesticide manufacturing and packaging companies distributed them to primary and secondary agents. These agent sale drugs to small private shops in the commune, then selling to the farmers. This situation contributed to a free market of trading plant protection chemicals. Farmers met no difficulties in buying the chemicals; they could apply any kinds of drugs to their vegetable basing on their own experience, which led

to the inappropriate use of chemicals as over using or use the wrong products, decreasing the desired effects of drugs, and affecting the productivity.



**Figure 1.** Plant protection chemicals management framework

*Current situation of people's use of pesticides*

The benefits that pesticides bring when using are instantaneous; hence, the pesticides are still used by farmers ignoring their effects in the future.

**Table 2.** Frequency of utilizing plant protection chemicals

Plant protection chemicals utilization	No. interviewee	Proportion (%)
Regularly	26	43.33
Only in needed	34	56.67
None of use	0	0
<b>Total</b>	<b>60</b>	<b>100</b>

Table 2 showed the number of farmers with regular use of plant protection chemicals accounts for 43.33%, using in necessary accounts for 56.67%, and there was no household that did not use plant protection chemicals. Thereby a large demand of using plant protection chemicals was significantly witnessed. Accordingly, the time of using drugs concentrated in March, April, May and August, September, October under the lunar calendar because this was the growing time of pests and diseases. Each cropping seasons, substances were used with an average of 5-7 times depending on the level of pests and diseases.

**Table 3.** Utilizing direction of plant protection chemicals in Huong Thuong commune

Factors	Interviewees' opinion	Proportion (%)
<b>Original products</b>	Chemical products	100
	Bio-product	30
<b>Deciding types of substances</b>	Due to instruction of extension workers	51.67
	Due to instruction of mass media as TV, newspaper, etc.	20
	Experiences	28.33
<b>Utilizing dosage</b>	Due to instruction of extension workers	58.3
	Due to instruction of extension workers and incorporate other chemicals	30
	Due to the situation of pest and diseases	11.7
<b>Isolating time</b>	Follow instruction on package	100
	Self-decision	0

According to Table 3, 100% of the interviewees confirmed that they used chemical products when detecting pests and diseases. 30% of them combined both chemical and biological products, which helps to quickly eradicate diseases and increase productivity, product quality. In term of using pesticides, most of interviewees (51.67%) followed the instruction from extension worker to decide which kind of pesticide they need to use for their crop; 28.33% of them spent their experiences and the rest of 20% followed the information in the mass media as internet, newspaper, etc. in making this choice.

Besides, in determining the dosage of substance, 88.3% of interviewed farmers followed the instruction from extension worker, of which 30% of them still incorporated other chemicals beside following the worker, and the rest of interviewees spent their experiences determining the dosage based on the situation of pest and diseases. However, in aspect of isolating time after spraying substances, 100% of interviewed famers followed the instruction on the package.

### 3.1.3. Management of personal protective equipment while utilizing plant protection chemicals

**Table 4.** Understand the health conditions when spraying plant protection products

No.	Health condition	Responded result		Proportion (%)	
		Yes	No	Yes	No
1	Illness, pregnancy and breast-feeding are not allowed to spray	52	8	86.7	13.3
2	The elderly and children are not allowed to spray	54	6	90	10
3	Periodic health examination	14	46	23.33	76.67
4	Spraying time does not exceed 2 hours/day, 2 weeks/time	13	47	21.7	78.3
5	Fully understand	21	39	35	65

As shown in Table 4, there was only 35% of interviewees having fully understanding of health conditions when spraying. The majority of respondents believed that the illness, pregnancy and breast-feeding should not use plant protection products, which accounted for 86.7%; the proportion of people agreeing that the elderly and children are not allowed to spray occupied 90%. The rest of proportion of 23.3% still had no awareness about the danger that chemicals products bring to the vulnerable groups as the illness, pregnancy, breast-feeding, the elderly and children; the reason for this situation can be explained by lacking main workers, they still have to spray even knowing the adverse affects to their health. The percentage of farmer understanding the importance of having periodic health check-ups and not to exceed the dosage of spraying was very low, accounting for 23.33% and 21.7% respectively.

**Table 5.** Use of personal protective equipment

No.	Protective equipment	Opinion		Proportion (%)	
		Yes	No	Yes	No
1	Glasses	11	49	18.3	81.7
2	Hats	54	6	90	10
3	Masks	60	0	100	0
4	Gloves	52	8	86.7	14.3
5	Protective clothing	37	23	61.7	38.3
6	Fully protective equipment	5	55	8.3	91.7

As the results in Table 5, people's awareness of using protective equipment when spraying chemicals was not high. Most of interviewees used protective equipment but not fully, because some of equipment caused discomfort, hindering the spraying process. In particular, masks and hats were fully used, glasses and gloves were least utilized due to their inconvenience while spraying.

### 3.1.4 Management chemical packaging after utilization chemicals

The chemical packaging, such as plastic bags, plastic bottles, glass bottles containing substance, after utilizing is discarded and becomes waste. The amount of this solid waste is

considered hazardous waste which has negative and long-term impacts on the environment and human health of the surrounding community.

**Table 6.** *Management of chemical packaging after utilization*

No.	Management	Results	Proportion (%)
1	Leave in the fields	33	55
2	Leave in public garbage tank	5	8.3
3	Leave in specific tank located in the field	7	11.7
4	Discharge into river, ponds, lakes	12	20
5	Landfilling, burring in garden	3	5
	<b>Total</b>	<b>60</b>	<b>100</b>

According to Table 6, 55% of interviewees left the packaging in the fields, 25% left then in the right place, while 20% of them threw away the shells, bottles, and jars freely to the public area as the river, canals or wherever they would be.

The process of disposing packaging is an issue that needs to be paid more attention when 20% interviewed households say that they disposed the packaging directly into the canal, ditches, ponds or lakes or poured into the ground above, which is considered as wrong way of treating them and bring harm to the environment. This situation directly affected the aquatic organisms, ultimately affecting human health when using water and food sources from such canals and lakes.

To increase awareness and knowledge of localities when using plant protection products, functional departments organized meetings, exchanges, and conferences to propagate and guide farmer.

**Table 7.** *Farmers' participation in training the use of plant protection products*

No.	Sessions	Results		Proportion (%)	
		Yes	No	Yes	No
1	Discussing about using plant protection products experiences	46	14	76.7	23.3
2	Extension workers guide farmers to use plant protection products	51	9	85	15
3	Participating environmental protection events	34	26	56.7	43.3

Most of the people already had knowledge about plant protection products, but that was not fully. The majority of interviewed people confirmed that they had awareness of danger when using those substances repeatedly and improperly, which would affect human health and the surrounding environment, but they never caught how and what specific effects would be.

There were 76.7% of interviewees participating in the exchange of experiences on the use of plant protection products, organized by functional agencies or a small group; 85% of them participated in the guidance sessions of agricultural extension officers to accumulate more knowledge when using chemicals, ensuring safety for their health and the surrounding environment. However, the number of respondents interested in environmental protection only reached 56.7% (Example: Workshop, training, meeting... on environmental and nature protection activities) (Table 7).

### **3.2. Effects of plant protection products on the environment and human health in local areas**

#### **3.2.1. Effects on the environment as soil, water, and air environment**

According to Table 8, due to limited understanding about toxic levels, farmers only used familiar products, often highly toxic level. The use of chemicals varied according to the crop area. The periods of spraying concentrated in March, April, May and August, September, October; while the rice farming area focused on winter-spring and seasonal crops.

**Table 8.** *Effects of plant protection products on the studied area*

No.	Effects	Results		Proportion (%)	
		Effectuated	Non-effectuated	Effectuated	Non-effectuated
1	Soil environment	34	26	56.7	43.3
2	Water environment	44	16	73	27
3	Air environment	37	23	61.7	38.3

All factors as soil, water and air environment were believed having strange signs. As described by the interviewees, these were signs of pesticide pollution, such as the smells during warm and hot days.

### 3.2.2. *Effects on human health*

Most of people said that using pesticides affected their health; they often encountered symptoms of skin allergies, rashes, headaches... after being exposed to the plant protection products (Table 9).

**Table 9.** *Symptoms of people when exposed to plant protection products*

No.	Symptom	Results		Proportion (%)	
		Yes	No	Yes	No
1	Dizziness	48	12	80	20
2	Fatigue, irritability	54	6	90	10
3	Headache	53	7	88.3	11.7
4	Tired	43	17	71.7	28.3
5	Weep	23	37	38.3	61.7
6	Shaky hands and feet	7	53	11.67	88.33
7	Dry throat	23	37	38.3	61.7
8	Salivation	32	28	53.3	46.7
9	Cough	31	29	51.7	48.3
10	Nausea	27	33	45	55
11	Blurred vision	25	35	41.7	58.3
12	insomnia	17	43	28.3	71.7
13	Itchy skin	35	25	58.3	41.7
14	Muscle weakness	5	55	8.3	91.67

Most of people experienced symptoms of dizziness, headache, shaky hands because chemicals can be easily to contact with the skin if farmers sprayed it without any protective equipment, which can cause allergic manifestations, and affect the central nervous system. The remaining symptoms including blurred vision, chest tightness, and vomiting were less common, and only appeared when people were exposed to substances too long and much times.

### 3.3. *Proposing a number of solutions to improve the management and use of plant protection chemicals*

Thai Nguyen city should have incentives and support programs on producing and application of organic and microbiological products to prevent harmful organisms to plant resources, selecting safe protection products with high fast decomposing in the nature, strengthening the inspection, handling of violations in utilizing plant protection chemicals.

## 4. Conclusion and recommendation

### 4.1. *Conclusion*

The survey showed that most of the used chemicals were pesticides, accounting for 57%; the rest were to prevent diseases. The substances used did not any of the WHO toxic group I which is

extremely hazardous; the majority belonged to group II and group III which are moderately and slightly hazardous respectively, accounting for 80%, the rest 20% of used substances belonged to Group IV of unlikely poisoning. 72% of plant protection products had chemical origin due to their rapid effectiveness to the pest in comparison with the bio-products.

In term of spraying the substances, 58.3% of farmers followed the instructions of agricultural extension staff, whereas 11% of farmer still used them on their own experiences without any scientific evidences.

In aspect of habit in spraying substances, only 35% knew the full range of health conditions when using sprays, and 8.3% of people used full labor protection when spraying. Even though there were a large proportion of people participating in propaganda and instruction on the use and exchange of experiences in using plant protection products, accounting for 76.7%, only 35% of people wanted to change the current use of chemicals in the district.

The results significantly showed effects of chemicals on human health and the surrounding environment. Some of the symptoms account for a high proportion: 80% getting dizziness, 90% getting fatigue, 88.3% getting headache, 38.3% getting eye disease, cough, etc. Meanwhile, majority of people believed natural environment as soil, water, and air had been affected by chemical use.

#### 4.2. Recommendation

It is imperative to ensure a continued focus on the effect of plant protection chemicals to environment and human health. Furthermore, the current impacts listed in the research need to be solved simultaneously, it is necessary for the authority to have plan to strengthen training courses about plant protection products to farmers, help people understand the benefits of proper use of products and point out the effects on human health and environment if using improperly. Besides, the authority also need to support to guide the production process of safe vegetables according to standards and ensure the output, and at the same time replicate the model of safe vegetable production to supply the market with safe vegetables.

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